Preface

The rising demand for water associated with population growth, water-intensive diets and rising of living standards has severely stressed water resources. This is much aggravated in arid areas where natural water resources depletion attributed low precipitation and high evaporation rates. The water budget deficit in arid areas, the high cost of water supply, the essential need for food and associated energy value among other challenges all need to be scientifically addressed to find solutions to world current and future water problems. Multidisciplinary and interdisciplinary fundamental and applied scientific research from the engineering sciences, atmospheric sciences, agro-sciences, hydrology and geology is essential to help in solving water problems. Moreover, fundamental and applied social sciences are important to address institutional, policy, and management issues.

In the views of the above challenges and developments, the International Conference "Water Resources in Arid Areas: The Way Forward" is planned and organized to bring water scientists, engineers, policy makers, managers and research and governmental institutions to share the latest knowledge in water research and explore the ways in finding solutions to water crises with emphasis on the arid areas. The present "Abstract Book" contains over 300 abstracts covering a wide spectrum of water science and addresses multiple issues and techniques. Thanks to all contributors and participants.

The Editorial Board (members listed is in the next page) has reviewed abstracts from several countries and institutions and recommends on the basis of quality and importance the ones published in this "Abstract Book". In addition, we have received over 200 full papers to be considered for publication in the special issue "Water Resources In Arid Areas: The Way Forward" in the Arabian Journal of Geosciences (AJGS) and also published in a Springer Book conference proceedings. Those papers are reviewed and under review by the Conference Scientific Committee members whose valuable contribution and time is highly appreciated. The book and the special issue will be published soon.

The reception of such large number of scientists and the organization of such large meeting is possible with the generous sponsorship of The Sultan Qaboos University, The Research Council, Ministry of Regional Municipalities and Water Resources, United Nations Economic and Social Commission for Western Asia, Haya Water and Middle East and North Africa Network for the Water Research Centers (MENA NWC). We are all indebted to our sponsors.

I would like to express my deepest thanks and gratitude to the organizing committee and the supporting staff (listed in the next pages) for excellent work performed to make this Conference a successful event.

Osman Abdalla
Director of Water Research Center
Sultan Qaboos University
Chairman of the Organizing Committee
EDITORIAL BOARD OF CONFERENCE PROCEEDINGS

- **Dr. Osman Abdalla**  
  Director of Water Research Center  
  Associate Professor-Earth Sciences Dept.  
  College of Science, Sultan Qaboos University  
  osman@squ.edu.om

- **Dr. Mingjie Chen**  
  Research Scientist  
  Water Research Center  
  Sultan Qaboos University  
  mingjie@squ.edu.om

- **Prof. Anvar Kacimov**  
  Professor  
  Department of Soils, Water and Agricultural Engineering  
  College of Agricultural and Marine Sciences  
  Sultan Qaboos University  
  anvar@squ.edu.om

- **Dr. Ali Al Maktoumi**  
  Environmental Engineering, PhD  
  Assistant Professor (Water Resources Management)  
  Dept. Of Soils, Water, and Agriculture Engineering  
  College of Agricultural and Marine sciences  
  Sultan Qaboos University  
  ali4530@squ.edu.om

- **Dr. Talal Al Hosni**  
  Assistant Professor  
  Department of Earth Sciences, College of Science  
  Sultan Qaboos University  
  hosni@squ.edu.om

- **Prof. Ian Clark**  
  Department of Earth Sciences  
  University of Ottawa  
  140 Louis Pasteur  
  Ottawa, Ontario K1N 6N5  
  Canada  
  idclark@uottawa.ca
Organizing Committee

- Dr. Osman Abdalla (chairman)  
  Sultan Qaboos University, Water Research Center
- Diana Austria (Secertariat)  
  Sultan Qaboos University, Water Research Center
- Dr. Mingjie Chen  
  Sultan Qaboos University, Water Research Center
- Prof. Anvar Kacimov  
  Sultan Qaboos University, College of Agriculture and Marine Sciences
- Dr. Mushtaque Ahmed  
  Sultan Qaboos University, College of Agriculture and Marine Sciences
Dr. Ali Al Maktoumi  
  Sultan Qaboos University, College of Agriculture and Marine Sciences
- Dr. Slim Zekri  
  Sultan Qaboos University, College of Agriculture and Marine Sciences
- Dr. Talal Al Hosni  
  Earth Science, College of Science
- Dr. Mohammed Al Abri  
  PCE, College of Engineering
- Dr. Mahad Baawain  
  Center for Environmental Studies And Research
- Dr. Hamdan Al Wahaibi  
  Dir. Of Water, Soil Research, Ministry of Agriculture & Fisheries
- Dr. Saoud Hamood Al Habsi  
  Director of Research Center, The Research Council
- Eng. Ahmed Al Barwani  
  Ministry Of Regional Municipalities And Water Resources
- Mr. Ibrahim Al-Rajhi  
  Public Authority for Electricity and Water
- Mr. Khamis Al Hadhrami  
  Public Relations, Sultan Qaboos University
- Mr. Mohammad Salim Al-Rawahi  
  Sultan Qaboos University  Admin Director
- Mr. Abdulkarim Al Kiyumi  
  Sultan Qaboos University, Public Relations
Supporting Committee

- Mr. Mohammed Al Belushi
  Sultan Qaboos University, College of Agriculture and Marine Sciences
- Zahra Al-Siyabi
  Administration
- Ahmed Nasser Al-Mufaraj
  Sultan Qaboos University, Water Research Center
- Rasha Al-Saadi
  Sultan Qaboos University, Water Research Center
- Hilal Al-Mamari
  Sultan Qaboos University, Water Research Center
- Amira Al-Rajhi
  Sultan Qaboos University, Water Research Center
<table>
<thead>
<tr>
<th>Theme</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Water Economics Policies and Governance in Agricultural, Urban and Industrial Sectors</td>
<td>5</td>
</tr>
<tr>
<td>2 Desalination sustainability in arid areas</td>
<td>103</td>
</tr>
<tr>
<td>3 Wastewater Treatment and Reuse</td>
<td>120</td>
</tr>
<tr>
<td>4 Subsurface Hydrology</td>
<td>159</td>
</tr>
<tr>
<td>5 Water Harvesting</td>
<td>200</td>
</tr>
<tr>
<td>6 Climate uncertainties &amp; Hydrological cycle</td>
<td>233</td>
</tr>
<tr>
<td>7 Education, Media, and Water Management Nexus</td>
<td>333</td>
</tr>
<tr>
<td>8 Water resources management and agriculture</td>
<td>362</td>
</tr>
</tbody>
</table>
# Water Economics Policies and Governance in Agricultural, Urban and Industrial Sectors

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Assessment and Mapping of Nitrate in the Groundwater of Northern Part of Khuzestan Province, Iran</td>
<td>9</td>
</tr>
<tr>
<td>2</td>
<td>Watering Frequency Effects On Quercus Pubescence</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Mapping And Modeling Of Areas At Risk Of Erosion: Case Of Aurès Center (Algeria)</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>Addressing Groundwater Quality Calamity And Its Management In The Thar Desert Of Sindh Province Of Pakistan</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>A Multi-Objective Model for Economic-Environmental Optimization of Underground Drainages</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Mapping Pollution Vulnerability By Using The Sintacs Method In Arid Area, The Ris-Nekor (Province Of Alhoceima, Morocco)</td>
<td>15</td>
</tr>
<tr>
<td>7</td>
<td>Groundwater Resources Of Bahari – Some Insights And Future Strategies</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Deficit Irrigation Of Fruit Trees Orchards Under Water Scarcity</td>
<td>17</td>
</tr>
<tr>
<td>9</td>
<td>Automatic Calibration Of Aquifer Hydrodynamic Coefficients Using Swarm-Intelligence-Based Optimization Algorithm</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>Study Of Groundwater Vulnerability To Pollution By The Drastic Method Coupled With A Geographic Information System (Gis): Application To Groundwater Beni Amir, Morocco</td>
<td>19</td>
</tr>
<tr>
<td>11</td>
<td>Groundwater Quality In The Northern Part Of Sub Basin Oued Labiod _Aures North 'Algeria</td>
<td>20</td>
</tr>
<tr>
<td>12</td>
<td>New Hydrological Modeling Approach For Peri-Urban Catchment</td>
<td>21</td>
</tr>
<tr>
<td>13</td>
<td>Assessment Of A Traditional Irrigation Management Scheme Using Remote Sensing And Tdr Techniques (Case Study: Pistachio Orchards In Central Iran)</td>
<td>22</td>
</tr>
<tr>
<td>14</td>
<td>Qualitative Assessment of Qantas as a Source of Irrigation Water in Arid Regions (Case Study: Yazd Province in Central Iran)</td>
<td>23</td>
</tr>
<tr>
<td>15</td>
<td>An Innovative Solution For Sustainable Groundwater Resource Management: The Case Of Khorasan Razavi – Iran</td>
<td>24</td>
</tr>
<tr>
<td>16</td>
<td>Effective Electrical Grounding System For Arid Regions</td>
<td>25</td>
</tr>
<tr>
<td>17</td>
<td>A Risk-Based Conflict Resolution Model For Optimum Water Resources Management In Arid Regions</td>
<td>26</td>
</tr>
<tr>
<td>18</td>
<td>Hydraulic Efficiency Of Water Distribution Networks: Case Study Of Antalya City-Turkey</td>
<td>27</td>
</tr>
<tr>
<td>19</td>
<td>Sustainable Groundwater Management</td>
<td>28</td>
</tr>
<tr>
<td>20</td>
<td>Integrated Hydrogeophysical Investigation in the Proposed Residential area, Bahri Locality, Khartoum State, Sudan</td>
<td>29</td>
</tr>
<tr>
<td>21</td>
<td>Agricultural Water Consumption changing in Egyptian Rafah Based on Remotely Sensed Data and Techniques</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Farmer’s Acceptance Of An Irrigation Decision Support Service At The Water Users Association Level</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>A Contribution To An Integrated Irrigation Water Management From Plot To Basin – Case Study Of Sidi Saad Dam System (Tunisia) –</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Identification Of Geogenic And Anthropogenic Sources In Altering The Groundwater Chemistry Through Silica Analysis In Parts Of Unnao District, India</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Groundwater Quality Assessment in Jazan Region, Saudi Arabia</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Groundwater Quality Assessment Using Drastic Model With Geospatial Technology</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Evaluating Of Tds Diffusion In Groundwater By Mt3d Model (Case Study: Lordegan Aquifer)</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Precise Fertigation Using Multiply-Connected Drip Tube Networks</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>Coastal Aquifer Management To Control Seawater Intrusion In Coastal Agricultural Areas</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>Smart Groundwater Metering and Management</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Analysis of Interference of Saltwater in Desert Aquifers (Case study: South Khorasan, Sarayan Aquifer)</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Impact Of Agricultural Activities On Groundwater Quality: Lysimetric And Mass Balance Approaches</td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Assessment Of Chemical And Biological Pollution Of Domestic And/Or Agricultural Use Wells Water, Located In Algerian Northeastern Arid Areas</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>The Impact Of The Invasion Of Modern Irrigation Systems In The Oasis Of Lahmar In The South Western Algerian</td>
<td></td>
</tr>
<tr>
<td>35</td>
<td>Estimation of pollution level in estuarine systems using magnetic and geochemical techniques along Chennai coast, Bay of Bengal, India</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Macrofauna as indictor of water quality in the lower Jordan River catchment- Eastern side</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>Irrigation Deficit Of Apple Trees For Better Value Of Water Resources And Its Impact On The Water Status And Soil-Plant-Water Status</td>
<td></td>
</tr>
<tr>
<td>38</td>
<td>The irrigation and risk of saline pollution. Example: Groundwater Of The Plain Of Annaba (North East Of Algeria)</td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>Physico-Chemical Analysis Of Ground Water, Spatial Distribution Of Contaminants And Impact Of Water Quality On The Health Of People In Khushaab City, Pakistan</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Diagnosis of Potential Water Contamination by nitrate in the plain of Sais (Morocco)</td>
<td></td>
</tr>
<tr>
<td>41</td>
<td>Impacts Of Supplemental Irrigation On Yield, Technical Efficiency And Production Risk In Rainfed Agriculture In The Arid Areas</td>
<td></td>
</tr>
<tr>
<td>42</td>
<td>Impacts Of Industrial Effluents On Microbial Diversity In The Yamuna River, Agra, India</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>Assessment of Trace elements and its impact on Groundwater quality in Aligarh City, Aligarh</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>Title““Human Impact Causes For Eutrofiering Rivers Of India With Special Reference To Panchaganga Black River Near Ichalkaranji Area, An Attempt For Restoration” M.S.India</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>46</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Page</td>
<td>Title</td>
<td>Authors and Details</td>
</tr>
<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>45</td>
<td>The Monitoring Of Water-Stock Changes And Nitrogen Transfer Down A Citrus Farm Soil At The Triffas Plain, Eastern Morocco</td>
<td>54</td>
</tr>
<tr>
<td>46</td>
<td>Impact Of Urbanization On Natural Drainage Pattern In The District Of Karachi, Pakistan</td>
<td>55</td>
</tr>
<tr>
<td>47</td>
<td>Crop Suitability Analysis Of Noyyal River Basin, Tamil Nadu, Using GIS Approach</td>
<td>56</td>
</tr>
<tr>
<td>48</td>
<td>On People Narrow With Agriculture Sewage Water In Closed Oases In Arid Environment, Siwa Oasis, Egypt As A Case Study</td>
<td>57</td>
</tr>
<tr>
<td>49</td>
<td>Irrigation Water Governance Analysis: A Positive Approach Applied To Irrigated Areas Of Nadhour-Tunisia</td>
<td>58</td>
</tr>
<tr>
<td>50</td>
<td>Impact Of Wastewater On Groundwater Resources In Sana’a Basin, Yemen</td>
<td>59</td>
</tr>
<tr>
<td>51</td>
<td>Groundwater Quality Mapping In Kodaganar Sub - Basin, S. India Using Gis Techniques</td>
<td>60</td>
</tr>
<tr>
<td>52</td>
<td>Groundwater Characterization In Intensive Agricultural Area Under Arid Climate: Case Of Chtouka Region, Morocco</td>
<td>61</td>
</tr>
<tr>
<td>53</td>
<td>Assessment Of Groundwater Quality In Salalah Plain</td>
<td>62</td>
</tr>
<tr>
<td>54</td>
<td>Assessment of the role of National Water Governance under the New Palestinian Water Reform Laws</td>
<td>63</td>
</tr>
<tr>
<td>55</td>
<td>Contribution of the systemic approach in the analysis of drinking water supply in urban areas. Case of urban cluster tlemcen, algeria</td>
<td>64</td>
</tr>
<tr>
<td>56</td>
<td>Quantifying Resilience of Aquifers: A Case Study from Northern New South Wales, Australia</td>
<td>65</td>
</tr>
<tr>
<td>57</td>
<td>Integrated Study On Groundwater Salinity In The Aquifer System Of Delhi, India</td>
<td>66</td>
</tr>
<tr>
<td>58</td>
<td>Hydrogeochemical And Geophysical Evaluation Of Groundwater Resources In Abu Madi Coastal Area, Northern Nile Delta, Egypt</td>
<td>67</td>
</tr>
<tr>
<td>59</td>
<td>Investigating Hydrochemistry And The Groundwater Quality Prospects Evaluation And Its Suitability For Agricultural, Northwestern Saudi Arabia</td>
<td>68</td>
</tr>
<tr>
<td>60</td>
<td>The Combination of Principal Component Analysis and Geostatistics as a Technique in Assessment of Groundwater Hydrochemistry in Arid Environment: A case study of Central Saudi Arabia</td>
<td>69</td>
</tr>
<tr>
<td>61</td>
<td>Fluoride Problem In Semi-Arid Region – A Case Study From India</td>
<td>70</td>
</tr>
<tr>
<td>62</td>
<td>Geochemical And Isotopic Study Of Salinization And Pollution Of The Coastal Aquifer Of Chott Meriem, Sahel Of Sousse, Tunisia</td>
<td>71</td>
</tr>
<tr>
<td>63</td>
<td>Nitrate Contamination Of Groundwater In Semi-Arid Rural Area: South India</td>
<td>72</td>
</tr>
<tr>
<td>64</td>
<td>Hydrochemistry and Quality Assessment of Shallow Aquifer Ground Water of Wadi Baye, North Central Region of Libya</td>
<td>73</td>
</tr>
<tr>
<td>65</td>
<td>Geo - Solution Techniques For Groundwater Exploration</td>
<td>74</td>
</tr>
<tr>
<td>66</td>
<td>Regional Groundwater Studies Using Aeromagnetic Technique</td>
<td>75</td>
</tr>
<tr>
<td>67</td>
<td>Major Ion Chemistry And Weathering Processes In The Midyan Basin, Northwestern Saudi Arabia</td>
<td>76</td>
</tr>
<tr>
<td>68</td>
<td>Application Of Dc Resistivity Method For Groundwater Investigation, Case Study At West Nile Delta, Egypt</td>
<td>77</td>
</tr>
<tr>
<td>69</td>
<td>Environmental Studies On Toxic And Radioactive Contaminant On The Groundwater Of Southwestern Sinai, Egypt</td>
<td>78</td>
</tr>
<tr>
<td>70</td>
<td>Contamination By Radioactive Heavy Metals And Trace Elements In Paleobeach Groundwater, Cox’s Bazar, Bangladesh: Potential Impact On Environment</td>
<td>79</td>
</tr>
<tr>
<td>71</td>
<td>Reexamining The Spatial Distribution Of Fluoride In Groundwater Of Sri Lanka: A Field Study At Nochchiyagama, Anuradhapura</td>
<td>81</td>
</tr>
<tr>
<td>72</td>
<td>Assessment Of Interaction Between Surface Water And Groundwater In Sawa Lake Area - Southern Iraq Using Stable Isotope Technique</td>
<td>82</td>
</tr>
<tr>
<td>73</td>
<td>The Peri-Urban To Urban Groundwater Transfer And Its Societal Implications In Chennai, South India – A Case Study</td>
<td>83</td>
</tr>
<tr>
<td>74</td>
<td>A Pre-Requisite For Restoration Of An Ecosystem Under Water Scarcity: Analysis Of Collaborative Actions For Agricultural Water Management</td>
<td>84</td>
</tr>
<tr>
<td>76</td>
<td>Research Of New Potentiality Of Drinking Water In The Province Of Aousserd (Southern Morocco)</td>
<td>86</td>
</tr>
<tr>
<td>77</td>
<td>Formation And Dissolution Of Salt Crusts As A Rapid Way Of Nitrate Mobilization In A Tile Drained Agricultural Field</td>
<td>87</td>
</tr>
<tr>
<td>78</td>
<td>Assessment Of Groundwater Vulnerability To Pollution In Governorate Of The Northern Gaza Strip Using A Gis Drastic Model</td>
<td>88</td>
</tr>
<tr>
<td>79</td>
<td>Hydrometeorology Of The Dhofar Cloud Forest And Its Implications For Groundwater Recharge</td>
<td>89</td>
</tr>
<tr>
<td>80</td>
<td>Subterraneous Flux In Arabian Sea Coastal Belt- Its Link With Coastal Mudbank Formation</td>
<td>90</td>
</tr>
<tr>
<td>81</td>
<td>Groundwater Residence Times In The Najd Based On Chlorine-36</td>
<td>91</td>
</tr>
<tr>
<td>82</td>
<td>Estimation Of The Groundwater Reserves Of The Salalah Coastal Plain</td>
<td>92</td>
</tr>
<tr>
<td>83</td>
<td>Groundwater Quality Of Domestic Shallow Dug Wells In Parts Of Tanah Merah District, Malaysia</td>
<td>93</td>
</tr>
<tr>
<td>84</td>
<td>Distribution Of Trace Elements In Groundwater Around Beris Lalong Landfill, Kelantan, Malaysia</td>
<td>94</td>
</tr>
<tr>
<td>85</td>
<td>Significance Of Silica Analysis In Groundwater Studies Of Domestic Shallow Wells In Parts Of Jeli District, Kelantan, Malaysia</td>
<td>95</td>
</tr>
<tr>
<td>86</td>
<td>Mapping Stakeholders’ Behaviors for Improving Water Management in an Agricultural Coastal Region in Oman</td>
<td>96</td>
</tr>
<tr>
<td>87</td>
<td>Study Of Hydro-Saline Soils’ Characterization Of A Palm Grove In Basin Ouargla (Northern Algerian Sahara)Title (Capital Letters, 12 Pt, Centered, Bold, 18 Pt After)</td>
<td>97</td>
</tr>
<tr>
<td>88</td>
<td>Dehydrated And Activated Carbons From Omani Date Palm Leaflets For The Removal Of Pharmaceuticals From Water</td>
<td>98</td>
</tr>
<tr>
<td>89</td>
<td>Role Of Ground And Surface Water In Triggering Landslides In Great Kabylia (Tizi-Ouzou, Algeria)</td>
<td>99</td>
</tr>
<tr>
<td>90</td>
<td>Co-Evolutionary Dynamics « Institutions-Innovations » And Productivity Gains In The Management Of Water Resources</td>
<td>100</td>
</tr>
<tr>
<td>91</td>
<td>A GIS-based entropy groundwater quality index for assessing groundwater quality for drinking purposes in Alton Kubri, northern Kirkuk province, Iraq</td>
<td>101</td>
</tr>
<tr>
<td>92</td>
<td>Modeling of Phosphorus Dynamic in Kuwait Bay</td>
<td>102</td>
</tr>
</tbody>
</table>
Assessment and Mapping of Nitrate in the Groundwater of Northern Part of Khuzestan Province, Iran

Mohamad Sakizadeh¹, Rouhollah Mirzaei²
¹Assistant Professor, Department of Environmental Sciences, Faculty of Sciences, Shahid Rajaee Teacher Training University, Tehran, Iran
msakizadeh@gmail.com
²Assistant Professor, Department of Environment, Faculty of Natural Resources and Earth Sciences, University of Kashan, Kashan, Iran

Abstract
The main objective of this study was to consider the extent and spatial distribution of nitrate in 89 wells and springs in Khuzestan Province, Iran. Mann-Whitney U test was applied to consider the statistical difference between wells and springs and between the two main cities in the region (Andimeshk and Shush). Geostatistical methods were utilized to study the spatial distributions of pollution. The health risk of nitrate was calculated through hazard quotients. The nitrate concentrations ranged from 4.50 mg/l to 23.98 mg/l in the springs and between non-detectable to 84.90 mg/l in the wells. There was not any significant difference between the wells and springs. The nitrate values were higher than the permissible levels in 13.5 percents of the stations. The resultant maps showed that the nitrate was concentrated around Andimeshk City. The maximum and minimum health risk values of nitrate for the adults were 0.03 and 2.03 while for the children they were 0.03 and 2.27, respectively. As a whole, 12.5 percents of the wells and springs had a risk of higher than one whereas in the case of children 13.6 percents of the wells and springs had a higher than one indicating the high risk for the health of consumers.
WATERING FREQUENCY EFFECTS ON QUERCUS PUBESCENCE

Valasia Iakovoglou
DEMETER-Forest Research Institute, Thessaloniki, Greece,
Email: viakovoglou@yahoo.com

Abstract

Mediterranean ecosystems are of high ecological value, mainly due to their increased biodiversity levels. However, in particular Greek areas are highly altered due to intense disturbance events, such as fires. The semi-arid climate that dominates especially during summer time in conjunction to climate change poses difficulties in restoring those areas. Consequently, the forest service has to produce the best quality of seedlings that could tolerate those adverse environmental conditions in order to successfully restore a site. The hypothesis is that seedlings that are pretreated to reduced watering frequency tent to shift their biomass allocation towards root development to better cope with water deficit transplanting growth conditions. Hence, the aim of this study was to test watering frequencies of the highly valued tree species of Quercus pubescence. Three year old seedlings were placed under controlled growth conditions (20° C root and air temperature) in order to test five watering frequencies that were three-, two- and one watering every week and one watering every two and four weeks. The indicator that was used to detect shifting towards root biomass allocation was the "Root Growth Potential (RGP)”. Other morphological and physiological measurements were also recorded at the end of an experimental month based on five seedlings per watering frequency. According to the results, seedlings that were watered the least (one watering every four weeks) had the longest roots, but seedlings that accumulated the most for root growth were the once that were watered once every two weeks. Our results suggest that watering only twice a week induces a shift to root allocation for the species of Quercus pubescence. Increased root biomass has been associated with increased ability to overcome transplanting shock. Consequently, with the least amount of watering frequency better equipped seedlings could be produced in order to overcome transplanting shock and successfully regenerate those semi-arid sites.
Abstract
At the Mediterranean region, the problems related to the agriculture, the defence of the soil and watershed management, are one of the most significant environmental problems. To solve this problem it is necessary to study, analyze and understand the impact of the erosive action in these semi-arid areas.

There are different methods that estimate soil erosion at the plot or watershed level; these methods range from simple to complex. For this work, the analysis has focused on modelling of water erosion by the RUSLE model (Revised Universal Soil Loss Equation) consisting of a modified version of the universal soil loss equation of (USLE) originally developed by Wischmeier and Smith (1978). A methodology of assessing the various risk indices of erosion around the geographic information system (GIS-Arc Gis 9.3). The RUSLE equation was applied by overlaying, using ArcGIS software, the various appropriate thematic maps for each factor.

According to the RUSLE model, over 70% of the study areas are subject to different soil loss levels: low (<5) to very high (50 - 200). The average loss by water erosion across all study sites is about 8.73 t / ha / year. Total annual losses for the six selected townships are of the order of 33.995,4 t / ha / year.

In light of these figures, we can conclude that the unequal distribution of areas with potential risk of erosion in the Aurès center results from the variability of the characteristics of the factors involved in the process and the model used. These results will be used for territorial planning, in reference to the project to reduce the vulnerability of these areas.
ADDRESSING GROUNDWATER QUALITY CALAMITY AND ITS MANAGEMENT IN THE THAR DESERT OF SINDH PROVINCE OF PAKISTAN

*Tahir Rafique¹, Shahid Naseem², Muhammad Iqbal Bhanger³, Tanzil Haider Usmani¹

¹Applied Chemistry Research Center, PCSIR Laboratories Complex Karachi, Pakistan
²Department of Geology, University of Karachi, Karachi, Pakistan
³HEJ Research Institute of Chemistry, ICCBS, University of Karachi, Karachi, Pakistan

E-mail: tahirrafque92@yahoo.com

Abstract

Water quality management is a critical challenge in the developed as well as developing countries. Water crisis in terms of scarcity has received considerable attention in Pakistan in the recent decades, while the water quality issues have been mostly neglected. At present, a local picture of water quality situation does not exist even for major cities, while the deterioration in water quality is evident in most of the parts of Pakistan and is more severe in remote areas like Thar Desert. The Thar Desert lies within the desert belt of the tropics in the southeastern part of Pakistan, on the western edge of the stable Indian Peninsula, covering an area of about 22,000 square kilometers with a population of more than one million. The people of this area rely on groundwater for drinking purposes, which is available at the depth between 20 and 300 ft. The water is typically quite salty but potable. The sources of water are perched, ephemeral aquifers at the contact of the Sub-recent deposits with the overlying dune sand. Investigations carried out have showed that groundwater quality of Thar Desert area has been deteriorated by the presence of total dissolved solids contents (TDS) in excess concentrations than the WHO maximum limit of 1,000 mg/L for drinking water. A total of 1,000 groundwater samples were representatively collected from all the areas of Thar Desert and the average TDS value has been found to be 4,345 mg/L within the wide range of 325-41,637 mg/L, while median value was found to be 3,304 mg/L. About 14.70% (n= 147) groundwater samples were found to be ≤1,000 mg/L, whereas in 85.30% (n= 853) of groundwater samples, TDS values have been found to be higher than the 1,000 mg/L limit of WHO, thus making most of the groundwater samples unsuitable for drinking. The groundwater is alkaline (pH 7.0 to 8.7), brackish, and classified as Na-Cl type water.
This prevailing chemical character reflects the influence of high evaporation rates, saltwater intrusion and rock weathering. This finding is not unexpected for an arid environment, and it suggests that the concentrations of major ions other than Na and Cl are largely controlled by the precipitation of lower solubility minerals (e.g., calcite) as evaporation causes salinity to increase. Due to the absence of canal system and adequate rainfall, recharge is negligible. Change in water quality of wells takes place according to the type and amount of salts present in the parent geological materials which are quite variable from place to place depending upon the bedrock geology, depth, rainfall, distance from the recharging aquifer and nearness to source of salts. Inhabitants of such remote areas are at higher environmental and health risks, if effective measures are not identified, decided upon and implemented. There is an urgent and emergent need to save these areas to ensure availability of good quality of water through efficient rainwater harvesting techniques, development of canals water supply system and installation of reverse osmosis plants.
A Multi-Objective Model for Economic-Environmental Optimization of Underground Drainages

Faeze Hajirajabi¹, Hamed Mazandarani Zadeh²

Water Engineering Group, Faculty of engineering, Imam Khomeini International University (IKIU) Qazvin, Iran.

¹M.Sc. Student of water resources engineering (faeze_hajirajabi@yahoo.com)
²Assistant professor of water engineering (hzadeh@iust.ac.ir)

Abstract

To minimize the construction costs and harmful effects of wastewater on the environment, choosing appropriate parameters of drainage systems design are so important. Design parameters are depth, diameter and drainage spacing. By using the simulated annealing optimization model, which is a kind of evolutionary algorithms, an optimization model has been introduced. To evaluate the model, a unit of Agro Industry Salman Farsi has been selected as a case study. In the economic-environment model both goals have been a priority and no one have superiority over that one. As a result of this model, a set of non-dominated answers is obtained. Range of depths of answers was laid between 1.1m and 2.8m and diameters 0.1m and 0.125m.
MAPPING POLLUTION VULNERABILITY BY USING THE SINTACS METHOD IN Arid Area, THE RIS-Nekor (PROVINCE OF ALHOCEIMA, MOROCCO)

J. STITOU EL MESSARI and A. SALHI
Dep. Geology University Abdelmalek Essaadi, B.P: 2121 93003 TETUAN (Morocco), stitoumessari@yahoo.fr

Abstract
The Ghis-Nekor aquifer is one of the most important underground hydric reservoir in the province of ALhoceima north of Morocco. The rapid growth of the water demand is contrasted by a climatic irregularity and crucial water quality degradation due to the multiplication of hazardous pollutants releases without prier remediation. Wherefore, the assessment of groundwater pollution vulnerability is used to guide and assist decision makers for a sustainable management of the environment.

In order to protect the aquifers against contamination, we have elaborate maps of pollution vulnerability using geological and climatic characteristics as a data base. This method has highlighted different features and regions of localized pollution vulnerability which are established for the first time. These maps can serve as a guide to territory managers at the time of planting installations. SINTACS method. It makes use of seven parameters: distance to the sheet, infiltration, lithology of the no-saturated zone, soil type, lithology of the saturated zone, hydraulic conductivity of the saturated zone and topography. We ascribe a weight (P) to each of these parameters, according to the importance of the parameter to the method, and a grade (W) which varies in space according to its category.

The application of this method for three different hydrological years, wet, mean and dry, has led to three different maps of vulnerability. The vulnerability maps of the wet year shows that the moderate class dominates the majority of plain 56% of the total surface area, divided between the centre, the south, and borders northeast and northwest. Area with high vulnerability (30.7%) appears under frome of belts that surround the previous class to three areas: between Hebkouch and the main dam of the dam, between Troughout and East of the town of Imzoren Hdidi and Ghis-plain. The high vulnerability class keeps 10.5% plain it extends throughout the coast.
GROUNDWATER RESOURCES OF BAHARIN – SOME INSIGHTS AND FUTURE STRATEGIES

Mubarak A. Al-Noaimi¹ and Pradeep K. Naik*²

1. Freelance Consultant (Hydrogeology), P O Box 29286, East Riffa, Kingdom of Bahrain,
   Previously Director of Water Resources,
   Ministry of Municipalities Affaires and Agriculture,
   Kingdom of Bahrain
   Email. malnoaim@batelco.com.bh

2. Central Ground Water Board, North Western Region, Ministry of Water Resources,
   River Development and Ganga Rejuvenation, Govt. of India, # 3B, Sector 27A,
   Chandigarh – 160019. India.
   *Email. pradeep.naik@water.net.in

Abstract

The Kingdom of Bahrain occupies a geographical area of about 760.5 km² with a population of about 1.2 million. High temperatures, scanty and erratic rainfall (annual average 78 mm), high evapotranspiration and high humidity assign it an arid to hyper-arid environment. The bulk of the population live in urban conglomerates with their main occupations as small to large scale trading, fishing and agriculture. Since no stream flows in its landmass, rainfall and groundwater are the only natural sources of water in the country, especially for irrigation purposes. It did have a large cultivated area (60 km²) before independence (1971), which reduced to only 15 km² in 1993 accounting for only 2% of the country’s land area. The reason for such a rapid decline has been the heavy and indiscriminate abstraction of the groundwater leading to its over-exploitation and quality deterioration. Relatively fresh water springs, which were once the pride of Bahrain, are non-existent. Although ground water is still the major source of water (59.4%) in the country, its volumetric consumption has drastically reduced from that in 1950s. The usage of the unconventional sources of water, such as the desalinated water and the treated sewage effluents (TSE), is on the rise, but they are at the expense of the country’s public exchequer. TSE utilization is a progressive venture, but it cannot afford to irrigate even half of the country’s agricultural water requirements. The present paper discusses the pros and cons of groundwater utilisation and suggests recommendations that would go a long way in solving the water crisis in Bahrain. Some of the recommendations include demand-side management, wise water use, application of IWRM principles, policy reforms, development of water markets, public-private partnership, regional cooperation, etc.
Deficit Irrigation Of Fruit Trees Orchards Under Water Scarcity

Mohamed Ghrab\textsuperscript{1}, Mohamed Moncef Masmoudi\textsuperscript{2}, Netij Ben Mechlia\textsuperscript{2}

\textsuperscript{1} Institut de l’Olivier, BP 1087, Sfax 3000 Tunisia
\textsuperscript{2} Institut National Agronomique de Tunisie, 43 av. Charles Nicolle, Tunis 1082, Tunisia
mghrab@gmail.com; ghrab.mohamed@iresa.agrinet.tn

Abstract

Peach is one of the most important fruit trees in Tunisia with an extended maturity season. Grown mainly under irrigation, it has high irrigation water needs particularly for late season varieties. With increasing water scarcity, efficient water management practices are needed in order to reduce irrigation supply while maintaining the productivity at acceptable levels. Deficit irrigation (DI) was developed as an irrigation technique to control vegetative growth and for water saving. Under semi arid conditions of Tunisia, this strategy was initially applied for late peach cultivar to save irrigation water depending on fruit growth stages. Recently, the use of rootstock and DI as means of improving water productivity was considered. DI is applied on scion-rootstock combinations with early and mid-season maturing peach cultivars grafted on two rootstocks with contrasting vigor. In both experimental works monitoring concerned tree water status, vegetative growth and yield. Analysis of data from these experiments focused on long-term impact of these irrigation restrictions on water productivity and water saving. Results obtained revealed that the late peach cultivar have better water productivity when deficit irrigation is applied during the whole season. For early and mid-season cultivars, irrigation practices allowed significant water savings mainly during late season growth stage. Furthermore, rootstock effects on tree water status, vigor and yield were detected. Leaf and stem ($\Psi_{\text{stem}}$) water potential measurements were used to develop practical tools for characterizing watering condition and irrigation scheduling. The ratio between water supply ($P+I$) and evapotranspiration ($ETo$) was used as supply indice ($K_s$). Significant correlations were found between stem water potential ($\Psi_{\text{stem}}$) and water supply indice ($K_s$) taken as the ratio between water supply and evapotranspiration ($ETo$) supporting the usefulness of such indices for scheduling. $K_s$ threshold values of 0.8 and 0.5 are proposed respectively for moderate and severe deficit irrigation.

Acknowledgements:

The authors wish to thank the SADIRA Company for providing the experimental field and the personnel of the INAT experimental station for their technical assistance. This research was financially supported by the Tunisian Ministry of Higher Education and Scientific Research, and the EU research project WASIA (“Water Saving in Irrigated Agriculture”).
AUTOMATIC CALIBRATION OF AQUIFER HYDRODYNAMIC COEFFICIENTS USING SWARM-INTELLIGENCE-BASED OPTIMIZATION ALGORITHM

Sadegh SadeghiTabas¹, Abolfazl Akbarpour², Mohsen Pourreza Bilondi³, S. Zahra Samadi⁴

1. Ph.D student of Water Resources Engineering, Department of Civil Engineering, Iran University of Science and Technology (IUST), Tehran-Iran
2. Department of Civil Engineering, University of Birjand, Birjand-Iran
3. Department of Water Engineering, University of Birjand, Birjand-Iran
4. Department of Civil and Environmental Engineering, University of South Carolina, Columbia-United States.

Email of corresponding author: sadeghitabas@yahoo.com

Abstract

Despite advanced developments in computational techniques and groundwater models, the issue of how to adequately calibrate and minimize misfit between system properties and corresponding measurements within a hydrogeology model remains a challenging task. Two important features of the groundwater system, hydraulic conductivity (k) and specific yield (Sy), spatially vary within an aquifer modeling scheme due to geologic heterogeneity. This paper provides the first attempt in using an advanced swarm-intelligence-based optimization algorithm (Cuckoo Optimization Algorithm) coupled with a distributed hydrogeology model (i.e. MODFLOW) to calibrate aquifer hydrodynamic parameters (Sy and k) over an arid groundwater system (Birjand aquifer, east Iran). Our optimization approach was posed in a single-objective context by the trade-off between sum of absolute error and the adherent swarm optimization experiment. The Cuckoo optimization algorithm further yielded both hydraulic conductivity and specific yield parameters with the least RMSE (root mean square) for calibration (RMSE<0.73; Oct. 2010-Sep. 2011) and validation (RMSE<0.89; Oct. 2011-Sep. 2012) periods. Estimation of depth to water table revealed skillful prediction in a set of cells located at the middle of the aquifer whereas it showed unskillful prediction at the headwater due to frequent water storage changes and boundary condition. Analysis suggests that groundwater depth reduced from the east toward the west and southwest parts of the aquifer because of extensive pumping activities which caused a smoothening effect on the shape of the simulated head curve. Calibration of groundwater parameters using coherence optimization algorithm can provide more insights into the functionality of arid ground water dynamics.

Acknowledgements:
The authors appreciate those persons and agencies that assisted in accessing research data. Special thanks are owed to Professor Theo Olsthoorn from the Delft University of Technology for his fruitful discussions and technical support on groundwater modeling and process. Particular acknowledgment is given to Cuckoo developer, Dr. Ramin Rajabioun, form University of Tehran, for providing Cuckoo MATLAB code freely available to the authors.
STUDY OF GROUNDWATER VULNERABILITY TO POLLUTION BY THE DRASTIC METHOD COUPLED WITH A GEOGRAPHIC INFORMATION SYSTEM (GIS): APPLICATION TO GROUNDWATER BENI AMIR, MOROCCO

N. Knouz, E. M, Bachaoui & A, Boudhar
Laboratory of Remote sensing and GIS applied to Geosciences and Environment, Department of Earth Sciences, Faculty of Science and Technology, B.P. 523, Béni Mellal, Maroc
E- mail : najat.alias@gmail.com

Abstract

Fresh water is the condition of all life on Earth for its vital role in the survival of living beings and the social, economic and technological. Groundwater is, as surface water, increasingly threatened by pollution. In this respect, the study of groundwater vulnerability to pollution is a very valuable tool for resource protection and management of its quality.

The main objective of this study in the irrigated perimeter Tadla, the first irrigated perimeter of Morocco, is the assessment of vulnerability to groundwater pollution Ben Amir using the DRASTIC method (depth of the water table (Depth), groundwater recharge, the aquifer lithology, nature Soil, Topography, Impact of vadose zone and hydraulic conductivity) and assessing the impact of parameters on the DRASTIC vulnerability index by a sensitivity analysis. This study also highlights the role of geographic information systems (GIS) in assessing vulnerability.

The developed map shows four vulnerability classes, 7% of the study area has a high vulnerability, 31% are moderately vulnerable, 57% have a low vulnerability and 5% are of very low vulnerability.

Keywords: Sensitivity Analysis, DRASTIC, Morocco, GIS, Vulnerability
GROUNDWATER QUALITY IN THE NORTHERN PART OF SUB BASIN OUED LABIOD _AURES NORTH 'ALGERIA

RIHANI Abla¹ et MENANI Mohamed Redha¹
1 : laboratory MGRE, Département STU, University Batna, Algérie
Email: abla.rihani@univ-batna.dz
Menani_redha@univ-batna.dz

Abstract

The increase in the severity and length of the low water poses more acutely the question of strong seasonal demand in some areas since the summer demand could increase further, posing an additional problem of matching needs and available resources. Insofar as tablecloths, themselves, could see their recharge decrease due to climate change impacts, it becomes essential to be able to quantify these samples to ensure sustainable management of aquifers. The purpose of this study is the location of aquifer could be exploited in the valley of Oued Labiod and knowledge of hydrochemical characteristics of the water that circulate.

The oued Labiod watershed may be important from the point of view hydrogeological; these aquifers consist of limestone and sandstone; aquifers that are circulating crack. Therefore their water potential depends strongly on the degree of cracking geological formations that compose them. The region is highly rugged with a typical Saharan Atlas tectonic style, giving rise to broad synclinal structures with flat bottoms separated by narrow anticlines in blanks recovered very elongated and rarely symmetrical.

The main reservoirs of groundwater is formed by limestones and conglomerates of Miocene limestones in the Flint Ypresian - Lutetian (potential aquifer in the region), chalky limestone and Paleocene limestones Maastrichtian.

Levels of many aquifers in the valley show a tendency to decline in recent decades, this being due, first, to over pumping of groundwater beyond their recharge, but also to a decrease in rainfall inputs.

waters are less crowded north while in central and southern waters become sulfated or chlorinated, reflecting the removal of feeding areas and the dissolution of evaporites in an area subject to an arid climate.

Keywords: the, underground water, sources, water quality
NEW HYDROLOGICAL MODELING APPROACH FOR PERI-URBAN CATCHMENT

Dr. BOUTAGHANE Hamouda
Laboratory of Hydraulics and Hydraulic Constructions, Badji Mokhtar-Annaba University, P.O. BOX 12, 23000, Annaba, Algeria
boutaghane.hamouda@univ-annaba.org

Abstract

Peri-urban catchment refers to a transition or interaction zone, where urban and rural surface are juxtaposed. Fueled by population growth and economic development, this specific zone is non-neutral. Landscape features are subject to rapid and discontinued urbanizations and cause an increased impervious. Those urban development can have major effects on hydrologic cycle and water quality. The hydrology of peri-urban catchment is characterized by a various behavior of hydrological surfaces (pervious or impervious), coexistence and interconnection of several drainage system such as hydrographical network and sewer system.

Hydrologic refined modeling of peri-urban catchment requires representation of different hydrologic processes as occurring at different time scales in dual drainage system (natural and artificial), and their interconnections. In traditional modeling, catchment is divided in two different partitions: a pervious areas modeling, to simulate contributions to natural hydrographic network and an impervious areas modeling to calculate contributions to the sewer network. This representation of peri-urban catchment creates some major complications related to data updating of and parameters in case of urban evolution.

This work, describe a new hydrological modeling approach for peri-urban catchment, named “Multi-Outlets Model”. Catchment is divided by sub-catchment of any shape according to the classical formalism of urban hydrology. Sub-catchment is then divided by compartments between which fluxes can be exchanged. This sub-catchment can have multiple outlets connected to different hydraulic systems (sewer system, river networks, Structural BMP,...). The compartments are represented by reservoir structures named boxes between which exchanged fluxes are depend only on stocks in the upstream and downstream boxes.
ASSESSMENT OF A TRADITIONAL IRRIGATION MANAGEMENT SCHEME USING REMOTE SENSING AND TDR TECHNIQUES (CASE STUDY: PISTACHIO ORCHARDS IN CENTRAL IRAN)

M.H. Rahimian¹, M. Shayannejhad², S.S. Eslamian², S. Taghvaeian³, M. Qeysari², R. Jafari²

¹- Ph.D Student in Irrigation and Drainage Engineering, Isfahan University of Technology & Research Expert of National Salinity Research Center, Yazd, Iran, 2-Faculty Members, Agricultural Department, Isfahan University of Technology, 3-Faculty Member, Department of Biosystems and Agricultural Engineering, Oklahoma State University, Stillwater, Oklahoma, USA

mhrahimian@gmail.com

Abstract

One of the methods of understanding and evaluating the irrigation performance is to measure soil moisture; RS based vegetation indices and canopy temperature. The present study aims to introduce a traditional scheme of irrigation management (continuous water rotation in an irrigation district) in the pistachio orchards of Ardakan, in central Iran, and evaluate its strengths and weaknesses. A TDR device was used in a one-month period in order to study the daily changes of the soil moisture. To do this, soil moisture was measured on a daily basis in four different depths in 25 points of the studied region. Moreover, Landsat satellite images were used to determine the normalized difference vegetation index (NDVI), and vegetation canopy temperature, and the results were compared to those of the neighboring pistachio orchards. The results showed that the average soil moisture of the studied land in 25 points were approximately the same in all days and is in a range of 15 to 20 volumetric percent (with the average of 17.6 percent and the standard deviation of 3.6 percent). This pattern caused a favorable microclimatic condition and proportional reduction in drought effects in pistachio gardens which is beneficial to the plants. Furthermore, the NDVI and vegetation temperature indices showed a better condition in the studied Pistachio orchard in comparison with the neighboring pistachios which is a result of irrigation management scheme. Promoting the aforementioned method of irrigation, (continuous water rotation in an irrigation zone and irrigation of scattered and distinct parts) – and applying it in other pistachio orchards – where irrigation starts in one part and goes through adjacent parts in a row to irrigate all the land_ is one of the achievements of this study; can be advised for other similar condition.

Keywords: Irrigation Pattern, Soil Moisture, NDVI, Vegetation Temperature, Pistachio, Satellite Images.
Qualitative Assessment of Qantas as a Source of Irrigation Water in Arid Regions (Case Study: Yazd Province in Central Iran)

M.H. Rahimian\(^1\), S.S. Eslamian\(^2\) and S. Poormohammadi\(^3\)

1-Ph.D. student of Irrigation and Drainage Engineering, Isfahan University of Technology & Research Expert of National Salinity Research Center, Yazd, Iran, 2-Professor of Water Resource Management, Isfahan University of Technology, 3- Research Expert of National Cloud Seeding Research Center, Yazd, Iran

mhrahimian@gmail.com

Abstract

Iran is one of the few countries that have the ancient technology of qanat, as important source of irrigation water, characterized by maximum flexibility with the environment and minimum pressure to the groundwater resources. Its importance takes more visible in times of water scarcity and droughts, which occur predominantly at large areas of the country. This study investigates quality and quantity of more than 110 qanat strings in Yazd province, central plateau of Iran. Length, depth, general slope, soil type, discharge, electrical conductivity and acidity of qanat water were the major characteristics that assessed in this study. Also Watsuit computational model carried out to investigate suitability of some qanats for irrigation of agricultural crops, and to predict steady-state soil salinity profile. From the view of qualitative assessment of qanats (mainly salinity), results of some cases indicate that the current uses of qanats are not in accordance with the crop salinity tolerance thresholds, that would yield lower biomass and income for the farmers. Additionally, the model predicts that there would be risks of soil sodicity in some cases. These notice to review our knowledge on suitability and allocation of qanat waters to the specified crops/soil conditions to higher their productivities. Leaching of soil accumulated salts by increasing of irrigation depth coupling with decreasing of irrigation surfaces are alternatives to overcome to the salinity hazards. Use of soil amendment such as gypsum is another alternative for cases with the risk of soil sodicity. Other solutions such as tillage operations, planting methods, selection of salt tolerant cultivars and fertilizer application can be advised to reduce the adverse effects of qanat water salinities on agricultural products.

Keywords: Qanat, Salinity, Watsuit, Irrigation, Iran.
AN INNOVATIVE SOLUTION FOR SUSTAINABLE GROUNDWATER RESOURCE MANAGEMENT: THE CASE OF KHORASAN RAZAVI – IRAN

Hassan Kashi, Kaveh Madani, Ali Mirchi,
Ehsan Mohammad Zadeh Lari, Mohsen Taravat, Seyed Foad Dolatabadi

Tehran, Iran

h.kashi@rsa-electronics.co

Abstract

Groundwater resources are used as reliable water sources in arid and semi-arid areas of the world such as Iran, which lack sufficient amounts of surface water to meet various demands. In Khorasan-Razavi province in the northeast of Iran, 75% of water supplies are provided from groundwater withdrawal, causing a deficit of about 1.12 million cubic meters in the aquifers. In light of the critical situation of Iranian plains and aquifers, and as part of Iran’s fourth and fifth development plans, as well as a long-term strategic plan to conserve the country’s water resources, the Iranian Ministry of Energy is charged with restoring 25% of the nation’s total water resources. To implement this strategy, Khorasan Razavi’s water authority introduced a groundwater withdrawal regulation plan to control over-pumping in order to stop further groundwater table drawdown as compared with 2005 levels. A central proposal was to install Smart Energy and Water Meters (SEWM), an innovative technology that produced promising outcomes (e.g., reduced pumping time and groundwater depletion) in parts of Iran. The SEWMs measure a number of parameters of interest to water and energy utilities, including energy consumption and water withdrawal. In 2014, Khorasan-Razavi water authority installed 1,164 SEWMs in the region, which led to saving 16 million cubic meters of groundwater. Furthermore, the SEWM technology provided an opportunity for mitigating over-pumping by charging additional withdrawal fees, which totaled 542,000 USD. This article provides an overview of the implemented smart metering strategy, discussing how it helped increase the effectiveness of the groundwater withdrawal regulation plan.

- Hassan Kashi: Rahrovan Sepehr Andisheh (RSA) Electronics Co. (Responsible Author)
- Kaveh Madani: Centre for Environmental Policy, Imperial College London, UK
- Ali Mirchi: Department of Civil and Environmental Engineering, Michigan Tech - USA
- Ehsan Mohammad Zadeh Lari: Regional Water Authority - Khorasan Razavi - Iran
- Mohsen Taravat: Rahrovan Sepehr Andisheh (RSA) Electronics Co.
- Seyed Foad Dolatabadi: Rahrovan Sepehr Andisheh (RSA) Electronics Co.
EFFECTIVE ELECTRICAL GROUNDING SYSTEM FOR ARID REGIONS

Chandima Gomes, Ashen Gomes and Zainal Kadir

Center for Electromagnetic and Lightning Protection, Universiti Putra Malaysia, Serdang 43400, Selangor, Malaysia

chandima@upm.edu.my

Abstract

Electrical grounding is one of the most daunting tasks assigned to electrical engineers that have to ensure human and equipment/system safety of building wiring systems, medium voltage grid and substation networks, signal and communication networks, and lightning protection systems. The major challenge in such cases is the inability to achieve and maintain low earth resistance of the grounding systems. Almost all types of soil have increasing trends in their resistivity with lack of moisture. For example, the resistivity of white clay soil (kaolin) could be increased by 3-4 orders as the moisture content reduces from saturation to about 20%. The increment in soil resistivity, inherently increases the earth resistance of electrode systems. Therefore, the cost of implementing a reliable electrical grounding system in an arid area may most often well exceed the acceptable financial limits. The experiments done in Malaysia for the last five years show that compact electrode systems that are backfilled with natural clays such as montmorillonite and agro products or agro wastes such as Kenaf powder give rise to remarkable moisture retaining capacities for the designed electrode systems. The paper describes one of the compact electrode systems designed by the research group that consists of perforated aluminium pipe that acts as a sacrificial electrode, a copper bonded steel electrode and a filler. The filler material is a mixture of montmorillonite, Kenaf powder, and several non-toxic green salts. The performance record of the electrode system at sites of high soil resistivity, shows that it can be used in semi-arid and arid regions with much lower values of earth resistance values than the typical conventional systems. Apart from achieving low electrical earth resistance at the beginning, the electrode system is capable of maintaining a reasonably low value for long periods without going through large fluctuations. The system performance could be seen improved with time, possibly due to the slow decaying of aluminium rod which produce mobile ions. Apart from the electrical parameters, the designed system has been tested for its mechanical and physical properties as well to ensure, easy installation, mechanical stability at the driving process and ability of withstanding rapid temperature changes.

Acknowledgements:

The authors would like to acknowledge the facilities and support rendered by the Centre for Electromagnetic and Lightning Protection, and the Department of Electrical and Electronics Engineering, University Putra Malaysia in making this project a success.
A RISK-BASED CONFLICT RESOLUTION MODEL FOR OPTIMUM WATER RESOURCES MANAGEMENT IN ARID REGIONS

Arash Malekian, Ali Salajegheh
University of Tehran, Iran
malekian@ut.ac.ir

Abstract

Conflicts related to the rights over the use of water resources have been important human issues throughout the history and increasing competition for water requires improved and integrated management. Exploitation of scarce water resources, particularly in areas of high demand, inevitably produces conflict among different stakeholders. Water resources managers are charged with the long-term optimal management, regulation and protection of water resources. However, it is recognized that water resources managers must take into account the multitude of water resources development preferences that are put forward by stakeholders such as drinking water users, farmers, water suppliers, industrial sectors, etc. As a result, conflict over the utilization of particular resource may occur. To address these issues, this study presents quantitative support using the risk-based model to identify the conflicts over the limited water resources over a basin in order to define an optimal water allocation pattern as well as the most efficient scheme in an arid region of Iran. The study area, Hableh Roud basin, is located in the north-central part of Iran which is a major agricultural area whose sustainability depends largely upon surface as well as groundwater resources. The short period of rainfall in this area, combined with high groundwater withdrawals and salinity of surface water, has produced aquifer overdraft and increase of water quantity and quality problems.

Based on the conflict modeling framework, different policies and scenarios which may affect water allocation at the basin scale were developed based on constraints and risks of the system and maximizing the economic benefits to water use. The proposed water resources allocation policies of the developed model were found to be acceptable that maintained the balance of the entire system, considering all the constraints and restrictions imposed. This may help water managers of the basin for better allocation of water resources especially in water shortage conditions for sustainable management of the arid regions to avoid current and emerging conflict over limited freshwater resources.
HYDRAULIC EFFICIENCY OF WATER DISTRIBUTION NETWORKS: CASE STUDY OF ANTALYA CITY-TURKEY

I. Ethem Karadirek, Selami Kara, Ayşe Muhammetoglu, Habib Muhammetoglu

Akdeniz University, Faculty of Engineering, Department of Environmental Engineering, Antalya, Turkey

E-mail: muhammetoglu@usa.net

Abstract

Water consumption rates in water distribution networks have wide temporal and spatial changes. Consequently, water pressures exhibit wide changes spatially and temporally. In Turkey, water pressures in water distribution networks should be kept between 20 and 60 m head. The upper pressure limit used to be 80 m head but the recent related Turkish legislation issued in 2014 stated that the maximum water pressure in water distribution networks should not exceed 60 m head in order to avoid excess physical water losses. The average total water losses (physical and apparent) in Turkey is around 50% of the supplied water volumes. In this study, hydraulic modelling using the US-EPA EPANET model was applied to a part of Antalya City water distribution network for a simulation period of one year. Flow rates and water pressures were continuously on-line measured with 5-minute intervals by Antalya SCADA (supervisory control and data acquisition) system. Friction coefficients of water pipes were calibrated and verified using different sets of field measurements. Model predictions and field measurements of water pressures were in good agreement. Accordingly, the model was used for pressure management in the water distribution network. Model predictions showed that there were always excess water pressure above 20 m head all over the year. Therefore, it was decided to reduce the excess water pressure by installing a PRV that was adjusted according to the hydraulic model results. Physical water losses showed considerable reductions after installing the PRV, as monitored by the SCADA system. However, the new trend is to use turbines or pump as turbine (PAT) to recover the excess energy from water distribution networks and produce electricity. Accordingly, detailed study were conducted to examine the application and performance of such a system to produce energy and reduce water losses at the same time. A fund was achieved from The Scientific and Technological Research Council of Turkey (TUBITAK) for the real application of a turbine in the field to produce energy and reduce physical water losses. The application that is expected to be completed early in 2016 is the first one in Turkey. The aim is to test the efficiency of such systems to reduce water pressure and recover the energy. Consequently, the water authorities will be encouraged to apply similar systems because of the environmental benefits of producing green energy and reducing water losses at the same time.

Acknowledgment

This research study was supported by The Scientific and Technological Research Council of Turkey (Project No.114Y203), Akdeniz University, ASAT & ALDAS.
Sustainable Groundwater Management
Bjørn Kløve, professor
Water Resources and Environmental Engineering Research Group
University of Oulu, Faculty of Technology
Finland
bjorn.klove@oulu.fi

Abstract

Groundwater is a vital and strategically important resource for water supply and food production. Important aquifers around the world are facing severe pressure from water abstraction for irrigation and other water uses, which is aggravated by land use and climate change in a non-stationary context. In many regions groundwater tables have declined considerably and aquifers have become polluted by various pollutants such as nitrates. The changes observed in groundwater quantity and quality are a threat (i) to the crucial ecosystems services groundwater provides such as drinking and irrigation water provision, natural attenuation processes, storage functions and habitats, as well as (ii) to groundwater dependent ecosystems such as springs, rivers, wetlands, and lakes and (iii) to the groundwater dependent socio-economic system (as the social and economic development in many regions is linked to the provision of safe and reliable water resources).

In order to provide sustainable solutions, new methods and policies are needed in groundwater management in which groundwater systems are considered in a more holistic and integrated way. Groundwater hydrogeology needs to be better integrated with hydrology and ecology. Sustainable solutions are needed that take into account socio-economic values and ecological aspects of groundwater and dependent ecosystems. Managed aquifer recharge provides a solution in some cases. In many cases successful management will involve the design of the proper institutional, legal and operational framework that ensures a long-term sustainable management of water and associated ecosystems. Decision making in groundwater quantity and quality management is often complex due to heterogeneous stakeholder interests, multiple objectives, different options, and uncertain outcomes. Conflicting stakeholder interests are often an impediment to the realization and success of any regulations, policies, and measures. Recent results from a 5 year European project will be presented with some examples also from the Middle East.
Integrated Hydrogeophysical Investigation in the Proposed Residential area, Bahri Locality, Khartoum State, Sudan

Khalid A. Elsayed Zeinelabdein¹, Fathelrahman A. Bireir², Abdalla E.M. Elsheikh¹
¹Faculty of Petroleum and Minerals, Al Neelain University, Khartoum, Sudan
²Department of Geology, University of Khartoum, Sudan
Email: kalsayed2001@yahoo.com

Abstract
The overall objective of this study is to investigate the groundwater potentiality in a proposed residential area in Bahri Locality, Khartoum State. This is achieved through evaluation of the groundwater resources within the study area, its storage, quality and suitability for domestic uses. The proposed residential area is located approximately 22 km north of Khartoum Town east of the Nile. The study area is characterized by semi desert climatic conditions with average mean temperature of 26 °C in winter and 47 °C in summer. The area is generally flat with slight slopes towards the River Nile, where the topographic gradient is 0.0038 m. Geologically, the area is part of an extensive sedimentary basin trending NW-SE where huge thickness of Cretaceous Sandstones were deposited. This is unconformably underlain by the Precambrian to Cambrian crystalline Basement Complex rocks and overlain by superficial deposits. Hydrogeologically, the River Nile represents the main source of recharge to the sandstone aquifer. This is in addition to the direct precipitation and seasonal stream which recharge the upper aquifers in the study area such alluvial, weathered and fractured basement aquifers. To achieve the objectives of this study, an integrated methodology was adopted. This involve office work, remote sensing and GIS investigations using Landsat 8 OLI multispectral image for identification of various land forms in the study area. Digital image processing was performed in order to detect the surfacial geological and hydrogeological guides for groundwater occurrence. SRTM data was used for the delineation of topographic features including elevation, slopes, drainage system and major faults. Satellite gravity data covering the whole study area and vicinity were processed to obtain general understanding about the distribution of basement rock and sedimentary cover. This was helped in the orientation of the VES measurement during the field work, where forty five VES measurements were executed. The measurements were made using SAS 1000 Terrameter instrument. VES data were analyzed and processed to produce geo-electrical sections that were further interpreted as hydrogeological sections using computer software such as IPI2win and Resix interpex. The observed VES curves reveal relatively thick multi-layered earth. Basement trend readings are registered within the surveyed area. Moreover, some of the curves tend to indicate relatively high resistivity range at the maximum separation attained, especially those located in the western side of the proposed residential area. The depths to the basement vary from that exposed at the ground surface to more than 200 m at the eastern part of the area. A number of VESs do not show basement resistivities. Due to the considerable thickness of the sedimentary rocks, the eastern points are considered to be more potential targets for groundwater production. Two potential groundwater zones were delineated during the course of the current study. The groundwater quality expected to be better toward the northeastern side of the study area, while in other parts the slightly saline to moderately saline water is expected, especially in the western, central and southern parts.
Agricultural Water Consumption changing in Egyptian Rafah Based on Remotely Sensed Data and Techniques

El-Shirbeny M. A.1, Orlandini S.2,3

1 National Authority for Remote Sensing and Space Sciences (NARSS), Egypt.
2 Department of Agrifood Production and Environment Sciences (DISPAA) – University of Florence, Italy.
3 Climate and Sustainability Foundation (FCS), Italy.

Abstract

The aim of this paper is to estimate crop water consumption changing depending on satellite data. The difference between air temperature ($T_{air}$) and Land Surface Temperature ($LST$) varies particularly by surface water status. In this paper, Normalized Difference Vegetation Index (NDVI) extracted from NOAA/AVHRR and Landsat8 satellite data to calculate emissivity as an intermediate step for producing $LST$. Linear relation between $T_{air}$ and $LST$ was established and $R^2$ was 0.88. Reference evapotranspiration ($ET_o$) estimated using agro-meteorological data through FAO-Penman-Monteith (FPM) which used as standard method and Hargreaves (Har) method. $ET_o$-FPM used to calibrate $ET_o$-Har under the same conditions through five years (2002-2006). Landsat8 data acquired on 13th of Sep. 2013 and 19th of Sep. 2015 and used to calculate Crop coefficient based on satellite data ($K_{c-Sat}$). $LST$ used to predict maximum, minimum, and mean $T_{air}$ ($°C$) in June 2013 and 2015. $ET_o$ estimated using predicted maximum, minimum, and mean $T_{air}$ according to Har method and used with $K_{c-Sat}$ to estimate $ET_c-Har$. $ET_o$-FPM used with $K_{c-Sat}$ to estimate $ET_c$-FPM. $LST$ and NDVI were used to estimate Water Deficit Index (WDI). WDI and $ET_c$ were used to calculate actual crop evapotranspiration ($ET_a$). $ET_a$-FPM used to evaluate $ET_a$-Har. Agricultural land decreased Dramatically in 2015 because of Egyptian arm politicians.

Keywords: Hargreaves (Har), FAO-Penman-Monteith (FPM), Land Surface Temperature (LST), actual evapotranspiration ($ET_a$), Crop Coefficient ($K_c$), and Landsat8.
Abstract

Irrigation water management has to meet the need of three levels of decisions makers, the farmers, the Water users association and the regional water resource manager. The access to information and tools regarding water resources management are available to the last one mentioned, but unfortunately access to these information and tools remains out of reach to the final water users namely the farmers. The main objective of this study was to investigate the acceptance of implementing an Irrigation Advisory Service at the level of a water user association that would facilitate outreach of information regarding water irrigation management. In order to reach the objectives, a study was conducted at the irrigated district of Cherfech in Tunisia, where four types of services was pointed out with information concerning respectively (1) Reference Evapotranspiration and Rainfall; (2) Water crop requirement of the area main crops; (3) Water irrigation requirement of the farmer’s crop and (4) Crop monitoring and real-time estimation of water irrigation requirement of crops settled using soil moisture sensors. These services would be available at the WUA offices and distributed directly to the farmer. Then, a technical study was done to determine the required tools and equipment to be used by the Service. Also, a survey was done in order to determine the acceptance of the service by farmers. With the survey, a farmers profiling of the region was determined. Then the current farmers’ practices of irrigation were assessed. Next, the perception of the water user association by farmers was evaluated and their acceptance of implementing an irrigation advisory service at the WUA level was appraised. Finally, an economic study coupled with a sensitivity analysis was conducted.

The results confirmed the possibility to implement the Service at the WUA level. When only 54 % of the farmers were satisfied by the WUA work, 77 % of them were interested by the implementation of the service. This is a proof that farmers are looking for ease of access information. Concerning the prices of the services, 59 % of the farmers selected the third Service because it saves the specificity of each farms and present an excellent accuracy. The feasibility study shows that economically, the project is feasible with a B/C Ratio of 1.018 and an Internal Rate Return of 29 %. The Sensitivity analysis shows that the project can be sustainable when considered as a social project.
A CONTRIBUTION TO AN INTEGRATED IRRIGATION WATER MANAGEMENT FROM PLOT TO BASIN
– CASE STUDY OF SIDI SAAD DAM SYSTEM (TUNISIA) –

(1) Institut National Agronomique de Tunisie (INAT), Tunis, Tunisia
(2) Water Users Associations: GDA Sidi Mansour, Sidi Saad, Touila, Fjij, Kairoaun, Tunisia
(3) Commissariat Régional de Développement Agricole de Kairouan (CRDA), Tunisia
(4) Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Hannover, Germany
(*) Head of CREM-BGR Project

abdallah1wajdi@gmail.com; sahli_inat_tn@yahoo.fr; JohannesWerner.Mueller@bgr.de

Abstract

The rational point of departure for enhancing irrigation water management is to provide decision makers with tools allowing them to improve the quantitative assessment of the actual performance of irrigated areas. Combining physically based soil water balance and simulation models with GIS tools is of a considerable interest to manage the available water amount. Indeed, this combination can enhance water supply management, optimize catchments management, and study impact of management intervention from small scale (plot) to a larger one, such as irrigated district and/or region. This work presents the case of Sidi Saad Dam System (central Tunisia). The main objectives were (1) to create a specific GIS data base for the four irrigated districts of the area (Sidi Mansour, Sidi Saad, Fjij and Touila) based on the characteristics of the cultivated crops, soil types and the used irrigation systems; (2) to assess the spatial and temporal variation of the soil water budget terms from plot and farm levels to irrigated district and regional scales; (3) to map results for different time steps. The achievement of these objectives was made possible using the WEAP-MABIA Model. Thus, daily Penman–Monteith reference evapotranspiration (ETo), effective precipitation (PE), crop water requirement (CWR), actual crop evapotranspiration (ETa), and irrigation water requirement (IWR) were estimated for the four irrigated districts using spatially distributed parameters on the climate, crop, soil characteristics, irrigation system, and basic irrigation management practice during the cropping season 2014/2015. The delivered information are maps of the Sidi Saad Dam System with its four irrigated districts and each of their farms and plots; representing the current land use, the water consumption at farm level; the crop water requirement (CWR) and the irrigation water requirement (IWR) at a daily, weekly and monthly steps. Also, these results could be displayed on Google Earth.

The Resulted DSS can be used by various stakeholders, the Farmers at the plot scale, the Water Users Associations at the scale of the irrigated district and the Water Resources Managers at regional scale for real time water irrigation monitoring as well as for analysis and evaluation purposes.
IDENTIFICATION OF GEOGENIC AND ANTHROPOGENIC SOURCES IN ALTERING THE GROUNDWATER CHEMISTRY THROUGH SILICA ANALYSIS IN PARTS OF UNNAO DISTRICT, INDIA

Rashid Umar and Naseem us Saba
Aligarh Muslim University, Aligarh
India
rashiduumar@rediffmail.com

Abstract

The study was undertaken in a part of Central Ganga Plain which hosts number of potential aquifers. Geologically, the area is underlain by Quaternary alluvium. Present study was conducted to assess the effects of natural as well as human- induced alteration in groundwater chemistry using correlation of silica with TDS, Cl and δ^{18}O. 36 groundwater samples were collected from hand pumps and analyzed for pH, hardness, EC, major ions (Ca, Mg, Na, K, Cl, SO_4, HCO_3, NO_3, F and SiO_2) for pre and post monsoon season of 2012. The groundwater facies identified are Na+K-Cl+SO_4 type in pre monsoon and Na+K-HCO_3 type in the post monsoon season. Three major groups were identified on the basis of L-L diagram mainly exhibiting mixed type, Ca+Mg-Na+K-Cl+SO_4 and lastly Ca+Mg-Cl+SO_4 in pre monsoon. During post monsoon, samples clustered into single group of mixed type. Silica released as a result of chemical breakdown of silicate minerals in rocks, the higher concentration of which in groundwater indicates rock-water interaction while Cl due to its large ionic size does not enter into common rock forming minerals. So, this relationship is used in the present study. Silica ranges with an average value of 25 and 33 mg/l in pre and post monsoon season, respectively. It has been correlated with Cl and TDS suggesting the water rock interaction and some non-geogenic processes responsible for the acquisition of high Cl (60 – 250 mg/l) and TDS (650 – 1200 mg/l). Silica has also been correlated with δ^{18}O representing rock water interaction as dominant process for the high concentration of SiO_2 (>40 mg/l). It has been observed from the data and various plots that water rock interaction (geogenic) and anthropogenic (non-geogenic) processes are responsible controlling the overall chemistry of groundwater of the area.
GROUNDWATER QUALITY ASSESSMENT IN JAZAN REGION, SAUDI ARABIA

Adel M. Alhababy$^{1,2}$ and Abdul Jabbar Al-Rajab$^{3}$

$^1$Department of Biology, Faculty of Science, Jazan University, Jazan, Saudi Arabia. e-mail alhababy@gmail.com

$^2$Department of Environment, Faculty of Marine Science and Environment, Hodeidah University, Yemen.

$^3$Center for Environmental Research and Studies, Jazan University, Jazan, P.O.Box: 114, Saudi Arabia.

Abstract

Jazan province is an arid area, located at the southwestern part of Saudi Arabia along the Red Sea coast. Groundwater is the only resource of drinking water in this area; thus, its suitability for drinking and domestic uses is of public and scientific concern. In this study, groundwater samples were collected from 23 sites in Jazan area during fall 2014; measurements and analysis of water quality parameters including pH, total dissolved solids TDS, turbidity, hardness, alkalinity, ammonia, nitrite, nitrate, sulfate, calcium, magnesium, chloride, iron and fluoride were carried out with references to WHO and Gulf Standardization Organization GSO. TDS values exceeded the permissible limit of 600 mg/l in 30.4% of samples, total hardness values exceeded the permissible limits of 300 mg/l in 34.8% of samples, and nitrate concentration exceeded the permissible limit of 50 mg/l in only one sample. However, the concentrations of investigated parameters in the groundwater samples were within the permissible limits of WHO. Our results showed that the water quality of groundwater in Jazan area is acceptable and could be used safely for drinking and domestic purposes. However, a special attention should be paid to the concentration of TDS and nitrate in groundwater in future studies.

Keywords: Groundwater, water quality, assessment, correlation matrices, physicochemical parameters, Jazan, Saudi Arabia.

Acknowledgements:

Authors would thank the General Directorate of Water in Jazan and especially Fahd Akeel the head of analytical laboratory for his assistance during this work. A special thank you to Moussa Al-Agsum (CERS, Jazan university) for his help in mapping.
GROUNDWATER QUALITY ASSESSMENT USING DRASTIC MODEL WITH GEOSPATIAL TECHNOLOGY

Presenting Author, S. PRABAHRAN AND R. MANONMANI

Assistant Professor, Paavai Engineering College, Pachal, NH-7, Namakkal-637018, Tamilnadu, India

Scientist, Institute of Ocean Engineering, Anna University, Chennai-600025, India

e-mail: haripraba@gmail.com

Abstract

Groundwater is regarded to be the most valuable resources. Groundwater quality is affected by virtually every activity of the society thereby making groundwater protection complicated. The protection of groundwater is always cheaper than restoring already polluted aquifer. DRASTIC index methodology helps in the assessment of groundwater pollution potential. DRASTIC index uses a set of seven hydrogeological parameters viz., D-depth to Groundwater table; R-recharge due to rainfall; A-aquifer media; S-soil media; T-topography; I-impact of vadose zone; C-hydraulic conductivity. These parameters are weighed with respect to their relative importance. All the DRASTIC parameter layers in spatial formats are put into GIS. The layers were assigned weights and ratings and they are combined interactively in the computer system. The DRASTIC index map was generated on a minute grid and seven categories of groundwater pollution potential zones were identified. The Drastic Index represents the relative measure of groundwater pollution potential, which helps planners and administrators in broadly screening areas for waste disposal sites. Pollution potential map also helps in evaluating alternatives for directing the financial resources and land use activities to the appropriate areas of Salem taluk.
EVALUATING OF TDS DIFFUSION IN GROUNDWATER
BY MT3D MODEL (CASE STUDY: LORDEGAN AQUIFER)

Maryam Yousefi¹, Taghi Ebadi², Hajar Sarmadi³

¹- PhD student of agriculture engineering-irrigation and drainage, Tehran university, Expert of Technical and engineering bureau of pension gulf and Oman sea watershed, Iran Water Resources Management Company, Ministry of Energy, Tehran, Iran

maria_yusefi@yahoo.com

²- General Director of water and wastewater engineering and technical standards Bureau, Ministry of Energy, Tehran, Iran

³- Water and environmental expert, Isfahan regional water company, Ministry of Energy, Tehran, Iran

Abstract

Iran based on koppen classification has dry and desert climate and for a long time, one of the most important issue was water and how to access it. Seventy billion cubic meter of groundwater were extracted for different purposes in a year, which is equivalent to two-third of country’s water consumption, this shows the important role of groundwater resources in country’s water supply. Groundwater resources are out of sight so understanding their characteristics need a long time and several exploratory studies that is very time consuming and costly. Groundwater models are appropriate instruments for evaluating and predicting the impact of natural and artificial condition on aquifers and also for monitoring groundwater quality and quantity. On of the most important parameter in water quality issue is total dissolved solids(TDS). In this paper, the quality and quantity model of Lordegan aquifer in Azarbayjan Sharghi province were run. The result of this study showed that the amount of TDS from the northern part of the plain(325 μmos/cm) was increased to the west part(500 μmos/cm).The TDS trend showed that feeder streams from eastern and southern part of the plain have a good quality. Long-term changes in TDS amount of groundwater resources in this plain was not significant and due to the influence of rainfall’s amount and withdrawals from the aquifer during different months of the year, is variable. Totally the groundwater’s quality of the region is classified as fresh water.
Abstract

Drip irrigation is a promising technology for precision agriculture in arid lands or greenhouses. Management of salinity in irrigation water is a major issue as it significantly affects the growth and the market value of plants. Proper leaching and drainage are prerequisite to avoid salt accumulation when irrigation water and/or soil contain salt originated from natural processes or fertilizer. An innovative drip tube fertigation system is proposed here so that irrigation water with different concentration of salt can be distributed over the spatio-temporal domain with a high degree of freedom. The proposed system consists of multiply-connected drip tube network having multiple water supply tanks. The term “multiply-connected” mathematically refers to a connected graph consisting of nodes and edges, where nodes represent junctions, emitters, or valves of drip tubes while edges represent pipe reaches. Different water supply tanks may contain water with different concentration of salt. The governing equations of flows and salt transport in multiply-connected drip tube networks are derived from conservation laws of mass and energy. Assuming incompressibility and cross-sectional well-mixture of the fluid, dynamic continuity equations for water supply tanks, static continuity equations for pipe flows, energy equations for pipe flows, and advection-dispersion equations for salt concentration in pipe flows are obtained. The domain of pipe flows is the locally one-dimensional connected graph. For development of an efficient numerical model to reproduce phenomena occurring in the system, different discretization schemes are applied to those governing equations. Special attention is paid for treatment of the advection terms as well as for functional regularity at the nodes. The numerical model is experimentally calibrated and validated at the experimental station of Kyoto University, Japan, using harvested rainwater and pump-lifted seawater. With the help of computational results, precise fertigation is implemented for a particular plant species gaining additional commercial value from saline water.

Acknowledgements:

This research is funded by a grant-in-aid for scientific research No. 26257415 from the Japan Society for the Promotion of Science (JSPS).
COASTAL AQUIFER MANAGEMENT TO CONTROL
SEAWATER INTRUSION IN COASTAL AGRICULTURAL AREAS

Dr. Khalil Ammar, Water Resources Management Scientist

kaa@biosaline.org.ae

Abstract

Pressure on coastal groundwater resources is high in several countries in the Middle East and North Africa region. Many factors are behind stressed coastal aquifer system: rapid expansion of intensified agricultural areas, on-farm poor management due to hiring unskilled labors with very limited knowledge of agricultural practices on using modern irrigation techniques, over-pumping from on-farm groundwater wells, growing high water consuming crops, and high water losses in the irrigation systems. These factors caused depletion of existing finite (non-renewable) groundwater resources, deteriorated groundwater quality, and caused seawater intrusion in these intensified coastal agricultural zones. The solutions to the above problems call for an integrated approach to manage the water resources and agricultural production in sustainable manner. This paper illustrates how integrating supply and demand management approaches taking into account environmental measures contribute to sustainability of groundwater resources. Geo-statistical analysis, overlying delineated agricultural areas over groundwater quality zones, and soil suitability maps, where intersecting these layers together produced groundwater and land zones. Groundwater and land zoning measures were illustrated. These zones matched the suitable soil to good water quality for agriculture, and the best economical crops that can be grown in these zones, such as vegetables. Suggested supply management options included: increasing water supply by using treated wastewater in agriculture, desalinated water, and recharged water from lakes behind the recharge dams. Demand management options included: reducing on-farm water losses through rehabilitating existing irrigation system, changing crop types to less water consuming crops, changing the cropping mix, adopt advanced irrigation technologies and hydroponic. Two case studies will be presented, one catchment area in Al Batinah coastal zone in Oman and one catchment area in coastal agricultural areas in Northern Emirates in the United Arab Emirates. The results of scenario analysis provided a range of possible solutions that can be evaluated using multi-criteria analysis.
SMART GROUNDWATER METERING AND MANAGEMENT

Slim Zekri¹, Kaveh Madani², Mohammad Reza Bazargan-Lari³, Edda Kalbus⁴

¹Department of Natural Resource Economics, Sultan Qaboos University, Muscat, Oman; email: slim@squ.edu.om

²Centre for Environmental Policy, Imperial College London, London SW7 1NA, U.K., PH +44 (20) 7594 9346; email: k.madani@imperial.ac.uk

³Department of Civil Engineering, East Tehran Branch, Islamic Azad University, Tehran, Iran; email: bazargan@iauet.ac.ir

⁴Department of Applied Geosciences, German University of Technology in Oman, PO Box 1816, Athaibah PC130, Muscat, Sultanate of Oman;

ABSTRACT

More than 50% of Oman’s agricultural area is located in the Batinah coastal region and is highly affected by seawater intrusion due to aggressive groundwater withdrawal. The resulting groundwater salinity has led to agricultural productivity decline and economic losses. Two dynamic optimization models (1) an Agent Based Model and (2) a Central Planned Model (CPM) to identify the feasibility of salinity control and agricultural productivity improvements in the region are developed. Both models are coupled to a groundwater simulation model using MODFLOW via a Bayesian Inference System. Comparison of the results of the CPM with the simulated outcomes under business-as-usual practices suggest that central planning and intervention can help reducing salinity, preserving profits, and conserving the agricultural area in the long run. The results show that groundwater metering alone is not enough to ensure agricultural sustainability in the area. It is recommended to cut down the irrigated area by 45% now, keeping the vegetable crops and reduce the area allocated to trees and forage crops. The agricultural cropped area would stabilize at a level of 5,500 ha compared to 3,300 ha in the case of business as usual by end of year 2084. The present value of net benefits would arise to $391.5 over the 70 years planning horizon. The major disadvantage of the CPM solution is that more than 3,500 farmers will have to quit farming. A compensation mechanism via land market could be implemented by allowing transformation of agricultural land to urban uses in the beach front areas, the most affected by salinity. The CPM results are expected to be used as the basis for developing intervention mechanisms that promote changes in the current practices and ensure sustainability of farming in the Batinah region of Oman. Further investigation is required to find out what kind of institutions is most efficient to make change happen.

Keywords: Groundwater management; seawater intrusion; dynamic optimization; coastal aquifers; smart meters.
ANALYSIS OF INTERFERENCE OF SALTWATER IN DESERT AQUIFERS

(CASE STUDY: SOUTH KHORASAN, SARAYAN AQUIFER)

Hamid Kardan¹ and Mohammad Ebrahim Banihabib²*

¹ PhD Candidate. Water Resources Engineering, University of Tehran, Iran
²* Corresponding author, Associate professor, University college of Aburaihan, University of Tehran, Pakdasht, Tehran, Iran, Email: banihabib@ut.ac.ir

Abstract

Study on groundwater quality variation is one of major issues especially in arid regions due to the increasing of water withdrawing and reduction of aquifer recharge. More than 70 percent of aquifers in Iran have water shortage and environmental crisis. In desert regions, concentration of minerals increases and causes environmental problems. In this study, applying a quantitative model, MT3D (a module of the MODFLOW model), groundwater quality was simulated using the measured TDS in wells. A 5-year period with 6-month time step was used for simulation and calibration of the model. The simulation was carried out taking into account the factor of 0.5 for the ratio of horizontal to vertical distribution, vertical diffusion length of 0.2, 1 meter for effective molecular diffusion coefficient, and 20 for longitudinal diffusion. Forecasting of the future status of aquifer water quality showed that continuing withdrawing of water intensified salt water interference from desert. In addition, the concentration of TDS will increase during the next 5 years. Therefore, the result of this research shows that the management of groundwater is necessary to improve the quality of desert aquifers and prevent salt water interference from desert to adapt recent draughts.
IMPACT OF AGRICULTURAL ACTIVITIES ON GROUNDWATER QUALITY: LYSIMETRIC AND MASS BALANCE APPROACHES

Houria DAKAK¹,²*, Ahmed DOUAIK¹, Brahim SOUDI³, Aicha BENMOHAMMADI², Ahmed GHANIMI⁴, Abdelmjid ZOUAHRI¹ and Hasna YACHOU¹.

¹: National Institute of Agricultural Research, Rabat, Morocco.
²: UFR ST 11/DOC/K, Ibn Tofail University, Kénitra, Morocco.
³: Hassan II Institute of Agricultural and Veterinary Sciences, Rabat, Morocco.
⁴: Mohamed V University, Rabat, Morocco.

* Corresponding author: dakak_h@yahoo.fr

Abstract

This work presents the quantification of the impact of agricultural activities on water quality, particularly on nitrate leaching. The methodology involves a lysimetric experiment, led with two types of crops (soft wheat and sugar beet), and has been conducted in the Tadla region in the experimental station of Ouled Gnaou, Central Morocco. This experimental device has allowed to determine quantities of nitric nitrogen really leached that are 51.2 kg N/ha and 34.6 kg N/ha for sugar beet and soft wheat, respectively. The determination of quantities of leachable nitrates has been equally approached by the mass balance approach whose results show a lixiviation of 76.1 kg N/ha and 40.3 kg N/ha for sugar beet and soft wheat, respectively. We deduce that the quantity of lixiviated nitrogen under wheat for the two methods is less important than the one recorded under sugar beet. The difference between the two crops is attributed to the weak efficiency of utilization of nitrogen by sugar beet and to high applied nitrogen doses.

Keywords: Pollution, groundwater, nitrate, lysimetric experimentation, mass balance.
ASSESSMENT OF CHEMICAL AND BIOLOGICAL POLLUTION OF DOMESTIC AND/OR AGRICULTURAL USE WELLS WATER, LOCATED IN ALGERIAN NORTHEASTERN ARID AREAS

Meribai,1,2 A., Bahloul1, A., Diafet1, A., Bachene, A., Naami1,S., Ouarkoub1,M. & A. Bensoltane2

Communicant Author: Abdelmalek Meribai E-mail Adress: hic.mer71@gmail.com
Phone+ 213 5 54 635232 FAX +213 35 608089
1. Applied Microbiology Laboratory - Faculty SNV- Bordj Bou Arreridj University (34000)- Algeria.
2. Food and Industrial Microbiology Laboratory – Biological Sciences Faculty – Oran1 University (31OOO)- Alegria.

Abstract

Introduction: Water; a vital body need, contains salts, elements trace. The water pollution, can be chemical and/or biological activity; can be also physical (radioactivity, temperature rise is the set of nuisance which the consumer is exposed. The study aimed to assess the degree of chemical, physical and bacteriological pollution of water samples collected from different domestic wells located in various Northeastern Algerian arid areas. Methods: Physical pollution was evaluated by measuring pH, temperature taking, conductivity, turbidity, hardness, alkalinity and dissolved oxygen. While the chemical quality: by determination of the magnesium, potassium, sulfate, nitrate, nitrite, calcium and chloride concentrations, finally the bacteriological quality by counting in colony forming unit/ milliliter of various microbial groups, Eukaryotic: (fungi, yeasts), prokaryotic: aerobic, mesophilic species, total and fecal coliform, sulphite-reducers Clostridium, and pathogens species: Staphylococcus sp, Salmonella sp and Vibrio Sp. The results showed an acceptable physicochemical quality and a biological pollution for two wells (%) where the presence of toxigenic bacterial species, and bacterial spores was recorded.

Conclusion: These water quality was not conform to the national and international standards established. Therefore, these water are a vital risk to the consumer and livestock herds.

Key words: Well Water, Pollution, physicochemical, microbiological, Standards.
THE IMPACT OF THE INVASION OF MODERN IRRIGATION SYSTEMS IN THE OASIS OF LAHMAR IN THE SOUTH WESTERN ALGERIAN

REZZOUG Cherif¹, REMINI Boualem², BELHADJ Mahdi³, BENMOUSSA Youcef⁴.
1- Department of Hydraulics, University of Chlef, 02000 Chlef, Algeria, cherifrezzoug@yahoo.fr
2- Department of Water Sciences, Blida University, 09000 Blida, Algeria,
3- Department of Hydraulics, University of Chlef, 02000 Chlef, Algeria,
4- Department of Hydraulics, University of Chlef, 02000 Chlef, Algeria,

Abstract:

For centuries, the oasis dwellers of the Algerian Sahara exploit the groundwater through the use of traditional techniques such as foggaras, ghotts and wells of chadouf, in the oasis of Lahmar in the Southwest of Algerian, the irrigators use the foggaras to irrigate his fields, they are the foggaras of source (foggaras ain). But today, thanks to the indiscriminate use of modern systems (boreholes and pumps) to procure water for irrigation and urban consumption, which leads to over-exploitation and drying off of the water table, traditional techniques are becoming day by day out services and the palm disappeared almost completely.

Key words: oasis, Lahmar, foggara, seguia, palm grove.
ESTIMATION OF POLLUTION LEVEL IN ESTUARINE SYSTEMS USING MAGNETIC AND GEOCHEMICAL TECHNIQUES ALONG CHENNAI COAST, BAY OF BENGAL, INDIA

K. Neelavannan, C. Lakshmi Narasimhan, S. M. Hussain

1Department of Geology, University of Madras, Guindy Campus, Chennai – 600 025
2Department of Geology, Anna University, Chennai – 600 025
Email: k.neelavannan@gmail.com

Abstract:
During recent times, rapid urbanization, economic development, population growth and intensive industrial development have produced high accumulation of trace metals in estuarine sediments along the Chennai coast. In this study, texture size, magnetic properties (magnetic susceptibility and $\chi_{fd}$%), trace metals (Fe, Mn, Ni, Pb, Zn, Cr, Cu, Zr, Rb, Sr, and Ti) and statistical analyses were carried out in two sediment cores collected from Ennore creek and Adyar estuaries along the Chennai coast to reconstruct the pollution history. Magnetic susceptibility profiles showed higher concentration of ferrimagnetic minerals are enriched in the upper parts of the core sediments than the bottom sediments. The elevated Enrichment Factor (EF), Geo-accumulation Index ($I_{geo}$) and Pollution Load Index (PLI) values in the upper part of sediment cores showed the excess of anthropogenic loading occurred in the recent past. This may be due to discharged of industrial waste, anthropogenic inputs and municipal sewage through the river. The significant relationship among the clay, magnetic susceptibility and pollution load index in two sediment cores suggested that the trace metals and ferrimagnetic minerals are derived from similar sources and incorporated in fine grained sediments. Thus, the magnetic and trace metals data obtained in this study provide ample evidence for metal pollution history along the Chennai coast as a result of industrial and urban activities, in the vicinity of the study areas. The result of the present study suggested that the regular monitoring is needed to improve the water quality of Chennai coast.
MACROFAUNA AS INDICTOR OF WATER QUALITY IN THE LOWER JORDAN RIVER CATCHMENT- EASTERN SIDE

Ikhlas Alhejoj1*, Klaus Bandel2, Elias Salameh1

1Department of Geology, the University of Jordan, 11942, Amman, Jordan.
2Geologisch-Paläontologisches Institut und Museum Hamburg, Universität Hamburg, D-20146 Hamburg, Germany
*Corresponding Author: ekl_hjouj@yahoo.com, i.alhejoj@ju.edu.jo, Tel:00962-6-5355000-Ext.22264

Abstract

In this study the qualities of surface water bodies feeding the lower Jordan River from its eastern side were studied and found reflected in the types of aquatic species of macrofauna surviving in them. Water, especially, in semi-arid countries, such as Jordan, with unpredictable seasonal rainfall are subjected to scarcity of water due to increasing demand as a result of population growth. This represents a great problem and challenge for scientists, planners and policy-makers. Surface water resources in Jordan have been, during the last few decades, negatively impacted by development through the addition of urban, industrial, and sewage wastes to the environment.

The prevailing conditions make it imperative to protect Jordan's surface water resources in order to keep these aquatic systems in healthy and productive conditions. This must also apply to other countries with similar environmental conditions.

Different aquatic fauna were studied on their types, sizes and species, and were identified and correlated with the chemical and physical properties of the water they are living in.

It is concluded that aquatic macrofauna can easily be used as indicators of water quality and it is a fast and trustful way of indicating changes taking place in the water quality, especially water salinity, trace elements contents and pollution parameters.
IRRIGATION DEFICIT OF APPLE TREES FOR BETTER VALUE OF WATER RESOURCES AND ITS IMPACT ON THE WATER STATUS AND SOIL-PLANT-WATER STATUS

Chenafi azzeddine¹, Monney philippe², Ferreira maria isabel³, Chennafi houria⁴ et Carlen christoph²

1 Department d’Hydraulique, Université de Bejaia, Algérie
2 Agroscope ACW, Centre de Recherche de Conthey, Suisse
3 Institut Supérieur d’Agronomie, Université de Lisbonne, Portugal
4 Département d’Agronomie, Université de Sétif, Algérie

chennaflhouria@gmail.com

Abstract

This study examines the impact of deficit irrigation (DI) apple on the water status of soil and yield of Gala apple variety. The experiment was conducted in the field in Switzerland during the years 2010-2011. The irrigation system consists of four treatments: T1; no-irrigation during the three fruit growth periods (PCF I, II and III), T2; irrigation comfort during PCF I, II and III, T3; Irrigation comfort during PCF I and III and no-irrigation PCF II T4; deficit irrigation (RDI) applied during PCF II and irrigation comfort during PCF I and III. Fruit trees under severe water stress T1 and moderate irrigation T3 have the low values of soil water potential (ΨS) and stem xylem water potential compared to other treatments. The most severe treatment has the lowest yield with 17 kg/tree compared to other treatments. No significant difference was observed between the comfort and regulated deficit irrigation RDI of the number of apples by size and by color. Significant differences between the sever irrigation and comfort irrigation were observed on the number of apples. The RDI (T4) during summer, allowed a water use reduction of 47% without loss in fruit yield, fruit weight, and fruit quality compared to the optimal irrigation (T4). This study shows that the application of deficit irrigation during the second growth period on apple trees is a useful strategy that can be applied in areas where water resources are limited.

Keywords: water resources, soil water potential, plant-water-status, Aquapro, watermark.
Abstract

The anthropic activities deployed in the Annaba plain (North East of Algeria) have important effects on hydraulic, geochemical and biological balances and consequently the socio-economic future of the region. Pollution in the studied sector was mainly related to the geologic, chemical and organic discharges. The reclaimed water can disturb the physical development of the plants by the absorption of the water which acts on the osmotic process, or chemically by metabolic reactions, such as those caused by the toxic components. A hydrochemical analysis was carried out in 29 wells distributed on the whole of the plain. The Sampling of groundwater was undertaken in the high water season (December 2013) and samples were analyzed for pH, TDS, Ca$^{2+}$, Mg$^{2+}$, Na$^{+}$, K$^{+}$, HCO$_3^-$, Cl$^-$, SO$_4^{2-}$. The groundwater in the region mainly belongs to noncarbonated alkali type and Cl$^-$ group are controlled by evaporation dominance, respectively due to the drainage, water-rock interactions and anthropogenic activities. The Us Salinity laboratory, the Wilcox diagrams and Na$^+\%$ used for evaluating the water convenience for irrigation suggest that the majority of the groundwater samples are not suitable for irrigation.

Keywords: Algeria, Annaba Plain, Quality, Groundwater, Irrigation, Salinization
Physico-Chemical Analysis of Ground Water, Spatial Distribution of Contaminants and Impact of Water Quality on the Health of People in Khushaab City, Pakistan

S.M. Talha Qadri*1,2, Arshad Raza2, Md. Aminul Islam1, Bushra Nawaz2, Khaista Rehman3, Riaz Ahmad Sheikh4, S.H. Sajjad2 and Wasim Haider2.

1Department of Physical and Geological Sciences, Faculty of Sciences, Universiti Brunei Darussalam, Kampong Gadong, BE1410, Brunei Darussalam.
2Department of Earth Sciences, University of Sargodha, Pakistan.
3National Centre of Excellence in Geology, University of Peshawar, Pakistan.
4College of Earth and Environmental Sciences, University of the Punjab, Pakistan.

Email corresponding author: talhaqadri_uos@hotmail.com

Abstract

Life on the blue planet is hooked with the water and vital source of its supply is ground water. Population blast, industrial and agricultural revolution all have made the human beings dependent upon the groundwater in last few decades. The rapid urbanization has not only enlarged the size of towns and cities but also recharged water bodies and aquifers with polluted water, containing human and industrial hazardous contaminants. Therefore, in order to provide unpolluted water a continuous monitoring of ground water is essential. A study was carried out to analyze the ground water samples from fifty sites within the urban settlements of Khushab city. All the water samples were analysed using physico-chemical parameters: pH, Electric Conductivity (EC), Total Dissolved Solids (TDS), Ca++, Mg++, Cl- and NH3 by using standard analytical methods. ArcGIS software was used to plot the spatial distribution of contamination, concluded from the observed physico-chemical parameters throughout the study area. A door to door survey was also conducted to get the feedback from 100 people living in the houses, working in offices and shops to know the issues of water quality along with the level of satisfaction for the present water quality. Results, when compared with WHO standards, showed certain sites indicating poor water quality through deviation from standard values of numerous physico-chemical parameters. This showed that ground water was unfit for drinking purpose and its prolonged utilization could cause serious health issues. More than 62% people reported their dissatisfaction regarding water quality and 80% agreed that water quality has been declining for two decades. Results were also correlated with the data collected from the Tehsil Headquarter Hospital which demonstrated that residents of Khushab city were suffering from the water borne diseases like Hepatitis, Cholera, Gastro, and Kidney stone etc. Almost 40,000 patients from Khushab city and the surrounding villages who suffered from water borne diseases visited the Tehsil Headquarter Hospital in the year 2014. It is has been concluded from the study that the ground water of the study area has declined and needs proper and urgent attention from the government and water must be processed through state of the art purification treatment plants, before supplying to people for drinking and domestic purposes.
Diagnosis of Potential Water Contamination by nitrate in the plain of Sais (Morocco)

Imane BERNI(1), Ibrahim EL GHAZI (2), Mohamed BEN-DAOUD (3), Samir EL JAAFARI(4), Patrick DUGUE (5).

1- UMI-Faculté des Sciences –Meknès, imane.berni@gmail.fr
2- UMI-Faculté des Sciences –Meknès, elghazi.ibrahim.gie@gmail.com
3- UMI-Faculté des Sciences –Meknès, bendaoud.mohamed304@gmail.com
4- UMI-Faculté des Sciences –Meknès, s.eljaafari@gmail.com
5- UMR Innovation & ENA Département Ingénierie de Développement ENA Meknès, patrick.dugue@cirad.fr

Abstract

In recent years, the protection and conservation of the natural environment, particularly water quality has become a major concern and a primary objective in the Moroccan development programs. The intensive cultivation of agricultural land in the irrigated areas has led, in recent years, the emergence of underground water resources pollution problem in the nitrate ion. This diffuse agricultural pollution is the largest and most problematic aquatic pollution sources in several regions of the world. In this context, the objective of this work is to propose a methodology for estimating the impacts of agricultural practices on groundwater in the plain of Sais, through surveys made on the ground from farmers. The survey questionnaire includes information on land cover for the year 2013/2014 (cultivated area, yield and crop sequences), mineral and organic N fertilization (given dose, form of fertilizer, method and date filler) and irrigation (origin of the water, as fertilizer, dose and frequency of irrigation by culture). Secondly, this work has led to characterization of the quality of groundwater based on quality settings selected by the hydrological basin agency Sebou (ABH Sebou, 2013). Finally, a thematic mapping for each parameter was determined using a Geographic Information System (GIS) in order to classify the groundwater, according to their degree of vulnerability to pollution. The results of these measurements indicate that the nitrate content of groundwater vary greatly from one well to another. They are located, during the monitoring period between 0.9 to 334 mg / l of NO3-, 9.28 to 378 mg / l Cl-. They go far beyond the standards set by WHO and the EEC (50 mg / l for NO3, 250 mg / l Cl). These results show that most of the wells are loaded with salts and nitrates, thus unfit for human consumption and may have a negative effect on vegetable crops in the region. Survey results show that farmers with the intensification of agriculture in the plain, especially in irrigated areas, excessive fertilizer application, repeated applications, and large quantities, the average doses wide the area are 148.45 kg N / ha, 130.9 kg P2O5 / ha and 79.70 kg K2O / ha for a total dose of 359.05 Kg (N P2O5 K2O) / ha. This value is well above the national average which is estimated at 62 kg / ha. This one shows a certain intensification in the area, especially for market gardening and arboriculture. Thus manure, surface irrigation, which proves the most dominant in the region with a rate of 59%, expanding localized irrigation in the area, rainfall and the rise of the web, all these factors have created a increasing pollution of water resources. The use of irrigation and fertilizer on agricultural fields is suspected to be the main source of contamination. However, non-point sources such as landfills, septic tanks, sewage discharged into rivers in the region and to a lesser extent, industry, contributing to the increase in nitrate concentration of groundwater phreatic (Dávila-Porcel et al, 2012).

Keywords: Agricultural Pollution - Groundwater - Nitrates - Salinity - survey - Sais Plain.
IMPACTS OF SUPPLEMENTAL IRRIGATION ON YIELD, TECHNICAL EFFICIENCY AND PRODUCTION RISK IN RAINFED AGRICULTURE IN THE ARID AREAS

Tamer El-Shater, Yigezu A. Yigezu*, Kamil Shideed, Aden Aw-Hassan

International Center for Agricultural Research in the Dry Areas (ICARDA), PO Box 950764 Amman 11195, Jordan, Tel: +962-6-553-1196, Fax: +962-6-5590-3120,
*Corresponding author: E-Mail: y.yigezu@cgiar.org

Abstract
We argue that a shift from flood irrigation (FI) to improved supplemental irrigation (ISI) in rainfed agriculture, particularly in the dry areas, increases technical efficiency and reduces production risk thereby contributing to national food security. Using a survey of 513 Syrian wheat farms as case study and a stochastic frontier model which explicitly and simultaneously accounts for technical inefficiency and production risk, this paper provides empirical evidence that the shift from FI to ISI led to average yield and productive efficiency gains of 14% and 7% respectively. At an adoption level of 22.3% in 2010, ISI increased national wheat supply by 120 thousand metric tons (11%). The stochastic dominance criterion also showed that the shift from FI to ISI led to 10% and 13% reductions in risk of obtaining yield levels below 4 tons/ha and 3 tons/ha respectively. Moreover, the adoption of ISI led not only to lower soil salinity and reduced quantity of fertilizer applications but, when accompanied with the adoption of improved wheat varieties, to further reductions in production risks.

Key words: Supplemental irrigation; wheat yield; technical inefficiency; production risk; stochastic frontier production function; stochastic dominance.

Acknowledgements: This study was carried out as a partial fulfilment for a PhD study. The authors thank ICARDA for the financial support, without which, this study would not have been possible.
IMPACTS OF INDUSTRIAL EFFLUENTS ON MICROBIAL DIVERSITY IN THE YAMUNA RIVER, AGRA, INDIA

Payal Mazumder* and Manish Kumar

1Tezpur University, Napaam, Assam, India
*Corresponding author
E-mail: payal.spinnerend@gmail.com

Abstract

The expeditive advent of urbanization and industrialization for economic growth has adversely affected the biological diversity, which is one of the major concerns of the developing countries. Microbes play a crucial role in decontaminating polluted sites and degrade pollution load of industrial effluent. The horizontally mobile gene pool of bacteria has been recognized to be very important for adaptive responses to selective pressures caused by diverse chemical compounds i.e. complex industrial effluents. The Present study was based on identification of microbial diversity along the Yamuna River of Agra, Uttar Pradesh, India. Water samples from industrial and non-industrial sites and effluent samples of before and after treatment were collected. It was found that microbial diversity was higher in the river water at the industrial site as compared to non-industrial site. Likewise, the microbial populations were found to be higher in the untreated effluent as compared to treated one in conventional treatment systems. The current study of river water and effluent suggested very high inorganic as well as organic pollution load, which also serves as nutrients for microbial population hence increasing their population in river water around Agra industrial hub as compared to the non-industrial site taken in this study. Pseudomonas sp., Achromobacter sp. (bacterial diversity) and Aspergillus fumigates (fungal diversity), found exclusively at the industrial site were reported to possess decolourization potential of dye effluent. Also the bacterial and fungal diversity in the untreated effluent was found to be higher than that of the treated effluent. From the study it can be concluded that there is a need to understand the systematic variation in microbial diversity along with the accumulation of pollution load through monitoring. There is possibility of the evolution of microbial species which naturally treat the effluent. Future, study should be focused on the bio-accumulation of toxic contaminants like heavy metals and its impact on human being.

Keywords: Speciation, Heavy metals, Cluster analyses, MINTEQA2, Brahmaputra River, CDI, HRI, India

Acknowledgements:
We thankfully acknowledge the financial assistance provided to the first author as DBT, JRF.
Assessment of Trace elements and its impact on Groundwater quality in Aligarh City, Aligarh

SHADAB KHURSHID*MASHKOOR KHAN

Department of Geology, Aligarh Muslim University, Aligarh-202002

Email: khurshid_shadab@yahoo.com

Abstract

Trace elements ions being used as an evidence for phenomenal rise in Agricultural as well as in Industrial sectors in present scenario. The present study was carried out in Aligarh city to evaluate to concentration of trace elements (Al, Cd, Co, Cr, Fe, Mn, Ni, Pb, Zn) in groundwater. Premonsoon groundwater sample were collected in 2013 from 10 locations distribution throughout the study area and have been analyzed using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). Trace element analysis show high concentration in Al, Fe, Mn, Zn and Pb in most analyzed samples. In few samples the high concentration of Co, Cu is found as per B.I.S (1991) and W.H.O (1994) standard for drinking water. These high concentrations of metal ions in groundwater were probably due to discharge of untreated effluents from Lock and Hardware Industries, Metal casting Industries. The adverse effects of large scale industrialization in these areas can now be distinctly observed in form of groundwater quality.

Keywords: Groundwater, Trace elements, Drinking water, Aligarh city, India.
Title“”Human Impact causes for Eutrofiering Rivers of India with special reference to Panchaganga Black river near Ichalkaranji area, an attempt for Restoration”’ M.S.India
Kamble .S.P.* & Hujare.M.S
Shri Swami Vivekanand Shikshan Sanstha Kolhapur’s Shikshan Maharshi Dr Bapuji Salunkhe College Miraj Maharashtra State India.

Email id :- sunilkamble107@gmail.com

Abstract
The process by which a body of water acquires a high concentration of nutrients especially phosphates and nitrates. These typically promote excessive growth of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication is a natural, slow-aging process for a water body, but human activity greatly speeds up the process.” - Art, 1993 Water is said as a liquid of life and is essence of all living organism. Water is universal solvent as it dissolves more substance than any component of nature has played an important role in life from molecules to man, hence since the time great civilization has originated evolved and flourished around the water resources. As we know that the water covers about 72% of the earth but only 2.7% of the total water is fresh water of which 1% is Ice free water in rivers lakes atmospheres and as biological water. It has been estimated that only 0.00192% of total water on earth is available for human consumption [Trivedi 1998]. The Panchaganga River of Ichalkaranji Maharashtra State India is an Important source of water supply to agriculture and to industries and most Importantly for Human Usage. The urban and Industrial and Hospital load of the city has increased many folds due to which the wastes and pollutants are being realized directly into the river making the river unfit every purpose. This has resulted into eutrophication of the river, reduced agricultural products, salty fields, and health hazards. Physico-Chemical and Biological aspects of water pollution of Pancha ganga River was analyzed seasonally with respect to following parameters from July 2014 to May 2015. 1) Water Temp. 2) Ph. 3) Dissolved solids 4) Dissolved oxygen 5) Free carbon Di oxide 6) Acidity 7) Alkalinity 8) Chloride content 9) Nitrates 10) Phosphates 11) Biological oxygen Demands (BOD) 12) Chemical Oxygen Demand (COD), etc. The water samples for analysis were collected from three sample stations in winter, summer and monsoon located at Shiradwade, Shirdone and Abdul Lat, near Pancha ganga river in Ichalkaranji area. The paper highlights alarming the condition of this Eutrofiering river in various seasons with respects to the parameters and if no quick action is not taken for restoration of the river it will have deadly effect on not only the human habitat surrounding the river but also on the flora, Fauna, and agricultural land, hence report is to be submitted to WHO, UNESCO-IHE, IWWA, SIDA, University grant commission of India, etc for restoration HELP.

Keywords: Indian Rivers - Human Impact - Pollution - Eutrofiering

Acknowledgements: The author wishes to thank the institution and college authorities for providing laboratory and library facilities for conducting my research work. I express my gratitude to Principal Sou Shailaja A. Salunkhe and Dr M.S. Hujare and other colleagues.
The Monitoring of water-stock changes and nitrogen transfer down a citrus farm soil at the triffas plain, Eastern MORROCO

Mourad ARABI¹, Houda BOUZIANE¹, Mohammed SBAA¹.
mourad.arabi.svi@gmail.com, h.bouziane@ump.ma mohsbaa@yahoo.fr

Eastern Centre of Water Sciences and Technologies (COSTE)
Faculty of Sciences, Mohammed Premier University – Oujda.

Abstract
Following the increase on agricultural product needs, the Moroccan state has committed to a proper water & soil management, by monitoring and controlling of the agricultural products quality and quantity, in order to ensure a good competitive ability into the international markets, by giving to the sector a plane named "Green Morocco Plan". Regarding the area of the Triffas plain, where a total area is 61,000 hectares, cultivated mainly in citrus plants, is considered one of the most fertile and productive areas of eastern Morocco. The present work aims the monitoring of water stock change and nitrogen transfer down the five pilot farms soils, which are located in the triffas plain, by adopting an approach based on the in-situ monitoring, and a laboratory analysis. To evaluate the concerned soil water potential, many tensiometer tubes were installed in five farms (2 tubes / farm), In fact, the water stock values were found continuously in the useful reserve range, which is the case of a drip irrigation system farms. While farms irrigated with a gravity system, these values have shown varying oscillations according to the irrigating frequencies. Also, results found have shown a positive correlation regarding the soil water content and the soil electrical conductivity, which is due to the varying values of nitrogen fertilizer applications.

Keywords:
Citrus, nitrogen, water monitoring, soil water potential, tensiometer.
IMPACT OF URBANIZATION ON NATURAL DRAINAGE PATTERN IN THE DISTRICT OF KARACHI, PAKISTAN

Sumaira Zafar, Arjumand Zaidi

Department of Remote Sensing and Geo-information Science
Institute of Space Technology, Karachi, Pakistan
sumaira.zafar_ncrg05@ist.edu.pk

Abstract

Karachi is a strategic city of Pakistan since it serves as the gateway for international trade through the country’s oldest port. This city has faced rapid population increase and industrial growth which are now causing environmental issues, social problems and economic stresses and challenges. Urban development and industrialization have extensively changed the landuse/landcover (LULC) and drainage pattern of the city. Majority of the old streams have been blocked that caused localized flash flooding in the city after heavy rainfall events. The natural drainage network of Karachi consists of two (2) major river systems; Malir River on the eastern side of the city and Lyari River which passes through the center of the city draining majority of its storm water. These rivers and their tributaries have been affected very badly due to the urbanization and bad urban management. This paper discusses the changes in LULCs over the past 16 years selecting Malir basin as a case study. Hydraulic flood modeling of Malir River is also presented here for 50 and 100 years floods. SRTM (Shuttle Radar Topographic Mission) Digital Elevation Model (1 Arc Second) and topographic sheets of 1975 and 2001 (1:50000) are used to demarcate natural drainage or Karachi District on digital maps and to delineate stream network using Geographical Information System (GIS) software tool Arc Hydro. Historical flow data are used to model flood extent using hydraulic model HEC-RAS and GeoRAS. GIS overlay analysis combines LULCs and river drainage layers to identify the blocked area and to quantify the specific LULCs that caused the river blockades. Maps of blockages and flood extent can be used for revival of natural drainage network and flood mitigation and preparedness. The beneficiaries of this study may include local disaster risk management, planning and development authorities.
CROP SUITABILITY ANALYSIS OF NOYYAL RIVER BASIN, TAMIL NADU, USING GIS APPROACH

T.Vahitha\textsuperscript{1} S.Abdul Rahaman\textsuperscript{1} K.Kumaraswamy\textsuperscript{2}

Department of Geography, Bharathidasan University, Tiruchirappalli, Tamil Nadu, India.
E-mail: vahithashankar@gmail.com

Abstract

On a global scale, water crisis is the most severe ecological devastation. Lack of wise and suitable agricultural practices results in low production and the deprivation of groundwater round the globe. Therefore concept of crop suitability evaluation was carried out in the present study to achieve best possible utilization of the available resources for sustainable agricultural production. Crop suitability evaluation is the main aim of the present paper undertaken in Noyyal river basin which is a semi arid region of Tamil Nadu, India.

Agriculture is the mainstay of the study area. The suitability is a measure of how well the qualities of land unit match the requirements of a particular form of land use. A total of major ten crops were spatially analyzed along with the land capability and important soil parameters including Reaction (pH), Depth, Electrical Conductivity (EC), Sodicity (ESP). Crop suitability was derived using the overlay analysis in Arc GIS software, considering the groundwater table and go for the less water consumable crops to preserve the groundwater table without disrupting the high yield.

Acknowledgement: We are grateful to the University Grants Commission, UGC, New Delhi for awarding UGC-BSR Research Fellowship in Science for Meritorious Students.
ON PEOPLE NARROW WITH AGRICULTURE SEWAGE WATER IN CLOSED OASES IN ARID ENVIRONMENT, SIWA OASIS, EGYPT AS A CASE STUDY

El Sayed A. El Gammal
National Authority of Remote Sensing and Space Sciences, Cairo, Egypt.
Email < elgammalelsayed86@yahoo.com >

Abstract
The Siwa oasis sits in a closed structural eroded depression; in North West Egypt with altitude 18 m below sea level, surrounded by limestone plateau with altitude 300 m above sea level. This article postulates the disaster of geo-environmental problem on the food delineating the human activities and landscape ravine. Aim to rescue Siwa from sinking under agriculture sewage waters for long life. Hence, deliverance the continental Nubia sandstone water aquifer under Siwa from contamination by agriculture sewage and water table rise. Remote sensing and spatial three dimensions models integrating with geomorphological situation in the field for determine the sewage water boarding. The current study found that; the water lakes had been replaced by salt bodies from April 2013 to 2015. And in case of moving and extracting the sewage water to the north or the west, the water will run downward through the limestone fractures again to Siwa Oasis and the water table in the depression will be raise again with high calcium carbonate content. In case of moving and extracting the sewage water to the east where altitude range from -2 to -6 inside the depression, we will lose a good flat terrain have old cultivated soil, water bodies, springs, and mixed soil near to water table ready for agricultural reclamation.

Key words; Agriculture sewage, Landsat ETM images, landforms and Siwa
IRRIGATION WATER GOVERNANCE ANALYSIS: A POSITIVE APPROACH APPLIED TO IRRIGATED AREAS OF NADHOUR-TUNISIA

Jamel BEN NASR¹ and Mohamed Salah BACHTA²

1 and 2: National Agronomic Institute of Tunisia (INAT) 43, Avenue Charles Nicolle 1082 -Tunis- Mahrajène TUNISIE. e-mail: jamelnasr@yahoo.fr

Abstract

Since 1989, Tunisia has embarked on a policy of decentralization and participatory water management in irrigated areas “IA”. This policy has led to the dissolution of development offices and the progressive State disengagement in favor of collective water management. And since then, water irrigation management becomes a task of irrigator associations. These associations have experienced a series of transformations ranging from “collective interest associations: CIA” to the current form “development groups of agricultural: DGA”. In spite of these mutations and institutional changes, DGAs are currently suffering from several problems impeding their functioning such as the increased budget deficits and conflict more and more accentuated. Thus, these associations are unable to accomplish their main mission: water management and allocation to irrigators in IA. Consequently, the situation is becoming more threatening in these areas and even chaotic: low rates farms, conflicts between farmers, leave irrigated activity by some farmers, the recovery payments rate is very low, inequality in distribution of water among farmers, illegal digging private wells by some farmers, etc.

The current situation of DGA and most IA hypothesizes the existence of local governance problems around the water resource, these governance problems are causing performance decrease in IA. The analysis of the interdependence between governance and performance of irrigation water management is the main aim of this paper. To conduct this analysis, a methodological approach inspired from the strategic analysis of Michel Crozier (1977) was adopted. Recourse to this positive approach flows from our acceptation of governance concept "is a regulation mode of relationships between a set of actors in a specified system”. IA in Nadhour-Zaghouan constitute an adequate investigation area to this purpose.

Assuming that IA constitute a concrete action system, the analysis of structured games between actors allowed to assess their power degrees, actors convergence and divergence degrees, actors ambivalence degrees. Results confirm the hypothesis of a significant effect of governance problems, including political source, on the performance of irrigation water collective management.

Key words: Governance, performance, water, collective action, politics, power.
IMPACT OF WASTEWATER ON GROUNDWATER RESOURCES IN SANA’A BASIN, YEMEN

Kamal Abbas Merghem¹, Abdelhakim Jilali², Anass Ali Alnedhary³, Hassan El Halouani¹, Khadija Dssouli¹

¹ Laboratory of Water Science, Environment and Ecology, Faculty of Sciences, University Mohammed I, Boulevard Mohammed VI, B.P: 717, C.P: 60000 Oujda, Morocco. e-mail: kamal58745@yahoo.com

² Laboratory of Mineral Deposits, Hydrogeology & Environment, Faculty of Sciences, University Mohammed I, Boulevard Mohammed VI, B.P: 717, C.P: 60000 Oujda, Morocco.

³ Department of chemistry, Faculty of Khawlan, Sana’a University, Boulevard Khawlan, C.P: 2312, Yemen.

Abstract

The use of wastewater in irrigation increase in Yemen country, and the effect on groundwater quality is spectacular. The presence of wastewater treatment plant station can improve the quality of wastewater rejected in Wadi Beni Hwat. To study the potential for contamination, the physicochemical (pH, EC, COD, BOD5, TSS, K+, Na+, Ca2+, Mg2+, Cl-, SO42-, NO3-, NO2-, NH4+, PO4-, and HCO3-) analysis of 28 samples of groundwater, wastewater, and soil were conducted in different times between 2013 to 2014. The results show that the shallow aquifer presents a high concentration of nitrates, COD, and BOD5. The contamination comes from the wastewater and pesticides used for irrigation.

Key-words: wastewater, groundwater, contamination, Sana’a basin, Yemen.
GROUNDWATER QUALITY MAPPING IN KODAGANAR SUB - BASIN, S. INDIA USING GIS TECHNIQUES

Gurugnanam, B and Kalaivanan, K

Centre for Applied Geology, Gandhigram Rural Institute, S. India.

E-mail gurugis4u@gmail.com

Abstract

Assessment of Groundwater quality study was carried out in Kodaganar sub basin, Tamil Nadu, India. Fifty samples were analyzed for variation quality of groundwater. To attempt this goal, samples were analysed for various physico-chemical parameters such as pH, temperature salinity, Na⁺, Ca²⁺, K⁺, Mg²⁺, Cl⁻, HCO₃⁻ and SO₄²⁻. The abundance of major cations concentration in groundwater is as Na > Ca > Mg> K, while that of anions is Cl > SO₄ > HCO₃. The Piper trilinear diagram observed that 96% of the samples fall in alkaline earths (Ca²⁺ and Na⁻), HCO₃⁻ and Cl⁻ exceed the other anions. According to USSL diagram, pre and post-monsoon season samples fell under 44 Location (88%) and 46 Location (92%) samples falls in C1-S1, C2-S1, C3-S1 and C4-S1 category. This category was predominant in the study area, and it is suitable for irrigation purposes. Gibbs diagram interpretation shows that falls in the rock dominance during both seasons. ArcGIS 10.1 software was used for the creation of different thematic maps and the final groundwater quality map. An interpolation technique inverse distance weighting (IDW) was used to prepare the spatial distribution map of the groundwater quality map. The final map classified the groundwater quality into two zones of the study area. The results of this research show that the growth of the management plans for the aquifer method is extremely required.

Keywords: GIS, Interpolation, Groundwater quality, Kodaganar Sub-basin.
GROUNDWATER CHARACTERIZATION IN INTENSIVE AGRICULTURAL AREA UNDER ARID CLIMATE: CASE OF CHTOUKA REGION, MOROCCO

Malki Mouna¹, Ait Brahim Yassine¹, Hirich Abdelaziz², Choukr-Allah Redouane³, Latifa Al Yacoubi¹ and Bouchaou Lhoussaine¹

¹ Applied Geology and Geo-Environment Laboratory, Faculty of Sciences, Ibn Zohr University, BP 8106 Agadir, Morocco,
² International Center for Biosaline Agriculture, Dubai, UAE
³ Salinity and plant nutrition laboratory, Hassan II Institute of Agronomy and Veterinary Medicine, BP773 Agadir Morocco,
malki.mouna@gmail.com

Abstract

Chtouka area, within the Souss-Massa basin (South of Morocco), shows an increasing in water scarcity during the last decades. This is was due to drawdown of water resources aggravated by agricultural intensification and climate change impacts exhibited by recurrent droughts. In order to assess the spatial evolution of Chtouka groundwater (Gw) quality, a sampling campaign was carried out in the different parts of the area (Costal area, Anti-Atlas Mountains Border, Along Massa River and the plain (farms)). Furthermore, historical data from the hydraulic basin agency of Souss Massa Basin and previous studies results are used to assess the temporal evolution of Nitrate concentrations in the area. Our Results indicate clearly that Chtouka groundwater salinity increase from the North to the South, and from the East to the West. The plain shows a relatively high Conductivity, however the highest value is observed along the Massa River. The most dominant elements in the water are bicarbonate, chloride and sodium-magnesium for farms samples, while Gw is mostly dominated by chloride, Sodium and potassium in the other parts. The temporal evolution of nitrate pollution according to the historical data shows that Nitrate levels do not exceed the limits of 50 mg/l and tends to decrease. Globally, the values measured in the plain remain higher than other parts. The relative trend decline observed can be explained by the improvement of the agricultural practices including the conversion of surface irrigation to drip irrigation with a better irrigation scheduling and management. This paper describes the current state of Gw quality in Chtouka zone with an overview of different sources of water salinity and nitrate evolution in agricultural areas.

Acknowledgment

We thank a lot the personnel of Hydraulic Basin Agency of Souss Massa for their support and cooperation in providing all necessary data and the University Of Bonn, Germany for their contribution to the sampling campaign.
ASSESSMENT OF GROUNDWATER QUALITY IN
SALALAH PLAIN

Dr. Brahim Askri

Caledonian College of Engineering, PO Box: 2322, CPO Seeb 111, Sultanate of Oman,
Muscat Email: askrib@yahoo.com

Abstract

The groundwater aquifer in the Salalah region, Sultanate of Oman, has been used extensively since the early 1970s for domestic, agricultural and industrial purposes. Over abstraction of this aquifer has contributed to the deterioration of the groundwater quality by seawater intrusion. This study was performed in order to identify the hydrochemical processes controlling the groundwater quality in this coastal region. Available data of groundwater chemistry collected from 40 wells during pre-monsoon season 2004 were analysed using multivariate statistics, modeling and molar ratio methods. Results indicate that groundwater salinity increased toward groundwater flow. A high percentage of Na-Cl type indicates the high rate of seawater intrusion and comparatively mixed water type shows the dilution activities of groundwater. The reverse ion exchange was the main source of calcium and magnesium in the groundwater. Besides, high nitrate concentrations, especially in downstream region, firm evidence for the impact of anthropogenic activities on groundwater quality.
ASSESSMENT OF THE ROLE OF NATIONAL WATER GOVERNANCE UNDER THE NEW PALESTINIAN WATER REFORM LAWS

Nasser Al-Khatib

Water and Environmental Development Organization (nasser@wedo-pal.org).

Abstract

Water governance addresses the management of available (conventional and unconventional) water resources, as well as the formulation and implementation of water laws and legislations. The water sector in Palestine faces rapid population growth rates, lack of communication among stakeholders, complex flow of information, and poor cooperation among the various governance sectors. This, in effect, called for urgent water sector reform in order to cope with the ongoing and increasing risks and crises in the water sector.

The new Water Law of 2014 provides recommendations based on the principle of equitable and efficient provision of water according to Article (3). The law also stresses the integrated management approach among all public water utilities, including the National Water Company, Water Regulation Council, and civil society institutions.

However, the reform did not take into consideration the Law of the Ministry of Agriculture (Instructions No. (3) For the Year 2012 for the reuse of treated wastewater for agricultural purposes. This has led to an overlap of governance among the responsible ministries in this sector.
CONTRIBUTION OF THE SYSTEMIC APPROACH IN THE ANALYSIS OF DRINKING WATER SUPPLY IN URBAN AREAS. CASE OF URBAN CLUSTER TLEMCEN, ALGERIA

Chérifa Abdelbaki
Department of Hydraulics, Faculty of Technology, University of Tlemcen, Algeria
e-mail: abdelbakicherifa@gmail.com

Abstract

In urban cluster Tlemcen (Algeria), the tension on drinking water supply continues to grow in response to increasing demand. The observed weather conditions, combined with a high urban population have contributed to an inevitable shortage of available resources. The policies adopted in the last twenty years, in terms of dams, desalination of sea water, remain insufficient. An unsuitable and inadequately planned management was grafted, and created tensions difficult to control the distribution of drinking water, water losses in the network of urban grouping of Tlemcen (UGT) has exceeded 55%. These losses are due to several factors, including the age of the pipes, a non-adapted to the terrain design, illegal taps due to uncontrolled construction, a lack of suitable equipment (detection and repair of leaks)....; Modeling of drinking water supply system of UGT becomes necessary, or even required. It is in this sense and to understand the operation of the water supply system of UGT a systemic analysis was developed with the aim to model the Water distribution system, to understand its operation. The systemic approach helps to better represent the complexity of the water supply system of UGT for modeling facilitates the practical and operational implementation of the systemic approach, and there by contributes to make intelligible the complexity says Distribution Water System. This model involves a double organization of the elements of a system, both structural and functional. The results are promising.

Keywords: Systemic approach, Water Distribution System, Management, Performance, Organization
Quantifying Resilience of Aquifers: A Case Study from Northern New South Wales, Australia
S.A. Prathapar, P. Wijesinghe, H. Bilge and C.I. McNeilage
Groundwater Modelling Unit, DPI Water, New South Wales, Australia

Abstract
Recent literature on agro-ecosystems inculcates the need for its resilience, implying that the services derived from an ecosystem should promote socio-economic development, while the integrity of the system is retained. This can only be possible if the band-width of resilience of the system is known. In other words, we need to know how far the agro-ecosystem can be bent, without breaking it. An agro-ecosystem is made of several components such as cropland, wetlands, surface water and groundwater. The net benefits from the system are greater than can be derived from each component individually. In some systems, there is interconnectivity between components, e.g., surface water bodies recharging aquifers or groundwater contributing to base flow in rivers. In summary, resilience of an ecosystem will depend on the sustainability of its components. By managing its components, the resilience of a system will be assured. Management of these components will require ‘metrics’ and these metrics will have a temporal dimension.

In this paper we will illustrate how historic groundwater levels can be used to test if an aquifer is resilient or not, without compromising provisioning services of the agro-ecosystem. The methodology involves removal of seasonal and spatial variation in observed groundwater levels across aquifers, and test for statistically significant trend in change in groundwater levels over long periods. Groundwater level data since 1986 till 2014 from Lower Gwydir Valley in Northern New South Wales will be used to demonstrate various metrics which could be used to measure resilience. A separate analysis of data from 2006 till 2014 will be done to evaluate performance of the Groundwater Sharing Plan, came into act in 2006.
INTEGRATED STUDY ON GROUNDWATER SALINITY IN THE AQUIFER SYSTEM OF DELHI, INDIA
AL Ramanathan ¹, Manish Kumar ², M. Someswar Rao ³, Jyoti Prakash Deak ², Bhishm Kumar ³
1. School of Environmental Sciences, Jawaharlal Nehru University, New Delhi
2. Department of Environmental sciences, Tezpur University, Assam, India
3. NIH, Roorkee, India

Abstract
National capital of India Delhi's aquifer systems has undergone rapid urbanisation and vast land use change and is still continuing. It is believed that salinisation is caused multiple combination of natural and anthropogenic processes. However, there is a lack of well-proven theory that can explain the salinity in the deeper aquifers of Delhi. This paper identifies inconclusiveness in the previous theories of marine ingression, evaporation enrichment and subsequent leaching of salt. Further, the study depicts a conceptual understanding of the origin of salinity in groundwater based on the integrated investigations of groundwater quality, age and stable isotopic fingerprinting as well as GIS based mapping of geomorphic features. In order to explain the salinity observed in groundwater of NCT Delhi, a phenomenological scenario is illustrated and supported by additional evidences. The highest average EC value was for the shallow aquifer and is strongly symptomatic of anthropogenic influences on groundwater chemistry. The results show, that the closed inland marine conditions developed and buried with the active sedimentation in the geological past in this region, and further intensive exploitation of groundwater, and enhanced evaporation have together resulted in saline playa condition in some part of the region.

Acknowledgements:
We are thankful to JNU and Tezpur university and NIH authorities for the facility and help in bringing better output through this work.
HYDROGEOCHEMICAL AND GEOPHYSICAL EVALUATION OF GROUNDWATER RESOURCES IN ABU MADI COASTAL AREA, NORTHERN NILE DELTA, EGYPT

Mohamed K. Salah, Zenhom E. Salem, A. M. Al Temamy, M. Kassab

1 Department of Geology, American University of Beirut, Beirut, Lebanon
2 Geology Department, Faculty of Science, Tanta University, Tanta 31527, Egypt
3 Desert Research Institute, Matariya, Cairo, Egypt
E-mail: ms264@aub.edu.lb

Abstract

Both hydrogeochemical and geoelectrical investigations were carried out to assess the origin and characteristics of a low-salinity groundwater in Abu Madi coastal area. Twenty six groundwater samples were collected and analyzed for various ions concentrations as well as the oxygen and hydrogen stable isotopic contents. In addition, a total of 20 Vertical Electrical Sounding (VES) sites distributed uniformly in the study area were carried out. Then, 2-D Electrical Resistivity Tomography along two profiles in the study area was measured in order to get more constraints on layers’ thicknesses and resistivities. The stable isotopic composition of oxygen and hydrogen and the chloride concentrations strongly suggest that the deep groundwater in Abu Madi area is dominated by inland freshwater with a minor seawater component. The brackish groundwater and higher piezometric conditions (about 0.5 to 1.25 m above the land surface) as well as the occurrence of vertical low-salinity seawater zone (30-200 m deep) in front of the study area, support the possibility of submarine groundwater discharge.

The geoelectrical resistivity surveying, on the other hand, revealed the presence of a number of geoelectrical groundwater-bearing layers. The first layer lies near the earth surface with a limited thickness that is recharged from the surface canals, drains and rain water. The second water-bearing layer is present under confined conditions but has low resistivity values due to the high water salinity. The main aquifer in the study area is represented by the sixth geoelectrical layer, which has relatively high resistivity values with a considerable thickness. Results from the hydrochemical analyses and the different hydrological data are consistent with the high resistivity values of this geoelectrical layer. However, the high specific conductance and high sodium hazards indicate that the groundwater in the study area should be carefully treated before irrigation and domestic uses.
Investigating hydrochemistry and the groundwater quality prospects evaluation and its suitability for agricultural, Northwestern Saudi Arabia

Yousef Nazzal*1, Fares. M. Howari 2, Nassir S. N. Al-Arifi3

1* Dept. of Applied Mathematics & Sciences, College of Arts & Sciences, P.O.Box 59911, Abu Dhabi University, UAE

3Department of Geology and Geophysics, King Saud University, PO Box 2455, Riyadh 11451, Saudi Arabia.

2College of Sustainability and Human Sciences, Zayed University; Abu Dhabi, United Arab Emirates

Abstract

The current study emphases on hydrochemical evaluation of groundwater in Northwestern part of Saudi Arabia and particularly in Tabuk, Jauf and Hail regions. In this region, the aquifers are appeared to be as confined aquifers. The main aquifer has extensive outcrop areas along the boundary with the Arabian Shield in the west, where it receives some recharge which is less than the volumes abstracted from the aquifer. Groundwater samples were gathered from about 60 groundwater wells and tested for various physico-chemical parameters such as electrical conductivity (EC), pH, temperature, total dis-solved solids (TDS), Na+, K+, Ca2+, Mg2+, CO3−, HCO3−, Cl−, SO4, and NO3. Groundwater in the area is slightly alkaline and hard in nature. Electrical conductivity (EC) varies between 171 and 5061 μS/cm with an average value of 982μS/cm. The distribution of major ions in the groundwater is Ca++ >Na+ > Mg++ >K+ and Cl− >SO4−2 >HCO3−. Using Pipers classification, groundwater was classified under Na-C-SO4 water type. The GW has acquired unique chemical characteristics through prolonged rock water interactions, percolation of irrigation return water and reactions at vadose zone.
The Combination of Principal Component Analysis and Geostatistics as a Technique in Assessment of Groundwater Hydrochemistry in Arid Environment: A case study of Central Saudi Arabia

Yousef Nazzal*, Faisal K. Zaidi, Izrar Ahmed, Habes Ghretat, Muhammad Naeem, Nassir S. N. Al-Ariff, Saeed A. Al-Shaltoni, Khaled M. Al-Kahtany

1 Department of Geology and Geophysics, King Saud University, PO Box 2455, Riyadh 11451, Saudi Arabia.
2 Colleges of Engineering, King Saud University, Riyadh 11451, Saudi Arabia.

Abstract
Central Saudi Arabia is one of the most arid regions of the world with very little precipitation and extreme climatic conditions. In the absence of available surface water supplies, the non-renewable groundwater resources stored in the Mesozoic sedimentary formations form the most important source for irrigation and domestic water requirements. Therefore, groundwater quality monitoring by different techniques and tools is very important and vital issue. The present study deals with 103 groundwater samples collected from Saq quifer which is considered as the major aquifer in the region. The study employed Principal Component Analysis (PCA) and Geostatistical analysis for groundwater quality mapping.

Using PCA, study intended to establish a series of factorial variables that summarize all the hydro-chemical information. Efforts have been made to identify the spatial development of the principle process acting on GW quality by mapping GW quality using factorial variables and ordinary kriging (OK) techniques. PCA helps to understand two important new variables showing that chemical characteristic acquired through rock water interaction and anthropogenic influences. By applying Kriging interpolation technique, the spatial variability of these variables over the extent of the MMA is mapped. The study results concluded that both natural and anthropogenic processes contribute to the groundwater quality, but anthropogenic impacts can be considered as the most important and influential one.

Key Words: Principal Component Analysis, Geostatistics, Arid region, Groundwater quality, Kriging, Central Saudi Arabia.
FLUORIDE PROBLEM IN SEMI-ARID REGION – A CASE STUDY FROM INDIA

Dr. S. K. Sharma
Head, Geography and Environmental Science Department
Carman Residential and Day School, Dehradun 248007, India
sks105@rediffmail.com

Abstract
India is among those nations around the world, where health problems occur due to the consumption of fluoride contaminated water. Fluoride problems are wide spread in India and has been reported from many parts of the country. The semi-arid region of Rajasthan is one of them. Over 70% irrigation and 95% drinking water supply schemes are based on ground water resources which has resulted in a rapid depletion in ground water level and deterioration in water quality. The withdrawal of ground water is more than the recharge due to over exploitation. The geo-chemical factors have resulted in increase of hydrochemical parameters viz. salinity, nitrate, and fluoride in ground waters and have adversely affected the lives of inhabitants. A systematic study has been carried out to understand the behavior of fluoride in natural water and its affect on human health in the southern part of Rajasthan in Bhilwara which is facing the acute problem of fluoride, in terms of geological setting, hydrological and climatic conditions and agricultural practices.
GEOCHEMICAL AND ISOTOPIC STUDY OF SALINIZATION AND POLLUTION OF THE COASTAL AQUIFER OF CHOTT MERICM, SAHEL OF SOUSSE, TUNISIA

M.F Ben Hamouda¹,², J Harkness², A.J Kondash², N Lauer², A Vengosh²
¹Isotope Hydrology and Geochemistry Unit, CNSTN, Sidi Thabet, 2020, Tunisia
²Nicholas School of Environment, Duke University, Durham, NC, 27708, USA
f_benhamouda@yahoo.fr

Abstract

Groundwater salinization and pollution are widespread processes that degrade water quality and endanger future water exploitation. The problem is intensified in coastal aquifers where human activities result in accelerating water quality deterioration, particularly in arid and semi-arid regions. The elevated salinity can also originate from other natural or anthropogenic processes, such as dissolution of halite and gypsum, evaporation of seawater, etc. In the Sahel region of Eastern Tunisia, near the coast, water quantity and quality are major concerns. The Chott Meriem coastal aquifer system is no exception. It is located in a coastal saline wetland along the Mediterranean Sea surrounding the city of Sousse. The aquifer is mainly characterized by high salinity waters compared to the surrounding aquifers. This study applieds geochemical analyses to distinguish between the different mechanisms of salinization in order to determine the origin of groundwater mineralization. Ionic ratios such as Na/Cl, Br/Cl, Ca/Mg, as well as the isotopic signatures of \(^{18}\text{O}, ^{2}\text{H}\) can be used to identify seawater intrusion in coastal zones. The Chott Meriem aquifer system consists of a shallow main reservoir, with thickness between 30 and 60 m and consisting of Mio-Pliocene sandstone formations with interbedded gypsum lenses (Segui formation). This shallow groundwater aquifer has a flow direction from inland towards the coast (SW - NE). Geochemical (ions Na\(^+\)/Cl\(^-\), Br\(^-\)/Cl\(^-\), Ca\(^{2+}\)/Cl\(^-\), B\(^-\)/Cl\(^-\)) and isotopic (\(^{18}\text{O}, ^{2}\text{H}\)) analyses were compared with the hydrodynamic information and salinity map for identifying the main processes involved in the increase in mineralization. Irrigation development that induces leaching of soils was identified as the main source of mineralization. However, it is not the only cause of the qualitative degradation as the salinity of the groundwater is also impacted by dissolution of evaporate rocks (gypsum and halite minerals) in the aquifer. There is no indication of presence of water enriched in \(^{18}\text{O}\) and \(^2\text{H}\) and don’t show mixing with seawater.

Acknowledgements: This study was funded by the division of Earth and Ocean Sciences, Duke University, NC, USA and the Fulbright visiting scholar program 2014-2015, Project “Use of geochemical and isotope techniques to improve water resources management of coastal aquifer of Chott Meriem, Eastern Tunisia”.

71
NITRATE CONTAMINATION OF GROUNDWATER IN SEMI-ARID RURAL AREA: SOUTH INDIA

P.D.Sreedevi*, Shakeel Ahmed and D.V. Reddy

CSIR-National Geophysical Research Institute, Uppal Road, Hyderabad – 500 007, Telangana, India

*E-mail: pd_sreedevi@yahoo.co.in

Abstract

Groundwater is the major source for using as drinking and irrigation in the study area. Excessive nitrate (NO$_3^-$) concentration in drinking water has been shown to cause significant effects on human health. In light of this, a study was conducted in a semi-arid rural area by measuring the physicochemical parameters in 36 groundwater samples collected from bore wells during Pre season (May 2105). The hydrochemical results indicates that the groundwater in the study area is near-neutral to weakly alkaline water. The order of major dominance of cations in the groundwater is Na$^+$ > Ca$^{2+}$ > Mg$^{2+}$ > K$^+$ and anions is HCO$_3^-$ > Cl$^-$ > CO$_3^{2-}$ > NO$_3^-$ > SO$_4^{2-}$ in the study area. Thereby four major hydrochemical facies were identified (1) Na$^+$ - HCO$_3^-$ type, Na$^+$ dominant HCO$_3^-$ type waters. (2) Ca$^{2+}$ - Mg$^{2+}$ - Cl$^-$ type, Ca$^{2+}$ - Mg$^{2+}$ dominant Cl$^-$ type waters. (3) Ca$^{2+}$ - Mg$^{2+}$ - HCO$_3^-$ type, Ca$^{2+}$ - Mg$^{2+}$ dominant HCO$_3^-$ type waters and (4) Na$^+$ - Cl$^-$ type, Na$^+$ dominant Cl$^-$ type waters.

The concentration of NO$_3^-$ in groundwater ranges from 2 to 1418 mg/l with mean of 182 mg/l. The permissible limit of nitrate in drinking water is 45 mg/l. It is observed that 78% samples were exceeded the permissible limits prescribed by drinking water standard. NO$_3^-$ has shown a significant negative correlation with pH and positive correlation with Eh, TDS, K$^+$, Mg$^{2+}$, Ca$^{2+}$, Cl$^-$ and SO$_4^{2-}$. The significant positive correlation between these ions indicates the anthropogenic pollution rather than naturally originated. The NO$_3^-$ pollution in the studied groundwaters originates through anthropogenic processes. Results thus indicated that the groundwater of the study area is highly unsafe for drinking purposes in normal condition.

Key words: Groundwater quality, Fluoride, Nitrate, Impact on human health, Geochemical mechanism.
Hydrochemistry and Quality Assessment of Shallow Aquifer Ground Water of Wadi Baye, North Central Region of Libya

Fathi Ali Swaid
The Great Man-made River Water Utilization Authority, Middle Region, Libya
fagswaid@yahoo.com.au

Abstract
Groundwaters with minimal rainfall during wet season are the main sources for agriculture and domestic uses in most of the reclaimed areas in Wadi Baye region. Two main aquifers were identified in the study area, Shallow Eocene aquifer (unconfined aquifer) and deep Kikla aquifer (confined aquifer). Groundwater samples were collected from 30 wells (shallow aquifer), which distributed within the Wadi area. pH, and Electrical conductivity were measured in situ, in addition to major soluble ions (Cations and Anions). Total dissolved solids, were analyzed in laboratory, and total hardness were calculated. Two water types were recognized; Cl·SO4-Na and Cl·SO4-Na·Ca. The ionic strength of each sample and saturation indices (SI) of calcite, dolomite and gypsum in aquifers were calculated, it was found that all the water samples were over saturated with respect to calcite and dolomite, and all water samples were under-saturated with respect to carbonate rocks. Depending on calculated of sodium adsorption ratio (SAR), sodium percentage (Na%), permeability index (PI), by using U.S. Salinity Laboratory diagram, Wilcox and also to the higher concentration of TDS, sulfates and chloride, and according to Libyan standards, the World Health Organization (WHO, 1996) and U.S. Environmental Protection Agency. The shallow groundwater aquifer in Wadi Baye region is unsuitable for drinking water and also it is considered as unsuitable for irrigation in all soil types.

Acknowledgements: (I would like to thank The Man-made River Water Utilization Authority, Middle Region for the opportunity the gave me to do this research.)
GEO - SOLUTION TECHNIQUES FOR GROUNDWATER EXPLORATION

E.S Joel¹*, M. Omeje², P.I Olasehinde³, O.O Adewoyin⁴
Covenant University Ota, Nigeria, Km. 10 Idiroko road Ogun state, Nigeria
*Corresponding author’s e-mail address: emmanuel.joel@covenantuniversity.edu.ng

Abstract

Groundwater has been one of the major purest sources of water in the world. This is because the source is been stored in an aquifer beneath the earth’s surface. However, exploring this source require certain skills or techniques in order to ease the trauma experienced by the searcher. Over the years various geophysical techniques have been applied to explore this source but with little or no success due to the approach. In this research therefore, aeromagnetic and electrical resistivity techniques were integrated to explore this source in Dahomey basin, southwestern Nigeria. The result established that no single geophysical technique can be used for detailed geophysical studies of an area. But the combination of these geophysical techniques yields better result because they complement each other.

Keywords: groundwater, aquifer, geophysical technique
REGIONAL GROUNDWATER STUDIES USING AEROMAGNETIC TECHNIQUE
E.S Joel¹*, A.P Aizebeokhai², P.I Olasehinde³, M. Omeje⁴
Department of Physics Covenant University Ota, Nigeria, Km. 10 Idiroko road Ogun state, Nigeria
*Corresponding author’s e-mail address: emmanuel.joel@covenantuniversity.edu.ng

Abstract
Geophysical techniques have played a major role for subsurface investigation. Those techniques include seismic, electrical, ground penetrating radar, gravity, electromagnetic, magnetic etc. The problems that have been buffeting the geologist or geophysical researchers are in the wide coverage of any area of interest when investigating subsurface. But aeromagnetic technique has proved to be successful in this regard. Though, magnetic technique (aeromagnetic) has been applied successfully for mineral resources and hydrocarbon exploration. This present study examined in detail the uniqueness of this technique (in terms of universality, acceptability and coverage) and its application to regional groundwater studies especially where there is absence of hydrogeophysical related equipments. Furthermore, this has been applied to determine the depth to magnetic source of Ota and environs, southwestern Nigeria. The result revealed that there are two geological environments in the study area namely sedimentary and basement complex terrain which are very significant in groundwater studies. The shallow sources characterized the basement complex with depth ranges from 102.8m to 246.1m and deep sources which characterized sedimentary terrain ranges from 710.0m to 1,980m.

Keywords: subsurface investigation, aeromagnetic technique, regional groundwater
MAJOR ION CHEMISTRY AND WEATHERING PROCESSES IN THE MIDYAN BASIN, NORTHWESTERN SAUDI ARABIA

Habes A. Ghrefat¹, Awni Batayneh, Haider Zaman², Taisser Zumlot¹, Eslam Elawadi³, Yousef Nazzal⁴

¹Department of Geology and Geophysics, Faculty of Science, King Saud University, Riyadh, Saudi Arabia
²Department of Geology, Faculty of Science, Taibah University, Medina, Saudi Arabia
³Airborne Exploration Division, Nuclear Materials Authority, PO Box 530, Maadi, Cairo, Egypt
⁴College of Art and Sciences, Applied Math and Sciences, Abu Dhabi University, United Arab Emirates

e-mail: habes@ksu.edu.sa

Abstract
Chemical characteristics of 72 groundwater samples collected from Midyan Basin have been studied to evaluate major ion chemistry together with the geochemical and weathering processes controlling the water composition. Water chemistry of the study area is mainly dominated by Na, Ca, SO₄, and Cl. The molar ratios of (Ca+Mg)/total cations, (Na+K)/total cations, (Ca+Mg)/(Na+K), (Ca+Mg)/(HCO₃+SO₄), (Ca+Mg)/HCO₃, and Na/Cl reveal that water chemistry of the Midyan Basin is controlled by evaporite dissolution (gypsum and/or anhydrite, and halite), silicate weathering, and minor contribution of carbonate weathering. The studied groundwater samples are largely undersaturated with respect to dolomite, gypsum, and anhydrite. These waters are capable of dissolving more of these minerals under suitable physicochemical conditions.

Acknowledgements: This work is financially supported by the National Plan for Science, Technology and Innovation (NPST) program, King Saud University, Saudi Arabia (project number 11-ENV1589-02). We also thank the General Directorate of Water in Al-Bad’ City (Ministry of Water & Electricity, Saudi Arabia) for their help and valuable information during the field work.
Application of DC resistivity method for groundwater investigation, Case study at West Nile Delta, Egypt

Adel K. Mohamed
Geology Dept., Faculty of Science, Mansoura Univ., Mansoura, Egypt.
E-mail: mohamedemamm79@yahoo.com; adelkamel@mans.edu.eg

ABSTRACT
New communities have been established in Egypt since 1990s. Among those are El Nubariya and El Bustan cities with associated land reclamation activities. These land reclamation projects are still having environmental implications. The main objective of this work is to delineate and detect one of these implications representing the rising of the groundwater level and related impacts along El-Nasr Canal and surroundings. It is evident that there is a remarkable change in groundwater level through monitoring of the groundwater level from 1960 to 2010. This is referred to the continuous recharge of the surface water from irrigation canals for reclamation activities. To achieve the objective of this work, thirty two discrete vertical electrical soundings (VES) have been measured in the study area. 1D/2D data analysis are applied for covering the lack of hydогeological information and for mapping the areas affected by this phenomenon. From the resistivity sounding results, it is observed that the groundwater mound is appeared northwest of El-Nasr Canal and along Cairo-Alexandria desert road. This is attributed to the application of flood irrigation method in new reclaimed areas, bad management, unplanning of water resources and the recharge of aquifer from the surface irrigation system.

Keywords: Hydrogeology, DC Resistivity, Reclamation, Rising of groundwater, Waterlogging, El Nasr Canal, West Nile Delta.
Environmental studies on toxic and radioactive contaminant on the groundwater of Southwestern Sinai, Egypt

K. A. Gaber1,∗, A. F. El Wakil1, B. H. Ali1, M. S. El-Nagdy2
1- Nuclear Materials Authority, P.O. Box: 530 Maadi, Cairo, Egypt
2- Physics department, Faculty of science, Helwan University, Cairo, Egypt
Corresponding author e-mail: karemabdelazeem@yahoo.com

Abstract

Six groundwater well samples were collected from wadi El Sieh and wadi Nasieb, southwestern Sinai, Egypt. The radioactive and heavy toxic elements were measured on the collected samples using ICP-OES. The result for radioactive measurements show that the level of uranium contamination in five wells was exceeds the maximum acceptable concentration guided by WHO. The pollution indices for heavy toxic elements were calculated. The calculation show that the contamination index in all wells suffers a medium contamination, the ecological risk factor of five groundwater wells suffer a considerable ecological risk contamination by toxic heavy elements and one well only have a moderate risk factors. Geo accumulated index (unpolluted to moderate) for Pb, Cd, Cr and Ni have unpolluted geo accumulated index for all groundwater wells. The effect of pH on radioactive and toxic heavy element solubility on the groundwater was studied. The study shows that $R^2$ for uranium and thorium concentration on groundwater have a medium relation with pH and there are no relation between toxic heavy elements and groundwater pH.
Contamination by radioactive heavy metals and trace elements in paleobeach groundwater, Cox’s Bazar, Bangladesh: Potential impact on environment

Ashraf Ali Seddique1*, Harue Masuda2, Ashraful Hoque3
1Dept. of Petroleum and Mining Engineering, Jessore University of Science and Technology, Bangladesh, 2Dept. of Geosciences, Osaka City University, Japan; 3Marine Fisheries and Technology Station, BFRI, Cox’s Bazar
*Corresponding author: aseddique@yahoo.com

Abstract

Cox’s Bazar town is one of the most densely populated (~50000/km²) coastal cities in Bangladesh located on the seafront of the Bay of Bengal and depends on groundwater (>90%). Cox’s Bazar paleobeach (backdune area) areas have been overexploited the subsurface aquifers to meet the demand for thousands of tourists (over 1,000,000 tourists visit each year) along with domestic and aquaculture purposes. A total of 105 groundwater samples randomly collected from different depths at Cox’s Bazar paleobeach and its adjoining areas during the pre-monsoon season (June, 2014) showed that 32% of shallow tubewells (<100m depth) are contaminated with seawater with high electrical conductivity values up to 7000µS/cm, and about 5% of studied shallow tubewells (10-50m depth) exceeding the uranium WHO (2004) guideline of 2.0µg/l, are contaminated with radioactive heavy metals with maximum concentrations of 10µg/l of U and 127µg/l of Th, which do not has WHO health-based drinking water guidelines. U and Th rich groundwater mostly occurred in the high Eh (0.35- 0.5V) i.e., oxic environment. Compared to the U and Th concentrations, U rich groundwaters were found in pH ranged from 6.6 to 7.5, while Th was found in pH ranged from 8.0 to 8.5 conditions. It implies that U and Th mobility in water-rock system taking place in oxidizing conditions, U and Th solution-mineral equilibrium and sorption reactions. The correlation analysis for U and Th in studied samples showed that only U gives a positive correlation between its concentration to TDS (131.3-2375.75mg/l) and alkalinity as HCO₃ values (1.24-13.12meq/l), indicating solubility of U-bearing minerals by uranium carbonate complexation in association with the
biodegradation of organic matter. However, U and Th concentrations showed an inverse relationship with Pb concentrations.

It is predicted that the successive recoils of U and Th and release of Ra, Rn and Pb isotopes in the same decay chain and the enrichments by adsorption in a zone of water-rock interaction. Thereafter, the Coz’s Bazar paleo-beach groundwater pollution was also compounded by high concentrations of Mn (0.01 to 29mg/l), B (0.01 to 1mg/l), Cl (3-2940 mg/l) and Fe (0.01 to 89mg/l) with 80% of the studied tubewells breaching the WHO (2004) drinking water guidelines.

However, this study reveals for the first time that the radioactive heavy metals (i.e., U, Th) are found in the groundwater in Bangladesh and the source(s) of U, Th, Mn, B etc are not identified yet. If the city dwellers keep drinking water from contaminated wells, many people will be exposed with various chronic diseases in the near future. It may lead to a serious health threat to the thousands of tourists as well as local people along with environment of Cox’s Bazar town in near future.

**Key words:** Cox’s Bazar, Paleobeach, Uranium, Thorium.
Reexamining the spatial distribution of fluoride in groundwater of Sri Lanka: A field study at Nochchiyagama, Anuradhapura

A.T. Cooray, T. De Fonseka, and S.P Deraniyagala,
Department of Chemistry, University of Sri Jayewardenepura

Abstract
Fluoride is well known for both beneficial and detrimental effects on human health. Fluoride improves the dental health by preventing cavities; however, excessive amounts of fluoride lead to the development of dental and skeletal fluorosis. There is a narrow range between fluoride intake which is advantageous and those which begin to be damaging. Dental fluorosis caused by fluoride rich drinking water is a common health issue in the dry climate zone of Sri Lanka. The spatial distribution of fluoride in groundwater in Sri Lanka has been extensively studied and several fluoride distribution maps have been published to date. However, careful analysis of these maps reveal that the fluoride distribution presented in some geographical regions does not agree with each other. This study is focused on examining the fluoride distribution in Nochchiyagama, Anuradhapura to re-evaluate its fluoride distribution. During the study, approximately 200 water samples were collected from dug and tube wells, water reservoirs and canals. Fluoride concentration of the samples was determined by the fluoride selective electrode method. Other physico-chemical properties of water such as pH, conductivity, hardness etc were determined by internationally accepted standard methods. The average fluoride concentration in Nochchiyagama was 1.1 ± 0.8 mg L\(^{-1}\) (n = 202) in the range 0.29 to 5.52 mg L\(^{-1}\); however, many of the published maps state the fluoride distribution in the Nochchiyagama area as 0.5 to 1.0 mg L\(^{-1}\). A careful examination of the fluoride data reveals two distinct fluoride distribution patterns. The geographical area between the Puttlam-Anuradhapura highway (A12) and the Wilpaththu National Park generally has a higher fluoride content with an average 1.2 ± 1.0 mg L\(^{-1}\) (n= 103) in the range 0.31 to 5.52 mg L\(^{-1}\). The area between Puttlam-Anuradhapura highway (A12) and Thabuththegama-Anuradhapura Highway (A28) has an average fluoride concentration of 0.9± 0.5 mg L\(^{-1}\) (n=99) in the range 0.29 to 2.53 mg L\(^{-1}\). The first geographical area had about eight fluoride hot spots (< 2.5 mg L\(^{-1}\)) while other region had only two. One of the most visible hydrological differences in these two regions is that the first region solely depends on rainwater for water requirements while the other one has a complex network of irrigational canals distributing water from the Kala Oya Irrigational Scheme. This study was funded by SJP grant ASP/06/RE/SCI/2013/09

Key words: Fluoride distribution, Nochchiyagama
ASSESSMENT OF INTERACTION BETWEEN SURFACE WATER AND GROUNDWATER IN SAWA LAKE AREA - SOUTHERN IRAQ USING STABLE ISOTOPE TECHNIQUE

Ali K.K.* and Ajina A.R.**

* College of Science- University of Baghdad-Iraq
**Ministry of Science and Technology.

kkak1962@yahoo.com

Abstract

Interaction between surface water represented by the Euphrates River, natural springs and Sawa Lake with groundwater (11 wells), southern Iraq were investigated in this study. Water samples were collected for hydrochemistry and stable isotopes (2H and 18O) analysis. Sampling of water from determined stations (10 station along the Euphrates, 3 springs and Sawa lake) were carried out during two stages; the first was in October /2013 (dry season) and the second one was in March /2014 (wet season). The aim of the research is to assess the interaction of groundwater- surface water, which includes Al-Atshan River (branch of the Euphrates River), Sawa Lake, and the groundwater in the study area by using hydrochemistry and isotope techniques. The results indicate that surface water have different type of water from that of groundwater. In δ²H and δ¹⁸O diagrams, all groundwater, springs and Sawa Lake water are plotted below GMWL and LMWL indicating the influence of evaporation processes and seasonal variation. The LMWL deviate by d-excess about (+13.71) towards the EMWL indicating the origin of the vapour source is from the Mediterranean Sea. The river water has different isotopic composition from that of groundwater and springs and Sawa Lake. The final conclusion is no clear influence of the groundwater on the river water while there is intermixing between the groundwater in the different locations in the study area.
THE PERI-URBAN TO URBAN GROUNDWATER TRANSFER AND ITS SOCIETAL IMPLICATIONS IN CHENNAI, SOUTH INDIA – A CASE STUDY

S.Packialakshmi1*, N.K Ambujam2
1Department of Civil Engineering, Sathyabama University, Chennai, India,
2Centre for Water Resources,Anna University, Chennai, India (10 pt, centered)
*e-mail bagyaram@gmail.com

ABSTRACT

The aquifer of the peri-urban/rural areas of Chennai Metropolitan Area in Tamil Nadu acts as a source of informal water market, and a huge amount of water is transferred and marketed by entrepreneurs, such as private water suppliers and packaged water industries. Water transfer from agricultural to non agricultural uses is not only common in India but most of the water starved developing countries experience it. It leads to temporal and spatial changes in the groundwater quantity and quality, and generates the inequity and affordability issues in accessing the water especially to the peri-urban poor. The paper analyzed the above issue with a case study conducted at Perumbakkam, a Chennai peri-urban village. The multivariate statistical analysis of field findings has been conducted in the peri-urban village for understanding the socio-economic implications of the groundwater market. The study identifies the major findings due to the prevailing informal groundwater market and emphasizes the institutional mechanism through regulatory and legal measures to protect the resource base and conservation and restoration mechanism to replenish the depleting resources.

Key words: groundwater, peri-urban, agriculture, socio economic implication, groundwater depletion, groundwater degradation, multivariate statistical analysis, groundwater market

Acknowledgements: This research was funded and supported by Wageningen University, Netherlands under the Crossing Boundaries (CB) Project. The authors sincerely thanks the South Asian Integrated Water Resources Management Consortium (saci WATERs), Hyderabad, coordinator of the CB project for providing the necessary support and fellowship to complete the present work.
A pre-requisite for restoration of an ecosystem under water scarcity: Analysis of collaborative actions for agricultural water management

Ali Azarnivand¹*, Hossein Azarnivand²
¹Faculty of Agricultural Engineering & Technology, University of Tehran, Iran.
²Faculty of Natural Resources, University of Tehran, Iran,
*Corresponding author: Azarnivand.ali@ut.ac.ir

Abstract
Despite the seriously inefficient agricultural productivity in Iran, more than 90% of water resources have been allocated to the agricultural sector. Lake Urmia, a vast hyper saline lake in north–west of Iran, is now considered as the symbol of the ecosystems which are adversely affected by unsustainable development and unwise agricultural management. One of the major drawbacks of current agriculture is lack of regional cooperative agricultural management institutions. Many voices are of the opinion that a committee involving farmers, NGOs, irrigation districts, and other responsible authorities can boost economic efficiency of farming as well as alleviating water crisis. With this knowledge in hand, a multi attribute decision making (MADM) framework was considered to assess performance of 12 alternatives of participatory management based on satisfying eight sustainable development attributes. Based on the results evaluated by Modified-TOPSIS, necessity of farmers’ participation in establishing an association for irrigation water users, updating and reforming the law and regulations, and setting up the pressurized irrigation stood superior to the other alternatives. Collaboration of stakeholders, NGOs, experts, and responsible authorities would build up trust among them. It can also provide equilibrium between efficiency and equity in the rural communities. The proposed framework can be employed by investigators in similar problems.

Keywords
Inefficient agriculture; Decision making; Water management; Stakeholders' participation; Development
NEW ELEMENTS ON THE NORTH AFRICAN SAHARA AQUIFER SYSTEM: A CONTRIBUTION OF GEOPHYSICS TO THE TUNISIAN JURASSIC AQUIFER

R. Ben Lasmar¹; R. Guellala¹,²; M. Garrach³, A. Mahroug⁴, B. SarsarNaouali⁴ & M. H. Inoubli¹

¹Département de Géologie, Faculté des Sciences de Tunis, Unité de Recherches de Géophysique Appliquée aux Matériaux et aux Minerais El Manar, Tunisia.
²Laboratoire de Géoressources, CERTE, Technopôle de Borj Cedria, Tunisia.
³Commissariat Régional de Développement Agricole de Tataouine, Tunisia.
⁴Entreprise Tunisienne d’Activité Pétrolière (ETAP), Charguia II, Tunisia.

Corresponding author: benlasmar.rafika@hotmail.fr

Abstract

Tunisia (North Africa) is among the most hydraulically stressed countries in the world. The southern part where the pluviometry doesn’t exceed 200 mm/year is the Tunisian driest zone. Any social and economic activities in this zone are relayed to the exploitation of water tables that belong to an immense hydrogeological system covering the North African Sahara and extending from Triassic to Miocene in age. In this study, surface geological informations, boreholes data and geophysical measurements are confronted to determinate tectonic and sedimentary events influencing the characteristics and the functioning of the Tunisian Jurassic aquifer. Well logs are used to precisely determine the position and the composition of current reservoirs and to identify other able to produce good quality water. They show that the Krachoua limestones (Bathonian), the Techout sandstones (Bathonian) and the limestones and sandstones of FoumTataouine formation (Callovian-Oxfordian) are the main Jurassic reservoirs. Well log correlations exhibit these reservoirs enrichment in clay towards the West which would express a permeability reduction. Sixty-eight seismic reflection sections are integrated within this study to reconstitute the Jurassic aquifer geometry. The interpolation between the interpreted sections leads to the construction of the isochronous, isobath, isopach maps and geoseismic cross-sections. The analysis of these documents controlled by available geological data highlights that compressive and extensive tectonic deformations influenced the Jurassic aquifer geometry. The Hercynian phase manifestation is remarkable by several important stratigraphic gaps of Mesozoic series including Jurassic reservoirs. The E-W, NW–SE, and NNW-SSE accidents reactivated in normal faults since Permian to Lower Cretaceous generated the structuration of Jurassic series in subsided and raised blocks. Their syn-sedimentary activity has controlled these series thickness and facies. The Austrian phase is responsible of the Jurassic deposits folding in some localities. The highlighted tectonic and sedimentary events have important impact on the Jurassic aquifer functioning by favoring the Jurassic reservoirs interconnection and their communication with Triassic and Cretaceous permeable series and by guiding the groundwater flow towards the East and the West on either side of the Jurassic outcrop indicating that this raised structure is both the recharge zone and the continental divide.
RESEARCH OF NEW POTENTIALITY OF DRINKING WATER IN THE PROVINCE OF AOUSERD (SOUTHERN MOROCCO)

A. SAAD 1, S. E. Elkanti 2
1- Faculty Polydisciplinary of Taroudant –Ibn Zohr University Agadir- Morocco

saad.aycha@gmail.com.

2- Hydraulique basin agency of Sakia el Hamra and Oued Ed-Dahab

elkanti01@gmail.com

Abstract

The province of Aousserd covers an area of 59,437 km2 and reaches a population of 20,513 inhabitants. The climate in this region is arid with an annual average plioviamétrie 28 mm / year. The tablecloth exploited in this province is characterized high salinity (2-4 g / l) with low flow rates. The scarcity and poor quality of the water table of Aousserd brought responsibles of hydraulique basin agency of Sakia el Hamra and Oued Ed-Dahab to launch a study to exploit the aquifer of the Continental terminal Bir Guendouz (Moroccan-Mauritanian border). These water resources are aimed at drinking water supply in satisfaction of the rural population and livestock in six rural towns that administratively belong to the province of Aousserd. Initial results showed productivity of the order of 1 to 5 l / s and a salinity of 1 to 2.7 g / l. the determination of the most productive areas of the studied aquifer and the implementation of a network of sampling points was drawn with the GIS tool.

Keywords: climate arid- GIS- transboundary aquifer - Southern morocco- drinking water.
Formation and dissolution of salt crusts as a rapid way of nitrate mobilization in a tile drained agricultural field

Nicolò Colombani², Dario Di Giuseppe¹, Barbara Faccini¹, Micòl Mastrocicco¹, Massimo Coltorti¹

²Dept. of Physics and Earth Sciences University of Ferrara, via Saragat 1, Ferrara, 44122, Italy.
¹Dept. of Earth Sciences “Sapienza” University, P.le Aldo Moro 6, Roma, 00185, Italy.
nicolo.colombani@uniroma1.it

Abstract
Agriculture is widely recognized as one of the human activities that have a major impact on pollution of water resources. Agriculture impact on the surrounding environment may consists of the deterioration of surface water and groundwater quality via export of nutrients and pesticides. The formation of salt crusts during dry periods and their fast dissolution and leaching via irrigation or rainfall events can produce extremely elevated concentrations of nitrate in both surface waters and groundwater. This process is rather common in arid environments but due to climate change it will have to be taken into account even in temperate environments. The formation of salt crusts was studied in a 6.3 ha experimental site located in the Po Plain, Northern Italy (45°50’33’’ N and 12°05’40’’ E). The soil, consisting of interfluvial silty-clay deposits recently reclaimed and equipped with tile-drains to avoid water logging conditions, was investigated for vertical spatial heterogeneity via depth profiles (down to -4 m below ground level) and for horizontal spatial heterogeneity collecting numerous surface soil samples. Major ions concentrations were monitored in pore-water using both ceramic suction cups and core samples. Extreme drought conditions were recorded over the monitoring period (summer-autumn 2012), leading to soil fracturing and then to fast water movement during the first rainfall events in autumn. The field monitoring highlighted a marked spatial heterogeneity in the nitrate salt crusts formation, both in the horizontal and vertical directions, showing that the synthetic urea applied was evapoconcentrated in the first 5-10 cm of soil and unevenly distributed over the field with a preferential appearance in the hollows. Monitoring results showed an elevated electrical conductivity of pore-water (>10 dS/m) and nitrate peaks of several grams per liter, suggesting the dissolution of nitrate salts. The field monitoring suggested rapid mobilization of nitrate towards tile-drains after the first rain events due to preferential flow paths into soil cracks developed during the summer season. Results of this study put on evidence the need of sound agricultural practices, accounting for climate change context, to limit fertilizers evapoconcentration and export to surface waters.

Acknowledgements:
Umberto Tessari and Francesco Droghetti from the Physics and Earth Sciences Dept. of the University of Ferrara are gratefully thanked for their help. This work has been supported by EC LIFE+ funding to ZeoLIFE project (LIFE+10 ENV/IT/000321).
ASSESSMENT OF GROUNDWATER VULNERABILITY TO POLLUTION IN GOVERNORATE OF THE NORTHERN GAZA STRIP USING A GIS DRASTIC MODEL

Dr. Akram Hassan Ahmad Al Hallaq
Associated Prof. in Al Aqsa University, Gaza Strip, Palestine
akamhallaq@gmail.com

Abstract

This study aims to assess the groundwater vulnerability to pollution in governorate of the North Gaza Strip, and to determine the areas most susceptible to pollution. It also provides a spatial analysis of the parameters and conditions under which groundwater may become polluted by applying the DRASTIC model within GIS environment. The model uses seven environmental parameters: Depth of water table, net Recharge, Aquifer media, Soil media, Topography, Impact of vadose zone, and hydraulic Conductivity to evaluate groundwater vulnerability. Based on this model and by using ArcGIS 9.3 software, an attempt was made to create vulnerability maps for the study area. According to the DRASTIC model index, the study has shown that in the western part of the study area the vulnerability to pollution ranges between high and very high due to the shallowness of water table, low slope, porosity of soil, and high recharge. In the middle part, the vulnerability to pollution is moderate, while the vulnerability to pollution is low in the eastern part due to the depth of water table. Vulnerability Analysis of the DRASTIC Model indicates that the highest risk of pollution of groundwater in the study area originates from the net recharge parameter. The soil media, topography, impact of vadose zone, and hydraulic conductivity imply moderate risks of pollution, while depth to water and aquifer media impose a low risk of groundwater pollution. The coefficient of variation shows that a high contribution to the variation of vulnerability index is made by the net recharge and hydraulic conductivity. Moderate contribution is made by the depth to water table and impact of vadose zone, while the least contribution is made by soil media and aquifer media. Moreover, the effective weights of the DRASTIC parameters obtained in this study exhibited some deviation from that of the theoretical weights. Depth to water level, soil media and topography were found to be more effective parameters in assessing groundwater vulnerability than assumed by the DRASTIC model because their mean effective weight were higher than their theoretical weight. This explains the importance of these three layers in the DRASTIC model. However, it is advised to get the accurate and detailed information on these three specific parameters. Given these results, this model highlights as a tool can be used by national authorities, and decision makers especially in the agricultural areas that use chemicals and pesticides which are most likely to pollute groundwater resources.

Keywords: Groundwater vulnerability to pollution, DRASTIC model, GIS, Governorate of the North Gaza Strip.
HYDROMETEOROLOGY OF THE DHOFAR CLOUD FOREST AND ITS IMPLICATIONS FOR GROUNDWATER RECHARGE

Jan Friesen¹, Thomas Mueller¹, Matthias Zink¹, Abdullah Bawain², and Anke Hildebrandt³

¹ Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany
² Ministry of Regional Municipalities and Water Resources, Salalah, Sultanate of Oman
³ Friedrich Schiller University of Jena, Germany

jan.friesen@ufz.de

Abstract
Cloud forests have the ability to harvest cloud water or horizontal precipitation in addition to rainfall and, through rainfall re-distribution, provide markedly different infiltration and therefore recharge behavior. Forest interception studies required to formulate interception processes and to quantify the recharge relevant net precipitation are, however, often only possible at point or experimental plot scale and limited to the studied tree species. Groundwater recharge, in contrast, is often linked to groundwater aquifer boundaries and thus is located at the other end of the spatial scale. To be able to utilize findings from ecohydrological site studies for regional groundwater studies we regionalize field site studies through cloud forest distribution and rainfall interpolation in a semi-arid, data scarce region heavily dependent on groundwater resources. Through different rainfall scenarios, based on regular precipitation and on cloud forest modified precipitation, for two mountainous groundwater recharge catchments we can show that even moderately forested catchments provide up to 1/3 more precipitation through cloud water.
SUBTERRANEOUS FLUX IN ARABIAN SEA COASTAL BELT- ITS LINK WITH COASTAL MUDBANK FORMATION

Joseph Sebastian Paimpillil
Center for Earth Research and Environment Management, Cochin 17, India
Email psjoseph@eth.net

Abstract

Groundwater occurs in shallow phreatic zone, semi-confined zones, and in confined deeper aquifers in Kerala (South India) coastal belt. The thickness of sediments in coastal area has range from 90.0 to more than 600 m. The water table is generally shallow. Since the sand is highly porous and permeable natural recharge takes place automatically and a major part of the percolated rainwater goes off as rejected recharge which reaches to the drain channel as surface run off or sub surface runoff. Along the south west coast of Arabian Sea, investigations in the regions of submerged porous lime shell beds had indicated the evidence of subterranean flows to coastal ocean with significant fluxes of freshwater and nutrients into coastal ocean and the coastal budgets of nutrients and coastal productivity were strongly impacted by such flows. The high nitrate-N, ammonia concentrations, enriched particulate organic carbon (> 3.5 mg/l) and chlorophyll a (14.8 mg/m^3) soon after the monsoon months at localized coastal regions were the indicators of clear near-shore nutrient sources. Bands of high N/P funneling out had indicated ‘external sources’ of nitrogenous compounds to the coastal water. The necessary forcing for the ground water flow is gained when the fresh water level in wetlands and the sea level difference reaching a critical value. These sub surface runoffs contain high concentrations of nutrients as they are from regions with high human population density and lacking proper sanitations, they are important in the coastal nutrient budget and act as triggering mechanism of the unique mud bank formations of the region.
GROUNDWATER RESIDENCE TIMES IN THE NAJD
BASED ON CHLORINE-36

Thomas Müller, S. Patevich, K. Osenbrück, G. Strauch, K.-S. Al-Mashaikhi
Helmholtz Centre for Environmental Research GmbH - UFZ

th.mueller@ufz.de

Abstract
Groundwater bodies in arid regions were often filled during more humid periods in the past. Under today’s climate conditions, with small precipitation rates and high air temperatures, recent inputs of fresh water to the subsurface system are usually very low. Due to the increased demand for agricultural products and with the development of sufficient technologies to abstract and distribute the water, an increasing amount of farm areas are installed in very dry regions. As a result, the aquifer systems which are assumed to be very old get recently explored. Our study site, the very arid Najd region in the southern government Dhofar of the Sultanate of Oman is an excellent example for such conditions. Within the last ten years measures have been taken to establish large farm areas in the region and the abstraction of huge groundwater volumes is planned. Here, the focus of the abstraction is on the Umm Er Radhuma aquifer, one of the major aquifer systems of the Arabian Peninsula. The objective of our study is the estimation of the groundwater residence times in the Najd using the radioactive isotope tracer $^{36}$Cl. The time the water has been in the system is an essential part in terms of water quantity of stored water, past and present recharge. Ten wells along a principal flow path were sampled for the analysis of $^{36}$Cl in the beginning of the year 2012. $^{35}$Cl was measured relative to the stable isotopes, $^{35}$Cl and $^{37}$Cl, by acceleration mass spectrometry (AMS). $^{36}$Cl/$^{35}$Cl decreases along the flowpath and is interpreted as radioactive decay of $^{36}$Cl along the groundwater flow direction. This confirms the conceptual idea of the Najd groundwater flow system with a groundwater flow direction from the Dhofar Mountains in direction north-east. The calculated residence times are significant larger than estimated by previous studies based on the radiocarbon ($^{14}$C) approach. The results of the different age patterns of the Najd groundwater will be discussed with respect to previous age dating results and the perspective of the Umm Er Radhuma aquifer as an important water resource for the region.
ESTIMATION OF THE GROUNDWATER RESERVES OF THE SALALAH COASTAL PLAIN

Thomas Müller, Jan Friesen
Helmholtz Centre for Environmental Research GmbH - UFZ

th.mueller@ufz.de

Abstract

Coastal aquifer systems are amongst the most vulnerable water resources worldwide. Estimates assume that more than one billion people are living in coastal regions (Small et al., 2003). While these aquifer systems may differ in lateral and vertical extent they all have in common that they interact with the salt waters of the world’s oceans. Excessive groundwater extraction can cause saltwater intrusion from the sea to the aquifers, resulting in negative impacts on the groundwater body. However, the opposite interaction, so the discharge of aquifer water to the sea, is possible as well. The head gradients from the landside to the seaside are often quite low and the availability of fresh groundwater is limited. This is in contrast to the rising demand for agricultural products and human population growth, making the coastal aquifers fragile ecosystems. It is for that reason that it is important to know how much water is stored in the system and what the recharge quantity is. Our study site is the Salalah coastal plain in the Dhofar governorate of the Sultanate of Oman. The coastal aquifer is the only source of fresh water for the city of Salalah and the surrounding coastal plain region. It is recharged from the adjacent Dhofar Mountains, which receive rainfall and fog precipitation during the annual monsoon season. The objective of our study is the refinement of the conceptual model of the coastal aquifer system and an estimation of the water in storage. We measured spring discharge and groundwater levels to estimate the inflow from the Dhofar Mountains into the plain. By combining hydrochemical and isotopic data with extraction rates and observed groundwater levels, we will discuss the water availability of the coastal aquifer. This will determine the regions vulnerability for saltwater intrusion or the possibility of submarine groundwater discharge.
GROUNDWATER QUALITY OF DOMESTIC SHALLOW DUG WELLS IN PARTS OF TANAH MERAH DISTRICT, MALAYSIA

Kishan Raj Pillai A/l Mathialagan, Mohammad Muqtada Ali Khan, Hafzan Eva Mansor and Dony Adriansyah Nazaruddin
Department of Geoscience, Faculty of Earth Science, Universiti Malaysia Kelantan, Campus Jeli, Locked Bag No. 100, 17600 Jeli, Kelantan, Malaysia
muqtadakhan@gmail.com, kishan18raj@gmail.com

Abstract

This study mainly focused on the groundwater quality assessment in parts of Tanah Merah district, Kelantan, Malaysia. Groundwater is one of the major source for domestic and agricultural purposes. Fifteen groundwater samples were collected during year 2014 to analyse major ion chemistry. Efforts have been made to define possible genesis of groundwater and to compare the major ion concentrations with WHO and MOH guideline. In two groundwater sample the concentrations of Sodium, Potassium, bi carbonate and nitrate are above the permissible limit while rest of the samples are safe for drinking purpose according to WHO and MOH guideline. The graphical presentation of major ion chemistry helps in identifying two types of groundwater. Ionic species such as NaK-HCO3 and Mixed type waters, are likely to occur in the groundwater system. The observed chemical variations may be attributed to sediment water interaction, ion exchange, dissolution mechanisms and anthropogenic influences such as application of fertilizers and effluents from the anthropogenic activities. There are few suggestions that have been recommended to improve the groundwater quality in the study area. A periodic groundwater monitoring program be implemented. This would help in identifying dissipation of waste such as pesticides, domestic waste and also industrial waste into the aquifer. Besides, groundwater awareness program, strict regulation should also be brought to conserve the class of groundwater by penalizing the violators.

Key words: Groundwater quality, Assessment, Tanamerah district, Malaysia

Acknowledgements: The authors are thankful to faculty of Earth Science, Universiti Malaysia Kelantan, Campus Jeli, for providing facilities to carry out this work
Abstract

The present study was conducted in the vicinity of Beris Lalong landfill, part of state Kelantan, Malaysia to determine the distribution of trace elements concentration in groundwater. A total of eleven groundwater samples and two surface water samples were analyzed for Lead (Pb), Manganese (Mn), Copper (Cu), Zinc (Zn), Iron (Fe), Chromium (Cr) and Aluminium (Al) using Atomic Absorption Spectrophotometer (AAS). These probe elements were further categorized as toxic metals (i.e. Pb), transition metals (i.e. Mn), metallic elements (i.e. Cu, Fe, Zn, Cr), and non-metallic elements (i.e. Al). This study shows that few groundwater samples have marginally high concentration of Mn, Pb, Fe and Cr as per W.H.O. standard for potable water. The high concentration of metal ions in groundwater is likely due to untreated effluents from landfill site, municipal wastewater, fertilizers and other activities. To help identifying the contamination sources, the study recommends that regular monitoring of the groundwater quality should be undertaken both temporally and spatially that can contribute in public health and as well agricultural uses.

Key words: Trace elements, Groundwater, landfill site, untreated effluent, Bachok.

Acknowledgements: The authors are thankful to faculty of Earth Science, Universiti Malaysia Kelantan, Campus Jeli, for providing facilities to carry out this work
SIGNIFICANCE OF SILICA ANALYSIS IN GROUNDWATER STUDIES OF DOMESTIC SHALLOW WELLS IN PARTS OF JELI DISTRICT, KELANTAN, MALAYSIA

Mohammad Muqtada Ali Khan, Fatin Wahida Fadzil, Hafzan Eva Mansor and Dony Adriansyah Nazaruddin
Department of Geoscience, Faculty of Earth Science, Universiti Malaysia Kelantan, Campus Jeli, Locked Bag No. 100, 17600 Jeli, Kelantan, Malaysia
muqtadakhan@gmail.com, muqtada@umk.edu.my

Abstract
The present study is highlighted to investigate the nature and behavior of silica in shallow groundwater in parts of Jeli district, Malaysia to address the surface water and groundwater interaction, to determine the depths, residence time of groundwater and to determine groundwater contamination by correlating silica with hydrochemistry and the temperatures at which silica has entered into the groundwater system. The most important factor controlling Silica concentration in the groundwater is the rock type with which water comes in contact. In the present study, silica analyzed in 7 samples which exhibits an average value of 14 mg/l. Such silica concentrations clearly manifest the least involvement of any anthropogenic activity and as a whole residence time of groundwater in terms of rock-water interactions is very short. The prolonged rock-water interactions would have resulted in acquisition of high silica concentrations as the area is mostly covered by igneous rocks. Such low silica values (7 to 21mg/l) also point to the influent nature of the rivers in the area where surface water has caused the smoothening of silica concentrations in groundwater. By employing silica geo-thermometry, the maximum temperature estimated is about 33°C which under normal geothermal conditions would corresponds to a depth of 0.20 km (200 meter) by taking into account an average heat flow of 30 °C/km. Such low depths (below 0.20 km) of groundwater circulations and low temperatures of silica acquisition are pretty reasonable for such deficient silica concentrations.

Key words: Silica analysis, Shallow wells, Groundwater, Malaysia

Acknowledgements: The financial assistance provided by Fundamental research Grant (R/FRGS/A08.00/00644A/002/2015/000228). The authors are also thankful to faculty of Earth Science, Universiti Malaysia Kelantan, Campus Jeli, for providing facilities to carry out this work.
Mapping Stakeholders’ Behaviors for Improving Water Management in an Agricultural Coastal Region in Oman

Al Khatri A¹,²; Grundmann, J.²; v.d.Weth, R.³; Schütze, N.²

¹Ministry of Regional Municipalities and Water Resources, P.O. Box 2575, Postal Code 112, Ruwi, Sultanate of Oman, avisha.khatri@hotmail.com

²Technische Universität Dresden, Institute of Hydrology and Meteorology, 01062 Dresden, Germany

³Dresden University of Applied Sciences, Work Science & Human Resources Management and Industrial Science, 01069 Dresden, Germany

Abstract

The scarcity of freshwater resources in the Sultanate of Oman, makes it essential that both surface and groundwater resources are carefully managed. Introducing new water demand management tools is important, especially for the coastal agricultural areas (e.g. Al Batinah coastal region) which are affected by sea water intrusion. Based on a social survey performed during this work, the existing situation generates conflicts between different stakeholders which have different interests regarding water availability, sustainable aquifer management, and profitable agricultural production. The current aim now is to evaluate the implementation potential of several management interventions and their combinations by analysing opinions and responses of all relevant stakeholders in the region. Influencing the behavior and drivers affecting farmers’ decision-making manner, can be a good tool to improve water demand management. The work also introduces the use of a participatory process within the frame of an integrated water resources management (IWRM) to support decision makers in taking more informed decisions. Data were collected by questionnaires from different groups of stakeholders. These data were analysed statistically for each group separately as well as regarding relations amongst groups by using the SPSS (Statistical Package for Social Science) software package. Differences were examined between opinions of farmers and decision makers (DMs) regarding potential interventions. Farmers’ frequency curves showed differences in opinions in some interventions, while differences in opinions were not so high within the group of DM’s. Therefore, a Discriminant Analysis (DA) was performed to identify the drivers influencing farmers’ opinions regarding the intervention measures. As an advanced step, a Bayesian Networks (BNs) approach is used for mapping stakeholders’ behaviors and to show the strength of a relationship between dependent and predictor variables. By using BNs it is possible to analyse scenarios for implementation and acceptance of interventions.

Key words: Stakeholders, Bayesian Networks, IWRM, Decision Support, Oman
Abstract

The Saharan soils are the most often face problems of development, taking account of the constraints hydro-edaphic, mainly of water type of groundwater, mechanical crusts gypso-limestone and saline by the irrigation water and capillary rise of ground waters. Our work is doing a soil characterization of a palm grove of Ouargla to study the constraints hydro-halomorphes. The results show that irrigation waters are very salty from 2,85 dS.m⁻¹. The conduct of the traditional irrigation is random type submersion. The conduct of irrigation is random traditional type submersion. The palm grove has a poor drainage with a level of ground water 217 ± 117.38 cm and a salinity of 35.59±36,09 dS.m⁻¹. The drains are open type and their maintenance is not regular. This situation of management of irrigation-drainage promotes the rise of the groundwater and the engorgement waters in soils. the study of soil profiles show the existence of mechanical obstruction of gypso-limestone crusts which limit the entrenchment of the date palms and the leaching of salts. Soil salinity is variable in profiles, between 8.52 ± 3,17dS.m⁻¹ and 9.67 ± 4.33 dS.m⁻¹. The high level of salinity shows an accumulation of salts. It is due to the dynamic ascending and descending of salts respectively under the effect of the rise of the groundwater and leaching by irrigation. The salinization, the rise of groundwater and the presence of gypso-limestone crusts recorded in Ouargla testify to a degradation hydro-halomorphe and mechanic of soil which constitute the major constraints in the management of the irrigation-drainage and the sustainable agricultural development of the palm groves of the basin of Ouargla. Somme hydro-agricultural planning are necessary in the oasis to improve the hydro-mechanical properties of soils and thus reduce their degradation.
Dehydrated and activated carbons from Omani date palm leaflets for the removal of pharmaceuticals from water

Chemistry Department, College of Science, Sultan Qaboos University, Al-Khodh 123, Muscat, Oman.
Dr_el_shafey2004@yahoo.co.uk

Abstract

Dehydrated and activated carbons were prepared from date palm leaflets. Dehydrated carbon (DC) was prepared via sulfuric or phosphoric acid treatment at 150 °C. DC was converted to activated carbon (AC) at 500 °C under nitrogen atmosphere. Dehydrated carbon is loaded with carbon-oxygen functional groups and exhibits low surface area (< 50 m²/g) whereas, activated carbon possesses high surface area (> 400 m²/g), with less carbon-oxygen functional groups on its surface. The developed carbons were tested for the removal of fexofenadine (FEX), diphenhydramine (DPH), chlorpheniramine (CP) and lisinopril (LIS) from aqueous solutions. Optimum pH for drug removal depends mostly on the drug chemistry and carbon surface. Kinetic and equilibrium studies were carried out at their optimal initial pH values with ~48 hours for equilibrium on DC while almost 24 hours equilibrium on AC. Adsorption data were found to follow the pseudo second order kinetic model. The equilibrium studies show very good fitting with Langmuir isotherm more than Freundlich. Equilibrium adsorption was found to increase with temperature rise in the range 25-45 °C. Column studies were also carried out. Dehydrated carbon, even with little surface area, still shows comparable drug adsorption capacities to that of activated carbon. Thermodynamic parameters showed that removal of drugs is spontaneous and endothermic in nature with physical adsorption dominating their removal from aqueous solution.

Acknowledgements: The Author would like to thank the National Pharmaceutical incorporation company (NPI) for supplying pure pharmaceuticals for this research.
ROLE OF GROUND AND SURFACE WATER IN TRIGGERING LANDSLIDES IN GREAT KABYLIA (TIZI-OUZOU, ALGERIA)

BOUAZIZ Nacira1, MELBOUCI Bachir1

1University Mouloud Mammeri of Tizi-Ouzou, Laboratory of Geomaterials, Environment and Planning (LGEA), BP N° 17, 15000, Tizi-Ouzou, Algeria.
bouaziz.nacira@yahoo.fr

Abstract

Landslides in unconsolidated formations are widespread in Algeria, particularly in great Kabylie. Indeed the morphology of the North of Algeria, essentially characterized by mountains and steep slopes, often gives rise to landslide of variable intensity. Water play a central role in the landslides processes in this region; it exerts on these soils a special influence which translates into several instabilities. This communication aims to the study of the impact of ground and surface water on the triggering of landslides in great Kabylia and numerical modeling of these instabilities caused by water in its various forms. The increase of the water content of ground is usually closely linked to the weather conditions: It is due mostly to seepage or groundwater lifts following the heavy or prolonged rainfall, at which can be added the snowmelt. Landslides in great Kabylia (Ain el Hammam, Azazga, Tizirt, Ililten, Tala Tgana, Azeffoune ... etc.) occurred or reactivated following the heavy rains and melting snowpack especially in winter 2012. If one must more often attributed the increase in water content of ground to natural causes, it also happens to be anthropogenic due to the presence of man and his activities (leakages, the rupture of underground pipes, concentration of water discharges after a waterproofing surfaces, abandonment of water sources, unplanned urbanization). The results of this study show the need to the realization of ground and surface runoff water management system (drainage systems blanked, bad raccordment in systems supply of potable water, the return to the use of water sources in mountains to reduce the pressure exerted by the ground water).

Keys words:
Seepage, modeling, instability, risk, landslides, Kabylia.
CO-EVOLUTIONARY DYNAMICS « INSTITUTIONS-INNOVATIONS » AND PRODUCTIVITY GAINS IN THE MANAGEMENT OF WATER RESOURCES

Sameh Rekik Bouguecha
Faculté Sciences Economiques et de Gestion de Tunis (F.S.E.G.T.)
Sameh.bouguecha@yahoo.fr
Mohamed Saleh Bachta
INAT bachta.ms_09@yahoo.fr

Abstract
Growth in agriculture depend on plan involving use of natural resources, especially water in an extensive way, which means also the possibility of waste and loss. This resource, classified as common property and as an economic good. Shall be used to produce products with the highest productivity. Accordingly, an intensive and inclusive growth model is the solution to ensure efficiency and optimal productivity in a context of collective welfare seeking.

The intensive growth model involves ongoing innovation. The dynamics of innovation at the local level proves co-evolutionary dynamics "Innovations institutions". It is assumed that the integration of the community in a local social network allows better dissemination of knowledge and innovations. This implies a perpetual institutional change, including social institutions, cognitive and cultural for adaptation of individual behavior to that of the network. The community is characterized by a group (or an individual) of leader whose productivity is highest. A process of convergence is triggered to reduce the productivity gap. This process is supposed to be stimulated with the qualification level of integration in the social network and the qualification of human capital. These two variables, object of this study, have produced two effects: (i) an indirect impact describing the absorption capacity of externalities through the network, and (ii) a direct impact by reducing the gap of productivity.
A GIS-based entropy groundwater quality index for assessing groundwater quality for drinking purposes in Alton Kubri, northern Kirkuk province, Iraq

Hussein B. Ghlib1*, Alaa M. Al-Abadi 1, Wasan S. Hamdan Al-Qrnawi1
1Department of Geology, College of Sciences, University of Basra, Basra, Iraq
* Corresponding author, e-mail: hbggeo@hotmail.com

Abstract
The objective of the present study is to develop decision supportive tools for identifying the optimal locations of groundwater in terms of water quality and to cope with the future demands in the Alton Kubri area. By means of accurate assessment of groundwater quality for drinking use, the drinking entropy-weighted groundwater quality index (EGWQI) has been considered and developed, with integration of GIS, of which helps in classification of groundwater of the Alton Kubri area. For this purpose, twenty five wells in the study area were selected for sampling during dry period and analyzed for pH, electrical conductivity, total dissolved solids and major ions. The results showed the significance of spatial variations in these parameters indicating that Ca-HCO₃ water type was predominant parameter. The groundwater properties are considerably different from site to another attributed to varying lithological nature of the area. The saturation index calculated by geochemical modeling technique pointing out that under-saturation level of sulfate and carbonate minerals are perceived (anhydrite, aragonite, calcite, dolomite, gypsum and halite dissolution). According to the WHO, 2011 and IQS, 2009 standards, the present study samples are suitable for drinking. Value of entropy-weighted groundwater quality index EGWQI seems perfect and makes the assessment results more reasonable. Based on EGWQI, the ground water in the area is excellent, with range of 39.15- 50%, to very good, with range of to 50.01- 79.01%, respectively.

Keyword: groundwater water quality, entropy weight, GIS, Kirkuk, Iraq, portable water
Modeling of Phosphorus Dynamic in Kuwait Bay

Eqbal Al-Enezi

*Kuwait Institute for Scientific Research, Environment Sciences Department, Kuwait*

*Email: eenezi@kisr.edu.kw*

**Abstract**

Phosphorus plays an important role in the eutrophication of the marine environment and aquatic systems. Sediment may act as a source or sink of phosphorus to the water depending on the physicochemical factors. The adsorption /desorption processes of phosphorus by the sediment were studied to understand the phosphorus behavior in the Kuwait Bay. Substantial quantities of inorganic phosphorus are released from the bed sediment of the Kuwait Bay, over periods of few hours.

In this study, experiments were carried out to determine the equilibrium distribution of phosphorus between the bed sediment and water quality in Kuwait Bay under a range of conditions such as (pH, salinity, DO and temperature). Eleven water and bed sediment samples were collected from the Kuwait Bay during winter. The range of adsorbed phosphorus in the bed sediment ranged from 0.1 to 0.35 mg/g. A numerical model is applied to simulate the effect of the sediment-adsorbed phosphorus on the water quality in the Kuwait Bay. Three-dimensional modeling was simulated by using the ECO-LAB of MIKE 3. The field data was collected and the laboratory experiments were performed. Several variable dynamics were calculated from advection-diffusion-reaction equation which the advection terms were derived from results of the hydrodynamic simulation. Overall, the phosphorus concentration on water column is high and might strongly be depended on a supply of nutrients from the outer sea and Shatt Al-Arab river and from internal sources fluxes like bed sediments.

*Keywords: phosphorus, adsorption, sediments, modeling*
## Desalination sustainability in arid areas

<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Energy Consumption Comparative Study Between RO&amp;NF</td>
<td>104</td>
</tr>
<tr>
<td>2</td>
<td>Evaluation Of The Salinity Of Groundwater Used In Irrigation And Risks Of Soil Degradation: The Perimeter Issen Plain Souss-Massa Morocco</td>
<td>105</td>
</tr>
<tr>
<td>3</td>
<td>Seawater Intake and Algae Blooms</td>
<td>106</td>
</tr>
<tr>
<td>4</td>
<td>Desalination Of Sea Water By Green Energy Technology</td>
<td>107</td>
</tr>
<tr>
<td>5</td>
<td>Modeling Of Brine Disposal For Gaza Central Seawater Desalination Plant In Palestine</td>
<td>108</td>
</tr>
<tr>
<td>6</td>
<td>Experimental Study On The Effects Of Artificial Vegetation Density On Forehead Velocity Of Saline Currents Flow</td>
<td>109</td>
</tr>
<tr>
<td>7</td>
<td>Feasibly Study On Using Solar Powered Desalination in Gulf Cooperation Council (GCC) Countries</td>
<td>110</td>
</tr>
<tr>
<td>8</td>
<td>Salinity Management In Oman: Challenges And Opportunities</td>
<td>111</td>
</tr>
<tr>
<td>9</td>
<td>Radium Removal From Raw Ground Water By membrane Treatment Using Commercial Nanofiltration Membranes Such As DK, HL and DL</td>
<td>112</td>
</tr>
<tr>
<td>10</td>
<td>Evaluation Of Low Cost Drinking Water Disinfection Techniques For Rural Communities In Arid Countries</td>
<td>113</td>
</tr>
<tr>
<td>11</td>
<td>The PH Variations Of High Nacl Concentration Brines With Temperature</td>
<td>114</td>
</tr>
<tr>
<td>12</td>
<td>Modeling Dispersion Of Brine Discharges From Multiple Desalination Outfalls</td>
<td>115</td>
</tr>
<tr>
<td>13</td>
<td>Ann Models For Predicting The Performance Index Of Fouka Desalination Plant In Algeria</td>
<td>116</td>
</tr>
<tr>
<td>14</td>
<td>Model Simulations Of Desalination Brine Discharge In Shallow Coastal Waters</td>
<td>117</td>
</tr>
<tr>
<td>15</td>
<td>Techno-Economical Comparison of MED and RO Desalination in a large power and water cogeneration plant in Iran</td>
<td>118</td>
</tr>
<tr>
<td>16</td>
<td>Salinity Evolution In The Near Surface</td>
<td>119</td>
</tr>
</tbody>
</table>
Abstract
This study aims at developing a comparative study between (RO) membranes and Nanofiltration (NF) in energy consumption. A pilot desalination unit was installed and used to compare two different types of spiral wound modules membranes (cross flow): Nanofiltration (NF90-4040) and Reverses Osmosis (TM-710). The experiment was carried out using two different type of water: aqueous solution and real brackish water from water wells. In aqueous solution the TDS concentration was varied between 4500 to 17000 ppm and the nitrate concentration was varied between 0 to 150 ppm. In real brackish water the TDS was varied between 1,724 to 19964 ppm and the nitrate in the range of 72 to 211 ppm. The applied pressure was ranged between 6 to 24 bars. The results indicated that the efficiency of nitrate rejection affected by the overall concentration of feed water TDS concentration. The nitrate rejection rate using NF membrane could be up to 95% while nitrate rejection rate using RO membrane may reach greater than 98%, according to concentration of TDS on feed water and the pressure used. The results also indicated that the use of NF membranes can provide a decrease of 25 to 60% of energy consumption compared with the use of RO membranes, according to the TDS concentration in the feed water.

Paper Sub-Domains
Desalination

Equipment Preferences
Computer
LCD Projector
EVALUATION OF THE SALINITY OF GROUNDWATER USED IN IRRIGATION AND RISKS OF SOIL DEGRADATION: THE PERIMETER ISSEN PLAIN SOUSS-MASSA MOROCCO

EL OUMLOUKi Kaoutar 1,2*, MOUSSADEK Rachid 2, DAKAK Houria 2, IAAICH Hamza 2, DAOUIK Ahmed 2, CHATI Mohamed Taoufiq 3, EL AMRANI Mahacine 1 et ZOUAHRI Abdelmjid 2

1 Ibn Tofail University, Faculty of Sciences, Chemistry Department, Separation Process Laboratory, PO Box: 133, 14000, Kenitra, Morocco.
2 National Institute for Agronomic Research, Regional Center of Agricultural Research of Rabat, Research Unit on Environment and Natural Resources Conservation, PO Box 6356, 10101 Rabat, Morocco
3 Ministry of Agriculture and Maritime Fishing, Irrigation Branch and Development of the Agricultural Area, service of Tracking and control the public-private partnership (ppp), PO Box: 1069, Rabat, Morocco.

* Correspondance de l’Auteur, E-mail: Kaoutar18@gmail.com

Abstract

In Issen perimeter of the plain of Souss-Massa, in a semi-arid climate, the use of irrigation is inevitable for most crops. Groundwater therefore increasingly sought. The studies Hydro-chemical and statistical have been conducted; they focused on major and secondary elements of water and soil. Three sampling campaigns were conducted over a period of two years (2013/2014). The 36 studied wells are spread across the plain. The values recorded during the sampling period show that 61% of analyzed wells are highly saline averaging 2ds/m. Chemical analyzes reveal a wide variety of chemical compositions, samples divided between two facies magnesium Sodi-potassium and facies chlorinated sulfated, then the analysis statistical of matrices of the variables studied show a very significant correlation and data allowed the establishment maps of salinity and SAR of risk in the irrigation water.

Keywords: Issen perimeter, irrigation, salinization, hydro-chemical, statistical

Acknowledgements The present work has the overall objective of contributing to sustainable agriculture development of agriculture in the Souss-Massa region. We would like to thank everyone who contributed to this work, in particular, my supervisor Mrs. EL AMRANI MAHACINE, Professor in the Chemistry department at the Faculty of Sciences of Kenitra Ibn Tofail, Dr. RACHID Moussadek, Dr. ZOUAHRI EL ABD MAJID, and Ms. HOURIA Dakak, IAAICH HAMZA, Dr.DAOUIK AHMED researchers to Institute for Agricultural Research (INRA) in Rabat, and Dr. Mohammed Toufik Chati of the Ministry of Agriculture, who opened the doors of their service and their laboratory. And not forgetting all INRA staff who helped me in the field and in the laboratory throughout this work.
Seawater Intake and Algae Blooms

Mohamed Darwish, Hassan Abdulrahim and Basem Shomar
Qatar Environment and Energy Research Institute (QEERI), College of Science and Engineering, HBKU, Doha, Qatar
E-mail: bshomar@qf.org.qa

Abstract

While thermal desalination processes require minimum pretreatment (mainly screening and chemical additions to prevent scaling), seawater reverse osmosis (SWRO) desalting plants require extensive pretreatment of feed seawater before entering the SWRO membranes. The algae bloom (AB) events that happened in the Arabian Gulf Countries raise real concerns about the ability of conventional SWRO pretreatment to provide the required feed quality. As seawater intakes are the first part of pre-treatment, this paper reviews several intake options (open and subsurface) in details and their effects on the feed seawater parameters which cause membrane fouling, especially bio-fouling type. These include concentrations of algae, bacteria, total organic carbon, particulate and colloidal transparent exopolymer particles (TEP), and the biopolymer fraction of natural organic carbon. Several forms of algal organic matters (AOM) are produced by the AB with varying concentrations, and include, intracellular organic matter (IOM) formed due to autolysis consisting of proteins, nucleic acids, lipids and small molecules; and extracellular organic matter (EOM) formed via metabolic excretion and composed mainly of polysaccharides. A subsurface intake using shallow well intake system are found to be very effective in reducing the algae and bacterial concentrations and somewhat effective in reducing TEP concentrations.
DESALINATION OF SEA WATER BY GREEN ENERGY TECHNOLOGY

Chandima Gomes*, Ashen Gomes, Mohammad Reza Maghami, Hashim Hizam, Maryam Isa

Center for Electromagnetic and Lightning Protection, Universiti Putra Malaysia, Serdang, 43400, Selangor, Malaysia

chandima@upm.edu.my

Abstract

Increased domestic, industrial and agricultural applications in many coastal areas in Northern African, Middle Eastern and Gulf regions demand more desalted water, out of which the highest requirement is for potable water. The desalination of water in such cases employ both thermal and chemical treatments. Due to various environmental issues, chemical processes are discouraged by many nature conservationists. However, on the other hand, thermal methods contributes to equal environmental degradation due to the burning of fossil fuel, the most prominent mode of generating heat for the desalination process at present. As a remedy to such issues, a team of scientists at Universiti Putra Malaysia planned to use an abandoned solar ball of diameter 13.5 meters constructed at the university premises, originally for an electricity generation project, to harness solar radiation to raise the temperature of water. In the initial phase a prototype of the solar-ball, of 2 m diameter has been constructed with aluminium foils on a stainless steel frame. Water is pumped through copper coil placed around the focal point of the solar radiator. The pumping of water is done at present with grid powered motor, however, it is planned to replace by a windmill towards the end of the project. The preliminary studies show that on a sunny day in Malaysia, the water could be raised to almost boiling point by the radiation of the solar ball. A low pressure chamber has been constructed and connected through a valve system to the outlet of the water from the coil so that in the case of brine water, the water vaporizes leaving salt depositing at the bottom of the container. The vaporized water is sucked into another tube and condensed by sending through a cooling tube, to produce potable water. All mechanical processes, which have been energized at present through grid power will be changed to wind-energy operations latter. The results of the project with the prototype, together with other ongoing research on irradiance measurement in Malaysia, will be used to estimate the potential mass-flow rate of potable water that could be collected for a given system during a one year period at the planned location.

Acknowledgements:

The authors would like to acknowledge the facilities and support rendered by the Centre for Electromagnetic and Lightning Protection, and the Department of Electrical and Electronics Engineering, University Putra Malaysia in making this project a success.
MODELING OF BRINE DISPOSAL FOR GAZA CENTRAL SEAWATER DESALINATION PLANT IN PALESTINE

Mazen Abualtayef and Hassan Al-Najjar
Civil Engineering Department, The Islamic University of Gaza, Gaza, Palestine

E-mail of corresponding author: mabualtayef@iugaza.edu.ps

Abstract
Increasing demand for water in urban areas in arid and semi-arid coastal regions has urged planners to look for alternative renewable water sources. Seawater reverse osmosis desalination plants have become an essential supply source for the production of freshwater in such regions. However, disposal of hypersaline wastes from the plants in many of these regions has not been fully and properly addressed. A simulation optimization approach is proposed to design a system for safe disposal of brine wastes. In Gaza, it is planned to construct Gaza Central Seawater Desalination Plant (GCDP) at Levantine basin. In the short term, Phase (I), the plant will desalinate seawater with a capacity of 55 Mm$^3$/year and to be extended, Phase (II), to 110 Mm$^3$/year. As a product from the reverse osmosis process, a huge amount of brine with a salinity reaches 60 ppt will be produced from the GCDP, nearly 12,200 m$^3$/h of brine will be rejected in Phase (I) while 24,400 m$^3$/h in Phase (II). In this study, a numerical simulation beside a sensitivity analysis were carried out to optimize the design of brine's disposal system of GCDP with respect to the continuous variations in ambient conditions. Three disposal scenarios have been modelled, the first scenario via an open surface channel at the sea face, the second scenario via an offshore submerged single port diffuser while the third scenario via an offshore multiport diffuser. For the surface discharge at sea face, the results represent the sensitivity of variation in the channel's width, channel's slope, disposal depth, brine's flow rate, Phase (I) and Phase (II), and seasonal conditions of brine and ambient waterbody show that no design meets the disposal regulations at regulatory mixing zone (RMZ) for Phase (I) and Phase (II) and exceeds the maximum concentration of 2000 ppm as recommended by the marine environment by Sultanate of Oman, 2005. The brine's concentrations in winter were above ambient at RMZ, 1105 and 1903 ppm whilst the results in summer were 1056 and 1781 ppm for Phase (I) and Phase (II), respectively. In the offshore submerged single port scenario, the results illustrated the sensitivity in the change of port's diameter, offshore disposal distance and seasonal variation in the properties of the brine and ambient waterbody show that the disposal regulations at RMZ were met at all port diameters in all seasons at offshore disposal distances of 1450 m or more for Phase (I) and Phase (II), but this scenario doesn't dilute the concentrate in manner that can guarantee the quality of the intake seawater. In third scenario, the general configuration given to the GCDP consists of an outfall pipe extends offshore to 1850 m and an alternating submerged multiport diffuser consists of four risers, each riser is capped by a turret that has four discharge ports spaced evenly around its circumference. Accordingly, the optimal device that can serve the GCDP in its short term and long term capacities is to use an offshore multiport diffuser system to reject the hypersaline brine in the marine environment without any negative effects on the marine's communities.

Acknowledgements: Great thanks go to Middle East Desalination Research Center (MEDRC) and the Palestinian Water Authority for funding the current research.
Experimental study on the effects of artificial vegetation density on forehead velocity of saline currents flow

Atena khalili naft chali 1, Hossein KhozeymehNezhad2, Abolfazl Akbarpoor3, Peyman Varjavand4.

1- M.S.C in Water Resources Engineering, University of Birjand
2- Assistant Professor, University of Birjand
3- Associate Professor, University of Birjand
4- Ph.D. in Hydraulic Structures, University of Tabriz

E-mail of corresponding author: hkhozeymeh@birjand.ac.ir

Abstract

Gravity current is one of the most important factors in the deposition and reservoirs useful life reducing. The progressive section (forehead of gravity current) is an important part of this process which is influenced by many factors. In the present research, behavior of the forehead of saline density currents flowing over artificial vegetation was studied by conducting experiments. Velocity and concentration profiles were measured for different flow sections. Artificial artificial vegetation were placed along the flow direction with two heights and five different densities. The results show that increasing artificial vegetation density causes decreasing of the gravity current velocity and concentration 13 – 28.5 Percent and 53.5 - 82 Percent, respectively, compared with smooth bed currents and Therefore the most effective artificial vegetation density in this work 1.4% can be concluded.

Keywords: saline current flow, velocity forehead, Artificial vegetation density, concentration changing.
Feasibly Study On Using Solar Powered Desalination in Gulf Cooperation Council (GCC) Countries

Mohamed A Dawoud

Water Resources Advisor, Environment Agency - Abu Dhabi, UAE

e-mail: mdawoud@ead.ae

Abstract

GCC countries are located in arid area with a scarcity of renewable freshwater and no freshwater bodies is available. Due to the deterioration of the groundwater aquifer systems, GCC countries started to depend on seawater desalination since 1960s to meet the growing water demand. At 2010, GCC countries produced more than 60% of the total world desalinated water with annual production of about 4.5 Billion cubic meters. The desalination water production is expected to be doubled by 2030. At present two types of desalination technologies are used in GCC countries; (1) mainly the thermal processes such as MED and MSF, and (2) membrane processes which is reverse osmosis (RO). The depletion of fossil fuels makes it imperative to consider alternate energy sources such as solar and nuclear energy for future water production. Figures indicate that most of the GCC countries including KSA, Kuwait and UAE use about 25% of their energy for water production. Recently, GCC countries are actively investing in using renewable energy as a source of power for fresh water production as an environmental friendly technology to protect their natural resources and increase oil exports. Using solar power can help to overcome a series of desalination related problems, the most significant of which are those related to energy consumption and environmental pollution caused by the use of fossil fuels. The current research aims to evaluate the present desalinated water production and technology, the growing trend in future desalinated water production in GCC countries including used technologies, and the challenges facing the desalination industry. Future prospects for integrated desalination techniques using solar power which could result in reduction of cost and environmental impacts will be outlined. Two pilot projects of solar powered reverse osmosis (RO) desalination plants in Abu Dhabi, UAE and Al Khafjee, KSA will be evaluated to assess the feasibility of using solar energy for desalination in GCC countries. The assessment will include the solar power generation technologies (PVC, CSP), desalination technology (thermal and RO), the optimal plant size, the capital and operational costs, and the long term feasibility.

Acknowledgements:

The author wishes to express his profound thanks and gratitude to his colleagues in Environment Agency - Abu Dhabi (EAD) for their suggestions and recommendations during writing this manuscript which help to achieve the successful completion of this research work.
Salinity Management in Oman: Challenges and opportunities

Asad Sarwar Qureshi
Irrigation/Water Management Scientist
International Center for Biosaline Agriculture (ICBA), Dubai, UAE

Abstract
This paper reviews the causes and extent of soil salinization in Oman and suggests challenges and possible opportunities for the rehabilitation and management of salt-affected soils. The land resources of Oman are limited and only 7% (2.22 m ha) of the area is suitable for agriculture. Despite this scarcity of land, increasing soil salinity is threatening the future of agriculture in Oman. Although no updated information is available about the extent of salt-affected areas, an estimated 44% of the total area is salinized, out of which about 39% is located in unsuitable lands whereas the rest 5% belong to suitable agricultural lands. Most of the salt affected areas are located in Batinah, where approximately 52% of the fertile agricultural area is affected from different levels of salinity. These salt-affected soils are causing an estimated annual loss of about 13 million Omani Rials. In this paper, the causes of salinity were assessed and elaborated based on the review of the past research. Based on this available information, challenges of salinity management are highlighted and different short term, medium term and long-term strategies are identified to combat salinity in Oman. These include technical, management and policy reforms that are needed to address the increasing problems of soil salinization.
RADIUM REMOVAL FROM RAW GROUND WATER BY MEMBRANE TREATMENT USING COMMERCIAL NANOFILTRATION MEMBRANES SUCH AS DK, HL AND DL

A. S. AL-Hobaib, Q. Kh. Al-Jaseem and Kh. M. AL-Sheetan
Institute of Atomic Energy Research, King Abdulaziz City for Science And Technology, P.O. Box 6086 Riyadh11442
E-mail: ahobaib@kacst.edu.sa

Abstract

Commercial thin film nanofiltration membranes, such as DK, HL, DL, were tested, using a single sheet Septa® CF Membrane Cell testing apparatus, for treatment of ground water to remove radium. The water contains combined radium ($^{226}$Ra + $^{228}$Ra) of levels exceed the national regulation limit (5 pCi/L) established for combined radium in drinking water. Although some operating problems were arose, the application of this technology showed good performance of the tested membranes under the present water characteristics and operating conditions for radium removal. Simultaneous reduction to the acceptable levels in total hardness and total dissolved salts was also observed.

Membrane fouling was the main operating problem. Successful attempts for membrane fouling prevention were conducted. The Atomic Force Microscope (AFM) characterization method is straight forward way to determine membrane physical morphology, that’s help in understanding fouling phenomena. The characterization were carried out with virgin DK, HL and DL membrane as well as with fouled DK membranes. Different kinds of cleaning agents have been used to clean both virgin and fouled NF membranes. Both virgin and fouled membranes have been characterized before and after cleaning. According to the obtained results some conclusions were drawn.
EVALUATION OF LOW COST DRINKING WATER DISINFECTION TECHNIQUES FOR RURAL COMMUNITIES IN ARID COUNTRIES

Abdullah Yasar, Rabbia Usman, Amtul Bari Tabinda, Muhammad Afzaal,
Sustainable Development Study Centre GC University Lahore Pakistan
yasar.abdullah@gmail.com

Abstract
Ten different disinfection techniques were observed including physical such as boiling, microwave treatment, filtration by cotton cloth, SODIS (Solar Water Disinfection), UV radiation as well as chemical water purification treatments by bleaching powder, KMnO₄, H₂O₂, SODIS+H₂O₂ and PAA (Per Acidic Acid). The disinfection efficiency was assessed for each treatment by observing the percentage removal of pathogens and also the effectiveness of each technique to prevent the re-growth of pathogens. All the physical treatments showed more than 65% removal efficiency except filtration with cotton cloth which resulted in a low percentage removal of 30% whereas microwave treatment, SODIS (white bottled) and UV (10 minutes exposure) resulted in 96% removal efficiency. For the chemical treatments percentage removal of KMnO₄ was 95.4% at 0.1mg while the maximum efficiency 97.2% resulted at 0.5mg. The highest percentage removal of H₂O₂ was recorded at 0.05ml of its dose which was 97.8%. Per acetic acid PAA appeared to be the best disinfectant as the lower doses also showed high efficiencies like 0.01ml, 0.02ml and 0.03ml resulted in 99.2%, 99.4% and 99.6% respectively which increased to 100% at 0.04ml with no re-growth even after two days. On the other hand physical treatments showed higher rates of re-growth of pathogens.
THE pH VARIATIONS OF HIGH NaCl CONCENTRATION BRINES WITH TEMPERATURE

Svetlana Rudyk1, Mona Lunde2, Pavel Spirov3

1Sultan Qaboos University, Oman, 2Aker Solutions, Norway, 3Soran University Iraq

snr@squ.edu.om

Abstract

The correct understanding of the interaction of such parameters as pH, temperature and salinity of water is fundamental in the field of water and environmental sciences. The knowledge of pH variation is of crucial importance in desalination or geothermal brine projects. For example, by increasing the brine’s acidity by about half of a pH unit (to a value between 5.0 and 4.5), the process prevents silica precipitation and scaling.

Various types of laboratory water are used to prepare synthetic brines, which implies that the difference in water properties may influence the experimental results and overall conclusions. The pH of six types of water such as distilled, deionised and tap, boiled and unboiled, were investigated at the temperatures 13, 23, 33 and 43 °C in the salinity range 0-140 g/L. The pH of boiled water of all types was up to 0.5 higher than of unboiled due to CO₂ release. Decreasing, increasing and neutral character of pH change with salinity was observed depending on the type of water. The pH of distilled and deionised water differed significantly while the pH values of boiled distilled water and boiled deionised water were close at 20-100 g/L. The pH graphs of distilled and deionised boiled water were reciprocal at all temperatures and salinities. The pH of distilled water is most sensitive to the salinity and temperature. The deionised water is slightly acidic. The knowledge of water properties can provide a set of criteria by which the suitable water models for use in subsurface aquifer monitoring can be assessed and compared.

Text body: 10 pt, justification. Please use Times New Roman CE as a typescript for each paragraph of the abstract. Margins: left 3 cm, all other margins 2,5 cm. Page size: 17,6 x 25 cm (B5). The abstract should not exceed one page. Store your text file in .doc or .docx.
MODELING DISPERSION OF BRINE DISCHARGES FROM MULTIPLE DESALINATION OUTFALLS

Anton Purnama

Department of Mathematics and Statistics, College of Science, PO Box 36
Sultan Qaboos University, Al-Khod PC123, Muscat, Sultanate of Oman
e-mail: antonp@squ.edu.om

Abstract
As desalinated water is indispensably required at all costs in the hot and arid climate countries, there are intense seawater desalination activities in certain (semi-enclosed) sea areas or coastlines, such as the Arabian Gulf, Red Sea, Mediterranean Sea, and the Gulf of Oman. Thus, along the coastal areas, many seawater desalination plants are commonly found to be operated closely clustered together.

Discharging hypersaline brine waste product through long outfall into the ocean is an economic disposal option for coastal seawater desalination plants. When many desalination outfalls are discharging brine to shallow open coastal waters, the interactions of two or more brine plumes are expected, and the potential environmental impacts are strongly inter-dependent and of a capacity limit of the receiving waters.

A mathematical model using a two-dimensional advection diffusion equation with multiple point sources in a highly simplified flat seabed is presented to study the dispersion of brine effluent discharge plumes. The analytical solutions are illustrated graphically by plotting contours of concentration to replicate the merging and overlapping process of brine plumes discharged from multiple outfalls in shallow coastal waters that spreading downstream and heading towards the beach. The maximum compounded shoreline concentration is formulated to evaluate how well the brine plumes are diluted in the coastal waters. It is found that the modern engineering practice which installs a multiport diffuser at the end of the outfall pipe does produce less potential environment impact.
ANN MODELS FOR PREDICTING THE PERFORMANCE INDEX OF FOUKA DESALINATION PLANT IN ALGERIA

Yacine AMEZIANE  
Master in Hydraulics, University of Batna 2, Batna, Algeria

Larbi HOUICHI  
Professor, Department of Hydraulics, Faculty of Engineering, University of Batna 2, Batna, Algeria  
houichilarbi@yahoo.fr

Abstract

Reverse osmosis desalination is nowadays a growing industry. This process is currently the most attractive investment in desalination. In the present work we have modeled its performance index, related to the conversion rate, using artificial neural network (ANN) methodology.

We have developed an ANN model for predicting the performance index (Y) using data from Fouka desalination plant in Algeria, based on both Principal Component Analysis (PCA) and Correlation Matrix (CM) as techniques for selecting input parameters. Two models were established with the same output which is the performance index (Y) and using BFGS training algorithm.

The first model designated by M14 (4-6-1) with 6 neurons in its single hidden layer and 4 inputs from the feed water characteristics which are by order of influence: Temperature (T), Pressure (P), Date (D) and feed water (QA).

The second model designated by M26 (6-7-1) with 7 neurons in its single hidden layer and 6 inputs, where 4 of them are the same as the first model and the remaining 2 inputs from the feed water characteristics are: Suspended Matter (MES) and Salt Concentration (CA).

In both models and in validation case, the overall agreement between the ANN predictions and experimental data was very good showing a correlation coefficient of 0.984 for M14 (4-6-1) and 0.982 for M26 (6-7-1).

Finally we retained the M14 (4-6-1) model which has better CC, $R^2aj$ and a better RMSE.

Keywords: Desalination, Reverse Osmosis, Conversion rate, Performance index, PCA, Correlation Matrix, ANN, Modeling, Fouka-Algeria.
MODEL SIMULATIONS OF DESALINATION BRINE DISCHARGE IN SHALLOW COASTAL WATERS

Ahmed A. Al-Kasbi, Khalid S. Al-Mashrafi, Anton Purnama

Department of Mathematics and Statistics, College of Science, Sultan Qaboos University, Al-Khod, Muscat, Sultanate of Oman
E-mail: m095573@student.squ.edu.om

Abstract

Seawater desalination is the reliable solution to the water shortages in the arid Middle East and North Africa countries. Due to prolonged drought conditions, and the national rapid economic development with sharp growth of the population in the industrial coastal areas, limited underground water resources are being used faster than they can be replenished. For Oman in particular, with the availability of desalination water, it is envisaged that groundwater abstracted from well be reduced, and it will also eventually resolve the critical problem of seawater intrusion into the coastal aquifer.

Current desalting technology however limits the efficiency of producing desalinated water, and up to 60% is lost via unwanted brine, a concentrate stream (typically double the seawater salinity) that must be continuously discharged back to the sea. Model simulations for the mixing and spreading of desalination brine discharged through long sea outfalls from coastal seawater desalination plants will be carried out by plotting contours of the solution of a two-dimensional advection diffusion equation with point sources in a tidally oscillating flow. The results will be applied to assess the potential environmental impacts of brine discharges into the marine environment. Simulations of VISJET software packages will also be carried out to visually replicate and capture the dynamics of brine discharged plumes in the near field region.
Techno-Economical Comparison of MED and RO Desalination in a large power and water cogeneration plant in Iran

Babak Golkar¹, Ramin Haghghi Khoshkhoo²*, Aliasghar Poursarvandi¹
¹ Research and Development Department of Monenco Iran Consulting Engineers, Tehran, Iran
² Mechanical and Energy Department of Abbaspour College of Engineering, Shahid Beheshti University, Tehran, Iran
*R_haghighi@sbu.ac.ir

Abstract
Seawater desalination is one of the major solutions to overcome water crisis in MENA region. In this paper, two main scenarios have been studied for desalting Seawater from the source of the Persian Gulf. First scenario is based on two 170 MW gas turbines, one 160 MW steam turbine and 143,000 m³/day MED thermal desalination while second plant is based on two 170 MW gas turbines, one 95 MW steam turbine and 143,000 m³/day SWRO membrane desalination. Technical and economical modeling of each scenario has been done and their levelized water costs have been compared. Results show that levelized water cost in cogeneration plant with membrane desalination is lower than cogeneration plant with thermal desalination in the range of 0 to 30 $/cent/m³ for fuel price. For Persian Gulf FOB gas price of 8.6 $/cent/m³, MED water cost is 1.16 $/m³ and SWRO water cost is 0.99 $/m³. Sensitivity analysis has been done for a range of availability, years of operation and capital cost margin.

Keywords: Desalination, MED, RO, Cogeneration of Water and Power, Water cost.

Acknowledgements: We acknowledge the support of the MAPNA group - Investment Project Division for financial and technical support
Salinity Evolution In The Near Surface

Dr. chuanhe Lu
Hoelderlin Str. 12, 72074, Tuebingen, Germany
Email: chuanhe.lu@uni-tuebingen.de

Abstract:
salinity evolution in the near surface.
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sustainable Water Softening, Bioenergy Production and Wastewater Treatment by Microbial Desalination Cell</td>
<td>122</td>
</tr>
<tr>
<td>2</td>
<td>Potential Of Treated Wastewater Usage For Adaptation To Climate Change: Jordan As A Success Story</td>
<td>123</td>
</tr>
<tr>
<td>3</td>
<td>Effect Of Operational Changes In Wastewater Treatment Plants On Bod And Total Suspended Solid Removal</td>
<td>124</td>
</tr>
<tr>
<td>4</td>
<td>Cost Effective Treatment Technology to Treat Grey water for Gardening Purpose</td>
<td>125</td>
</tr>
<tr>
<td>5</td>
<td>Factors Controlling The Adsorption Of Nylosan Navy Dye From Aqueous Solution By Dried <em>C. edulis</em> Plant As Natural Adsorbent</td>
<td>126</td>
</tr>
<tr>
<td>6</td>
<td>Potential Of Charcoal For Removal Iron From Groundwater</td>
<td>127</td>
</tr>
<tr>
<td>7</td>
<td>Establishment Of A Planted Filter For Wastewater Treatment Of The Faculty Of Science Ain Chock Casablanca</td>
<td>128</td>
</tr>
<tr>
<td>8</td>
<td>Implementing Decentralized Wastewater Management in Jordan</td>
<td>129</td>
</tr>
<tr>
<td>9</td>
<td>New Water Treatment Technology And Water Reuse Management For Sustainable Development – A Green Concept</td>
<td>130</td>
</tr>
<tr>
<td>10</td>
<td>Application Of 2d Electrical Resistivity Tomography Method And Geochemical Tracers For Delineation Of Groundwater Recharge By Treated Wastewater From Dhraa Tammar Wastewater Treatment Plant In Kairouan Region (Central Tunisia)</td>
<td>131</td>
</tr>
<tr>
<td>11</td>
<td>Enhanced Phosphorus Uptake Using Polyphosphate-Accumulating Bacteria Recovered From Activated Sludge</td>
<td>132</td>
</tr>
<tr>
<td>12</td>
<td>Contrasted Arsenic Speciation In Two Alkaline Pit Lakes From The Abandoned Pb Mining Area Of Zeida (Moulouya, Morocco)</td>
<td>133</td>
</tr>
<tr>
<td>13</td>
<td>Valorisation &amp; Sustainable Management Of Sludge Residues From The Waste Water Treatment Plant Of The City Of Tiaret (Algeria)</td>
<td>134</td>
</tr>
<tr>
<td>14</td>
<td>Design Of An Efficient Reed Bed System For The Treatment Of Sewage Under Semi Arid Condition</td>
<td>135</td>
</tr>
<tr>
<td>15</td>
<td>Effect Of Temperature And Ph On The Ozone Treatment Of Pharmaceutical Wastewater</td>
<td>136</td>
</tr>
<tr>
<td>16</td>
<td>Bathymetry Study And Sludge Characterization Of Anaerobic Ponds In Al Hoceima Waste Stabilization Pond (Mediterranean Moroccan Coast)</td>
<td>137</td>
</tr>
<tr>
<td>17</td>
<td>Removal of Cd(^{2+}) and Zn(^{2+}) Ions From Aqueous Solution By Natural Zeolite</td>
<td>138</td>
</tr>
<tr>
<td>18</td>
<td>The Adsorption Of Chromium (Vi) From Wastewater Using Activated Carbon Prepared From Groundnut Shell</td>
<td>139</td>
</tr>
<tr>
<td>19</td>
<td>Adsorption Of Chlorpheniramine Maleate On Surface Functionlaized Carbonaceous Materials From Low Cost Omani Date Palm Leaflets</td>
<td>140</td>
</tr>
<tr>
<td>No.</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>20</td>
<td>Historical Pollution Trend And Suitability Studies On Agriculture River Basin, Southern India</td>
<td>141</td>
</tr>
<tr>
<td>21</td>
<td>Sustainable Water Management And Re-Use By Effective Natural Treatment Methods</td>
<td>142</td>
</tr>
<tr>
<td>22</td>
<td>Evaluation Of Quality Of The Effluent From The Sanaa Wastewater Treatment Plant Used In The Agriculture In Yemen</td>
<td>143</td>
</tr>
<tr>
<td>24</td>
<td>New Approach For Expanding Access To Sanitation</td>
<td>144</td>
</tr>
<tr>
<td>25</td>
<td>Maximum Use Of Treated Wastewater In Agriculture</td>
<td>145</td>
</tr>
<tr>
<td>26</td>
<td>Research On Oil Production Water In Oman</td>
<td>146</td>
</tr>
<tr>
<td>27</td>
<td>Diagnostep: Tool For Diagnosis Of Wastewater Treatment Plant - Application To The Wwtp Of Ain Defla, Algeria</td>
<td>147</td>
</tr>
<tr>
<td>28</td>
<td>Low cost Waste Water treatment by using Biofilm technology Successful case studies</td>
<td>148</td>
</tr>
<tr>
<td>29</td>
<td>New Biosorbent In Removing Some Metals From Industrial Wastewater In El Mex Bay, Egypt</td>
<td>149</td>
</tr>
<tr>
<td>30</td>
<td>Delineation The Contamination Zone By Using Electrical And Hydrochemical Measurements Around El Moheet Drain, El Minia District, Egypt</td>
<td>150</td>
</tr>
<tr>
<td>31</td>
<td>Reuse Of Spent Wastewater Based Culture Medium In Alga <em>Microcoleus Vaginatus</em> Cultures After Uv Treatment</td>
<td>151</td>
</tr>
<tr>
<td>32</td>
<td>Adaptation And Performance Of Six Eucalypt Species Irrigated With Qom Sewage</td>
<td>152</td>
</tr>
<tr>
<td>33</td>
<td>Modeling Of Contaminant Transport In Drinking Water Distribution System: A Study For Al-Khobar City In Saudi Arabia</td>
<td>153</td>
</tr>
<tr>
<td>34</td>
<td>Physico-Chemical Quality Of Waste Water And The Risk Of Pollution Of Bechar River ( Algerian Sahara)</td>
<td>154</td>
</tr>
<tr>
<td>35</td>
<td>Treatment Of Domestic Wastewater From The Town Of Bechar (Arid Areas) By A Marsh Artificial Drainage Vertical Planted With <em>(Typha Latifolia)</em></td>
<td>155</td>
</tr>
<tr>
<td>36</td>
<td>Treatment Of Domestic Wastewater By A Sand Filter In Arid Areas (South West Of Algeria)</td>
<td>156</td>
</tr>
<tr>
<td>37</td>
<td>Current Situation Of Treated Wastewater Reuse In Golf Courses In Marrakesh: Problems And Solutions</td>
<td>157</td>
</tr>
<tr>
<td>38</td>
<td>Current Situation Of Treated Wastewater Reuse In Golf Courses In Marrakech: Problems And Solutions</td>
<td>158</td>
</tr>
</tbody>
</table>
Sustainable Water Softening, Bioenergy Production and Wastewater Treatment by Microbial Desalination Cell

Mostafa Ghasemi, Wan Ramli Wan Daud, Tahereh Jafary
Fuel Cell Institute, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

Abstract
Microbial desalination cells (MDCs) are an emerging and novel technology which apply for three simultaneous tasks. MDC use electric current, which was produced by microorganisms, to desalinate brackish water, treat the wastewater and produce bioenergy. A Microbial desalination cell originally is a microbial fuel cell which cathode and anode compartments have been separated by a desalination chamber. In this study we have applied MDC for desalination of brackish water with different salt concentration (10,20,30,40 g/l) to observe the effect of salt concentration in power output of MDC as the amount of produced electricity was highly related to the conductivity of the liquid in desalination chamber moreover in the other side the potential of MDC for desalination of different concentration of salt in water have been reported.
Abstract
Jordan sustainable development is obstructed by severe water scarcity that induces imbalances and shortages of water supply for various uses especially under high population growth rate, sudden immigrations, and climate change. Reserving water for drinking by treating WWTPs effluent and reusing for non-drinking could be a solution. This paper investigated the capability and contribution of the existing WWTPs’effluent for reuse in agriculture sectors as an adaptive measure. The paper provided clear understanding for the current and future climate changes impacts, developed climate change and water policies, current water resources and demands for agriculture sector, and suggested adaptive measures. Further, it emphasized on characterizing the WWTPs and quantification of effluent taking into account the satisfaction to Jordanian standards and guidelines. Major WWTP’s effluents are within Jordanian standards; however some WWTP’s have concerns to microbial quality that restricts their reuse. Samra WWTP effluent can be used for highly restricted class of cooked vegetables, parks, and playgrounds. The results demonstrated that wastewater reuse can be set as integral part of water resources and the national water budget, can solve environmental problems, and can be a feasible adaptive option when managed properly. Further recommendations for WWTP operations, managements, reuse, and monitoring are included.
EFFECT OF OPERATIONAL CHANGES IN WASTEWATER TREATMENT PLANTS ON BOD AND TOTAL SUSPENDED SOLID REMOVAL

Mustafa Bob\(^1\) (Presenting Author), Zakaria Al Quadah\(^2\), Abdul Moniem Ali\(^3\)
\(^1\)Taibah University, College of Engineering, Civil Engineering Department. Madiah city, Saudi Arabia
\(^2\)Taibah University, College of Engineering, Civil Engineering Department. Madiah city, Saudi Arabia
\(^3\)Khatib and Alami Consultants, Consultants to Madiah Water Directorate. Madinah city, Saudia Arabia

E-mail of corresponding author (mustafambob@gmail.com)

Abstract

Proper treatment of wastewater in urban areas is of a critical importance since the disposal of untreated wastewater can have serious impacts on human health and the environment. In addition, treated wastewater that meets reuse standards can contribute to minimizing water scarcity problems. Minimizing the cost of operation while producing high quality treated water is the ultimate goal of all water treatment plants. The research presented in this paper investigates the effect of a significant operational change occurred in a wastewater treatment plant in Madinah city, Saudi Arabia on the effluent water quality. The operational change involved the cancellation of the primary settling tanks of the plant, and as a result, the raw wastewater received at the plant directly entered the aeration tanks. The effect of these changes on treated wastewater quality as determined by BOD and total suspended solids (TSS) concentration was evaluated. These parameters were measured for one month before and one month after the cancelation of the primary settling tanks and the average values were calculated. Results showed that the average removal percentage of BOD and TSS for the last month before the operational change was implemented was 89% and 88%, respectively. The average removal percentage for the same parameters in the first month immediately after implementing the operational changes was 92% and 94% respectively, indicating similar removal efficiency for these parameters. These results show that the treated wastewater quality was not affected by the significant operational change implemented at the plant. Results of this research provide useful information for the authorities responsible for wastewater treatment as well as for the scientific community.

Acknowledgements:

The authors thank the authorities at the Madinah Wastewater Treatment Plant for providing important data and information and for useful discussion.
Cost Effective Treatment Technology to Treat Grey water for Gardening Purpose

Natiq Joodi¹, Sathiraju.V.S².

¹Assistant Professor & Deputy Head, Department of Built and Natural environment, Caledonian College of Engineering, Muscat, Sultanate of Oman.

²Senior lecturer, Department of BNE, Caledonian College of Engineering, Muscat, Sultanate of Oman.

E-mail of corresponding author (natiq@caledonian.edu.om)

Abstract
The world is facing acute shortage of water. Ground water levels are depleting day by day due to over exploitation of ground water resources. In the Gulf, due to desalination process the cost of drinking water is nearly equal to the cost of petrol. There is a need to recycle and reuse every drop of water. Grey water is being generated from each and every house from the kitchen. At present, the grey water is mixed with sewage and finally treated using activated sludge process at a community level. The aim of this project is to treat grey water by using physical separation methods like screens, cyclone and activated carbon filter. Activated carbon filter removed color, odor and organic matter. The results are very encouraging. Each and every house can have their treatment facility. The COD reduction efficiency was 62%. By treating grey water economically; it can be reused for gardening and also for date's plants.
FACTORs CONTROLLING THE ADSORPTION OF NYLOSAN NAVY DYE FROM AQUEOUS SOLUTION BY DRIED C. edulis PLANT AS NATURAL ADSORBENT

R. Aziam, H. Eddaoudi, A. Soudani, M. Zerbet, F. Sinan, M. Chiban*

Department of Chemistry, Faculty of Science, Ibn Zohr University, Agadir, Morocco

* Corresponding author. Phone: +212661.16.24.39, Email: mmchiban@yahoo.fr

Abstract

Contamination of surface water and groundwater by organic and ionorganic pollutants is a serious global problem due to their persistence, bio-accumulation and bio-magnification through food webs. Dyes are widely used in textile, paper, rubber, plastic, leather, cosmetic, and pharmaceutical and food industries. The discharge of colored wastewater even at very low concentrations from these industries into natural streams has caused many significant problems such as increasing toxicity and chemical oxygen demand of the effluent, and also reducing light penetration, which has a derogatory effect on photosynthetic phenomena. Current methods for removing dyes from wastewater are costly and cannot effectively be used to treat wide range of such wastewater. There are very different studies on the use of low-cost materials for removing dyes, such as various agricultural wastes, coal, lignite, chitosan, fly ash, alumina and kaolinite, perlite, sepiolite, montmorillonite and zeolite. The use of dried plants as alternative adsorbents has been receiving attention for the removal of dyes from wastewater in recent years.

In the present study, we aimed to evaluate the potentiality of dried C. edulis plant as low-cost adsorbent for the removal of the industrial dye Nylosan Navy from aqueous solutions using the batch equilibration technique. The effects of adsorbent dose, contact time, initial dye concentration, solution pH, temperature and acid-activation on adsorption rate of anionic Nylosan Navy on microparticles of dried C. edulis plant were investigated. The experimental data were analyzed using pseudo first-order and second-order kinetic models. The effect of presence of several ions as competing ions during the adsorption process of anionic Nylosan Navy dye on dried C. edulis plant has been also studied. These results indicate that dried C. edulis plant as an environmentally friendly adsorbent, could be potentially used for the removal of anionic dyes from aqueous solutions.

Key words: adsorption, Nylosan Navy dye, C. edulis plant, wastewater treatment.
Potential of charcoal for removal iron from groundwater

Manel Ruiti , Bechir Ben Thayer
National Agronomy Institute –Tunisia

rouitimanel@gmail.com

Abstract
The water pollution by heavy metals is a major environmental problem; several techniques for treatment and recovery of these toxic effluents are developed.

In This context, we chose the study of the retention of ferrous iron in groundwater by adsorption on charcoal of Aleppo pine. The technique of adsorption of the metal ion by charcoal was carried in batch system.

We identified different physicochemical characteristics of the adsorbent (pH, pH_{pzc}, surface area, Rate of ash…)

The study of the kinetics adsorption reveals an important capacity of adsorption by charcoal; we scored a progressive decrease in the iron concentration in the function of time and charcoal mass.

Keywords : Adsorption- Iron-Groundwater- Charcoal – Kinetics
Abstract
In the context of water stress, the Faculty of Science Ain Chock has taken the initiative to develop a system to purify its wastewater and to reuse it for the irrigation of green spaces and cleaning its premises. In order to bring out an optimized system under the local condition, different tests have been made for various types of constructed wetlands (CWs). After identification and characterization of Faculty’s wastewater, we designed and implemented four constructed wetlands, using pozzolan as filter material in two constructed wetlands and gravel in the other two CWs. In the case of both types of CWs (pozzolan and gravel), one is vegetated with reeds and the second is unvegetated. All CWs are fed by the Faculty’s toilet wastewater, after decantation. The results show that the reduction of organic pollution parameters is satisfactory mainly due to the combined action of macrophytes, bacteria and the physical barrier of the filter body. Indeed, we got to a settling of wastewater 48 hours:

- A good removal of suspended solids (67%) in the settling basin.
- A good reduction of the three physico-chemical parameters selected at the exit of the two filters pozzolan:
  - 84.88% of COD for the filter planted and 81.26% for the non-planted filter.
  - 82.46% of BOD5 for the filter planted and 73.68% for the non-planted filter.
  - 95.37% of the MES for the filter planted and 94.36% for the non-planted filter.
- A good reduction of the three physico-chemical parameters selected in the output of both gravel filters:
  - 81% of the COD to the planted filter and 74% for the non-planted filter.
  - 75% of BOD5 for the filter planted and 70% for non-planted filter.
  - 95% of the MES for the planted filter and 94% for non-planted filter.

In conclusion, using as pozzolan materials instead of gravel gave better results in terms of reduction of pollutants.

Keywords: Vertical flow filters, constructed wetland, filter material, gravel, pozzolan.
Implementing Decentralized Wastewater Management in Jordan

Mi-Yong Lee*, Ali Subah+, Malek Al-Rawashdeh**, Bassim Abbassi++, Manfred van Afferden* and Roland Müller*
* Helmholtz Center for Environmental Research – UFZ
+ Ministry of Water and Irrigation of the Hashemite Kingdom of Jordan
** Water Authority of Jordan, Hashemite Kingdom of Jordan
++ School of Engineering University of Guelph, Guelph ON, Canada
mi-yong.lee@ufz.de

Abstract
This paper focuses on gained knowledge and experiences with establishing decentralized wastewater management (DWWW) in Jordan, which is impacted by extreme water scarcity, ranking among the most water scarce countries worldwide. The geopolitical condition of Jordan has made it a "safe harbour" in midst of recurrent political crises. Ensuing accelerated population growth (massive refugee influx) further aggravates the stress on water supply and disposal and associated infrastructure. Non-conventional water resources for substitution of fresh water have become an indispensable resource to tackle water stress. At that reuse of treated wastewater, particularly in rural and suburban areas, has the potential to contribute to substituting Jordan’s finite fresh water supply.

Decentralized wastewater management systems are combined infra- and management structures for the collection and treatment of wastewater and sludge with the purpose to

- Enhance groundwater protection from infiltration with untreated wastewater
- Enhance sanitary conditions, especially, but not exclusively so, in rural and suburban areas of the Kingdom
- Close local water cycles thus providing treated wastewater and sludge for either reuse (agricultural, horticultural, landscaping, industrial, etc.) or storage (e.g. groundwater recharge) near its point of generation.

In this paper, the integrated activities of the SMART and the NICE projects towards implementing DWWW in Jordan are assessed and lessons learnt drawn from their challenges and accomplishments. Furthermore, a summary of current activities in advancing DWWW in Jordan and expected milestones is also provided.

Keywords: Integrated water resources management; decentralized wastewater management (DWWW); decentralized wastewater treatment; reuse; capacity development, Water Fun; framework conditions; GIS analysis
NEW WATER TREATMENT TECHNOLOGY AND WATER REUSE MANAGEMENT FOR SUSTAINABLE DEVELOPMENT – A GREEN CONCEPT

Singanan Malairajan
PG and Research Department of Chemistry
Presidency College (Autonomous), Chennai – 600 005, Tamil Nadu, India.
Email: misinganan@yahoo.com

Abstract

Fresh water is certainly essential for human survival, but water-related illnesses are the most common health threat in the world. The recent UNEP report reveals that, nearly 25000 peoples are losing their life daily worldwide. It is also closely underlines that, poverty and water are closely linked, and access to water resources has become widely equated with ensuring basic human needs. Today, economic growth and development strategies require policies that integrate water into national economies and environmental sustainability. Recent global survey report concluded that scarcity and misuse of freshwater pose serious and growing threats to sustainable economic development, food security and protection of the environment. In developing countries, industrial sectors consuming most of the available fresh water for their productions. At the same time, it releases equal amount of wastewater into the environment and causes ecosystem damages. In the concept of environmental and economic sustainability, a proper wastewater management and water reuse system can help to a greater extent in development of national economy. Existing water purification and conventional water treatment technologies are very much costly and not eco-friendly in nature and consumes large amount of energy and produces secondary effluent. In this context, a new search for cheap and low cost water purification technology is essential. Recently, we introduced new biocarbon technology in water purification process. The biocarbon is generated using a novel medicinal plant *Tridax procumbens*. The characteristics of the biocarbon is unique and having good potential for the removal of salts and organic components and heavy metals in wastewater. As a model trial, an industrial wastewater of 3000 mg/L was introduced in the reactor system, after equilibrium time of 3hrs; the concentration of outlet water is 425mg/L. The removal of color from industrial wastewater was performed with the initial concentration of 100mg/L with optimum biocarbon dose of 2.5g/100mL. An excellent result (98.5%) of color removal is achieved in 150min. These results suggest that, new biocarbon technology is a promising option for water and wastewater treatment. The treated water can be reused for various purposes in industries as well as in agricultural development. This type of scientific and technological approaches can help to prevent the misuse of available fresh water resources and to protect the water quality of water resources and its management.

Keywords: Desalination, water reuse, water management, green concept, sustainable development.
APPLICATION OF 2D ELECTRICAL RESISTIVITY TOMOGRAPHY METHOD AND GEOCHEMICAL TRACERS FOR DELINEATION OF GROUNDWATER RECHARGE BY TREATED WASTEWATER FROM DHRAA TAMMAR WASTEWATER TREATMENT PLANT IN KAIROUAN REGION (CENTRAL TUNISIA)

Fethi LACHAAL 1,*, Marwa M’RABET 1,2; Youssef MANSOURI 3; Hakim GABTNI 1

1 Georesources Laboratory, Water Research and Technology Centre, Borj Cedria Ecopark, PO Box 273 Soliman 8020, Tunisia.
lachaalfethi@yahoo.fr / fethi.lachaal@certe.rnrt.tn

2 Faculty of Sciences of Tunis, Department of Geology, University Tunis El Manar, 2092 Tunis El Manar, Tunisia.

3 Regional Directorate of the Environment and Steppes, Kairouan, Tunisia.

Abstract

The Kairouan aquifer (Central Tunisia) is one of typical example of overexploited aquifer in semi-arid region. In fact, the piezometric levels are decreased and the water quality is deteriorated. In this hydrogeological environment, a treated wastewater from Dhraa Tammar Wastewater Treatment Plant (DTWTP) are discharged directly in the wadi Zeroud upstream. The aim of this work is to study and to find out the hydrogeological impact of artificial recharge by treated waste water on the hydrodynamics comportments and the water quality of the Kairouan groundwater.

In this context, a hyd-geophysical and hydrochemical studies are carried out in Mai 2015. Four electrical tomography profiles of 315m length are installed at the upstream of DTWTP and in the river bed. To simulate the infiltration area, inverted apparent resistivity models has been developed. The hydrochemical study consist of physico-chemical analysis of water samples from 11 boreholes, 3 deep wells, surface water, and waste water before and after treatment. The electrical resistivity contrast between the treated water infiltration and groundwater shows the infiltration of treated water at the DTWTP upstream and at the wadi Zeroud bed, where the groundwater salinity was decrease.

Keywords

Wastewater treatment, treated wastewater reuse, Semi-arid, Groundwater, Electrical resistivity tomography, salinity.
ENHANCED PHOSPHORUS UPTAKE USING POLYPHOSPHATE-ACCUMULATING BACTERIA RECOVERED FROM ACTIVATED SLUDGE

L. Benammar¹, T. Menasria¹⁴*, A. Ayachi³ and H. Chenchouni¹²
¹ Department of Natural and Life Sciences, Faculty of Sciences, University of Batna, Algeria.
² Department of Natural and Life Sciences, Faculty of Exact Sciences and Natural and Life Sciences, University of Tebessa, Algeria.
³ Veterinary and Agricultural Sciences Institute, Department of Animal Sciences, University of Batna, Algeria.
*Email: tahamenasria@hotmail.com

Abstract

In this study, phosphorus-accumulating bacteria were successfully recovered from activated sludge in a sequencing batch reactor using synthetic basal acetate salt medium (BASM). An attempt was made to evaluate enhanced phosphorus uptake and the results showed an efficiently phosphate uptake ($P < 0.001$) of a bacterial community, with rates related to initial concentration carbon sources. Volatile fatty-acids presented the suitable substrates for enhanced biological phosphorus removal, of which maximum yield reached 99.23% in basal salt medium supplemented with 0.5% of sodium acetate. The total bacterial analysis of sludge sample showed the presence of about 15 phosphate reducers and the best rate of phosphate uptake using pure culture was achieved using Acinetobacter sp. AS3 (83.36%).

Keywords: Phosphate uptake, polyphosphate-accumulating bacteria, activated sludge
Abstract

In the Zeida mining area (Morocco), two pit lakes called ZA and ZL1 originated from the Pb ore exploitation are currently used for irrigation, livestock watering and domestic consumption. The lake waters are slightly alkaline (8.7 < pH < 9) and contain extremely high concentrations of lithium (1-4.5 mg/l), boron (1-2.5 mg/l) and arsenic (40-150 µg/l), jeopardizing the sustainable use of the water resource for local residents. The analysis of major ions reveals a sodium chlorinated water. Major ion and trace element concentrations vary little with water depth. The concentration of total organic carbon differs from a lake to the other, with an average value of 40 mg/l in the ZA Lake and 2.7 to 5 mg/l in the ZL1 lake. Lithium and arsenic concentrations were lower in ZA lake (∼ 1 mg/l Li; ∼ 60 µg/l As) than in ZL1 lake (4.5 mg/l Li; 150 µg/l As). Speciation of arsenic differs considerably in the two studied lakes. In ZA, dimethylarsenic largely predominates. Inorganic arsenite As (III) represents no more than 7% of the total dissolved arsenic. In ZL1, arsenate As (V) is the only species detected. This suggests that in ZA, inorganic arsenic can be methylated by microorganisms or algae. Observations made on suspended particulate matter show the presence of microscopic algae whose morphology could be related to Chlorella genus and other smaller eukaryotes in ZA. Conversely, in ZL1, the suspended particulate matter consists essentially of inorganic colloids.

Acknowledgements: alkaline pit lakes, arsenic speciation, heavy metals, mining, Morocco.
Valorisation & sustainable management of sludge residues from the waste water treatment plant of the city of Tiaret (Algeria)

SOUĐANI Leila*, MAATOUG Mhamed*, ROMAN Tandlich** and KHALDI Habiba*

*-Ibn Khaldoun University, Algeria
**- Rhodes University, South Africa

Abstract

Wastewater treatment plants release into the environment a purified water and a byproduct of the wastewater designed to as "sludge". This sludge is composed of a mixture of solid substances (organic and inorganic) and water. Their origins will determine their dangerousness. Its dryness (dry matter content) and their chemical characteristics will condition their disposal route.

The sludge has a real agronomic interest because of the presence of organic matter, nitrogen and phosphorous, and a carbon / nitrogen ration favorable

This study is designed to identify the problematic "Valuation and sustainable management of sludge from the treatment plant of the city of Tiaret (Algeria)"

This project includes two areas:

- Physical properties: solids content, volatile content, interstitial water content, viscosity, specific load, specific strength, compressibility, calorific values.

- Chemical properties:
  - Nutrients: Total nitrogen levels, phosphorus, potassium, calcium, Fe, Mg…..
  - Micro pollutants : to assess the risks of trace metals (Pb, Zn, Ni, Cd etc …)

The second phase is a valorization of sludge

Value for the sludge, a soil mixture - sludge was carried out. Eucalyptus plants were prepared by forest nursery in ordinary soil, and then they were put in bags containing the mixture.

Three new soils substrate are obtained; they are composed of 20% of sludge and 80% soil, 40% of sludge and 60% soil and 60% of sludge and 40% of soil, respectively.

Valorization the substrate of each of the new soil is to measure, once a week, the following morphological parameters: diameter growth, plant height, and number of leaves.

Key Word: sludge residues, water treatment, Physical properties, Chemical properties, valorization, Tiaret, Algeria
DESIGN OF AN EFFICIENT REED BED SYSTEM FOR THE TREATMENT OF SEWAGE UNDER SEMI ARID CONDITION

Abdullah Yasar, Ayesha Zaheer, Amtul Bari Tabinda, Muhammad Afzaal, Maryam Khan

Sustainable Development Study Centre GC University Lahore Pakistan
yasar.abdullah@gmail.com

Abstract

Reed bed System is a low cost and efficient technique for the treatment of sewage naturally with the help of plants. The efficiency of the system varies significantly due to change in design of reed bed system. In the present study two designs Vertical reed bed system and Horizontal reed bed system are compared and two different species of plants *Pistia stratiotes* L. and *Phragmites karka* are used, after comparing the designs it is concluded that Vertical reed system is more efficient than Horizontal reed bed system. Total suspended solids (TSS), biological oxygen demand (BOD), sulphates, chlorides and electrical conductivity has shown almost similar trend for the percentage removal efficiency however maximum efficacy is achieved in vertical reed bed design upto 50%, 100%, 80%, 51% and 90% respectively. Turbidity is also significantly removed up to 96% by Vertical reed bed system having *Phragmites karka*. For fecal coliform it is observed that plants play an important role in their removal as compared to the design, *Pistia stratiotes* appears to be more efficient than *Phragmites karka* as it reduced fecal coliform up to 98% in both horizontal and vertical reed bed system.
EFFECT OF TEMPERATURE AND PH ON THE OZONE TREATMENT OF PHARMACEUTICAL WASTEWATER

Abdullah Yasar, Sidra Muhammad Afzal, Amtul Bari Tabinda and Muhammad Afzaal
Sustainable Development Study Centre GC University Lahore Pakistan
yasar.abdullah@gmail.com

Abstract
Ozone is a versatile and feasible technology for the treatment of the pollutants. Ozone was used for the treatment of pharmaceutical wastewater by varying the dosage at different pH levels and different Temperatures. Ozonation resulted in color removal of 56.2% at 14 minutes with pH 7. Which was increased to 97.95% at pH 11 while COD, TSS ,EC removal was of 91.78%, 99.44%, 98.26% respectively. The removal efficiency for different parameters at pH 11 was three times higher as compare to pH 3,5 and 9.

Temperature was varied as 20°C,30°C and 40°C. Variation in temperature appeared to be non significant for the increase in efficiency. It can been concluded that change in pH has more efficient removal as compare to change in temperature. Electric energy per order was used to measure the electric energy efficiency. At pH 11 electric energy consumption for maximum removal efficiency was 0.48kwh/m³ at 14 minute of the ozonation process.
Abstract

Morocco has taken over the desire to ensure sustainable development and to promote the treatment of domestic and industrial wastewater. In this context, several sewage treatment plants were created, in order to protect the environment from direct discharges of wastewater, and to hope for the reuse of treated wastewater.

This work is interested by-product of Wastewater Stabilization Pond (WSP) that affects directly the hydraulic system and the treatment efficiency, it is sewage sludge. The main objective of this study was to diagnose the sludge accumulation of the wastewater treatment plant (WWTP) of Imzouren-Béni Bouayach zone, Province Al Hoceima, North of Morocco. It appears from this study that the treated water has efficiencies of around 35%, 50% 37% and < 20% for TSS, BOD₅, COD and NH₄⁺, against 60%, 60 till80%, 50 till 70% and 60% till 80% recommended.

The question was at this level; are low yields due to silting up?

To have an answer, a bathymetric study was conducted; more than 80% of anaerobic ponds are occupied. The Bathymetry made, confirmed the silting expressed by a sludge production rate estimated on the entire system of the order of (0.0394 m³/person/yr).

Physicochemical analyzes, trace metals and bacteriological characteristics have done. The study of the quality of sludge shows that it is rich in organic matter and fertilizer elements (N, P, K). Trace metals show negligible levels and a presence of eggs lower than the norm.

Keywords: Wastewater stabilization pond, effluent quality, Bathymetry, Sludge accumulation rate, Sludge characterization, Mediterranean Moroccan coast.
Removal of Cd$^{2+}$ and Zn$^{2+}$ ions from aqueous solution by natural zeolite

Eshagh Safarzadeh, Sajjad Aghazadeh, Mahdi Gharabaghi*
School of Mining Engineering, College of Engineering, University of Tehran, Tehran, Iran, gharabaghi@ut.ac.ir, m.gharabaghi@gmail.com

Abstract

The ability of natural zeolite, clinoptilolite for Cd$^{2+}$ and Zn$^{2+}$ sorption from aqueous solution was studied. In this regard, the effects of important parameters such as initial ions concentration, initial pH, chemical conditioning, environmental temperature and contact time on the Zn$^{2+}$ and Cd$^{2+}$ sorption were investigated. Mineral characterization was done by optical microscope, XRD, XRF and SEM as well. Results showed that clinoptilolite, quartz and gypsum were the main minerals and natural clinoptilolite contained high amounts of SiO$_2$ (61.3%) and Al$_2$O$_3$ (9.55%) in the representative sample. The results showed that the Zn$^{2+}$ and Cd$^{2+}$ sorption behaviors were highly dependent on the pH. Sorption data have been interpreted in terms of Langmuir and Freundlich equations. Sorption isotherms of Zn$^{2+}$ and Cd$^{2+}$ ions could be best modeled by the Langmuir equation and based on observation, clinoptilolite has particularly a high potential for Cd$^{2+}$ and Zn$^{2+}$ removal.

Keywords: sorption; cadmium; zinc; zeolite; clinoptilolite, waste water
The present work involves an investigation of the possible use of activated carbon developed from groundnut shell wastes by chemical activation with zinc chloride (ZnCl$_2$) for the removal of chromium (VI) from wastewater. The effect of activation temperature, activation time, impregnation ratio (R) and concentration of activating agent (ZnCl$_2$) on iodine number were studied for the developed activated carbons. Result show that, increasing the activation temperature from 400°C to 500°C decreases the iodine number. Optimum temperature for the production of activated carbon was then obtained at 400°C and an optimum activation time of 2 hours with the impregnation ratio (R) of 3:1. Moreover, the highest iodine value obtaine at optimum condition is 1540.5mg/g. The surface properties of the developed adsorbents were characterized using FTIR. Analysis of FTIR shows that the hydroxyl, carbonyl, aliphatic, ethers, alcohol, phenol and carboxylic groups were present on the surfaces of activated carbons. The efficiency of these adsorbents was tested via separation of artificial wastewater containing chromium. This is evaluated by varying the adsorbent doses, temperature, pH of the solution and contact time. It was found that, the removal efficiency increased from 22.41% to 85.9% by increasing the adsorbent dose from 0.4g to 1g using ZnCl$_2$ activated carbon prepared at 400°C and activation time of 2 hours. Removal of chromium was found to be highly pH dependent and a maximum removal (92.81%) was obtained at pH 2.0. Further, the percentage adsorption of chromium increased with the increase of the temperature and contact time. The data generated in this study can be used to design treatment plants for chromium rich industrial effluents. Adsorption results indicate that ZnCl$_2$ activate carbons adsorbents can be effective for the removal of chromium from aqueous solutions.

**Keywords:** Activated carbon; Chromium adsorption; Groundnut shell; Characterization; Treatment of wastewater

**Acknowledgements:** The financial assistance from University of Khartoum (UofK) is gratefully acknowledged for enabling this research work to be undertaken.
ABSTRACT

The adsorption capacity of chlorpheniramine maleate (CPM) was determined on various dehydrated (DC), activated (AC) and surface functionalized DC's & AC's prepared from Omani date palm leaflets. Sulphuric acid and KOH was utilized for preparation of DC and AC respectively. AC was further Oxidized by HNO₃ to produce oxygenated activated carbon (OAC). Both DC and OAC were surface functionalized using ethylene diamine and propylene diamine to produce basic surfaces while ethylamine and aniline to produce hydrophobic carbonaceous surfaces (BDC-EDA, BDC-PDA, BAC-EDA, BAC-PDP, HDC-EA, HDC-AN, HAC-EA and HAC-AN). Solid to liquid ratio, pH effect on CPM sorption, kinetics and equilibrium studies were carried out at pH ~ 7. OAC and HAC-EA shows maximum sorption capacities 241.86 mg/g and 217.44 mg/g, respectively, because of electromagnetic and hydrophobic force of attraction between CPM and acidic surface of OAC and hydrophobicity nature of HAC-EA.

Acknowledgements: (TRC, SQU)

Keywords: Date palm; Dehydrated; Activated; chlorpheniramine maleate; Sorption, Carbon
ABSTRACT

Suitability of the river water for irrigation use depends upon the minerals and other chemical constituent present in the water. Over the last 50 years, the increasing global use of toxic synthetic pesticides has seriously affected human health, environmental hazards and agricultural sustainability. The Tamiraparani river basin irrigation system is one of the oldest irrigation systems in the state of Tamil Nadu, Southern India. It lies between latitude 8° 20’ N and 9° 13’ N and longitude 77° 10’ E and 78° 10’ E. The irrigation development dates back several centuries, and eight dams have been constructed across the main river to date. Rice (Oryza sativa) is the major food crop in the Tamiraparani command area followed by banana (Musa spp), blackgram (Vigna mungo) and sesame (Sesamum indicum, locally known as ‘gingelly’) in that order. Rice occupied 56% of the gross cropped area (GCA) followed by blackgram (17.3%), banana (8.4%) and sesame (3%). Intensive agricultural practices and industrial development have led to the additional input of fertilizers and heavy metals significantly to the river basin. Based on our study, the vast differences in spatial distribution of nutrients through the course of the river is due to the confluence of several tributaries, channels and canals entering the main river at different points. The hydrological characteristic of the river basin, such as seasonal variation of flow and damming activities, can influence the spatial and temporal distribution of OCPs in water and sediments. The ratios of (DDE+DDD)/DDTs were in the range of 0.1 to 0.86 with most values being less than 0.5 indicates the source of DDT contamination is from the aged and weathered agricultural soils with signature of recently used DDT in Tamiraparani river catchment area. Detailed sediment chemistry on surficial and core samples were carried out in association with sediment accumulation rates using Pb\(^{210}\) and Ra\(^{226}\) methods. The sediment accumulation rate varying from 5 to 12 mm yr\(^{-1}\) and comparison was made between polluted and unpolluted region. The sedimentation rates were high in downstream region and were relatively constant in midstream due to damming effect. The study also proved, estuary region is filled with freshly deposited sediments which is of recent origin by the river. Human activities such as agriculture, deforestation, grazing, and dam construction across the river influences the sediment load. The estuarine region did not show any clear exponential radioactive decay mainly due to bioturbation within the system. Variations in heavy metal distribution with vertical core explain nature of suspended sediment load and other anthropogenic activities.
SUSTAINABLE WATER MANAGEMENT AND RE-USE BY EFFECTIVE NATURAL TREATMENT METHODS

R. Arthur James¹, K.V. Emmanuel¹ and Hans-Uwe Dahms²

¹Department of Marine Science, Bharathidasan University, Tiruchirapalli – 620 024, India
²Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung 80708, TAIWAN.

Corresponding author: james msbdu@gmail.com / james@bdu.ac.in

ABSTRACT

In the present environmental scene, water scarcity is becoming increasingly alarming. This problem can be tackled in many ways like optimized use, waste reduction and reuse of wastewater etc. This paper focuses on various natural treatment method and reuse of domestic and certain industrial wastewater and their working procedures. The performance of combined anaerobic and aerobic treatment system with different natural filter medias (gravel, slag and pebbles) and their efficiencies were examined for domestic wastewater. The gravitational flow rate to the system includes Anaerobic Baffled Reactor (ABR), Anaerobic Filter (AnF) and Aerobic Filter (AF) was kept constantly giving hydraulic retention time of 7.6h, 7.2h and 11.4h respectively. In anaerobic baffled reactor (ABR), the TSS reduces to 90% when compared with all other parameters. At the first chamber, the elevated concentration of 930 mg/L was observed and it reduces to 210 mg/L in the sixth compartment. Similarly COD reduced from 350mg/L to 170 mg/L as it treats the organics more or less 50%. The anaerobic filter (AnF) process is emerging as an efficient and economic method for the treatment of wastewater. In the present system, the bio film is retained within the reactor on filters made from materials such as gravel and slag. The BOD at the inlet of the gravel media varied from 100 to 110 mg/L and the outlet it reduces to 40 to 50 mg/L. Similarly at slag media the reduction ranges were from 100 to 60 mg/L. The aerobic filter (AF) encompasses the life interaction of various species of bacteria, fungi, micro organisms, roots of wetland plant (halophytes), filter bed media (sieved sand in the range of 2-5 mm and pebbles of 4-10mm) and water. From this study the planted gravel filter and pebble (8-10mm) got maximum treatment capacity and smooth operation. To confirm the consecutive over all treatment efficiency for the combined system, COD concentration shows steady performance during sixth months time (from 100mg/L to 40mg/L) and the reduction rates were observed by reduce in concentration (from 380mg/L in ABR to 40mg/L in AnF) curve by 90%. Hence by designing these systems in such a way that gravitational flow pattern can be employed to run the unit without any care as well as to reduce operational cost.
EVALUATION OF QUALITY OF THE EFFLUENT FROM THE SANAA WASTEWATER TREATMENT PLANT USED IN THE AGRICULTURE IN YEMEN

Kamal Abbas Merghem¹, Hassan El Halouani¹, Khadija Dssouli¹, Anass Ali Alnedhary², Wafae Mokhtari¹, Raya Qaid Alansi³, Abdelhakim Jilali⁴

¹ Laboratory of Water Science, Environment and Ecology, Faculty of Sciences, University Mohammed I, Oujda, Morocco e-mail: kamal58745@yahoo.com
² Department of chemistry, Faculty of Khawlan, Sana’a University, Yemen
³ Department of chemistry, Faculty of Sciences, Taiz University, Yemen
⁴ Laboratory of Mineral Deposits, Hydrogeology & Environment, Faculty of Sciences, University Mohammed I, Boulevard Mohammed VI, B.P: 717, C.P: 60000 Oujda, Morocco

Abstract

The Sana’a Basin is located in central highlands of Yemen. This basin is characterized by water crisis due to arid climate with low rainfall (170 mm/year), and drawdown of piezometric levels. Promoting water reuse of treated wastewater for irrigation could mitigate this water crisis. This study assesses the performance of Wastewater Treatment Plant (activated sludge) of Sana’a City by analyzing the quality raw and treated wastewater predominantly by domestic sewage. A comparison with Yemen and international guideline reveals the results of pH, EC and PO₄ show that the effluent from SWWTP are in admissible standard limit for irrigation. But, the others parameters such as BOD, COD and NH₄ are very high than the standard values due to the overloaded of SWWTP. The added of facultative ponds can improve the performance of this station. Therefore, the quality of final effluent will be better.

Key-words: Wastewater, Treatment plant, Quality, Sana’a Basin, Yemen.
New Approach For Expanding Access To Sanitation

Dr. khaoula lamzouri¹, Dr. Mustapha MAHI²

¹ONEE/IEA, Station de traitement, Av Mohamed Bel Hassan El Ouazzani, Rabat, morocco.Email: khaoulalamzouri@gmail.com
²ONEE/IEA, Station de traitement, Av Mohamed Bel Hassan El Ouazzani, Rabat, Morocco.Email: mumahi@onee.ma

Abstract:
In the Middle East and North Africa, small communities have virtually no access to centralized wastewater collection and treatment systems. In the absence of such services, sewage disposal is often left to the discretion of homeowners. In many cases, untreated sewage is discharged into surface waters or the landscape, contaminating already dwindling surface water and groundwater resources. This practice will continue unabated unless appropriate and affordable treatment systems are made available. The project will develop, test and promote low cost sustainable technologies for decentralized wastewater treatment through a partnership of local communities, research institutions, government and businesses.

After selecting the two pilot technologies to be installed in the two sites in Jordan (Sakeb village) and Morocco (Talat Marghen village), the design specifications for each technology were identified in accordance with the assessment of wastewater quality and quantity:

Jordan case study: MST (Modified Septic Tank) and VFCW (Septic tank followed by Recirculating Constructed Wetland

Morocco case study: SML : Multi-Soil-Layering

The results of the technologies piloted and implemented in Jordan and Morocco will be compared, according to social, socio-economic, technical criteria. The project asks for the best way to adapt the wastewater treatment systems for small communities in MENA region and some part in Africa.
Maximum Use Of Treated Wastewater In Agriculture

Dr. Ahmed Salim Al-Busaidi

Sultan Qaboos University, College of Agricultural & Marine Sciences, P.O. Box 34, Al-Khoud123, Muscat, Oman

Email: ahmed99@squ.edu.om

Abstract
This study contributed to the existing knowledge on urban treated wastewater reused for agriculture in MENA region by identifying means to optimize wastewater reuse by taking into consideration various parameters such as return to farmers, groundwater quality and impacts on soil and groundwater. The aim of the study was to identify means/tools to optimize treated wastewater reuse in conjunction with other available water resources by taking into consideration their quantity and quality, in addition to the agronomic, environmental, and economic components. The study was done in open field at Sultan Qaboos University, Oman. Three types of crops (radish, okra and eggplant) were grown and irrigated by four types of waters (A: 50% groundwater and 50% treated wastewater, B: 100% groundwater, C: 75% treated wastewater and 25% groundwater, and D: 100% treated wastewater). Soil physicochemical properties did not show significant differences with treated wastewater irrigation as compared to groundwater. On other hand, some chemical properties significantly increased (p<0.05) when treated wastewater was applied such as total carbon and some major elements (N, P, K). Crop physical analysis showed significant increases in plant productivity when plants were irrigated with treated wastewater with insignificant changes in heavy metals between treatments and no biological contamination in crop yield was recorded.
Research On Oil Production Water In Oman
Dr. Mushtaque Ahmed
Sultan Qaboos University, College of Agricultural & Marine Sciences, PO Box 34, Al-Khod 123 Muscat, Oman Email: ahmedm2316@gmail.com

Abstract
Large quantities of water are produced during oil extraction in Oman. This water is usually utilized for reservoir pressure maintenance by injection or disposed by injecting them into aquifers that are not usable. The produced water is mostly saline and contaminated with oil. Studies done in Oman have shown that some produced water can be used for growing salt tolerant crops and trees in sandy soils without causing serious damage to soil or environment. A pilot scale study was conducted at Sultan Qaboos University (SQU) to treat the produced water using a combined air floatation-adsorption process. The process successfully reduced oil in the water from 100-300 ppm to less than 0.5 ppm. After removal of this oil, the water can be used for growing salt tolerant crops and trees. A reed-bed system (constructed wetland) is functioning with the ultimate objective of using saline water from this system for production of salts necessary for the oil industry or other useful purposes. This facility in Nimr, Oman has a capacity to treat 95,000 m3/day of produced water. Since 2011, the Nimr Water Treatment Project has treated produced water generated by the oil fields in Southern Oman. It is one of the world's biggest commercial natural water treatment systems covering more than 700 hectares of constructed wetlands. A study at SQU demonstrated that date seeds can be a low-cost adsorbent for the removal of DOC from produced water. Very promising results were achieved using ceramic membranes for oily water treatment. Extremely high removal of oil and turbidity were achieved and moderate levels of removal of COD and TOC attained in lab experiments using production waters of an oil-field in Oman.
Abstract

The treatment of a large amount of data; process and energy spread in time to bring out a proper diagnosis of a waste water treatment plant (WWTP) is not an easy task, it requires a tool, both oriented and specialized. To satisfy this requirement, the National Office of Sanitation (ONA), Chlef region and specifically the Service of Operations and Maintenance are using a tool called DIAGNOSTEP. This tool is completely written in Structured Query Language (SQL), it queries a dozen tables and reports on the state of a WWTP activated sludge. Ten (10) parameters are analyzed by using this tool: Six (06) parameters related to the process and four (04) parameters related to the electrical energy required for waste water treatment. To have a reliable diagnostic tool allows at any time, to check the status of the operation process of WWTP something that was, until now, a very difficult and tedious task. The WWTP of Ain Defla has been selected to illustrate this approach.

Key words: Database, Waste water treatment plant, Monitoring, Diagnosis.
Low cost Waste Water treatment by using Biofilm technology  
Successful case studies  
Dr.-Eng. Noama Shareef1  
1CIM- IF Water Expert, Arab Countries Water Utilities Association (ACWUA)  
P.O. Box: 92 62 38 Amman-11190 Jordan, Noama.shareef@cimonline.de &  
nash123@hotmail.de.

Abstract  
The trickling filter is an aerobic treatment system to remove organic matter from municipal and industrial wastewater. Today Trickling filters are a modern and highly attractive process due to the development of different kinds of plastic media, which provides full carbonaceous treatment. Nitrification to very low concentrations, and high rate applications. Secondary treatments filters process reduces the levels of BOD and Ammonia within the waste water to levels that can be discharged into watercourses without compromising the condition of the receiving waters. According to this research, several trickling filters are operated in many countries and treat the municipal and industrial wastewater. The aim of the project is the development of a commercially attractive (investment and operating cost by saving energy consumption).

According to some case studies for this technology in several countries, it shows extremely high treatment rates that can be achieved by using high rat filters which designed to reduce the BOD loads to 70%. The reduction of BOD achieved with high quality standard at many TFs: the BOD reduction in Managua trickling filter was in effluent to 87% more than the request limit and energy demand to less than 0,2 kWh per kg reduction in BOD (comparing to activated sludge system for the same treatment plant which has energy demand of 0.6kWh/kg BOD reduction). Low energy demand in Case trickling filter is because of the natural draft which created by the small temperature differences resulting from shaded and sun exposed surfaces, wetted surfaces in the filter, cooling effects by evaporation etc. This type of filter is installed in many countries to produce a very high specific nitrification rate producing very low ammonia concentration in the effluent (reduction of NH4-N by TF in WWTP France was to 2mg/l, by TF-Germany to 3 mg/l, and by TF-Dubai to 1mg/l in outlet). Based on this research, the treated water by trickling filter technology BOD less 20 mg/L, COD less 60mg/l, NH4-less 2 mgN/l with very low energy consumption (0.2kWh/kg BOD reduction) can be reused for irrigation purpose according to the irrigation standards.

Keywords: Trickling filter, Biofilm, Nitrification, Wastewater treatment, Biological treatment.

References  
1. [DWA, 2007a]: DWA-Arbeitsbericht IG-5.6 (2007): „Aerobe Biofilmverfahren in der Industrieabwasserreinigung – Beispielanlagen“.  
NEW BIOSORBENT IN REMOVING SOME METALS FROM INDUSTRIAL WASTEWATER IN EL MEX BAY, EGYPT

Presenting Author, Maha Ahmed Mohamed Abdallah¹, Mohamed E. Mahmoud², Maher M. Osman², Somaia B. Ahmed¹
¹National Institute of Oceanography and Fisheries, Marine Pollution Lab, Qait Bey, Alexandria, Egypt
²Faculty of Sciences, Chemistry Department, Alexandria University, Egypt
mahaahmed7@ymail.com

Abstract
Biosorption is an extensive technology applied for the removal of heavy metal ions and other pollutants from aqueous solutions. In the present study, the biosorption of cadmium, lead, chromium and mercury ions from polluted surface seawater in El-Max Bay was determined using hybrid active carbon sorbents. These sorbents were treated chemically by acid, base and redox reaction followed by surface loading of baker’s yeast biomass for increasing their biosorption capacity and the highest metal uptake values. The surface function and morphology of the hybrid immobilized sorbents were studied by Fourier Transform Infrared analysis and scanning electron microscope imaging. The results of metal removal values are prove the vital role of baker’s yeast as a significant high removable due to functional groups at baker’s yeast cell wall surface that have the ability to forming various coordination complexes with metal ions. A noticeable increase in the removal of all studied metals was observed and reached to 100%.

Keywords: Activated carbon, baker’s yeast, wastewater, El Mex Bay, Egypt
DELINEATION THE CONTAMINATION ZONE BY USING ELECTRICAL AND HYDROCHEMICAL MEASUREMENTS AROUND EL MOHEET DRAIN, EL MINIA DISTRICT, EGYPT

Abou Heleika M., Ismail E.
Geology Department, Faculty of Science, Minia University, El Minia, Egypt
essam.ismail@mu.edu.eg

ABSTRACT

El-Moheet drain represent the main drainage system in El Minia district and receives all waste water e.g. agricultural, domestic, and sewage from lateral minor drains. These wastes considered a source of contamination for surface water which may be extended to the ground water aquifer through a seepage process. For delineating the contamination zone, Self potential and electrical resistivity measurement were carried out. Chemical analyses for trace and major elements were performed for 28 water samples which collected from the drain and drilled wells. Surface water from El Moheet drain and ground water samples exhibit substantial concentrations of trace elements. The electrical data were processed and interpreted through iteration process by using IX1D V3 software. The contaminated zone was characterized by higher bulk electrical conductivity, positive SP anomaly. This zone is perpendicular to El –Moheet drain in nearly E-W direction with wide reached to more than150 m. Management waste water in El-Moheet drain is strongly recommended for further protection of the groundwater aquifer.

Key words: El Moheet drain, Self potential, electrical resistivity, trace and major elements
REUSE OF SPENT WASTEWATER BASED CULTURE MEDIUM IN ALGA MICROCOLEUS VAGINATUS CULTURES AFTER UV TREATMENT
Abdolmajid Lababpour
National Institute of Genetic Engineering and Biotechnology, Tehran 14965-161, Iran
lababpour@nigeb.ac.ir

Abstract
Reuse of wastewater is increasingly becoming popular because of potable water shortages across the globe. The aim of this research is reusing wastewater for cultivation of the microalga, Microcoleus vaginatus, and recirculation of spent water after UV treatment. Recent studies on using wastewater in microalgae cultivation have proposed various systems to develop its applications. However, the combined application of wastewater as culture medium and its recirculation have not yet been investigated. This study proposes integration of wastewater and reuse of spent culture medium for cultivation of M. vaginatus. The paper introduces an integrated system for better use of water resources with a more economically viable microalgae production system. The prokaryotic microalga, Microcoleous sp. was used for experiments. It was previously isolated from the biological soil crust in the south of Iran for application to arid soil rehabilitation. The inoculum were prepared in BG-11 culture medium in 250 mL Erlenmeyer flasks illuminated with white fluorescent lamps from both sides with a light intensity of 40 μE m-2 s-1. Mixing was conducted on a shaker at 150 rpm and the temperature was maintained at 25°C ±1. The cultivation was carried out in 1L flasks for 45 days with wastewater as the culture medium, under the same conditions of light, mixing and temperature. After harvesting the cells by centrifugation, the spent supernatant was recirculated. It was returned to the culture systems following UV treatment (with UV lamp and a light intensity of 20 Wm-2 for 5 min) twice a week from the third day of cultivation (11 recirculation operations in total). Cell growth and contamination were then monitored by microscopic evaluation of cells, and EC analysis was used for evaluation of supernatant quality. The results of integrated wastewater reuse and recirculation reveal the potential of spent culture medium reuse whereby cell productivity was not affected during 45 cultivation periods as compared to the control without recirculation. The UV treatment was shown to be effective in reducing culture contamination. These results were also confirmed by other reports showing the recycling of Chlorella vulgaris and Nannochloropsis sp. culture media. However, a more efficient water treatment system will guarantee repeated water circulation systems for microalgae cultivation.

Acknowledgements: The author would like to thank the National Institute of Genetic Engineering and Biotechnology.
ADAPTATION AND PERFORMANCE OF SIX EUCALYPT SPECIES IRRIGATED WITH QOM SEWAGE

Hossein Sardabi¹ and Hossein Tavakkoli-Neko²

1*- Research Institute of Forests and Rangelands, P.O. Box 13185, Tehran, I.R. Iran. Email: hosseinsardabi@gmail.com, sardabi@rifr-ac.ir
2- Qom province Agricultural and Natural Resources Research Center, Qom, I.R. Iran

Abstract
The aim of the study was to evaluate adaptation and performance of six eucalypt species and provenances. For this reason, a trial was conducted in 2007 and continued to 2014 in a site located five kilometers north east of Qom city in Iran, near sewage release station under statistical design of Randomized Complete Blocks with four replicates, six treatments and 5 x 5 m. spacing. Sewage was used for irrigation at one week interval. The treatments consisted of six eucalypt species and provenances, including: E. camaldulensis Qom, E. camaldulensis 41-ch, E. camaldulensis 41-zh, E. microtheca Qom, E. microtheca 62 and E. rubida 166-sh. The growth and morphological parameters consisted of: total height, dbh, survival, height increment, dbh increment and height/diameter ratio. Tree inventory was made at two times per year: spring (after cold period) and autumn (after warm and dry season) due to evergreen characteristics of eucalypts. Data were analyzed, using variance analysis and Duncan test and applying MSTA, SPSS and SAS softwares. Results showed that E. camaldulensis and E. microtheca had the best performance (survival, height increment and diameter increment), respectively. In addition E. microtheca achieved the greatest value of diameter/height ratio, for this reason it is more useful for windbreak establishment than E. camaldulensis.

Key words: Survival, dbh, height/diameter ratio, height & diameter increment, sewage
MODELING OF CONTAMINANT TRANSPORT IN DRINKING WATER DISTRIBUTION SYSTEM: A STUDY FOR AL-KHOBAR CITY IN SAUDI ARABIA

Ashraf Farahat¹, Muhammad Nadeem Sharif¹, Muhammad A. Al-Zahrani², Rehan Sadiq³

¹College of Applied and Supporting Studies, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia
²Department of Civil and Environmental Engineering, Water Research Group, King Fahd University of Petroleum & Minerals, Dhahran 31261, Saudi Arabia
³School of Engineering, University of British Columbia, Okanagan Campus, Kelowna, BC, V1V1V7, Canada
farahata@kfupm.edu.sa

Abstract
In the Kingdom of Saudi Arabia, approximately 50% of drinking water comes from desalination, 40% from the mining of non-renewable groundwater and remaining 10% from surface water.

In this paper, we present a model to investigate chemical contaminants transport and mixing patterns into drinking water distribution systems in Al-Khobar city, one of three major cities in the Eastern province of Saudi Arabia with an area of approximately 64 km² and population of about 300,000. The water distribution system serving the city contains about 470 km of pipes with different diameters ranging from 5 cm to 1m. The network consists of 190 pipes, 130 junctions, 12 reservoirs, 2 tanks and 12 pumps.

Extended Period Simulation (EPS) using EPANET has been employed to perform hydraulic analysis of the water network system. The model is run using the available Al-Khobar city network data at different values of pipe coefficients, pumps characteristics and water tank levels. The network vulnerability for contaminant intrusion was tested. The model outputs are compared with the observational field data.

Acknowledgements:
The authors would like to acknowledge the support provided by the King Abdel Aziz City for Science & Technology to fund this work under the National Science, Technology and Innovation Plan (NSTIP), Grant No. (12-WAT2390-04). The support provided by the Deanship of Research at King Fahd University of Petroleum & Minerals (KFUPM) is gratefully acknowledged.
PHYSICO-CHEMICAL QUALITY OF WASTE WATER AND THE RISK OF POLLUTION OF BECHAR RIVER (ALGERIAN SAHARA)

Mohammed amine Kendouci, Benali Kharroubi, Saliha Mebarki, Ali Bendida resenting
1: Department of Civil Engineering and Hydraulic, university of Bechar, Algeria
2: Department of Hydraulic. University of Science and Technology Oran – Mohamed Boudiaf B.P.1505 El-M’Naouer 31000 Oran, Algeria.
E-mail of corresponding author: aminekendouci@gmail.com

Abstract
In urban environment, the increase in population generates considerable quantities of waste water which is treated in the purification plants to specialize or reject directly without control in the courts of water case of Bechar River. Because of their various origins (domestic rejections), this water is generally charged in organic, mineral elements and in micro-organisms of which some could be harmful with health and strongly takes part in the degradation of the tablecloths which could be irreversible. The town of Bechar (Southern Algerian West) which is in an arid Saharan area knows like all the Algerian cities of the problems of surface and underground pollution the waters, whose main causes are: the discharge of waste water in nature without purification and the absence of the systems of purification and depollution of waste water. The present study is undertaken on the course of Bechar River, carried out in April 2014 revealing a polluting load: (Nitrate 7.94 mg/l, Nitrite 0.6 mg/l, Ammonium 26.60 mg/l, NTK 62.18 mg/l). In April 2014, of samplings of waste water noted Wi were realized according to the recommendations of WHO. The choice of the sites was fixed according to the direction of flow. The results obtained according to the study analyzes physic-chemical samples of the rejections testify in their majority that a contamination of subterranean water of the tablecloths by waste water of the river according to a process of infiltration which depends on several environmental and climatic factors is extremely probable and which an urban treatment of the rejections is paramount to protect the tablecloth and the ecosystem.

Keywords: Algeria, Bechar River, environment, urban Rejection, contamination, parameters physico-chemical.
TREATMENT OF DOMESTIC WASTEWATER FROM THE TOWN OF BECHAR (ARID AREAS) BY A MARSH ARTIFICIAL DRAINAGE VERTICAL PLANTED WITH *(TYPHA LATIFOLIA)*

Ali BENDIDA¹, Abdellatif El-Bari TIDJANI², Mohamed Amine KENDOUCI¹, abdelghani BAKHIRA¹.

¹University of Bechar, BP 417, 08000 Bechar, Algeria. e-mail ali_bendida@live.fr
²Laboratory of Hydrology and management of Water resources (HYDRE). University Science and Technology of Oran -Mohamed Boudiaf B.P.1505 El-M’Naouer 31000 Oran Algeria

Abstract

The treatment and disposal of sewage is one of the major environmental concerns in developed countries and in the process developing. These water filled with biodegradable organic matter, inorganic and organic chemical, toxic substances and pathogenic microorganisms. What makes the choice of the treatment process difficult. The choice of economical and efficient processes are the concern of several researchers. The use of natural methods of treatment (phytoremediation) has proven its efficiency in treatment of industrial wastewater and domestic. The technique uses floating or emergent aquatic plants in constructed wetlands for treatment of heavily polluted waters. The constructed wetlands are potentially a low-cost solution for treating domestic sewage and industrial countries to developpement.ces constructed wetlands could provide economic benefits encouraging communities of natural systems of water treatment and biomass production, used by the following production of biogas in animal feeds, and paper manufacturing.

This work is to test the effectiveness of system Marsh Artificial drainage Vertical planted with *(Typha latifolia)* to purify domestic sewage from the town of Bechar. In this work we use three bins: two bins which are implanted in two spaces (Typha, Smar) and the third for the control. Removal rates of pollutants are found: DOC (100%), TNK (79.27% ), NH₄⁺ (91.11%), NO₃⁻ (50% Typha,), NO₃⁻ (87.63%). Both plants seem to be well adapted to the waste water and the weight increase.

**Keywords:** phytotreatment, domestic waste water, aquatic plants, Southwest Algeria.

155
TREATMENT OF DOMESTIC WASTEWATER BY A SAND FILTER IN ARID AREAS (SOUTH WEST OF ALGERIA)

Ali BENDIDA¹, Abdellatif El-Bari TIDJANI², Mohamed Amine KENDOUCI¹, abdelghani BAKHIRA¹.

¹University of Bechar, BP 417, 08000 Bechar, Algeria. e-mail ali_bendida@live.fr
²Laboratory of Hydrology and management of Water resources (HYDRE). University Science and Technology of Oran -Mohamed Boudiaf B.P.1505 El-M’Naouer 31000 Oran Algeria

Abstract

In Algeria, little importance is given to the coverage of sanitation services compared to the coverage of water supply services and even less importance is given to the" purification. Indeed, for a coverage of sewerage network in the order of 85%, only 20% of collected wastewater is treated in Algeria.

In the town of Bechar, the sewage discharged into Bechar river whitch is a factor behind pollutiot in the city, which leads one to open with all the adverse consequences on the health of the population and causing damage to the environment. Pollution that take a long time to disappear, causing contamination even with judicious control. There is much to do to stop such infiltration of wastewater into groundwater. The implementation of pollution control systems is a remedy to this harmful problem and also for a reuse of treated wastewater.

The objective of this work to test the effectiveness of a sand filter system to purify can of the domestic wastewater of the city of Bechar. Our experimental device consists of a plastic 45 cm length, 35cm width and 30 cm height (5 cm gravel 8/15, and 5 cm of gravel 3/8) and sand (10 cm).

Keywords: sand filter, domestic waste water, arid areas, Bechar, Algeria Southwest.
CURRENT SITUATION OF TREATED WASTEWATER REUSE IN GOLF COURSES IN MARRAKESH: PROBLEMS AND SOLUTIONS

Hajar BENLOUALI*, Redouane CHOUKR-ALLAH¹, Moulay Cherif HARROUNI¹ and Abdelaziz HIRICH²

¹ Hassan II Institute of Agronomy and Veterinary Medicine, Agadir, Morocco
² International Centre for Biosaline Agriculture, Dubai, UAE
* Corresponding author: h.benlouali@gmail.com

Abstract
The golf tourism is developing in Morocco where it is considered as a vector of economic development. However, golf courses consume large amounts of water. The use of conventional water resources for golf course irrigation is contested, especially in countries that suffer from water deficit such as Morocco. Therefore, the Moroccan government launched in 2006, the National Sanitation Plan (NSP) and wastewater treatment aiming at the promotion of the reuse of treated wastewater to irrigate golf courses and green spaces.

This paper presents the results of a survey carried out in eight golf courses that use reclaimed wastewater in Marrakesh to investigate the situation of this practice. It also shows the institutional regulatory and financial frameworks that are implemented in order to achieve the goals of the NSP. The analysis of the survey data reported in the study is related to general information about the studied golf courses including total area, water uptake, water storage equipment, soil type, irrigation systems, and the extent to which wastewater reuse is considered satisfactory. The survey showed a reluctance of golf courses managers regarding the use of treated wastewater for irrigation. The main reason for that is due to problems mainly consisting in the clogging of irrigation systems and salinity which affect irrigation distribution on the one hand and grass growth on the other.

These results show that the reuse of treated wastewater is not likely to be as attractive as supposed and therefore the objectives of the NSP may not be achieved. As a conclusion in this study, it is suggested that further investigations are necessary to assess the quality of treated wastewater and to find solutions to the problem of salinity. Some practical solutions are suggested for the promotion of treated wastewater reuse as well as good management practices to cope with salinity in golf courses.

Keywords: Reclaimed wastewater, Golf course, Irrigation, Clogging, Salinity, Marrakesh, Morocco
CURRENT SITUATION OF TREATED WASTEWATER REUSE IN GOLF COURSES IN MARRAKECH: PROBLEMS AND SOLUTIONS

Benlouali Hajar¹, Choukr-Allah Redouane¹, Harrouni Moulay Cherif¹ and Hirich Abdelaziz¹²
¹ Hassan II institute of Agronomy and Veterinary Medicine, Morocco
² International Center for Biosaline Agriculture

Abstract
The golf sector is a rising tourism and economic development vector in Morocco. However, Golf courses consume large amount of water. The use of conventional water resources for their irrigation is contested and not a matter of priority, especially in regions that suffer from water deficit as Morocco. Therefore, Moroccan government launched the National Plan for Sanitation (NSP) and wastewater treatment in 2006, that aims partially to raise and promote reuse of treated wastewater in golf courses, landscapes and crop irrigation.

This paper presents the results of survey carried out in eight golf courses that use reclaimed water in Marrakech showing the institutional regulatory and financial frameworks that are implemented in order to involve performance and achieve the goals of the NSP. Moreover, an analysis of general data about the golf courses including superficie, water uptake, water storage structures, soil type, and irrigation systems is reported. The survey showed a reticence of golf courses managers toward the use of treated wastewater for irrigation, because it causes problems that are mostly the clogging of irrigation system and salinity problems which affect the irrigation distribution homogeneity and grass growth. In the light of the results obtained in current situation diagnostic we suggest some practical solutions for promoting treated wastewater reuse as well as good practices to cope with salinity damages in golf courses.

Keywords: Reclaimed water, Survey, Marrakech, Golf course, frameworks

Acknowledgment: this study is supported by the GLOBAQUA EU funded project. Our thanks go to surveyed golf courses managers as well as the wastewater treatment plant of Marakech city.
<p>| 1 | Estimation of Groundwater Recharge in Northern Oman Mountains Using Multiple Techniques | 161 |
| 2 | Problematic Of Flood Risk In Urban Area - Case Of Urban Agglomeration Of Sidi Bel Abbes, Algeria | 162 |
| 3 | Delination Of A Fractured And Karstified Aquifer Formation At Bahr Al-Najaf Basin, Iraq | 163 |
| 4 | Use of 2D Resistivity Imaging Technique in Delimitation of Hydraulic Connection between Dammam and Umm Er Radhuma Aquifers Within Abu-Jir Fault Zone, Central Iraq. | 164 |
| 5 | Characteristics Of The Gases And Waters Issuing From The Kizildag And Erzin Ophiolites (Hatay/Turkey): Comparison With The Remnants Of The Peri-Arabian Ophiolitic Belt Including Semail Ophiolite | 165 |
| 6 | Paleoclimatic Registers From Semi-Arid Costal Sediments Of Southeastern India: A Multi Proxy Approach. | 167 |
| 7 | Bathymetric Mapping For Ghazi Headpond Using Adcp At Downstream Of Tarbela Dam, Pakistan | 168 |
| 8 | Dye Tracer Test For Characterization Of Flow Of Kuwait Aquifers: A Case Study | 169 |
| 9 | Geologic, Morphologic And Geotechnical Survey Of The Sarrath Dam (North West Of Tunisia) | 171 |
| 10 | Hydrochemical Assesment Of Groundwater Within The Lower Wadi Ranyah, Western Saudi Arabia Using Multivariate Statistical Technique | 172 |
| 11 | Identification Of The Hydrogeochemical Processes, In Zahrez Basin, Algeria | 173 |
| 12 | Using Remote Sensing And Gis For Evaluation Of Groundwater Resources In Relation To Landforms (Case Study: Maharlou-Bakhtegan Watershed, Fars Province, Iran) | 174 |
| 13 | Hydrogeological Setting Of The Karstic Aquifer In A Semi Arid Region: Case Cheria Plain, Eastern Algeria | 175 |
| 14 | Geochemical Of Groundwater Of The M’sila Plain In North Algeria | 176 |
| 15 | Hydrochemical Characteristics Of Groundwater In Mio-Plio-Quaternary And Zeuss-Koutine Aquifers, Southeast Of Tunisia | 177 |
| 16 | Isolating Groundwater Salinization Processes In Coastal Aquifers Of Southeastern India: Geophysical, Hydrogeochemical And Numerical Modeling Approach | 178 |
| 17 | Aquifer Porosity In The Semi-Arid Context | 179 |
| 18 | Subsurface Thermal Regime To Delineate The Paleo-Groundwater Flow System In An Arid Area, Kufra Basin, Libya | 180 |</p>
<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>Helium Fluxes And Age Dating Of Nubian And Post-Eocene Groundwater In Aquifers Of Central-Se Libya</td>
<td>181</td>
</tr>
<tr>
<td>20</td>
<td>Integration Of Remote Sensing And Hydrologic Data In Southern Wadi Qena, Egypt</td>
<td>182</td>
</tr>
<tr>
<td>21</td>
<td>Assessment Of Groundwater Natural Recharge In Eastern Abu Dhabi</td>
<td>183</td>
</tr>
<tr>
<td>22</td>
<td>Coupled Effect Of Flow Velocity And Solution Ionic Strength On Suspended Particles Transport In Saturated Porous Media</td>
<td>184</td>
</tr>
<tr>
<td>23</td>
<td>Recharge And Discharge Of Main Aquifers In Oman: Investigation On The Basis Of Stable And Radioactive Isotopes And Mg/Ca Ionic Ratio</td>
<td>185</td>
</tr>
<tr>
<td>24</td>
<td>Hydrological Processes Within The Jurassic And Cretaceous Aquifers Of The Occidental High Atlas Basins In Morocco: Using Chemical And Isotopic Tools</td>
<td>186</td>
</tr>
<tr>
<td>25</td>
<td>Monitoring And Modelling Of Groundwater Salinity And Hydrogeochemical Processes In Laghouat Region, Algeria</td>
<td>187</td>
</tr>
<tr>
<td>26</td>
<td>Groundwater Contamination Monitoring At A Landfill Sited On Fractured Hard Rock (Case Mediouna Landfill, Casablanca, Morocco)</td>
<td>188</td>
</tr>
<tr>
<td>27</td>
<td>Contribution Of The Finite Element Method To The Hydrogeological Modeling Of El Haouita Syncline (Medium Saharian Atlas – Laghouat-Algeria)</td>
<td>189</td>
</tr>
<tr>
<td>28</td>
<td>Monitoring Of Groundwater Storage Changes Using Grace Data At Konya Closed Basin, Anatolia, Turkey</td>
<td>190</td>
</tr>
<tr>
<td>29</td>
<td>Groundwater Quality Evaluation And Environmental Impacts At Fares Area, Aswan, Egypt</td>
<td>191</td>
</tr>
<tr>
<td>30</td>
<td>Mapping Of Salinity Ingress Using Galdit Model For Sirkali Coastal Region: A Case Study</td>
<td>192</td>
</tr>
<tr>
<td>31</td>
<td>Groundwater Level Analysis Using Geostatistics And Gis Techniques In Dindigul District, Tamil Nadu, India</td>
<td>193</td>
</tr>
<tr>
<td>32</td>
<td>Analysis Of Groundwater Vulnerability In Loni And Morahi Watersheds Using Geospatial Approach</td>
<td>194</td>
</tr>
<tr>
<td>33</td>
<td>Interpretation Of Groundwater Chemistry Data Using Statistical Analysis</td>
<td>195</td>
</tr>
<tr>
<td>34</td>
<td>Development Water Resources in arid and semi-arid regions: Case Study of Wadi EL Tarfa, Eastern desert, Egypt</td>
<td>196</td>
</tr>
<tr>
<td>35</td>
<td>Geostatistical Analysis For Mapping Variables On Reservoirs And Water Resources: Case Of Rmel-Oulad Ogbane Aquifers (North-Western Of Morocco)</td>
<td>197</td>
</tr>
<tr>
<td>36</td>
<td>Water Resources Quantity Assessment In Al Jabal Al Akhdar Of Oman</td>
<td>198</td>
</tr>
<tr>
<td>37</td>
<td>Extraction Of Water Features Using Modified Normalized Difference Water Indices From Landsat-8 Satellite Images</td>
<td>199</td>
</tr>
</tbody>
</table>
Estimation of Groundwater Recharge in Northern Oman Mountains Using Multiple Techniques

Mansoor Amerjeed
Department of Earth Science, College of Science, Sultan Qaboos University
amerjeed@hotmail.com

Abstract

Recharge/discharge fluxes are very complex components to assess in any groundwater system due to their temporal and spatial variations and to uncertainties in their estimates. However both fluxes represent an essential component in any groundwater budget analysis, especially in arid areas like Oman. This will provide key information for future water development/management plans and water legislations and abstractions.

The present work shows how the combination of several known techniques (numerical modeling, Chloride Mass Balance (CMB) and Water Table Fluctuation (WTF)) methods leads to a better understanding of the groundwater systems in northern Oman, especially the identification of the dominant recharge areas, the recharge/discharge relations, the distribution of the aquifer potential and the estimation of occurring groundwater fluxes from the highland to the coastal plain.

A numerical Groundwater Modeling System (GMS) model was used to estimate groundwater recharge in Wadi Al Fara Catchment in the Northern Oman Mountain. The catchment shows a long-term water balance deficits. The abstraction (51.5 Mm³/yr.) is more than the recharge (31.23 Mm³/yr.). The system is balance by inflow from aquifer storage and sea.

Another notable result in the calibrated water balance is that recharge flux from the upper catchment (highland) to the coastal zone is a major component of the overall balance, about 12.04 MCM/yr. This is the primary source of recharge to the coastal plain, sustaining the underlying stable hydrograph trend along the southern margin by the large storage in the adjoining highland, fractured rock aquifers. This fact proved the hypothesis by previous consultants that highland is the main source of groundwater in the coastal area and that direct recharge from precipitation over the plain is quite small compared to bedrock seepage from the highland, which is now proven to be the main source of recharge.

The fractured bedrock aquifers in the highland are lithologically and structurally complex and difficult to quantify by analytical or numerical methods. However while monitoring networks are generally sparse due to poor access, a flaj and spring samples provide a valuable supplementary data source and provide sufficient coverage for the use of chloride mass balance method.

Preliminary assessments of the water table fluctuation chloride mass balance methods have shown variation in recharge from higher lands to the coastal area owing to variation in precipitation. It is estimated that about 20% of rainfall percolates to the aquifers. Further analyses are needed to constrain these results.
PROBLEMATIC OF FLOOD RISK IN URBAN AREA - CASE OF URBAN AGGLOMERATION OF SIDI BEL ABBES, ALGERIA

Chérifa Abdelbaki, Mohamed Bachi, Mohamed Amine Allal
Department of Hydraulics, Faculty of Technology, University of Tlemcen, Algeria
e-mail: abdelbakicherifa@gmail.com

Abstract:
The problem of the natural risks in general and the Floods in particular is a subject of topicality which marks a memorable action in the world and specifically in Algeria, in particular taking into consideration last great catastrophic risings. As a result, the management of this risk becomes more and more a need which must include all the actors and all the means available possible. In this work, I exposed the cartography of the risk flood by the approach of hydraulic modeling through the example of the Mekerra river which divides the town of Sidi Bel Abbès and while supporting on the contribution of the geographical information system and of hydraulic modeling (HEC RAS). This cartography seems as one of the methods very effective within the framework of an efficient management, it can be used like background document for the public authorities to define the general rules contributing to a better management of urban space while constituting information means of the population on the risks of floods and a tool of organization in the decision makers who are not inevitably technicians, and whose to them returns the final choice of the fight plan against the flood risk.

Key words: Cartography, Risk, Flood, Sidi Bel Abbès, Modeling.
DELINATION OF A FRACTURED AND KARSTIFIED AQUIFER FORMATION AT BAHR AL-NAJAF BASIN, IRAQ

Jassim M. Thabit1* Ameen I. Al-Yasi1 Ala’a N. Al-Shemmari2
1Department of Geology, College of Science, University of Baghdad, Iraq.
* e-mail of corresponding author: jassimthabit@yahoo.com

Abstract

The studied area was geoelectrically surveyed with twenty five (VES) stations using Schlumberger array. Nine of total stations were also benefitted from the use of (Cross-VES) survey along two perpendicular electric lines, to identify subsurface variations of the anisotropy, as well as determining direction of groundwater flow in Dammam aquifer. 2D imaging survey was carried at two stations by using Wenner array, in order to detect the cause of emission of (H2S) gas in Ezia region. The invers model showed occurrence of fractured zone at depth (60m) approximately. The upper confining layer of M. Dammam aquifer is also found at a depth of (40m) approximately. The results of inverse modeling related to these two kinds of surveys were used to construct three geoelectrical sections of (VES) and two inverse modeling of 2D imaging along the selected electric profiles. All geoelectrical sections were calibrated with lithological sections of the vicinity wells and with available structural and hydrogeological information to match them with the true geology of the studied area. The predicted subsurface structure as shown from the hydrogeophysical model includes occurrence of a confined aquifer with an uniform saturated thickness that reaches (160m), and belongs to the M. Dammam member. It is characterized by extensive underground drainage system, as deduced from many self-flowing and artesian wells of high discharges. The reason may be caused by presence of enlarged fractures caused by structural features as Abu Jir fault and the local block faulting. These features are verified by the results of the qualitative and quantitative interpretations.

Key words: hydro geophysical model, Vertical Electrical Sounding, Fractured Rock Aquifer, Dammam Formation.
Use of 2D Resistivity Imaging Technique in Delimitation of Hydraulic Connection between Dammam and Umm Er Radhuma Aquifers Within Abu-Jir Fault Zone, Central Iraq.

Ahmed S. Kadhem 1, Jassim M. Thabit2 and Naseer H. Albasrawi3

1 General Commission for Groundwater, Ministry of Water Resources, Baghdad, Iraq. Ahmed.srdah@yahoo.com
2 Department of Geology, College of Science, Baghdad University, Baghdad, Iraq. jassimthabit@yahoo.com
3 Iraq geological survey. Geosurv. Baghdad, Iraq. al_basrawi1262@yahoo.com

Abstract:

A 2D resistivity imaging survey was used to confirm the presences of hydraulic connection between Dammam and Umm Er Radhuma aquifers within Abu-Jir fault zone, southwest of Karbala city, central Iraq. This survey was carried out by Wenner-Schlumberger array through (4) 2D imaging stations. Each 2D station consisted of survey line with 120 electrodes at (10m) spacing. The results showed two types of fracture zones. The first is formed from connected cavities, which locate near the earth's surface. The second is formed by tectonic movements and that typically occurs as vertical and nearly vertical zone of fractures. The vertical fracture zones indicate the presence of hydraulic connection between the Dammam and Umm Er Radhuma aquifers, due to it is extended with depth and penetrate those aquifers. In addition, the hydraulic connection between aquifers led to the similarity between the resistivity values of Dammam and Umm Er Radhuma layers.

Keywords: 2D Resistivity Imaging Technique. Hydraulic Connection. Aquifers.
CHARACTERISTICS OF THE GASES AND WATERS ISSUING FROM THE KIZILDAG AND ERZIN OPHIOLITES (HATAY/TURKEY): COMPARISON WITH THE REMNANTS OF THE PERI-ARABIAN OPHIOLITIC BELT INCLUDING SEMAIL OPHIOLITE

Galip Yüce¹, Walter D’Alessandro², Francesco Italiano², Sergio Bellomo², Didem Yasin³, Ahmet H. Gülbay³

¹ Hacettepe University, Department of Geological Engineering, Hydrogeology, Beytepe, 06800 Ankara, Turkey (galipyuce@gmail.com)
² Istituto Nazionale di Geofisica e Vulcanologia, Section of Palermo, 90146 Palermo, Italy
³ Eskisehir Osmangazi University, Department of Geological Engineering, Meselik, 26480 Eskisehir, Turkey

Abstract

The Kizildag and Erzin (Hatay) ophiolite bodies are an extension of the peri-Arabian ophiolite belt that includes the Troodos (Cyprus), Baër-Bassit (Syria) and Semail (Oman) ophiolites in the Eastern Mediterranean Region which genetically and tectonically belong to the Southern Tethys oceanic lithosphere (Sengör and Yilmaz, 1981). This study aims to understand the chemical and isotopic characteristics of bubbling and dissolved gases of the hyperalkaline waters related to the serpentinization process in ultramafic rocks at the Amik Basin (Hatay-Turkey) and compare them with the remnants of the peri-Arabian ophiolite belt. The Amik Basin is seismically very active and many catastrophic earthquakes hit the area at historical times due to the Dead Sea Transform and Karasu Faults which further north join to the East Anatolian Fault (Mahmoud et al., 2013). The basin is very close to the triple junction point with the tectonic lineaments connecting the Anatolian, Arabian and African plates. Around 23 dry seeps, free and dissolved gas samples were taken from the study area and analyzed their chemical and isotopic composition. Three main groups of groundwater have been recognized in the area: i) Low salinity and pH between 6 and 9 (shallow groundwater), ii) High salinity and pH between 7 and 8 (deep groundwater), iii) Low salinity and pH between 10 and 12 (groundwater circulating in the ophiolites).

Because of serpentinisation processes, many hyper-alkaline springs (pH>9 up to 12.2) are found in the area. Hyper-alkaline springs flow through the creeks along the narrow valleys, having low yields and are characterized by snow-like deposits due to the precipitation of
brucite and hydrotalcite.

The study shows a great variability in the gas composition of the fluids circulating in the Kizildag ophiolite complex. All gases show very low CO$_2$ and O$_2$ concentrations and their composition is dominated either by H$_2$ or CH$_4$ or N$_2$. He isotopic composition reveals a mixing trend between atmospheric air and a deep end-member of prevailing crustal origin but with a significant mantle contribution (10-20%). Methane has generally an abiotic origin, although for some of the samples a contribution of biotic methane cannot be completely ruled out due to mixing process (Yüce et al., 2014). Dissolved gases collected in the groundwater of the nearby Amik Basin (Yüce et al., 2014 and 2015) show a similar mixing trend for the majority of the shallow (<300 m) groundwaters while the remaining shallow groundwaters and all the deep (>800 m) groundwater samples align along a mixing trend between atmospheric air and a nearly pure crustal end-member.

When we move further to north of the Amik basin towards the Erzin-Dortyol Basin, we have encountered some gas manifestations with abundant CO$_2$ besides methane production wells. Gases in this basin are characterised by a higher mantle helium fraction (up to 48 %) probably due to the presence of seismogenically active faults.

The gases of Kizildag ophiolite and Erzin area are compared to gases of other ophiolithic systems. The sampled gases of Kurtbagi and A71 (Erzin) display $\delta^13$C values which are typical of abiogenic methane while other show more negative values especially for $\delta^15$D.

**Acknowledgements:**

This work has been funded by the Scientific and Technological Research Council of Turkey (TUBITAK) with the project (COST) no 111Y090.
PALEOCLIMATIC REGISTERS FROM SEMI-ARID COSTAL SEDIMENTS OF SOUTHEASTERN INDIA: A MULTI PROXY APPROACH.

Vidyasakar, Anburaj(a,b*), Sant’Ovaia, Helena(b), LintoAllapat(c), P.Morthekai(d†), Srinivasalu, Seshachalam(a), A.K Singhvi(e), Ferreira, Jorge(f), Celeste, Gomes(g)

(a) Department of Geology / Faculty of Science & Humanities, Anna University, Chennai, India.
(b) Earth Sciences Institute, Pole of the Faculty of Sciences, Rua do Campo Alegre 4169-007 Porto, Portugal.
(c) Department of Geology/ Environmental Science, Christ College, Kerala, India.
(d) National Geophysical Research Institute, Uppal Road, Hyderabad - 500 007.
(e) Planetary and Geoscience Division, Physical Research Laboratory, Ahmedabad 380-009, India.
(f) Laboratório Nacional de Energia e Geologia, I.P/ Rua da Amieira, Apartado 1089, 4466-901 S. Mamede de Infesta, Porto, Portugal.
(g) CGUC, Department of Earth Sciences/ Faculty of Sciences and Technology, University of Coimbra, Largo Marquês de Pombal, 3000-272 Coimbra, Portugal.

† Present Address: Luminescence Dating Laboratory, Birbal Sahni Institute of Paleobotany, 53 University Road, Lucknow - 226007.
* Corresponding author; E-mail address: a.vidyasakar@gmail.com; Phone: 00 91 9884266546, +351-933657975

Abstract:
The red sand dunes appear along the south east and west coast of Tamil Nadu, India between the latitudes and longitudes of 8°07’ to 8°22’N; 77°19’ to 77°53’E. The dune sands from these region were studied through magnetic methods such as magnetic susceptibility measurements and acquisition of isothermal remanent magnetization, geochemistry and X-ray diffraction methods. Optically stimulated luminescence (OSL) dating method was used to constrain the chronology of deposits. Three sections were excavated up to 5 - 9.5m with one inland deposit (TPV) and two near coastal sections (THOP & MUT). The magnetic parameters show both significant contribution of hematite structures and indicate the presence of multi-domain magnetite or mixed mineral contents of magnetite and anti-ferromagnetic minerals in the sample. The occurrence of magnetite in THOP and TPV sections is possibly due to the marine sediments transported by sturdy onshore winds. In XRD data, correlation analysis indicated TPV and MUT sections have a similar type of deposition and THOP did not show any positive correlation with TPV and MUT and even with its own deposition. In a comparision with geochemistry data, χ variation and OSL dates, it was shown that the sample [MUT 21 (200cm) with an OSL age of 14±2 ka indicated deposition during humid interval and at [~17±2 ka to ~19±2 ka MUT 61 (600cm) depicts the dry period of deposition.

Acknowledgements:
The researchers are thankful to Dr. Ana Lourenço for their valuable advice and comments during the work. Special thanks to Ms. Sujita Ganaraj for her support in documentation assistance and Mr. Arul Britto for their timely during sample collection in this distinct field. Lastly, acknowledgements to Erasmus Mundus (INDIA4EU II) scholarship officials for their continuous financial support to the research study of Mr. Vidyasakar Anburaj (Indi1200057) during 2013-2015.
BATHYMETRIC MAPPING FOR GHAZI HEADPOND USING ADCP AT DOWNSTREAM OF TARBELA DAM, PAKISTAN

Muhammad Armaghan · Iftikhar Ahmad · Waqas Sikander
MM Pakistan (Pvt.) Ltd 2nd Floor, CTI Building, 27-Empress Road, Lahore, Pakistan
Department of Earth & Environmental Sciences, University of Punjab, Lahore, Pakistan
armaghanmuhammad@gmail.com

Abstract:
Ghazi Head Pond is a prominent feature in the northwest of Pakistan and located downstream of Tarbela dam Pakistan, with a high esteemed potential of water resource. This study provides in depth bathymetric analysis in the headpond, which is of principal importance. In this study it is ascertained that due to environmental and ecological changes the hydrology and sedimentation yield of Ghazi Headpond is being affected and requires comprehensive research and development for future scenarios. For bathymetric mapping the affiliated physical parameters, including depth, volume, area and their mutual relationships were derived.

The maximum depth measured almost at the geographical center of the pond was 22m and the maximum elevation was 343.2m (AMSL). A range of maps like contour map and composite map were produced. In addition Stage-Storage curves were also produced by using HYPACK 2012 software. The bathymetric survey was carried out using a combination of the ADCP and Global Positioning System (GPS), to generate XYZ hydrographic data points. HYPACK 2012, SURFER 12 and ArcGIS 10.1 computer software were used to finalize data evaluation. These conclusions provide decisive strategy for the operation of Barrage and power channel.

Acknowledgements:
The authors are grateful to World Bank for sponsoring this project. Our thanks are also for Water and Power Development Authority (WAPDA) to procure expensive surveying equipment. We would like to appreciate Tarbela Dam Project office for providing us relevant data and boat operator.
DYE TRACER TEST FOR CHARACTERIZATION OF FLOW OF KUWAIT AQUIFERS: A CASE STUDY

U. Saravana Kuma, A. Al-Khalid, K. Al-Fahad, H. Bhandary
Water Research Center, Kuwait Institute for Scientific Research
P.O. Box 24885, Safat, Kuwait
ukumar@kisr.edu.kw

Abstract
Applied tracers (dyes, salt, radioactive isotopes), are powerful investigative tools in hydrogeology because the tracer application (or source term) is controlled and well characterized. This permits quantification of transport parameters and measurement of subsurface properties in a way often unmatched by standard physical methods.

The carbonate Dammam Formation of Eocene age and the unconformably overlying clastic Kuwait Group of rocks of Mio-Pliocene age are the two aquifers that provide useable groundwater in Kuwait. These aquifers extend beyond the political limits of the country to Saudi Arabia and Iraq. Rhodamine WT tracer test was conducted in a beach well located in Shuwaikh area in Kuwait to estimate the filtration velocity of groundwater. A single well borewell technique is a relatively simple hydrogeological technique used to determine the volumetric flow rate of groundwater through a borewell. Tracer is injected into the test borewell and is monitored as the prevailing flow dilutes the concentration of tracer in the well. The rate of dilution is determined through repeatedly profiling the well after the initial establishment of a uniform tracer concentration. The rate of dilution is indicative of the flow velocity and therefore hydraulic conductivity in the immediate vicinity of the well.

About 2 ml of the tracer was mixed with 30 litres of the well groundwater and the diluted tracer solution was continuously injected into the well at a constant rate for 30 min. Subsequent to the tracer injection, number of water samples were collected at several depths at various times and the tracer concentrations were measured using spectrophotometer.
From the tracer concentrations, the filtration velocity and pore water velocity were calculated. Since the tracer test site is located close to the coast, owing to the possibility of tidal influence on the groundwater flows, two consecutive tracer concentrations were taken while calculating the filtration velocity (i.e., $C_t$ and $C_{t+1}$, respectively, as $C_0$ and $C_t$ with $t$ being the difference between $t$ and $t+1$) rather than a single initial concentration at the beginning of the experiment (i.e., at time $t = 0$). The calculated filtration velocity at various depths and time showed variation with depth and time which could be attributed to variation in the well lithology and due to the tidal influence. The filtration velocity ranged from near stagnant (0.07 m/day at 30 m depth) to 0.5 m/day (at 7 m depth). Relatively higher filtration velocity was observed at 7, 18 and 25 m depth, which is due to the more permeable formation at those depths (silty beach sand/gravelly sand). The observed lower filtration velocity at depths 21 and 30 m is due to the silty sand conditions at that depth. The negative filtration velocity observed at 3 and 21 m depth possibly indicate the reversal of flow due to reversal of the tide. A mathematical correction in the calulation of filtration velocity, in case of non-uniform mixing of the tracer in the well, is also proposed.

**Acknowledgements:**

The authors would like to thank Kuwait Institute for Scientific Research and the Kuwait Foundation for the Advancement of Sciences for funding the project. The authors would also like to express their thanks to their colleagues (Mr. Amitabha Mukhopadhyay, Mr. Bandar Al-Salman, Ms. Ruby Crasta, and Ms. Sushma Bangera) for their support at various stages of the investigation.
Abstract
The Sarrath dam’s reservoir is dominated by a quaternary detritical series with conglomeratic intercalations. A multidisciplinary study (geologic, morphologic and geotechnical) is essential to quantitatively and qualitatively characterize these outcrops. The geologic study supported by seismic and gravity analysis shows that the future dam retention is structurally associated with Ouled Bouganem - Kalaâ Khesba grabens. The reservoir central part is occupied by a 300 m thick Quaternary series. The morphologic study of the banks reservoir shows that they are affected by several types of sliding such as slides straight and curved, landslides and scours. However, the cohesion of the particles does not exceed 0.12 MPa and it disappear in the saturated state. This confirms the bank instability status and contributes to the rapid siltation of the future reservoir.

Key words: Sarrath dam, retention, bank stability, geological study, seismic study, gravity, geotechnical.

Acknowledgements:
I would like to thanks Mme. Mazrougui lecturer at the center of research and water technologies (CERTE) for leading my research. As well, I want to express my gratitude to Mr. H.Gabtni senior lecturer in (CERTE) for his moral support, encouragement and assistance in the field and in the geophysics part.
HYDROCHEMICAL ASSESSMENT OF GROUNDWATER WITHIN THE LOWER WADI RANYAH, WESTERN SAUDI ARABIA USING MULTIVARIATE STATISTICAL TECHNIQUE

1Hassan A. Saleem, 1Mohammed O. Alharbi and 2Ali M. Subyani
Hydrogeology Dept. King Abdulaziz University, Jeddah, Saudi Arabia
Email: hassansaleem32@gmail.com

Abstract:
Wadi Ranyah, located in the Western mountains province of Saudi Arabia, is highly potential resource of both surface and groundwater and it is subject to intense exploitation to accommodate all water demands of this semi-arid area. The groundwater of its shallow aquifer in the lower part of Wadi Ranyah undergoes increasing salinity and significant decline in water level. 18 groundwater samples were collected and analyzed for a total 21 water quality descriptors (variables) for both major and trace elements. Multivariate statistical techniques, such as cluster and principal components analysis were employed for groundwater assessment. For water classification, Piper diagram were used, the water quality is Calcium-Bicarbonate type. In addition, saturation indices (SI) were calculated for Anhydrite, Gypsum and Halite and the results show that the groundwater is undersaturation state. R- and Q-modes of cluster analysis resulted two distinctive sources of water chemistry, groundwater-rock interaction and human activities. Three main principal components influenced the water chemistry and pollution of groundwater in the study area. In addition, assessment of drinking quality suggested the salinity increases with $\text{SO}_4^{2-}$ - $\text{Cl}^-$ - $\text{Ca}^{2+}$. 
IDENTIFICATION OF THE HYDROGEOCHEMICAL PROCESSES, IN ZAHREZ BASIN, ALGERIA

Fatah BOUTELDJAOUI 1 Ahmed KETTAB2, Mohamed ACHITE. 3

1 National Polytechnical School, Algiers, Algeria, Corresponding author.
2 Water Science Research Lab., National Polytechnical School, Algiers, Algeria
3 Laboratoire Eau Environnement., Hassiba Benbouali University Chlef, Algeria

E-mail: theldjaoui@yahoo.fr

Abstract:
The Zahrez basin (Fig. 1) belongs to the vast steppes region located in the central northern part of Algeria, covers an area about 8,989 km² and lies between north latitude 34°35’ to 35°30’N and east longitude 2°15’ to 4°08’E. The region is characterized by semi-arid climate, typically Mediterranean, with an irregular annual rainfall. The mean annual precipitation is about 250 mm. Groundwater resources in the study area occur in four main hydrogeological units: (1) Mioplioquaternary consists of conglomerate and clay, (2) Turonian made up of fractured limestone, (3) Albian, and (4) Barremian aquifer made up of sandstone. Groundwater chemistry is controlled by many natural processes as well as anthropogenic processes. The aim of this study is to identify the Hydrogeochemical processes which are responsible for the evolution of chemical composition of groundwater. These processes were identified based on the combination of geochemical methods, graphical methods, scatter diagrams, and multivariate statistical methods. The hydrogeochemical analysis reveals that major ion constituents were of the following order: Cl > SO₄ > HCO₃ and Ca > Na > Mg > K. According to the piper diagram, the dominant hydrochemical facies in the study area is Ca-Mg-Cl-SO₄, which represents 87% of the samples. Mineral saturation indices calculated from major ions, indicate that the groundwater is generally oversaturated with respect to carbonate minerals and undersaturated with respect to evaporite minerals, indicated that the chemical composition of groundwater in the study area is influenced by natural processes of water–rock interaction such as dissolution of evaporitic rocks (gypsum, anhydrite, and halite). In addition, the ionic ratio Ca/Mg explains the contribution of calcite and dolomite to the groundwater calcium, magnesium and bicarbonate content. The first three components of the PCA account for 71.80 % of the total variance in the dataset. PC1 explains 45.66% of total variance, which can be initially assigned to mineralization processes originating from the rock-water interactions. PC3 (10.38%) characterizes source pollution of groundwater.

Acknowledgements:
The authors wish to thank the organizing committee of the International Water Conference 2016.
USING REMOTE SENSING AND GIS FOR EVALUATION OF GROUNDWATER RESOURCES IN RELATION TO LANDFORMS (CASE STUDY: MAHARLOU-BAKHTEGAN WATERSHED, FARS PROVINCE, IRAN)

Marzieh Mokarram¹ and Dinesh Sathyamoorthy²
¹Department of Range and Watershed Management, College of Agriculture and Natural Resources of Darab, Shiraz University, Iran, 
   Email: m.mokarram@shirazu.ac.ir
²(Science & Technology Research Institute for Defence (STRIDE), Ministry of Defence, 
   Malaysia 
   E-mail: dinesh.sathyamoorthy@stride.gov.my

Abstract:

The aim of the study is the determination of the relationship between landform classes with compound topographic index (CTI) and groundwater level for the Maharlou-Bakhtegan watershed, Far Province, Iran. In order to evaluate the groundwater level for the study area, CTI and geomorphology (landforms) were derived from a Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM). The results of landform classes extracted using topographic position index (TPI) show that the largest landform is open slope, while the smallest is plains. It was found that CTI and groundwater level values are high in plain classes, while low in local ridges. High groundwater levels were found to be mostly confined to the pit regions in the plain landform, because groundwater recharge occurs in the zones where standing water remains for sufficient long period of time and has favorable condition for recharge.

Acknowledgements: (10 pt, justification, bold, 6 pt after)

Text body: 10 pt, justification
HYDROGEOLOGICAL SETTING OF THE KARSTIC AQUIFER IN A SEMI ARID REGION: CASE CHERIA PLAIN, EASTERN ALGERIA

Chamekh Khemissi¹, Baali Fethi¹, Yahiaoui Abde El Wahab², Kerboub Djawher³.

¹Labo Eau et Environnement Tebessa Algeria, Department of Geology, Chiekh Larbi Tebessi University. Tebessa, Algeria. E-mail: geologie84@gmail.com
²Laboratoire des risques naturels d’aménagement du territoire (RNAT), Faculté des sciences, Université de Batna – Algeria. E-mail: wahabuniv@yahoo.fr
³Laboratoire d’hydrogéologie, Université de Tébessa Algérie. E-mail: djawhark@yahoo.fr.

Abstract:
The purpose of this study was to identification the Karst cavities in the Cheria syncline, are widespread in the Eocene forming the upper formation under the Quaternary cover. The movement of karst groundwater, especially through solution channels and cavities. Karst hydrogeology research consists mainly of research as well as special geophysical methods, hydrochemical and environmental isotope studies, using stable isotope analysis data, show that all water are meteoric in origin.

Karstification depends on various conditions, including geological, chemical, and climatological factors, rock proprieties, the permeability of the ground, and tectonic movements. The basin is affected by many different tectonic phases and neotectonic movement. These data compared with observations of some subsurface karstic phenomena (karstified fractures) makes it possible to propose a diagram for the evolution of the preferential directions of karstifications (orientations N40 and N140 principally). In other words, if we will give a hydrogeological meaning to the geological, hydrochemical, geomorphological and climatic factors, if we will examine their influence on the groundwater flow field, then we have translate them into conditions and hydraulic properties of the karstic aquifer in the Cheria syncline.

Keywords Hydrogeological- Hydrochemical -Groundwater- Karst- Cheria-Algeria
GEOCHEMICAL OF GROUNDWATER OF THE M’SILA PLAIN IN NORTH ALGERIA

Dougha M, Hasbaia M, Aouina S
Department of Hydraulic, Technology faculty, University of M’sila, Algeria.
Nouveau pôle universitaire, route de BBA, 28000 M'sila, Algérie
m_dougha@yahoo.fr

Abstract:
Geochemical investigations were carried out in the Msila plain, semi-arid area in north Algeria, to assess the quality of groundwater for its suitability for drinking.

The chemistry of groundwater is mainly ordered by the interactions of water-rock, but also influenced by others processes such as presence of K’sob Wadi and changes in climate aridity. Groundwater samples were then collected during the nine years (2004 and 2012). Physical and chemical parameters were analyzed in each sample for a total of 19 water quality descriptors (variables). A multivariate statistical technique, factor analysis, was used to limit the number of variables and understand Geochemical association and processes.

Results were analysed based on the following main variables DR, EC, NO₃⁻, SO₄²⁻, TH, HCO₃⁻, Cl⁻, Ca²⁺, Mg²⁺, Na⁺ and K⁺. The spatial distribution of same variables was presented in the study area.

The groundwater of the mixed aquifer is characterized by the facie: Chlorinated and sulphated calcic and magnesian shown by the diagram of Piper. The water of the M’sila plain has a very remarkable tendency towards the salinisation. Magnesian and calcic cations mark the totality of the samples represented on the triangle of the cations, thus translating the origin of this water. Some variables presented high concentrations which can make mediocre quality of this water. The origin of these variables was studied. The explanation of these changes is strongly related on the heterogeneity of geology and the exchanges between the different aquifers (mixed aquifer) and the influence of K'sob wadi on the phreatic aquifer through the sedimentary layers of conglomerates.

Acknowledgements

Acknowledgements this work has been realized through the framework of CNPRU project G02920060041 and G02920060086. We would like to thank Bourezg Said (University of M’ sillya) for the help and assistance.
HYDROCHEMICAL CHARACTERISTICS OF GROUNDWATER IN MIO-PLIO-QUATERNARY AND ZEUSS-KOUTINE AQUIFERS, SOUTHEAST OF TUNISIA

Hanen Jarray, Mohamed Ouessar2, Mounira Zammouri3, Manuela Barbieri4, Albert Soler i Gil4, Ammar Zerrim2

2 Unit of GIS and Remote Sensing: Laboratory of Eremology and Combating Desertification, Institut des Régions Arides Médenine (IRA), 4119 – Médenine, TUNISIA, Phone: + 216 75 633005 - Fax: + 216 75 633006

1. 4 Grup de Mineralogia Aplicada i Geoquímica de Fluids, Departament de Cristal·lografia, Mineralogia i Dipòsits Minerals, Facultat de Geologia, Universitat de Barcelona, C/Martí i Franquès s/n, 08028 Barcelona, Spain. Tel.: (+34) 93 402 13 43; fax: (+34) 93 402 13 40

Corresponding author: PhD student in Ecole Nationale des Ingénieurs Sfax, E-mail address : jarray_hanen@yahoo.fr

3 Faculté des sciences de Tunis, University Tunis El Manar.Tunisia.

Abstract:
Water scarcity and quality degradation is an important issue in arid regions. Groundwater assessment is prominent to guarantee safe use of water. In the Southeast of Tunisia, Zeuss-Koutine and Mio-Plio-Quaternary aquifers are the main source of water supply for drinking, agriculture and industry. A number of 43-wells were sampled in February 2015 from the two aquifers. These samples were analyzed in the laboratory of the University of Barcelona. Several parameters (pH, Electric Conductivity, Anions, Cations, Heavy metals, Bicarbonates HCO₃⁻ and fluoride (F⁻)) were obtained for each sample. Spatial distribution maps of these parameters have been created using GIS contouring methods with ArcGIS 10. The analytical results obtained were interpreted using hydrochemical methods reinforced by statistical analysis (trend analysis, principal component analysis and correspondence analysis) which has been widely used to analyse large sets of variables in environmental studies. The electric conductivity varies from 1.51 mS/cm to 7.58 mS/cm. Piper diagram was used to identify that the dominant chemical type of both aquifers is sulfated and / or chlorinated calcium and / or magnesium (SO₄²⁻-Cl⁻-Ca²⁻-Mg²⁺). Fluoride concentrations results exceed the World Health Organization (WHO) maximum permissible limit of 1.5 mg/l and vary from 1.9 mg/l and 3.09 mg/l.

Key words: Zeuss-Koutine/MPQ groundwater, water quality, principal component analysis, contamination.

Acknowledgements: While conducting this study, the main author was partially financially supported by the Institut des Régions Arides (IRA) through the following programs: Eremology and Combating Desertification Laboratory supported by the Tunisian Ministry of Higher Education and Scientific Research, and the EU-funded projects WADIS-MAR (n°ENPI/2011/280-008) and WAHARA (FP7/2007-2013, n° 265570).
ISOLATING GROUNDWATER SALINIZATION PROCESSES IN COASTAL AQUIFERS OF SOUTHEASTERN INDIA: GEOPHYSICAL, HYDROGEOCHEMICAL AND NUMERICAL MODELING APPROACH

Srinivasamoorthy K* and Gopinath S
Department of Earth Sciences, School of Physical, Chemical and Applied Sciences, Pondicherry University, Puducherry – 605 014, India
*e-mail of corresponding author: moorthy ks@yahoo.com

Abstract:
One of the most serious problems of water supply in coastal India is the salinisation of groundwater due to natural developments and anthropogenic factors. Salinisation is mainly due higher groundwater withdrawal, global sea-level rise, usage of agricultural fertilizers and pesticides, waste disposal, industrial and domestic effluents. The area proposed for the study Nagapattinam and Karaikal located in southeastern coastal tracts of India between latitudes 10°85’ and 11°40’N and longitudes 79°01’ and 80°01’E with a total geographical spread of 1000 km². The area is marked with rapid increase in population, intensive industrial activities and agricultural usages resulting in groundwater abstraction of 246.81 (million cubic meter) ensuing deeper water level. This has influenced the natural equilibrium between groundwater and saline water resulting in saline ingress and groundwater contamination. The aim of the present study is to assess the sources of groundwater salinization using geophysical, hydrochemical and numerical modeling approach.

The Vertical Electrode Spacing isolated resistivity ranges between 0.5 to 1.5 Ωm as saline intruded up to a stretch of 20 km inland along the eastern parts of the study area. A total of 122 groundwater samples were collected during South west monsoon (SWM) and Summer (SUM) seasons and analyzed for major, minor and trace elements. Results demarcate higher Conductivity (12,430.0 μS/cm), Cl (5060.0 mg/L) and Na (1330.0 mg/L) indicating the saline nature of groundwater. Saline water mixing index indicates 35 % of samples influenced by sea water intrusion. Higher Mn, Zn and Pb suggests anthropogenic influences. The PAAS normalized REE of groundwater exhibits enrichment of HREEs than LREEs due to its higher mobility. The La/Gd and La/Tb ratios compared with Cl and pH suggests influences of anthropogenic and rock water interaction. The process contributing groundwater salinisation were, saline intrusion along the coast, cation exchange and rock water interaction along southwestern and northwestern parts, and anthropogenic sources like sewage, industrial and agricultural activities along southwestern parts of the study area. The SEAWAT code for density-dependent groundwater flow and solute transport modeling predicted sea water intrusion along the eastern parts of the study area due to excess withdrawal and further simulation for 50 years suggests further migration inland.

Acknowledgement:
The corresponding author thanks University Grants Commission (UGC), India for financial grant through major research project No. 41-1036/2012 (SR) dtd.1.7.2012 and the second author acknowledges UGC for granting Project Fellow position.
AQUIFER POROSITY IN THE SEMI-ARID CONTEXT

Zakari Arétouyap
Postgraduate School of Science, Technology and Geosciences, University of Yaounde I,
P.O. Box 812 Yaounde-Cameroon
aretouyap@gmail.com

Abstract:
Water scarcity is one of the major concerns people are facing worldwide. Although the liquid is absolutely abundant through the globe, its availability poses too much problems specifically to each region. These problems can result in one or a combination of three basic situations: declining water (drought), overabundance of surface water (floods) or degradation of the quality of water (pollution). All these situations are reflected in the scarcity of good quality water. Arid areas are particularly concerned. In such areas where groundwater contained in aquifers is usually perceived as providence, exploitation of those resources must be carried out with extreme care in order not to deplete them, and to ensure a long-lasting use of water. Efficient management of groundwater resources, therefore, depends on accurate groundwater modelling to predict aquifer behavior during exploitation. Beside fundamental properties as hydraulic conductivity, the present Paper that addresses the water sector in the semi-arid region of northern Cameroon, shows the importance of the aquifer porosity. The porosity of the local aquifer has then been determined using the Waxman & Smits model which relates the apparent and corrected formation factors, $F_a$ and $F_c$, taking the clay effects into consideration. Other similar semi-arid regions can benefit from the approach successfully applied in the study area.
SUBSURFACE THERMAL REGIME TO DELINEATE THE PALEO-GROUNDWATER FLOW SYSTEM IN AN ARID AREA, KUFRA BASIN, LIBYA

Zenhom E. Salem

Geology Department, Faculty of Science, Tanta University, Tanta, Egypt.
zenhomsalem@yahoo.com

Abstract:
The purpose of this study is to understand the groundwater flow system in the study area. It is become known that the subsurface temperature is affected by groundwater flow and the temperature data can be used to estimate the direction and velocity of groundwater flow. The temperature-depth profiles and water levels were measured in 8 open well fields overall the study area. Vertical and horizontal 2D distribution of the subsurface temperature showed two flow systems, one is shallow and the other is deep. The shallow system is topographically controlled. The deep system is regional and following the regional Nubian flow direction and affected by fault system in the area. The one dimensional temperature-depth profiles modeling was used to estimate the vertical flow velocity and then tracing the recharge and discharge areas.
Helium Fluxes and age dating of Nubian and post-Eocene Groundwater in aquifers of Central-SE Libya

Mohamed Al Faitouri1 and William E. Sanford2

1Department of Sciences, Faculty of Earth Sciences, Benghazi University, Benghazi, Libya, e-mail: alfaitouri2@yahoo.com

2Department of Geosciences, Colorado State University, Fort Collins, CO, USA e-mail: William.Sanford@Colostate.edu

Abstract

Libya like other African countries suffers from a shortage in water resources due to arid climate. However, Libya has large resources of good quality groundwater distributed in its six basin systems beneath the Sahara. Two sedimentary basins, (Sirt and Kufra) which located in central and southeast of Libya respectively were selected for a comprehensive hydrogeological study. The analysed samples were selected from three water wellfields, these are the Sarir wellfield is located within the Sirt basin; the Tazerbo wellfield and Al Kufra wellfield in the Al Kufra basin in order to determine the age of the water in the aquifers and when recharge occurred and to estimate the climate at the time of recharge (paleotemperatures). This was the first study used Helium isotope method for dating the aquifers at Sirt and Al Kufra Basins. In addition, the helium content of the water will allow for the determination of the fluxes of helium in the crust at the locations of the aquifers. These fluxes include the helium produced in situ in the aquifer and fluxes from outside the aquifer (crust and mantle helium). The analyses of the noble gas data show that there are significant amounts of 4He in the waters in excess of what is to be expected by water equilibration with the atmosphere. This indicates that for each aquifer, there is a strong component of terrigenic helium (helium produced within the earth due to radiogenic decay of U and Th decay products). Groundwater age in the aquifer can be estimated by determining the in-situ production rate of 4He using the U and Th content (assuming no external sources of helium). This method yields average water ages of 1.3 x 105 years for Al Kufra, 5.1 x 105 years for Sarir and 4.5 x 106 years for Tazerbo. The 4He ages for Sarir and Al Kufra are about one order of magnitude greater than the 14C ages and the Tazerbo 4He age is about two orders of magnitude greater. Based on looking at helium isotope ratios, it can be seen that there are external fluxes to the aquifers which would add more helium to the system than could be produced in situ. 3He to 4He ratios indicate that much of the helium in the aquifers is acquired from external fluxes (aquitards, crust and mantle).
INTEGRATION OF REMOTE SENSING AND HYDROLOGIC DATA IN SOUTHERN WADI QENA, EGYPT

Mohamed Abdelkareem*1,2, Fathy Abdalla1,3, Kareem M Moubark1,
1 Geology Department, South Valley University; 2 Center for Remote Sensing, Boston University; 3 Research Chairs Programme, Deanship of Scientific Research, King Saud University, Saudi Arabia

e-mail:mismail@bu.edu; Mohamed.abdelkareem@sci.svu.edu.eg

Abstract

In this article, an integrated approach of remote sensing (RS), field data, geochemical characteristics and geographic information systems (GIS) methodologies were integrated to assess the hydrologic and hydrochemical characteristics of groundwater resources in southern Wadi Qena area. This is because, the groundwater is the most important for land reclamation, industrial, and mining activities in one of the most important national projects what is called the 'Golden Triangle'. The characteristics of the groundwater aquifers include depths, water level, flow of the water, chemical characteristics, suitability for agriculture and domestic uses are considered here. The results show two main aquifers; Quaternary and Nubian. The Quaternary contains two layer bearing-water; one is shallow (< 10m), and second layer with average depths is 30 m. The depth to the Nubian aquifer is an average 430 m. The TDS of collected water is varies between 1440 to 19400 mg/l. The Sodium Absorption Ratio (SAR) values ranges from 1.4 to 27.22 notably higher in Nubian aquifer, and low in Quaternary aquifer.
ASSESSMENT OF GROUNDWATER NATURAL RECHARGE IN EASTERN ABU DHABI

Mohamed M. Mohamed¹, Ahmed Murad², and Rezaul Chowdhury¹

¹Department of Civil and Environmental Engineering,
²Department of Geology,
United Arab Emirates University, Al Ain, P.O.BOX 17555, UAE.

m.mohamed@uaeu.ac.ae

Abstract:
Despite the continuous increase in water supply from desalination plants in the United Arab Emirates (UAE), groundwater remains the major source of fresh water satisfying domestic and agricultural demands. Additionally, groundwater has always been considered as a strategic water source towards groundwater security in the country. Understanding the groundwater flow system; including identification of recharge and discharge areas, is a crucial step to achieve groundwater sustainability. As such, the main aim of this research is to identify groundwater recharge regions to the shallow unconfined groundwater aquifer in the eastern part of UAE. Generally, estimation of groundwater recharge and discharge fluxes in unconfined systems in arid regions are difficult because of lack of knowledge on how to distribute water flux and vapor discharge. Previous investigations of groundwater resources in the eastern region of UAE indicated that the surficial groundwater is one of the main sources of fresh groundwater. Most of the recent natural recharge to this surficial aquifer is associated with the high precipitation near Omani Mountains across the eastern border of the UAE. However, these studies warned that this aquifer has limited natural recharge and can be affected by pumping. In this study, The importance of the border zone between UAE and Oman from the point of the recharge by the precipitated water was investigated by groundwater samples collected from several groundwater wells in the area between Hafit and Al Waqan district. The field measurements of the salinity (TDS mg/l) exhibits values ranges between 400 to 14900 mg/l. Furthermore, the calculated results of laboratory analysis of the major cations and anions refers clearly to the marine origin of this water which, slightly affected by the recharge in some wells. The dominant water type among the hydrochemical composition of the groundwater was the sodium chloride type as well as the salts of permanent hardness have the prevalent order rather than the salts of temporary ones. Results of this study will be of great importance to water resources managers in UAE as it will help to accurately estimate sustainable extraction rates, assess groundwater availability, and identify pathways and velocity of groundwater flow as crucial information for identifying the best locations for artificial recharge.

Acknowledgements:
The authors would like to express their sincere appreciation to the National Water Center at the United Arab Emirates University for the financial support of this project under fund grant # NWC - 3-2013.
COUPLED EFFECT OF FLOW VELOCITY AND SOLUTION IONIC STRENGTH ON SUSPENDED PARTICLES TRANSPORT IN SATURATED POROUS MEDIA

Lyacine Bennacer¹*, Nasre-Dine Ahfir², Abdellah Alem², Huaqing Wang²

¹Adrar University, route nationale No. 6, 01000 Adrar, Algeria.
²LOMC, UMR 6294 CNRS-Le Havre University, 53 rue de Prony, BP 540, 76058 Le Havre Cedex, France

*E-mail: lyacine.bennacer@laposte.net

Abstract:

Suspended particles transport in saturated soils interests many fields. In the field of environment, understanding the transport of solid particles in the subsurface system is essential to the protection of groundwater resources from contamination by microorganisms and solid particle bound contaminants. The mechanisms of transport, deposition, and remobilization of particles in saturated soils is complex and depend on many factors that can be interdependent such as: particle concentration in the influent; geometry and surface-roughness of the grains; physicochemical interaction, and hydrodynamics.

For this purpose, an experimental study in laboratory columns was conducted using particulate and dissolved tracers of controlled characteristics. In this study, a pulse injection technique was used to investigate the influence of ionic strength on the transport and deposition of suspended particles in saturated sand. The used ionic strength varies from 0 to 600 mM (NaCl). Two velocities were tested: 0.15 and 0.30 cm/s. Selected polydisperse silt particles ranging from 0.27 to 8 µm with a median diameter (d_{50}) equal to 2.8 µm were used. The particle size distribution of the injected and recovered particles was obtained using a particle counter (Coulter Multisizer II). The suspended particles transport behaviour is compared to that of a dissolved tracer (Fluorescein). The analytical solution of an advection–dispersion equation with a first-order deposition kinetics was used to describe the experimental breakthrough curves, and to determine the transport parameters. The results show that increasing the ionic strength promotes the retention of the suspended particles in the porous medium. The hydrodynamic dispersion is not affected by the ionic strength variations. The suspended particles deposition kinetics increases linearly with the square root of the ionic strength.

Acknowledgements:

I would like to express my gratitude and acknowledgements to the members of the Geomaterials and Environment group of the Waves and Complex Media Laboratory at Le Havre University, France for their contribution to the elaboration of this study.
RECHARGE AND DISCHARGE OF MAIN AQUIFERS IN OMAN: INVESTIGATION ON THE BASIS OF STABLE AND RADIOACTIVE ISOTOPES AND Mg/Ca IONIC RATIO

Khadija Semhi1, Osman Abdalla1 and Rashid Al Abri1,2
1Department of Earth Sciences, College of Science, Sultan Qaboos University, P.O.box 36, Al-Khod 123, Muscat, Sultanate of Oman
2Ministry of Regional Municipalities and Water Resources
*Corresponding author: semkhad@yahoo.fr

Abstract:
Groundwater samples collected from different aquifers in Oman were analyzed for conventional hydrochemistry, stable and radioactive isotopes (deuterium D and ¹⁸O and ⁸⁷Sr/⁸⁶Sr ratio) to assess recharge and aquifers interaction. The main aquifers are: the limestone of the Hajar Super Group (HSG, Cretaceous), Tertiary rocks, Hawasina sedimentary rocks, ophiolites and alluvium. D and ¹⁸O in precipitation reveals two moisture sources: summer dominant from the Indian ocean and winter dominant from Mediterranean sea. Ionic Mg/Ca ratio indicates that chemical composition of groundwater is influenced by dissolution of dolomite in addition to calcite for most of investigated wells from HSG, tertiary and alluvium aquifers. Groundwater from ophiolite is characterized by high Mg/Ca ratio which can reflect its interaction with magnesian silicate minerals. The ⁸⁷Sr/⁸⁶Sr ratio measured in groundwater from the different aquifers showed that in addition to calcite and dolomite the waters reflect their interaction with evaporite rocks. Using isotopic evidences (□D-□¹⁸O relationship on one hand and ⁸⁷Sr/⁸⁶Sr-¹/Sr relationship on the other hand) revealed that in addition to waters from HSG: 1) ophiolite aquifer is recharged from direct infiltration of precipitation and from infiltration from alluvium, 2) both alluvium and Hawasina are recharged from infiltration from ophiolite and 3) tertiary aquifer is recharged from ophiolite and from alluvium. Based on strontium isotopes, a mass balance calculation allowed to estimate that about less than 10% of ophiolite groundwater is recharged from alluvium and about more than 90% from HSG.
Abstract:
The Agadir-Essaouira basin belongs to the western part of High Atlas Mountains in the South-East of Morocco. The inhabitants of this semi-arid region suffer from water scarcity, compounded by recurrent long drought periods. In these circumstances and in the absence of surface water supplies, the groundwater resources from the Jurassic and Cretaceous aquifers are solicited for drinking and irrigation purposes. Herein, we investigate the groundwater quality and characterize the functioning of the Jurassic and Cretaceous aquifers and their possible relationships using chemical and isotopic tracers. The water quality is variable with electrical conductivity values ranging from 580 µs/cm to 6170 µs/cm. Chemical analyses show that the dominant ions in groundwater are Ca$^{2+}$, Mg$^{2+}$, HCO$_3^-$, and SO$_4^{2-}$. This water type is related to water/rock interactions including the dissolution of carbonate rocks (Limestone and Dolomite) and cation exchange process with clay minerals. The δ$^{18}$O and δ$^2$H values range from -3.1 to -6.9 ‰ and -22.54 to -48.14 ‰ respectively. These results reveal an evaporation process affecting the recharge runoff of the Cretaceous aquifer, while there is a direct infiltration of precipitation in the Jurassic karstic aquifer. The δ$^{18}$O signal also indicates a local groundwater recharge of both aquifers from areas with altitudes between 1000 and 1500 m. These chemical and isotopic tracers are very useful for identifying the mixing process and water recharge.

Acknowledgment: This work is carried out within Collaborative Project between Grenoble and Agadir Universities.
Abstract

Groundwater is considered one of the most important water resources in the Algeria. Due to rain Shortage and high population growth in the last years, wells excavation and groundwater use for different purposes had been increased without any planning. This is a great challenge for this region. Moreover, this scarcity of water resources in this region is unfortunately combined with, severe deterioration of groundwater quality due to salinity and contamination processes. Consequently, it is necessary to conduct the studies about groundwater quality in Algeria and define its suitability uses.

The main objective of this study was to identify the main sources of groundwater salinity and the major hydrogeochemical processes controlling the groundwater evolution in Laghouat region.

The results show that the physiochimecal assessment of groundwater quality, mapping of salinity groundwater distribution and spatial interpolation was applied to map the spatial and directional distribution of each parameter.

Analyzed results demonstrated that the salt rocks are responsible of this height salinity. Moreover, the results can serve as an important reference for water utilities during future facility renewal projects.

Keywords: groundwater, salinity, modelling, characterization, Laghouat.
GROUNDWATER CONTAMINATION MONITORING AT A LANDFILL SITED ON FRACTURED HARD ROCK (CASE MEDIOUNA LANDFILL, CASABLANCA, MOROCCO).
Soukaina.HICHAM 1, Ahmed.FEKRI1, Chakib.MARRAKCHI1 and Ouafaa.ELHAMMOUMI1

1: Geology department, laboratory of geology applied, geomatic and environment, faculty of sciences Ben M’sik, Casablanca, Morocco
E-mail: h.soukaina20@gmail.com

Abstract

Groundwater monitoring program around landfill area is usually undertaken not only to determine groundwater quality but also, to understand the hydro-geological conditions. It consists of describing the occurrence and distribution of pollution and delineating contamination plume in aquifer at long term. The groundwater quality degradation represents a significant threat to public health and to the environment. Furthermore, the fractured aquifer presents a higher vulnerability especially when it concerns landfill pollutants. The Mediouna landfill located 10 km SE of Casablanca is sited on fractured hard rock since 1986. This unlined landfill without any system to collect the leachate has a volume capacity around three million m³. The present study aims to delineate pollution plume downstream the landfill. The assessment of groundwater quality is monitored through three hydro chemical monitoring campaigns carried out in 2001, 2011 and 2014. A number of 15 wells groundwater’s water samples have been selected from up and downstream of the landfill. Key parameters, such as pH, electrical conductivity and major ions have been measured as well as chemical oxygen demand for organic pollution indication.

The statistical treatment using Principal Component Analysis has identified three wells water groups according to their dissolved elements. As a result, (i) the front of pollution is progressing toward Casablanca city, due to a structural control by the lineaments. The high contaminants values are registered close to the landfill and they decrease far of it; (ii) the mineral pollution is progressing downstream faster than the organic one.

Keywords: groundwater, monitoring, pollution, leachate landfill, hard rock.
CONTRIBUTION OF THE FINITE ELEMENT METHOD TO THE HYDROGEOLOGICAL MODELING OF EL HAOUITA SYNCLINE (MEDIUM SAHARIAN ATLAS – LAGHOUAT-ALGERIA)

MOUATTAH K.(1)*, CHETTIH M.(1), MAKOUDI M.(1)

Water Resources, Soils and Environment Laboratory, University Ammar Thlidji, Laghouat, Algeria

*k.mouattah@lagh-univ.dz

Abstract

The structure of El Haouita (Laghouat-Algeria) syncline corresponds to a wide fold-oriented SW-NE shifted by periclinal endings and by large amplitude kinks. The asymmetrical syncline is attacked by erosion that left a perched syncline. The sandstone formations of the Lower Cretaceous is the most important aquifer of the region, with multiple porosities of gaps, cracks and channels constituting a multilayer system. The finite element method is the most commonly used method, and a powerful tool, when dealing with complex geometry system and strong heterogeneity.

The purpose of this study is to propose a numerical model able to reproduce the main hydrodynamic characteristics of the studied system and hence to distribute them spatially. To this end, a conceptual finite element model was established in this study. The modeling of the aquifer using the Micro-FEM software was employed to exploit the data of the various campaigns for recognition and lead to practical and important results. These results depend on the assumptions made and on the quality of data collected. But they remain of practical use since they allow to have an order of magnitude close to reality. The advantage of this model is, however, more noticeable insofar as it can provide relatively accurate information on the evolution of the aquifer in the short and medium term, and since it may constitute, for the long term, a new informations collecting device that will improve the accuracy of long term forecasts.

Keywords: modeling, finite elements, aquifer, hydrogeology, haouita, saharian atlas
MONITORING OF GROUNDWATER STORAGE CHANGES USING GRACE DATA AT KONYA CLOSED BASIN, ANATOLIA, TURKEY

Mohamed Saber¹, ², Koray K. Yilmaz², and M. Tugrul Yilmaz³

¹Geology Department, Faculty of Science, Assiut University (Assiut 71516, Egypt)
²Department of Geological Engineering, Middle East Technical University, (Ankara, Turkey)
³Department of Civil Engineering, Middle East Technical University, (Ankara, Turkey)

msaber_75@yahoo.com

Abstract

The Konya Closed Basin (KCB), Central Anatolia, Turkey, is a semi-arid region where groundwater is the main water resource. Monitoring of groundwater storage changes using Satellite Remote sensing data in such a semi-arid basin is critical due to the scarcity of water resources and the need for effective water management strategies to avoid further depletion of the groundwater resources. Therefore, the main objective of this study is to examine and assess the utility of the Gravity Recovery and Climate Experiment (GRACE) and the Global Land Data Assimilation System (GLDAS), along with GIS techniques to monitor and investigate the groundwater storage changes at the target groundwater aquifer. Groundwater storage changes are derived using GRACE and GLDAS data and then are compared with the groundwater changes derived from the observed groundwater levels. The initial results of the comparison indicates an acceptable agreement between declining trends in GRACE-based and observed groundwater storage changes during the study time period (2002 to 2014). The declining trend of groundwater storage changes obtained from GRACE shows a decreasing rate of about 0.121 km³/year within the study period. The link between the groundwater storage changes and land subsidence was also investigated. Additionally, the results indicated that the study region exhibited remarkable drought conditions in 2007 and 2008. This study shows that the GRACE/NLDAS datasets, along with the application of GIS techniques, can be used to monitor the equivalent groundwater storage changes and consequently to investigate potential land subsidence which are crucial for long-term effective water management strategies.

Acknowledgements

This research was supported by the Scientific and Technological Research Council of Turkey (TUBITAK) fellowship, Program 2221, Turkey.
GROUNDWATER QUALITY EVALUATION AND ENVIRONMENTAL IMPACTS AT FARES AREA, ASWAN, EGYPT

Mohamed Saber 1, Omar Ahmed1, Esmat A. Keheila1, Mohamed Abdel-Moneim Mohamed1

1Geology Department, Faculty of Science, Assiut University (Assiut 71516, Egypt)

msaber_75@yahoo.com

Abstract

Groundwater contamination and environmental impact of groundwater uprising are critical issues in Egypt. The main purpose of this study is to evaluate the groundwater quality and to investigate the environmental impacts of groundwater uprising at Fares area, Aswan, Egypt. The environmental impacts of the groundwater uprising level were investigated revealing that the use of flood irrigation system in the upper new lands reclamation is the main cause of groundwater uprising levels. Hydrochemical and biological analysis of groundwater aquifer carried out. Thirty three samples were collected and chemically analyzed from three groundwater wells. The chemical characterization of groundwater at well 1 was changed from NaHCO₃ to NaCl due to the over-drafting from it. The chemical concentrations of all parameters are considerably showing an increasing trend with the time to exceed the standard limits in all samples from Well 1. Microbiological analysis of the groundwater samples shows negative results because the wells are far away from the urbanized areas. It is recommended that the governorate of Aswan, Egypt must control and manage the use of groundwater in Fares area because the current research stated that the quality of groundwater is decreasing within a few years and its chemistry are dramatically changeable.

Acknowledgements

This work has been funded by the TEMPUS Project of Applied Environmental Geosciences and Water Resources Management (JEP-32005-2004), Assiut University, Egypt.
Abstract

A model is traced to evaluate and enumerate the significance of vulnerability to seawater intrusion due to excessive ground water withdrawals and some anthropogenic activities at coastal aquifers. So taking these issues into account few thematic maps which were influencing the saline water intrusion were prepared and overlaid using Geographical Information Systems (GIS). Based on GALDIT method, the groundwater vulnerability cartography has been assessed. To reckon the GALDIT index it requires six parameters like Aquifer type, Aquifer Hydraulic Conductivity, Depth to groundwater level (AMSL), Distance from the shore, Impact of existing status of seawater intrusion and Thickness of the aquifer. This GALDIT is the indicator scores and summing them and dividing by the total weight for determining the relative role of each one. A part from this an Identification of saltwater intruded area is done by using indicators of saltwater intrusion like Cl/(HCO3+CO3) ratio and Na/Cl ratio. The vulnerability areas are classified as good, moderate and poor respectively based on the thematic maps. The final thematic map can be used for management of the coastal ground water resources.

Keywords: Saline water intrusion, GALDIT Index, coastal aquifer, vulnerability assessment, GIS.
GROUNDWATER LEVEL ANALYSIS USING
GEOSTATISTICS AND GIS TECHNIQUES IN DINDIGUL
DISTRICT, TAMIL NADU, INDIA

P. Siva Kumar¹ T. Vahitha¹ K.Kumaraswamy²
Department of Geography, Bharathidasan University, Tiruchirappalli,
Tamil Nadu, India.
Email: geosiva@yahoo.in

Abstract

In the present paper an attempt has been made to analyse the groundwater level fluctuation in Dindigul District, Tamil Nadu, India. Groundwater is replenished by precipitation and depending on the local climate. The Industrial development, urban growth and increase in agricultural production have led to the freshwater shortages in many parts of the Dindigul District. The availability of groundwater is extremely uneven, both in space time and depth.

Geostatistics which has been introduced as a management and decision tool by many researchers has been applied in the present analysis to reveal the spatial and temporal structure of groundwater level fluctuation for identifying critical location over the study area where water saving and groundwater augmentation techniques can be implemented to preserve the groundwater. Geostatisics and geographic information systems (GIS) have been proved as successful tools for efficient planning and management of the groundwater resources.

Acknowledgement:

We are thankful to the University Grants Commission, UGC, New Delhi for awarding UGC-BSR Research Fellowship in Science for Meritorious Students.
ANALYSIS OF GROUNDWATER VULNERABILITY IN LONI AND MORAH WATERSHEDS USING GEOSPATIAL APPROACH

Rajat Agarwal, P. K. Garg

Geomatics Engineering, Department of Civil Engineering, Indian Institute of Technology (IIT), Roorkee 247667, India

Email: agarwalraja@gmail.com

Abstract

Groundwater vulnerability assessment is necessary because human health and economic impacts are associated with groundwater contamination. In this paper, a detailed study is carried out using the DRASTIC model with slight modification on a GIS platform for assessing groundwater vulnerability. In DRASTIC model, seven layers (Depth of water, Net Recharge, Aquifer media, Soil media, Impact of vadose zone, Topography and Hydraulic Conductivity) have been used for groundwater vulnerability mapping. As the terrain is almost flat, topography layer of the aquifer is not included in computing the final DRASTIC index for vulnerability mapping. In groundwater vulnerability studies, Land Use Land Cover (LULC) pattern plays an important role so it has been added as a new parameter in the DRASTIC approach. The resulting groundwater vulnerability map was then integrated with the LULC map as an additional parameter in the DRASTIC model to assess the potential risk of groundwater to contamination in the study area. The normalized values of vulnerability index is varies between 0.21 and 0.96. It has been further classified into four classes: low, moderate, high and very high on the basis of their histograms. The combination of the model parameters that pertinent to groundwater vulnerability like very shallow depth to water table (< 6 m) in the most part of study area with almost flat area (< 2% slope) and high to very high recharge rate in study area led to this high pollution potential index. The result was validated using nitrate and fluoride data of aquifers, and found that majority of sampled sources which violated BIS, 2012 limit value of nitrate and fluoride are located in high to very high vulnerable zones.
INTERPRETATION OF GROUNDWATER CHEMISTRY DATA USING STATISTICAL ANALYSIS

Faisal Rehman and Tariq Cheema
Faculty of Earth Sciences, King Abdulaziz University, Jeddah, Saudi Arabia
faisalrehman_atd@yahoo.com

Abstract

Hydrogeologists in general and hydrogeochemists in particular are commonly asked to collect and interpret groundwater chemistry data for determining the groundwater quality at a particular site. More often, this involves graphical representation of data and a comparison with the drinking water quality standards. However, public laws and regulations (eg. RCRA, CERCLA, CWA, etc.) require rigorous and a comprehensive quantitative approach including statistical analysis to interpret the groundwater chemistry data. The analysis might be helpful in identifying the contaminated sites. 19 groundwater samples were collected from Wadi Bani Malik located 40 km to the east of Jeddah, Saudi Arabia. The area once known to be a dumping ground for untreated waste has now been partially remediated. The common ion analysis performed on the groundwater samples showed TDS concentrations much higher than the normal. Na\(^+\) and Cl\(^-\) concentrations in one of the samples were 17900 mg/l and 29820 mg/l, respectively. To establish that the higher concentration of salts is due to the sewage dumping, the data was compared with an adjacent Wadi Madsus that was not known to have any history of dumping. A distribution-free method of multivariate data analysis was employed to compare the variation in species abundance and composition among sampling units. Analysis of similarity (ANOSIM) provides a way to test statistically whether there is a significant difference between two or more groups of sampling units.

Analysis of similarity (ANOSIM) using R package vegan indicates strong correlation (R = 0.82) between Wadi Bani Malik and Wadi Madsus. The P factor calculated while performing the analysis suggests that sewage dumping significantly contaminated (P = 0.001) the groundwater quality of Bani Malik area.
Development Water Resources in arid and semi-arid regions: Case Study of Wadi EL Tarfa, Eastern desert, Egypt

Elsayed M Abu El Ella

Geology Department, Faculty of Science, Assiut University, Egypt
Abuelellaem@gmail.com

Abstract

Development of the Nile Desert fringes and establishing of new communities and settlements are among the future national plans of Egypt. Wadi El Tarfa represents one of the interested areas for the future land reclamation. It is characterized by large surface area (4436 km²) and good groundwater and soil potentialities. Accordingly, the evaluation of the water resources is required. Based on field investigations and using different maps (topographic and geologic) the area of study is geomorphologically, geologically and hydrogeologically evaluated. The Middle Eocene limestone rocks represent the productive aquifers in Wadi El Tarfa area. The groundwater is available in two aquifers; Maghagha marly limestone aquifer and Samalut-El Minia chalky limestone aquifer. The groundwater of Maghagha marly limestone aquifer is recorded at depths range from 109 m to 129.14 m and the groundwater salinity of the collected groundwater samples representing this aquifer is relatively high and ranges from 4415.3 mg/l to 17147 mg/l. The groundwater of Samalut-El Minia chalky limestone aquifer is recorded at depths range from 13.20 m to 80.46 m and the groundwater salinity ranges from 257 mg/l to 1872.2 mg/l. Water samples representing the investigated groundwater were collected, chemically analyzed and evaluated. The major elements are determined and their genesis are suggested preliminary.

Keywords: Hydrogeology, geomorphology, Wadi El Tarfa, Middle Eocene aquifer, Eastern Desert- Egypt.
GEOSTATISTICAL ANALYSIS FOR MAPPING VARIABLES ON RESERVOIRS AND WATER RESOURCES: CASE OF RMEL- OULAD OGBANE AQUIFERS (NORTH-WESTERN OF MOROCCO)

M. Jalal EL HAMIDI, A. LARABI, M. FAOUZI, M. SOUISSI
Regional Water Center of Maghreb, LIMEN, Mohammed V University, Agdal, Rabat, Morocco.
e-mail : elhamidi.mohamed.jalal@gmail.com
e-mail: larabi@emi.ac.ma

Abstract

The objective of this study is to identify and assess the distribution and spatial changes of variables relating to reservoirs and water resources using geostatistical modeling. This study focuses on the coastal area of Rmel-O. Ogbane aquifers, where the increase in water demand, due to demographic and agricultural development, is accompanied by pressure on groundwater abstraction. This situation causes significant drops of the groundwater level and may eventually cause a deficit water balance of the aquifer, as well as a degradation of freshwater quality by seawater intrusion; and therefore risk in the future to know the problems of the most serious shortages.

The study area of Rmel-Ouled Ogbane aquifers, with a surface of approximately 303km², is located in Low-Loukkos basin in northern Morocco (south of Larache city). This area is delimited to the west by the Atlantic Ocean, to the east by succession of hills of prerifan aquifer and to the south by marl outcrops from Mio-Pliocene.

The prediction of these variables was performed using an interpolation method: kriging in a Geographic Information System (GIS). The normality test and trend analysis were applied to each variable to select the appropriate variogram model and check the results using cross-validation. Hence, several thematic maps of reservoirs and water resources have been produced to be used by the decision maker. These products of geostatistical analysis allowed, updating the water balance in 2014 and constructing the conceptual model of these aquifers. This product will also be used to support a set of groundwater simulations based on Visual MODFLOW code; and to develop a mathematical model in steady state and transient flow, pollutant transport and seawater intrusion in these aquifers.

Acknowledgements:

The authors express thanks Mohammadia School of Engineers and Delegate Ministry of Water that have made available data as part of the agreement DRPE, ABHL / EMI, to perform such a geostatistical analysis.
WATER RESOURCES QUANTITY ASSESSMENT IN AL JABAL AL AKHDAR OF OMAN

Mohammed Saif Al-Kalbani1,*, Martin F. Price1, Mushtaque Ahmed2
1Centre for Mountain Studies, Perth College, University of the Highlands and Islands, Crieff Road, Perth PH1 2NX, UK
2Department of Soils, Water & Agricultural Engineering, College of Agricultural and Marine Sciences, Sultan Qaboos University, PO Box 34 Al-Khod 123, Oman
*Corresponding author E-Mail: Kmohd2020@yahoo.com

Abstract

Al Jabal Al Akhdar, in the northern Oman Mountains, has experienced rapid development over the last decades, resulting in the deterioration of water resources quantity. The objective of this paper is to assess water quantity in this mountain fragile region by analyzing data series of trends and changes in water quantity over the last few decades. Trends in temperature and precipitation showed statistically significant increases in temperature and a general decrease in total precipitation from 1979-2012. The analysis of the current state and changes of groundwater levels in the aquifers indicated lower levels since high rainfall in 1997. The National Aflaj Inventory conducted from March 1997 to June 1998 identified 72 aflaj in the area, of which only one was inactive (dry). By 2012-2013, the number of the active aflaj had decreased to 38. The water flow rates of the five main aflaj are influenced by the regional rainfall and the resulting availability of water in their mother wells. The flow rates of these aflaj increased during the wet years from 1992 to 1997, but generally declined until the beginning of this century. Water for irrigation is supplied not only by aflaj, but also by dams which are constructed to entrain wadis; dams’ water storage are also critically dependent on rainfall. Data on water consumption in the North Halfayn Water Assessment Unit Area (WAUA), which includes the study area, showed that more than 92% of water is consumed by agricultural activities. Water extraction and consumption for domestic use from the two main wells in the area increased by 386% from 2001 to 2012. The assessment of monthly data water consumption by tourism sector showed that the average consumption is around 641 to 1305 litres per guest per day, which is many times higher than the water consumption in Muscat Governorate; 123 liters per person per day. Water balance data for the North Halfayn WAUA in 2012 indicated an imbalance between supply and demand with a deficit of -9.69 million m3/year. The paper recomends some policy options which should be directed towards improving water-use efficiency through installing modern irrigation technology, water conservation methods, use of greywater and treated wastewater, and rainwater harvesting as well as integrated water resources management, and climate change mitigation and adaptation measures.

Acknowledgements: The authors would gratefully acknowledge the Ministry of Regional Municipalities and Water Resources, Public Authority of Electricity and Water, Directorate General of Meteorology and Air Navigation, Oman National Engineering and Investment Company for providing different data series for this research. We would also like to send our greatest appreciations to the Ministry of Environment and Climate Affaires for funding this research.
EXTRACTION OF WATER FEATURES USING MODIFIED NORMALIZED DIFFERENCE WATER INDICES FROM LANDSAT-8 SATELLITE IMAGES

Kuldeep, P.K. Garg
Geomatics Engineering Group, Civil Engineering Department
Indian Institute of Technology Roorkee, Roorkee, India
kchaurasia.nitb@gmail.com

Abstract

The main advantage of essential component of life for any living being is that it can be recycled and used for various human needs but the disadvantage of the water resource is that it is finite. The increasing scarcity and shortage of water have necessitated the development of the methods for water resource assessment and management. In this paper, water regions have been extracted using a two step approach, firstly model generation and secondly, image segmentation. NDWI, MNDWI$_1$ and MNDWI$_2$ models have been generated and their segmentation has been accomplished using thresholding method. The minimum and maximum values of the threshold have been chosen as 0.070 and 0.229 for segmentation of MNDWI$_1$ image and 0.155 and 0.251 for MNDWI$_2$ respectively. The total surface area of the watered region using NDWI, MNDWI$_1$ and MNDWI$_2$ models is found to be 18.28 km$^2$, 25.6086 km$^2$, and 25.6257 km$^2$ respectively. These methods have been tested over the very recent satellite data of Landsat-8 which proved to be very useful for water region mapping. The research work has also revealed the utility of SWIR$_1$ and SWIR$_2$ bands of landsat-8 satellite image for mapping of water areas. The MNDWI$_1$ and MNDWI$_2$ methods outperformed the NDWI method in terms of accurate water extraction.
<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A New Strategic Planning Approach to Resolve A Potential Conflict over Great Zab Transboundary River Basin Applying Graph Model for Conflict Resolution “GMCR II”</td>
<td>202</td>
</tr>
<tr>
<td>2</td>
<td>Methodological Variability In Developing IDF Curves: Implications On Flood Protection And Runoff Storage</td>
<td>203</td>
</tr>
<tr>
<td>3</td>
<td>Estimating Threshold Values For Partial Duration Series Of Peak Flows In Mahanadi River Basin, India</td>
<td>204</td>
</tr>
<tr>
<td>4</td>
<td>Dohuk Syncline as Artificial Water Aquifer, Northern Iraq</td>
<td>205</td>
</tr>
<tr>
<td>5</td>
<td>Armenian Rivers Ecological Flow Decision New Methods</td>
<td>206</td>
</tr>
<tr>
<td>6</td>
<td>Modelling Of Seepage Through Embankments Of Earth-Filled Recahrge Dams In Oman: Steady And Transient Regimes</td>
<td>207</td>
</tr>
<tr>
<td>7</td>
<td>Estimation Of Flood Discharges And Mapping Of Flood Inundation Areas For Urban Area Of Wadi Qows Jeddah In 2009</td>
<td>208</td>
</tr>
<tr>
<td>8</td>
<td>Hydrogeological Aspects Of Dam Site Selection In Arid Regions: Salalah Stony Plain</td>
<td>209</td>
</tr>
<tr>
<td>9</td>
<td>A GIS Based Integrated Fuzzy Logic And Analytical Hierarchy Process Model For The Assessment Of Suitable Water Harvesting Zone In Southern Iraq</td>
<td>210</td>
</tr>
<tr>
<td>10</td>
<td>Aquifer Potential Mapping In Coastal Dune-Complex Areas Using Ground Penetrating Radar (Gpr) And Well Observation Data</td>
<td>211</td>
</tr>
<tr>
<td>11</td>
<td>Geophysical Investigation for Groundwater Exploration and Quality Assessment in Coastal Area of Kalapara, Patuakhali, South Part of Bangladesh</td>
<td>212</td>
</tr>
<tr>
<td>12</td>
<td>A Study On The Influence Of Water Resources At Egyptian Southwestern Desert On Natural Earthquakes</td>
<td>213</td>
</tr>
<tr>
<td>13</td>
<td>Targeting Water Resources In Western Desert Of Egypt Using Remote Sensing Images And Hydrologic Data</td>
<td>214</td>
</tr>
<tr>
<td>14</td>
<td>Studying Utilization Of Traditional Rainwater Harvesting Methods In Iran For Sustainable Development (Hutak And Jessour)</td>
<td>215</td>
</tr>
<tr>
<td>15</td>
<td>Assessment Of Runoff And Design Of Storm Water Drain In A Semmenchery Settlement Of Chennai Metropolitan Area</td>
<td>216</td>
</tr>
<tr>
<td>16</td>
<td>Modelling Of Seepage Through Embankments Of Earth-Filled Recahrge Dams In Oman: Steady And Transient Regimes</td>
<td>217</td>
</tr>
<tr>
<td>17</td>
<td>Operational Rules For Micro-Dams Solving Stochastic Control Problems</td>
<td>218</td>
</tr>
<tr>
<td>18</td>
<td>A Linear Bi-level Multi-objective Program for Optimal Allocation of Water Resources in Swat River Basin, Pakistan</td>
<td>219</td>
</tr>
<tr>
<td>19</td>
<td>The Impact Of Dams On The Environment</td>
<td>220</td>
</tr>
<tr>
<td>20</td>
<td>Salinity Prediction By Artificial Neural Networks In Ajichai River</td>
<td>221</td>
</tr>
<tr>
<td>21</td>
<td>Quantifying Changes Of Surface Water Quality Under The Effect Of Drought Conditions</td>
<td>222</td>
</tr>
<tr>
<td></td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>22</td>
<td>Satellite-Based Estimates Of Groundwater Storages Changes At The Najd Aquifers, Oman</td>
<td>223</td>
</tr>
<tr>
<td>23</td>
<td>Darfur IDPs Groundwater Resources; Capacity and Depletion Risks Darfur Region western Sudan</td>
<td>224</td>
</tr>
<tr>
<td>24</td>
<td>Storm Water Injection In Bahrain: Pilot Studies</td>
<td>225</td>
</tr>
<tr>
<td>25</td>
<td>Evaluation of Precipitation Enhancement Projects (PEP) in arid and semiarid regions in Iran in order to improve country's water resource using historical data and Reanalysis and weather global data</td>
<td>226</td>
</tr>
<tr>
<td>26</td>
<td>Exploitation of atmospheric water resources by clouds seeding feasibility in arid and semi-arid in Iran</td>
<td>227</td>
</tr>
<tr>
<td>27</td>
<td>Runoff Estimation For An Ungauged Catchment Using Geomorphological Instantaneous Unit Hydrograph And GIS</td>
<td>228</td>
</tr>
<tr>
<td>28</td>
<td>Role of Irrigation by Mini Dams Techniques in Socio Economic Development of Poor Farmers</td>
<td>229</td>
</tr>
<tr>
<td>29</td>
<td>Cloud Seeding Techniques: Success And Failure</td>
<td>230</td>
</tr>
<tr>
<td>30</td>
<td>Rain Water Harvesting For Agriculture Development Based On Gis Spatial Model Case Study : North Western Coast - Egypt</td>
<td>231</td>
</tr>
<tr>
<td>31</td>
<td>Investigating the Effects of Obstacles’ Arrangement on the Development of Saline Density Current’s Front in Experimental Conditions</td>
<td>232</td>
</tr>
</tbody>
</table>
A New Strategic Planning Approach to Resolve A Potential Conflict over Great Zab Transboundary River Basin Applying Graph Model for Conflict Resolution “GMCR II”

Ramadhan Hamza Mohammed

Water Strategies and Policies Senior Expert, University of Duhok, IRAQ, Email: ramadhan56_2000@yahoo.com

Abstract

The Great Zab basin has been selected as a study basin for the application of Graph Model for Conflict Resolution II, ‘GMCR II’, using non cooperative, cooperative game theory concepts to this transboundary basin.

In this investigation the study and analysis of potential conflict of the basin of the River Great Zab one of the largest tributaries of the Tigris River, is carried out through two main contributions, the GMCR II modelling and analysis, and Bankruptcy rules applications, due to the importance of studying this tributary which represents more than 33% of the Tigris river annual discharge using the possibilities of modern technology to resolve the potential conflict and support the viewpoint of the negotiator and the lack of similar studies on this important tributary of the Kurdistan Region and Iraq. To find resolution for the potential conflict among Turkey and Iraq over the Great Zab river basin, (GMCR II), software (one of the Game Theory) applications has been used to resolve the dispute through modelling and analysing to find acceptable solutions to all parties involved in the conflict (riparian States). In a strategic design of the conflict, the application GMCR II, Characterized by flexibility and ease of use. Therefore, the use of GMCR II, software on shared water sources will lead to the provision of a new culture towards water in the region. Focusing on the importance of cooperation between peoples and nations in resolving the dilemma of the water and through these applications, one may learn the value of water use that can be made available for hydropower, irrigation, and environmental needs. In order to get use from the outputs of the (GMCR II), Bankruptcy Rules applications are chosen to find solutions to secure accepted quotas of water for each of the two riparian (Turkey and Iraq), due to increased demand and need and address the lack of processed quantities of water from the Great Zab.

The results from this study represent one of the basic pillars to enhance the dialogue and negotiation in future between the two neighbours in searching for cooperative options in water management and other economic flows in the region of the Tigris and Euphrates.
METHODOLOGICAL VARIABILITY IN DEVELOPING IDF CURVES: IMPLICATIONS ON FLOOD PROTECTION AND RUNOFF STORAGE

Ahmed Al-Areeq, Shakhawat Chowdhury and Muhammad Al-Zahrani
Department of Civil and Environmental Engineering, King Fahd University of Petroleum and Minerals, Water Research Group, Dhahran 31261, Saudi Arabia.
Email: Schowdhury@kfupm.esdu.sa

Abstract:
The southwestern Saudi Arabia experiences occasional flash floods, due possibly to inadequate understanding of rainfall, runoff and lack of infrastructure. Several studies have investigated rainfall intensity, duration and runoff while the infrastructures are not adequate to avoid floods. One possibility might be the limitations in handling rainfall data. In this study, rainfall intensity-duration-frequency (IDF) curves were developed for five areas (Abha, Al-Baha, Bisha, Gizan and Khamis-Mushait) in the southwestern Saudi Arabia. Four methods of depth – duration relationship were applied. The 25-year daily maximum rainfall were converted into hourly and sub-hourly data using these methods. The methods showed considerable variability in the IDF relationships, which may influence the essential protective measures against floods and runoff collection. This study observed significant variability in the requirement of storage capacities in different areas. The effects of methodological variability can be minimized through long-term monitoring of data, calibrating the methods using these data and constructing watersheds to store the wide ranges of runoff. The areas showed significant differences in IDF curves, which emphasizes the needs of study on smaller areas rather than considering the entire region. Better understanding on the variability of IDF relationship may assist in controlling flash flood and maximizing runoff storage.

Acknowledgements:
The author(s) would like to acknowledge the support provided by the Deanship of Scientific Research (DSR) at King Fahd University of Petroleum & Minerals (KFUPM) for funding this work through project No. RG 1302-1 & 2
ESTIMATING THRESHOLD VALUES FOR PARTIAL DURATION SERIES OF PEAK FLOWS IN MAHANADI RIVER BASIN, INDIA

Nibedita Guru\textsuperscript{1} and Ramakar Jha\textsuperscript{2}

\textsuperscript{1}Research Scholar, Department of Civil Engineering, National Institute of Technology, Rourkela, India, nibeditaguru149@gmail.com

\textsuperscript{2}Professor, Department of Civil Engineering, National Institute of Technology, Patna, India

ABSTRACT:

The Partial Duration Series (PDS) is used for flood frequency analysis considering all the flood peaks exceeding certain threshold, which may include more than one value per year. The present work investigates different approaches to estimate the threshold value for obtaining most appropriate partial duration series suitable for flood frequency analysis using GP distribution in Mahanadi river system, Odisha, India. The PDS has been extracted from daily discharge data by considering (i) all the flood peaks above the minimum of Annual Maximum Series (AMS) occurred in one of the years under study (ii) average number of flood peaks per year ($\lambda$=1, 1.5, 2, and so on), (iii) standard frequency factor ($f$), for $f=3$ proposed by Rosbjerg and Madsen (1992), and (iv) observed Highest Flood Level (HFL) at each sampling location and corresponding discharge values using Rating Curve. PDS is generated by assuming that it is best defined by a Generalized Pareto (GP) distribution. Moreover, different frequency distributions (Exponential, Gumbel, Logistics, Generalised Extreme Value (GEV), Lognormal (LN), Generalised Logistics (GL) and Pearson Type 3) were tested for their applicability in the basin. Daily discharge data were collected from 22 sampling location for the year between 1972 to 2012 in Mahanadi river basin for the analysis. Various statistical parameters were used to obtain the paramount threshold value suitable for generating PDS and providing best estimates of peak flood for different return periods using flood frequency distributions. The results indicate the suitability of GP distribution for $\lambda$ values ranging between 2 to 5 at various sampling locations. However, the $\lambda$ values ranging between 2 to 3 are appropriate, when the peak flood values beyond the threshold causes flood inundation and damage to the human beings/property in Mahanadi basin. For Tikarapara and Rajim sampling stations, the $\lambda$ values are found to be 2.85 and 2.12, respectively when observed HFL and corresponding discharge values were obtained using rating Curves. The results confirm that the precision and stability of GP distribution parameters occurs for higher values of $\lambda = 3, 4$ and 5, which are having more number of flood peaks in each PDS but do not cause any flood in the basin presently and may be used to develop future scenario.

Acknowledgements:

This research was supported by the National Institute of Technology, Rourkela, Odisha.
Dohuk Syncline as Artificial water Aquifer, Northern Iraq

Nabeel K. Al-Azzawi * and Myasar Samir Al-Saraj
Dept. of Geology/ College of Science/ University of Mosul

e-mail: nabazzawi@yahoo.com

Abstract

Artificial water storage was carried on Dohuk Syncline. The syncline is located between Baikher Anticline to the north and southwardly Dohuk Anticline. Dohuk city was occupied the surface area of this structure. The syncline is extended about 17 Km in the east-west direction. Generally, it is narrow syncline due to its location between two steep limbs of Baikher and Dohuk anticlines. Moreover, the syncline is very narrow near Itut Village at which its eastern plunge is sited and be wider toward the west near Aloka village. Alluvial deposits, vegetations and civilization are covered the surface central part of this syncline where the Fat'ha and ridges of Pila Spi formations surrounded it. The distinct property of the Pila Spi Fm (M. to L. Eocene) is well-jointed limestone that is make it an excellent aquifer for water storage. Moreover, it is overlie by Fat'ha Fm. which considered as sealed materials. The geometry and shape of this syncline was determined by mathematical Lagrangian Interpolation method. It was used to obtain the subsurface or the hidden parts of the syncline depending on the wells data and the available seismic sections. This method was applied on three sections transverse the structure. Finally, SURFER program was utilized to display the final geometrical shape of Dohuk Syncline in three dimensions. The project is an attempt to determine the capability of this syncline for artificial recharge of water and to be used as an aquifer for the city domestic uses. The size of this aquifer is estimated as (11) Km³ and the pore size is (2.33) Km³ depending upon the limestone porosity is 20%. In addition, an estimation of the water quantity that can be taken from this aquifer is about (60652.8) m³. Subsequently, it becomes an economic and important to recharge this syncline artificially in addition to the natural recharging and used it as artificial aquifer. Moreover, some ideas were proposed for recharging this aquifer.
ARMENIAN RIVERS ECOLOGICAL FLOW DECISION
NEW METHODS

Misakyan E.E.
Ministry of Territorial Administration and Emergency Situations of Republic of Armenia
Armenian State Hydrometeorological and Monitoring Service,
54 Leo str, 0002 Yerevan, RA
E-mail: e.misakyan@mail.ru

Abstract
The development of economic activity in the river basins usually leads to the violations of rivers natural flow in quantitative and qualitative indicators, because of which is worsening living and developing conditions of organisms in the aquatic environment.
The aim of this work is to develop, for Armenian rivers, river ecological flow assessment more accurate methods, in which, unlike its previous one, is necessary to consider not only hydrological, but also hydromorphological, hydrochemical and hydrobiological characteristics, which require complex research implementation.
For that was developed a methodology to calculate the ecological flow in annual and monthly values, for that as a basis taken decision of the ten days average discharge minimum value in dry winter period, December-February month. Ecological flow monthly value decision is adjusted to the EU Water Framework Directive requirements. In the absence of hydrobiological, hydromorphological and hydrochemical monitoring data, in the hydrological observation point, monthly ecological flow values calculated by winter minimum ecological flow adding the 33% of minimum natural flow value of that month (the adding of 33% is a "safety factor" which provides river hydromorphological, oxygen and heat conditions, that would ensure the survival and reproduction of aquatic organisms, as well as the norms of the dynamic flow). If a defined ecological flow monthly value is bigger than the monthly minimum natural flow value, then as an ecological flow is assumed to be the minimum natural discharge value of that month.

Keywords: ecological flow, natural flow, the average 10-days discharge, minimum discharge, hydrological observation point.
MODELLING OF SEEPAGE THROUGH EMBANKMENTS OF EARTH-FILLED RECAHRGE DAMS IN OMAN: STEADY AND TRANSIENT REGIMES

A.R.Kacimov¹, A. Al-Maktoumi¹, Yu.V.Obnosov²

¹Department of Soils, Water and Agricultural Engineering, Sultan Qaboos University, Oman
anvar@squ.edu.om
²Institute of Mathematics and Mechanics, Kazan Federal University, Kazan, Russia

Abstract

Recharge dams in Oman, which so far have been operated in intermittent seepage regimes after flash floods, are currently considered for a permanent storage of tertiary treated waste water, with the reservoirs potentially filled more regularly. Consequently, we consider both steady state and transient Darcian seepage through an earth-filled embankment with a clay core, sandwiched by two highly permeable shoulders, from an upper reservoir towards a horizontal, constant head drain. For steady seepage we assume a homogeneous isotropic capillarity-free core and shoulders and for sudden fillings or drawdowns of reservoirs we implement the Green-Ampt model of capillarity. Following the analytic element approach, we consider seepage through the core conjugated with flow through the downstream (right) shoulder to compute a steady flow rate and the shape of the phreatic surface. As a collateral benefit of this solution, we show that the see water intrusion problem in a confined aquifer is mathematically identical with the dam problem, modulo rescaling of the physical sizes and complex potential function. We illustrate that the decrease of the core permeability causes a strong decrease of the flow rate, drop of the free surface position in the right shoulder and reduction of the “active” length of the drain, which has to intercept water seeped through the core. The drain gets clogged with time. The corresponding rise and downstream propagation of the phreatic surface is assessed. For a sudden emptying of the reservoir we used the Toth 2-D model of an instantaneous pore pressure field and the Lembke model of a parametrized phreatic surface draining through a seepage face and spreading laterally in an opposite direction along an impermeable levee bed. For a sudden filling of the dam, we study imbibition of a wetting front with the Nelson-Skornyakov limiting steady regime. Refraction of seepage at a wedge (conjugation zone of the core, shoulder and levee’s base) is analyzed. Suffusion, colmatage, heaving, piping and other seepage-triggered phenomena affecting the embankment stability are discussed.

Acknowledgements: This work was funded by SQU, grant IG/AGR/SWAЕ/14/02; USAID-FABRI, grant AID-OAA-TO-11-00049, project code:1001626 – 104; Russian Foundation for Basic Research grant No 13-01-00322.
ESTIMATION OF FLOOD DISCHARGES AND MAPPING OF FLOOD INUNDATION AREAS FOR URBAN AREA OF WADI QOWS JEDDAH IN 2009

Kuswantoro Marko¹², Amro Elfeki², Nassir Alamri², Hatem Abdel Rahman Saied Ahmed Ewea²

¹Department of Geography, Faculty of Mathematics and Natural Science, University of Indonesia, 16424
²Department of Hydrology and Water Resource Management, Faculty of Meteorology, Environment, and Arid Land Agriculture, King Abdulaziz University, Jeddah-Saudi Arabia
kuswantoro@ui.ac.id

Abstract

The flood happened on November, 25th 2009, in Jeddah City caused a death of more than 100 people, and thousands of vehicles and homes were damaged. The extreme weather conditions and the unplanned housing developed by people in the low land areas of the wadi streams have contributed in the occurrence of such floods. This study is aimed at estimating flood discharges and mapping flood inundation areas in the urban area of Jeddah in that event on Wadi Qows. The integration of the hydrologic and hydraulic modeling using WMS, HEC-HMS, and HEC-RAS software has been implemented. A hydrologic model driven by considering the digital elevation model (DEM), rainfall, and landuse/soil properties was generated for this valley, and ultimately the flood discharges were produced by utilizing HEC-HMS. One dimensional (1-D) steady non-uniform flow driven by the information obtained from the estimated flood discharges, Triangulated Irregular Network (TIN), floodplain area, and surface roughness coefficient was conducted using HEC-RAS to produce flood depth models in one dimensional channel. The flood inundation areas (2-D) was delineated using WMS based on the 1-D flood depth results. Field measurement to get flood depth and flood extent information from the residents was done. The results showed that the measured rainfall from King Abdulaziz Airport station is 70mm which is corresponds to 10 year return period. The estimated flood discharges during the flood event ranges between 34.8 m³/s (AMC I), 116.2 m³/s (AMC II) and 215.2 m³/s (AMC III). The flood inundation areas for different flood discharges, respectively, that is 16.72, 17.07, and 18.35 km² which is more than 70% fit to the observed inundated areas. So that, the coupled WMS and HEC-RAS has the ability to map flood inundation in urban area. However, the high resolution DEM is required to get more accurate of the depth and areas of flooded.

Keywords: Jeddah floods, hydrologic and hydraulic modeling, flood discharges, flood inundation
HYDROGEOLOGICAL ASPECTS OF DAM SITE SELECTION IN ARID REGIONS: SALALAH STONY PLAIN

Hamid Reza Zarei
MAHABGHODSS Consulting Engineering, Tehran, Iran
Enggeol2012@gmail.com

Abstract

Artificial recharge of groundwater using flood retention dams is a common solution for sustainable manage of water resources in arid regions. These dams retain the flood water in reservoir and regulate downstream surface flows and subsequent permit infiltration into the recharge aquifer. In stony plains with small water infiltration capacity, selection of dam site is a preliminary but an important issue for a successful design from recharge and cost viewpoint. Considering major aquifers and evaluate their hydraulic connectivity to the surface is very important and play significant roles in selection of dam site. This paper discusses some engineering geologic aspects in selection of dam sites in Salalah of Oman. The amount and type of sediments, rock mass permeability in reservoir and downstream wadi channels, the depth and type of recharging aquifer and its hydraulic connectivity to the surface are essential for selection of dam sites.

Keynotes: Recharging dam, engineering geology, site selection
A GIS BASED INTEGRATED FUZZY LOGIC AND ANALYTICAL HIERARCHY PROCESS MODEL FOR THE ASSESSMENT OF SUITABLE WATER HARVESTING ZONE IN SOUTHERN IRAQ

Title (Capital Letters, 12 PT, Centered, Bold, 18 PT After)

Alaa M. Al-Abadi¹, Shamsuddin Shahid², Amna M. Handhel¹, Hussain B. Ghalib¹
¹Department of Geology, College of Sciences, University of Basra, Basra, Iraq
²Faculty of Civil Engineering, Universiti Teknologi Malaysia, Johor 81310, Malaysia
alaaatiaa@gmail.com *Corresponding author

Abstract

Identification of potential sites for water harvesting (WH) is very crucial for efficient water resource management in arid region. A GIS based model that combines fuzzy logic and analytical hierarchy process (AHP) multi-criteria decision technique has been proposed in this article to delineate suitable areas for constructing water harvesting structures in the arid region of southern Iraq, where severe water scarcity has forced thousands of marshland residents to abandon their home. Based on literature reviews, availability of data, and expert opinions five parameters were selected to develop the model, namely, hydrological soil groups (HSG), land cover, surface runoff depths, slope, and distance to intermittent rivers. Fuzzy logic approach was used to standardize the factors and AHP was used to derive the weights. The obtained WH suitability values were classified into five different classes, namely unsuitable, poor, moderate, good, and excellent. The study revealed that 393 km² or 18% of the area is unsuitable or poor, 538 km² or 26% of the area is moderately suitable, and 1167 km² or 56% of the area is good or excellent for water harvesting in the study area. The field data revealed that the only existing WH dam in the area is situated within the excellent WH suitable zone demarcated by the model, which indicates the capability of the model to identify the areas suitable for WH structure. It is expected that the method proposed in the paper would help in quick assessment of suitable zones for WH.

Key words: Water harvesting, fuzzy logic, analytical hierarchy process, GIS, Iraq

210
AQUIFER POTENTIAL MAPPING IN COASTAL DUNE-COMPLEX AREAS USING GROUND PENETRATING RADAR (GPR) AND WELL OBSERVATION DATA

I. C. Das, Manne Gopaiah and V. K Dadhwal
National Remote Sensing Centre, Indian Space Research Organization, Hyderabad, Telangana, India Postal code-500625
Email of corresponding author: icdasiirs@gmail.com

Abstract:
Shallow fresh water coastal aquifers are generally buried under recent deposits and are thin in nature as deeper aquifers are saline in coastal areas. Because of the uniform and monotonous surface cover, locating these aquifers in this terrain is a challenge. Thin fresh water aquifers in this region are the precious resource as majority of the area is having saline water. Marginal subsurface flows accumulate in small pockets of buried aquifers at shallow depths. Dynamics of sea water intrusion also pollutes the fresh water resources easily through tidal activity. Hence shallow fresh water aquifers can serve as the major source of water pockets in these areas. Detecting these aquifers is a major challenge for sustainability of drinking water sources in these perennially fresh water deficient regions.

In the present study, ground based GPR data was combined with well observation data in a GIS environment to detect the subsurface anomaly that links to the fresh water reservoir below the shallow and thin sand/silt layers. The study was taken up in a beach and swells complex area hosting 20 habitations in Andhra Pradesh coast, India. GPR data showed that the water table of the study area varies between 1.4 – 3 meters below the ground and the depth of the fresh water aquifers varies between 3-6 meters. The fresh water and saltwater interface in these areas occur at very shallow depth of 4-6 meters. Pre-monsoon volume of the fresh water was estimated in the area using geospatial technique and corroborated with the field data. Ground water being the only source of drinking water in these near-shore habitations, delineation of the fresh water zones helps in solving the drinking water needs of the increasing population in these areas. Over consumption of the ground water for drinking, agriculture and domestic purpose resulted in depleting the fresh water resource and the saltwater intrusion into the fresh water aquifers. Hence, reliable and rapid monitoring measures are essential for keeping close watch on the freshwater pockets of the near shore coastal areas.
Geophysical Investigation for Groundwater Exploration and Quality Assessment in Coastal Area of Kalapara, Patuakhali, South Part of Bangladesh

Md. Ibrahim Khali*a, Ratan Kumar Majumder*a, S. M. Didar-Ul Islamb, Mohammed Jamal Uddinb

a Nuclear Minerals Unit, Atomic Energy Research Establishment, Savar, Dhaka, Bangladesh
b Department of Environmental Sciences, Jahangirnagar University, Dhaka, Bangladesh.

*Corresponding author, e-mail: ibrahimbaec@gmail.com

Abstract:

As groundwater becomes more important as a source of uncontaminated water, methods for locating good aquifers must become more efficient. Geophysical methods are playing an increasingly important role in groundwater investigations. Of all surface geophysical methods, the electrical resistivity method has been the most widely used in groundwater investigations. The surface geoelectric resistivity method is a tool uniquely suited to groundwater exploration in the coastal zone, and its capability to detect change in pore-water conductivity makes it highly responsive to the fresh-water/salt-water interface delineation in coastal region.

To identify different water bearing horizons within the coastal plain sands, geoelectrical soundings using Schlumberger configuration were carried out in the coastal Kalapara upazila, Patuakhali district of Bangladesh. A total of 10 VES were surveyed in the study area. The equipment used comprised SARIS, Canada resistivity meter for sounding studies. For electrical sounding (VES) with Schlumberger array, the maximum current electrode separation AB was limited to 350 m. To obtain the initial model parameters, geoelectrical sounding data were interpreted by partial curve matching technique. This initial model was then used to obtain the final layer parameters through inversion technique. The best-fitted models were correlated with the litholog.

On the basis of geoelectrical and borehole lithological data the coastal plain groundwater aquifer of the study area can be divided into two major water bearing horizons: (i) an upper zone consisting of very fine sands having apparent resistivity of 0.66–14.02 Ωm attributing brackish to fresh water containing aquifer and (ii) a lower zone consisting of fine sands with 0.21–5.99 Ωm apparent resistivity value, which attribute saline to brackish water containing aquifer. The water quality of upper zone varies geographically from south to northern part of the study area. Apart from the coast in the northern part of the area water quality found fresh in upper zone while in the lower zone aquifer it is reported as brackish water.

Acknowledgments

The authors are thankful to geologists of Nuclear Minerals Unit and local people of the study area for their assistance during field work. The authors are also grateful to various water agencies for access to some of their records. This work is financed by the Ministry of Science and Technology, Government of The People’s Republic of Bangladesh under the Special Allocation program 2013–2014.
A STUDY ON THE INFLUENCE OF WATER RESOURCES AT EGYPTIAN SOUTHWESTERN DESERT ON NATURAL EARTHQUAKES

Sayed Abdallah Dahy
National Research Institute of Astronomy and Geophysics, Egypt
Sayeddahy78@yahoo.com

Abstract
Water resources in Egypt are becoming scarce and the River Nile is the only main source for Egypt's water. The Egypt's territories lie in arid and semi-arid zones, with very poor rainfall and under-ground aquifers, after the construction of the Aswan High Dam across the waters of the Nile the Nasser Lake was created. It is a vast reservoir in southern Egypt and northern Sudan; it is one of the largest man-made lakes in the world. The purpose of this investigation is to discuss and understand the effect of the fluctuation of the water level in the Nasser Lake on natural and human-induced environmental like earthquakes in the Egyptian southwestern desert. In summary, the correlation between the temporal variations of earthquake activity and water level changes in the Nasser Lake from 1982 to the end of 2014 are studied and analyzed. This analysis confirms a weak relation between the fluctuation of the water level and earthquake activity in the area around Nasser Lake and southwestern desert. The result suggests that the earthquake activity in this area becomes active during a period when the water level of the reservoir is decreasing from the maximum to the minimum. Behavior of the water level in this reservoir characterized by a special manner that is the unloading season extends to July or August, and the loading season starts to reach its maximum in October or November every year. The change in level of Nasser Lake is controlled by the difference between the sources of inflow and outflow, compared to the total volume of the lake. Finally, daily rate of change in the water level of the reservoir did not show any direct relation with the size of the earthquakes, hence, it is not possible to be used as a single tool for prediction.

Keywords: Water Resources, Naser Lake, Fluctuation of the water level, Earthquake, Egypt.
TARGETING WATER RESOURCES IN WESTERN DESERT OF EGYPT USING REMOTE SENSING IMAGES AND HYDROLOGIC DATA

Karem M Moubark1, Mohamed Abdelkareem*1,2

1 Geology Department, South Valley University
2 Center for Remote Sensing, Boston University

Abstract
Remote sensing, field data, geochemical characteristics through geographic information systems (GIS) methodologies were applied to delineate the water resources in the desert fringes, west of Qena Governorate, Egypt. This area is one of the most important regions for sustainable development in fields of investment, land reclamation and urban extension. It includes about 200 thousand acres ready for agriculture dependent on availability and suitability of groundwater. Groundwater potentiality map was prepared after assigning weight factor of several layers e.g., topography, structure, rainfall, lithology, land-use, streams, slope, and wadi deposits. Field data validated the predicted groundwater map, and reveal that the depths of water bearing formation ranges from 8 to 75 m and decreases toward the Nile. The chemical characteristics of groundwater and its suitability for agriculture and domestic uses are established. Moreover, the spatial distribution of TDS, Na, K, Ca, Mg, Fe, Cl, and SO4, NO3, and SAR ratio was performed using GIS. The chemical analysis reveals that the salinity of collected samples range from 315 to 9770 mg/l, and classified to 32.2 % fresh water, 59.3 % brackish, and 8.5 saline water. Most of the investigated wells are not suitable for domestic uses; however, suitable for agriculture and industrial uses.
STUDYING UTILIZATION OF TRADITIONAL RAINWATER HARVESTING METHODS IN IRAN FOR SUSTAINABLE DEVELOPMENT (HUTAK AND JESSOUR)

Ghezelsofloo, A.A¹, Azimi, R.², Kianian, M.K.*³, Khoshbakht, F.⁴

¹. Assistant professor of IAUM, Mashhad, Iran
². PhD student, Faculty of Range Land and Watershed Management Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
³*. Corresponding author: Academic member of Desert studies faculty, Semnan University, Semnan, Iran
⁴. B.A of English translating, Tabriz University, Iran

Abstract

Water is the most valuable commodity and wealth given to humans; in world dry areas where the extent of this wealth is low, its importance is felt more and it has a specific value. Considering that Iran is placed on the dry belt and its average rainfall is lower than one third of the world rainfall, it is necessary that water collection and storage procedures are noted. Indigenous water and soil management methods in the world, including Iran, date back to 3 to 5 thousand years ago. In spite of development of new methods, the methods have still had efficiency in different areas in Iran. This research tries to shortly address two methods of several traditional methods common in Iran, in particular in Sistan and Baluchestan: hutak and jessour,

Keywords: Hutak, Jessour, Rainwater harvesting, Sustainable development
ASSESSMENT OF RUNOFF AND DESIGN OF STORM WATER DRAIN IN A SEMMENCHERY SETTLEMENT OF CHENNAI METROPOLITAN AREA

K. Parameswari*, T. K. Padmini**
*,**Department of Civil Engineering, Sathyabama University, Chennai, India
e-mail: param.rm@gmail.com

Abstract

A good and efficient design of storm water system is necessary to protect the health of the public and conservation of water for sustainable development. The drainage designer is primarily concerned with saturated gravity flow, which can be determined by application of Darcy’s law. In south India, especially in Tamil Nadu, the north east monsoon is the major source of precipitation. The characteristic feature of this rainfall is that intensive heavy downpour occurs for a short spell of time resulting in a heavy runoff. The rapidly increasing demand of water can be met only by properly managing the monsoon rainfall. In Semmenchery village located in the southern part of Chennai Metropolitan Area (CMA), Tamil Nadu, India, had to face the problem of excess runoff throughout the region during the monsoon season. Therefore the present study focuses on providing a solution to the excess runoff problems in an indigenous manner.

The runoff is calculated by rational method and suitable storm water management system is designed. The study assessed the topography thereby knowing the terrain feature to design the storm water pipe. Leveling has been done to find the difference in levels, to differentiate low lying and elevated areas. The levels were used to generate digital elevation map and thereby determine the tank location for storm water collection and the flow direction of each pipeline. A ductile iron pipe of diameter 300 mm is chosen and the runoff velocity is calculated, which helps to find the self cleansing velocity to design the slope of the network of pipelines. The harvested water shall be effectively used for the domestic purpose if it is properly managed.
MODELLING OF SEEPAGE THROUGH EMBANKMENTS OF EARTH-FILLED RECAHRGE DAMS IN OMAN: STEADY AND TRANSIENT REGIMES

A.R.Kacimov¹, A. Al-Maktoumi¹, Yu.V.Obnosov²

¹Department of Soils, Water and Agricultural Engineering, Sultan Qaboos University, Oman anvar@squ.edu.om
²Institute of Mathematics and Mechanics, Kazan Federal University, Kazan, Russia

Abstract

Recharge dams in Oman, which so far have been operated in intermittent seepage regimes after flash floods, are currently considered for a permanent storage of tertiary treated waste water, with the reservoirs potentially filled more regularly. Consequently, we consider both steady state and transient Darcian seepage through an earth-filled embankment with a clay core, sandwiched by two highly permeable shoulders, from an upper reservoir towards a horizontal, constant head drain. For steady seepage we assume a homogeneous isotropic capillarity-free core and shoulders and for sudden fillings or drawdowns of reservoirs we implement the Green-Ampt model of capillarity. Following the analytic element approach, we consider seepage through the core conjugated with flow through the downstream (right) shoulder to compute a steady flow rate and the shape of the phreatic surface. As a collateral benefit of this solution, we show that the see water intrusion problem in a confined aquifer is mathematically identical with the dam problem, modulo rescaling of the physical sizes and complex potential function. We illustrate that the decrease of the core permeability causes a strong decrease of the flow rate, drop of the free surface position in the right shoulder and reduction of the “active” length of the drain, which has to intercept water seeped through the core. The drain gets clogged with time. The corresponding rise and downstream propagation of the phreatic surface is assessed. For a sudden emptying of the reservoir we used the Toth 2-D model of an instantaneous pore pressure field and the Lembke model of a parametrized phreatic surface draining through a seepage face and spreading laterally in an opposite direction along an impermeable levee bed. For a sudden filling of the dam, we study imbibition of a wetting front with the Nelson-Skornyakov limiting steady regime. Refraction of seepage at a wedge (conjugation zone of the core, shoulder and levee’s base) is analyzed. Suffusion, colmatage, heaving, piping and other seepage-triggered phenomena affecting the embankment stability are discussed.

Acknowledgements: This work was funded by SQU, grant IG/AGR/SWAЕ/14/02; USAID-FABRI, grant AID-OAA-TO-11-00049, project code:1001626 – 104; Russian Foundation for Basic Research grant No 13-01-00322.
OPERATIONAL RULES FOR MICRO-DAMS SOLVING STOCHASTIC CONTROL PROBLEMS

Erfaneh Sharifi*, Koichi Unami*, Osama Mohawesh**, and Masayuki Fujihara*

*Graduate School of Agriculture, Kyoto University, Kyoto, Japan
**Faculty of Agriculture, Mutah University, Karak, Jordan

unami@adm.kais.kyoto-u.ac.jp

Abstract

Groundwater and springs were historically major water sources in arid areas such as Middle East and North Africa (MENA). Recent development of large dams and deep aquifers, as well as desalination technologies, has enabled the increasing population in the region to maintain a certain level of living, but their renewability and sustainability issues are still under debate.

Construction of micro-dams to harvest surface water in relatively small catchments is another option to develop water resources. Experiences in temperate and semi-arid areas such as Japan show both robustness and vulnerability of using micro-dams, and it is highly recommended to scientifically adapt those lessons for application of micro-dams to other regions including MENA.

This study firstly introduce few examples of micro-dams in temperate or semi-arid areas, focusing on operational rules practiced by local communities. Then, a mathematical model is developed to explain why such operational rules have been built in the context of social and hydrological conditions for respective micro-dams.

The mathematical model defines stochastic control problems in terms of dynamic programming, involving Hamilton-Jacobi-Bellman (HJB) equations. For adaptation to different social and hydrological conditions, different coefficient values, source terms, and boundary conditions are set for the HJB equations.

Finally, an example of application to the Jordan Rift Valley is demonstrated. A water harvesting system targeting flash floods from a 1.12 km² catchment has been constructed with a micro-dam irrigating its command area. Existence and uniqueness of solutions to the adapted HJB equations, as well as optimal operational rules, are discussed to establish better management strategies for the system.

Acknowledgements:

This research is funded by grant-in-aid for scientific research No. 26257415 from the Japan Society for the Promotion of Science (JSPS).
A Linear Bi-level Multi-objective Program for Optimal Allocation of Water Resources in Swat River Basin, Pakistan

Ijaz Ahmad*
College of Water Conservancy and Hydropower Engineering, Hohai University, Nanjing 210098, China
engr.ijaz786@gmail.com

Abstract

Development and application of a bi-level multi-objective linear program (BLMOLP) for the optimal allocation of water resources among competing water demand sectors has been presented in this chapter. The developed model was applied in Swat River basin of Khyber Pakhtunkhwa province, Pakistan to evaluate the model applicability. The bi-level programming has a hierarchy of two levels—an upper level and a lower level. The simultaneous compromise constraint (SICCON) technique was used in solving the upper level (ULP) and lower level (LLP) programming problem, which creates a compromise between upper level and lower level DMs and thus the multi-objective function virtually turns into a single decision making problem. The upper level decision makers (DMs) control the water allocation plan, and tend to maintain equity in allocating water resources among competing sectors for sustainable water resources development and management, thus maximize the overall benefits from the water allocation plan. However, the lower level decision makers (DMs) try to maximize the benefits of their own sectors by receiving maximum quantity of water. Therefore, to solve such a problem in which conflicts exists among different water competing sectors, BLMOLP is used which could be helpful in the sustainable water allocation planning.

In order to evaluate the model applicability under different conditions and to support the decision makers’ four flexible scenarios were developed by assigning priorities to different water demand sectors. As in the different regions the priorities keep changing, in a developing country like Pakistan the priority could be the agriculture sector and the maximization of economic benefits can be tolerated and vice versa for developed countries. The results of model application showed that the developed program can effectively balance the amount of allocated water among all the sectors based on the priority of upper level programming and further revealing that in a scenario in which a sector given priority produces highest economic returns among all the scenarios because model first allocated the water to prioritized sector then to other sectors based on their water demands and economic benefits produced. Therefore, this model can be helpful in water allocation planning because of its applicability under different conditions.

Further, the developed model in this study is mathematically simple and provides implementable, optimal reservoir operating policies. As in most of the developing countries including Pakistan, the reservoir operators and managers are not well-trained to adopt complex stochastic water allocation models therefore, the technology transfer is considered to be more effective since the model is not mathematically complex.
THE IMPACT OF DAMS ON THE ENVIRONMENT

Saliha mebarki1, 2, Banali Kharroubi 2, Mohammed Amine Kendouci 1, 2, Samira Boufeldja1.
1 Department of Architecture, Civil Engineering and Hydraulics, university of Bechar, Algeria
2 Laboratory of Hydrology and management of Water resources (HYDRE), University of sciences and technology, Oran, Algeria.
E-mail of corresponding author : saliha.mebarki@yahoo.fr

Abstract

The need to limit the damage to nature resulting from the 1970's by laws to mitigate the impacts of development projects. To do this, the "impact of dams on environmental studies" became mandatory prior to their realization that the importance of their size or their impact on the natural environment may affect it. Dams are infrastructure which, by construction, changes the liquid flow, solid flow, material flow and agencies and the thermal regime of rivers on which they are located.

The various potential impacts of the implementation of a dam can be decomposed between a biotic compartments (flows, sediment chemistry and thermal energy ) and biotic ( aquatic organisms ) Furthermore the influence of dams is not limited to their sole control over the bed of a watercourse, but cause changes upstream and downstream of the structure. The construction of a dam is followed by a water retention dam formed by the tank contained a large and lead to the disappearance of forests, flora and fauna as well as numerous problems of siltation and lack of silt which makes the most fertile lands in the valleys downstream. We now realize that these buildings have many disadvantages: they belong to a development model that is increasingly challenged.
SALINITY PREDICTION BY ARTIFICIAL NEURAL NETWORKS IN AJICHAi RIVER

Shahir Kanani, GH.Fardi, A. Ghanbari
Ministry of Energy, Address: Tehran, Kordestan Highway, 1996832611, Iran
Shahir_kanani@yahoo.com

Abstract

The salinity of surface water is considered as a very important problem for agricultural and drinking consumption. So the salinity prediction is very necessary for management, planning and use of water. Water salinity problem and the methods of salinity reduction have a great importance in the rivers. In this research, salinity prediction is considered by using effective parameters and artificial neural networks. Ajichai basin and Vanyar station where is one of the very important stations in this river have been selected in the case study of the thesis. In order to salinity prediction, effective parameters such as Discharge and Total Dissolved Solid (TDS) have been used as predictors and the artificial neural networks have been used as the simulation instrument. In this research the delay time for discharge parameter and for TDS parameter is 24 hours and 1 month respectively. After considering the above parameters, artificial neural networks have been used for salinity prediction. The multi-layer preceptron networks (MLP) and input delay neural networks (IDNN) have been studied as the static and dynamic artificial neural network in this thesis. The discharge and TDS parameters are used as two independent forecasters in the neural networks models and the adequacy of them have been evaluated for the case study regions. The dynamic networks have been more accuracy than static networks which is logical due to temporal nature of the process involved. The best results have been gained by using IDNN network with the discharge parameter. The results of this research can be used for salinity prediction in this river basin and then can be utilized in planning and management of water resources of this river.
QUANTIFYING CHANGES OF SURFACE WATER QUALITY UNDER THE EFFECT OF DROUGHT CONDITIONS

Mohammad Ghabaei Sough
Ph.D. Candidate, Department of Water Engineering, Faculty of Agriculture, Bu-Ali Sina University, Hamedan, Iran
e-mail of corresponding author (ghabaei.m63@gmail.com)

Abstract

Water quality properties are the very important component of water resources management and conservation. Although the impacts of drought on water quantity are increasingly investigated via drought indices, but its effects on water surface quality are less studied. The main objective of this study is to assess the effects of drought condition on the water quality of the Chehlchaei river in Golstan province, based on analysis of Standardized Precipitation–evapotranspiration index (SPEI) and existing water quality parameters. In addition to the Mann–Kendall statistical test was run to detect the long time trends of water quality parameters. For this purpose climatic data at Minoo-dasht station and water quality variables at Lazoreh hydrometric station were collected over the hydrological year 1362-63 to 1392-93. The meteorological variables consist of monthly Precipitation and evapotranspiration and the water quality parameters including discharge, electrical conductivity (EC), calcium (Ca²⁺), magnesium (Mg²⁺), sodium (Na⁺), potassium (K⁺), bicarbonate (HCO₃⁻), chlorine (Cl⁻), sulfate (SO₄²⁻), anions sum, cations sum and sodium adsorption ratio (SAR). To evaluate the probable changes of water quality parameters under the drought conditions, the wet and dry periods were divided according to the SPEI index. After that the t-test was performed to detect the significant differences between dry periods with wet and entire periods. also, by linear regression the relationship between water quality parameters and discharge during wet and dry periods were investigated. The results of trend analysis showed a significant decreasing trend in the discharge and significant positive upward trend for the majority of water quality parameters at the 95% confidence level during the 31 examined years that represent the reduction of downstream river water quality for farming use and drinking. The result of comparing mean water quality parameters in wet and dry periods using t-test showed that the p-value at 90% confidence level is significant for most of the investigated parameters such as discharge, EC and anions sum. In general, it can be concluded although the water quality of Chehlcchaei river is declined over the time and drought conditions but according to Wilcox diagram its classified in good and medium classes (C1S1-C3S1) for farming purposes.
SATELLITE-BASED ESTIMATES OF GROUNDWATER STORAGES CHANGES AT THE NAJD AQUIFERS, OMAN

Mohamed Saber¹,², Saif Al hinai³, and Ahmed Al Barwani⁴
¹Geology Department, Faculty of Science, Assiut University (Assiut 71516, Egypt)
²Department of Geological Engineering, Middle East Technical University, (Ankara, Turkey), msaber_75@yahoo.com
³Water Management Systems, Special Economic Zone Authority, (Duqm, Oman), shinai@duqm.com
⁴Ministry of Regional Municipalities and Water Resources, (Muscat, Oman)

Abstract

The Najd Aquifers, Oman, are located at one of the most arid zones in the world. In such regions, there is a shortage in the water resources where groundwater is very critical component for human lives. The main aim is to use the satellite remote sensing data such as the Gravity Recovery and Climate Experiment (GRACE) along with the Global Land Data Assimilation System (GLDAS), to estimate the groundwater storage changes at the target aquifers. Groundwater storage changes were calculated from both GRACE data/ GLDAS using GIS technique. The groundwater level measurements were also used to estimate the equivalent groundwater storage changes from the available groundwater wells in these regions. Groundwater changes derived from GRACE/GLDAS are compared with groundwater changes estimated from water levels. It was found that the results are coincide in their trends and showing a noticeable declining in the water storage changes with the time period from 2002 to 2015. The preliminary analysis show that the declining rate of groundwater depletion is about 0.2 km3/year. This study could be helpful for the sustainable water management in these regions where it depends mainly on the cheap technology resulting in ease in application in other arid regions.
Darfur IDPs Groundwater Resources; Capacity and Depletion

Risks Darfur Region western Sudan

Abdalla Elsheikh
Ph.D. Water Resources
Al Neelain University, Khartoum, Sudan
Email: abdalla.elsheikh@gmail.com

Abstract

Currently more than two million are the internally displaced peoples (IDPs) in Darfur Region, western Sudan due to civil war. Mainly they depend on groundwater as water source for their daily water requirements. The main groundwater aquifers in the IDPs areas are either alluvial or weathered/fractured Basement aquifers, which are characterized by their limited storage capacity/extension and high interaction with both natural and artificial surface/subsurface water recharge sources. Because of the concentrated population in the IDPs locations at the limited available water resources zones, groundwater overuse is recognized in the areas with a high extraction rates combined with low aquifer storage and recharge capacity. In Darfur region, the average annual rainfall totals is estimated as 66 billion m$^3$/year of water in the major water sheds, approximately 85% of this total is lost due to high evaporation rates. The remaining 9.9 billion m$^3$/year of water, replenish the groundwater aquifers, becomes surface runoff into the neighboring regions, or is retained as soil moisture and transpired by vegetation cover. In many cases more complex systems were identified in which two aquifers systems existed in the same area, the coexisted aquifers are either interconnected or isolated. The camps that depend on the alluvial aquifers they have no problems of water supply in case of normal climatic condition, the camps depends of the basement aquifers they considered at risk and highly affected by the climatic degradation. The fractured basement aquifers indicate less groundwater storage capacity compared with the alluvial aquifers, but it indicates good fractures connectivity. Two general groundwater levels trends are recognized, in the fractured media aquifers, the water level needs some time after the rainy season to rise, while in the alluvial aquifer systems the groundwater level rises during the rainy season directly affected by the surface water regime.
STORM WATER INJECTION IN BAHRAIN: PILOT STUDIES

Pradeep K. Naik*1, Marcial Mojica2, Faizul Ahmed2, Shawki Al-Mannai2

   *Email. pradeep.naik@water.net.in
2. Agricultural Engineering and Water Resources Directorate, Ministry of Municipalities Affairs and Urban Planning, PO Box 30490, Kingdom of Bahrain.

Abstract

Kingdom of Bahrain often suffers from urban flooding problems despite being a desertic country, possibly due to unfavourable physiographic conditions. An attempt has been made in this contribution to study the efficacy of the storm water injection systems not only in tackling urban flooding problems but also in augmenting the depleting ground water resources of the kingdom. Two pilot studies were taken up in a centrally located area, one in a relatively open area and another in a densely populated location. A set of one recharge well and one observation well of about 40 m depth 30 m apart was drilled in each site, and storm water was injected into the recharge wells after passage through a specifically designed natural filter system. Ground water levels were monitored in the observation wells and water samples were collected periodically for chemical analysis. Initial results showed that the volume of storm water injected is proportional to the volume of storm water generated in an area. However, in the long run, the injection well having favourable hydrogeological situation and lesser silts in the storm water performed better despite having lesser volume of available storm water. Ground water quality remained an issue of concern, but could be controlled through construction of stricter filter system. Dilution of the injected storm water with the host ground water too significantly reduced the risks of contamination. The injection well located in the open area performed better than that of the densely populated area despite having lesser volume of available storm water. Site selection of the recharge wells is, therefore, very important for efficacy of the storm water injection systems.

Acknowledgements: The financial grants for construction of the project features by the Roads Planning and Design Directorate (RPDD), Ministry of Works (MoW), Kingdom of Bahrain is highly acknowledged. Thanks are due to Mubarak Al-Noaimi, Past-Director of the Water Resources Directorate, Kingdom of Bahrain for initiating the pilot studies. Thanks are also due to Mamdooh Mubarak from RPDD for coordination, Sameera Abdulla from the Roads Projects and Maintenance Directorate, MoW for overseeing the construction activities and Jess Stores from M/s. Nass Asphalt, Contractor for actually carrying out the construction works in the field.
Evaluation of Precipitation Enhancement Projects (PEP) in arid and semiarid regions in Iran in order to improve country's water resource using historical data and Reanalysis and weather global data

Mansoureh Seyyedhasani¹, Farid Golkar², Vahideh Khatibisarabi³, Samaneh Poormohammadi⁴, Amir Rivandi⁵

¹- Senior Experts in Environmental Engineering and Expert of National Cloud Seeding Research Center, Water Research Institute, Ministry Of Energy, Yazd, Iran. 2, 3, 4, 5- Senior Experts of National Cloud Seeding Research Center, Yazd, Iran

Email: ms_act@yahoo.com,
Tel: +983538250551-2, Fax: +983538251403

Abstract

In order to strengthen water resources, Iran has implemented 10 cloud seeding projects in arid and semiarid regions using different methods since 1999. In aerial method, seeding materials include Silver Iodide components and Nitrogen liquid. The main evaluation method includes establishing the historical Regression between target and control stations. Distribution of seeding material within two hours as per speed and direction of wind at the flight level where material are injected in cloud, determines the target area. However, some limitations this method consist of establishing correlations between target and control stations in order to recognize seeding effects from natural variations (signal to noise) and also the definition of seeding materials distribution in the clouds and recognition of affected area with reasonable accuracy. In this paper, in addition to use of Data Mining statistical technique to predict rainfall in target stations in the absence of seeding operation, in order to compare results of two methods (Regression and Data Mining) is utilized Reanalysis weather global data, outputs of WRF in return of data obtained from seeding airplane, radiosondes and weather radars data to define the distribution of seeding material in clouds. After, these data are processing by some practical software especially HYSPLIT and SPSS; the map of affected area for each seeding flight operation is drawn in Arc GIS. By doing this, it is possible to determine the stations that are located in target area accurately; and calculate seeding results in these stations acceptability.

Keyword: precipitation enhancement, Data Mining, Reanalysis weather global data, arid region, Iran.

Acknowledgements: Authors do appreciate to National cloud seeding Research Center, which help to provide this research and article
Exploitation of atmospheric water resources by clouds seeding feasibility in arid and semi-arid in Iran

Samaneh Poormohammadi¹, Farid Golkar², Vahideh Khatibisarabi³, Mansoureh Seyedhassani⁴

¹-PhD in Watershed Science and Engineeringin Water Research Institute and Expert of National Cloud Seeding Research Center, Ministry Of Energy, Yazd, Iran. 2, 3, 4-Senior Experts of National Cloud Seeding Research Center (water resources institute), Yazd, Iran

Email: s.poormohammadi@gmail.com, Tel: +983538250551-2, Fax: +983538251403

Abstract

Recent drought and climate change has harmful effects on water resources in Iran, especially in last decades. Water resources management and optimum use of all available water resources are ways for the adaptation of climate change and drought conditions. Weather modification, commonly known as cloud seeding, is the application of scientific technology that can enhance a cloud's ability to produce precipitation. Cloud seeding projects has being performed in Iran since 1999 as one of the most important strategies to increase water supplies. However, determining the time and place of cloud seeding operation are the necessities to achieve the best possible results. This paper explains innovative and scientific methods of feasibility study of Tehran province (semi-arid area) and Hormozgan province (arid area) by meteorological stations data, upper air data, satellite imagery (TRMM), weather radars products, topographic and vegetation maps. Factor analysis and World Meteorological Organization classification methods of PEP are applied to determine of seeding proper time. Eventually, cloud seeding susceptible areas are classified as levels and altitudes. In Tehran province, the results showed that the northwest, west and central catchments are capable for cloud seeding operation in December, January, February and March at an altitude of 2500-3000 meters. Suitable months of cloud seeding operation in the north and northwest of the catchment of Hormozgan province are January, February and March in order of priority.

Keyword: atmospheric water resources, cloud seeding, arid region, Iran.

Acknowledgements: Authors do appreciate to National cloud seeding Research Center, which help to provide this research and article
RUNOFF ESTIMATION FOR AN UNGAUGED CATCHMENT USING GEOMORPHOLOGICAL INSTANTANEOUS UNIT HYDROGRAPH AND GIS

Saravanan. S¹, Sivaranjani. S², And Kasiviswanathan S³.
Assistant Professor National Institute of Technology Tiruchirappalli, India.
PG student, Bharathidasan University, Tiruchirappalli, India.
Post-doctoral fellow, department of Civil Engineering, Schulich School of Engineering, University of Calgary, Canada.
ssaravananirs@gmail.com

Abstract

Simulation of flood hydrograph is essential for the design and construction of various hydraulic structures and watershed development and management. Number of methods are available to model the surface runoff hydrograph. Derivation of Synthetic unit hydrograph (SUH) technique is widely used for runoff estimation and determining peak discharges. Geomorphology of a catchment has a strong relationship with the transformation process of rainfall into runoff. For ungauged catchments, unit hydrograph may be derived using either regional unit hydrograph approach or alternatively Geomorphological Instantaneous Unit Hydrograph (GIUH) approach. The concept of the GIUH is a catchment transfer function in relating the shape, stream network topology and channel characteristics. In this respect, the Geographic Information System (GIS) and remote sensing image processing tools have been found to be helpful for the determination of geomorphologic characteristics of the watershed.

In this study, a geomorphologically based unit hydrographs were developed in two different approaches: (1) Conventional GIUH model, (2) Kinematic wave based GIUH model (KW-GIUH). These two models are tested with observed runoff hydrograph for the Koraiyar sub-watershed located in Tamilnadu, India. The geomorphological information of each sub-watershed i.e. cell to cell flow path, stream network are extracted from the ASTER Digital Elevation Model (DEM) of 30 m resolution. The travel times for different orders of overland areas and channels were derived using the kinematic wave theory and then substituted into the GIUH model to develop a KW-GIUH for runoff simulation. Effective rainfall is determined using the Soil Conservation Service Curve Number (SCS-CN) method. The developed model was applied to five storm events and the results are compared with observed hydrographs. According to these results, the derived flood hydrograph by using KW-GIUH and conventional GIUH model were closely matching with the flow records of the watershed. This indicates the suitability of present modeling approach for predicting the flood hydrograph for an ungauged watershed.

Keywords: ASTER DEM, flood, Geographic Information System, GIUH, KW-GIUH.
Role of Irrigation by Mini Dams Techniques in Socio Economic Development of Poor Farmers

Dr. Muhammad Tariq Khan

Abstract

Water is one of the most important natural resource and its management needs utmost attention. Agriculture is by far the largest user of the world’s water but it is still a limiting factor for agriculture (World Water Forum 2006) and some 80% of agricultural land worldwide is under rain-fed cultivation (World Commission on Dams 2000). So the efficient use of water in rain-fed systems will have a major part to play (WWF 2006). According to a research study globally most of the poor are concentrated in rural areas and depend heavily on agriculture and related activities for their livelihoods support (JBIC Institute 2007) but for agriculture water is a limiting factor no doubt it is a very powerful agent in bringing about socio-economic development of the society. WWF (2006) and WCD (2000) expressed that some 80% of agricultural land worldwide is under rain-fed cultivation, contributing to 60% of food production. Purpose of this research was to explore the role of mini dams to cope up water shortage in rain-fed water scarce arid areas of Pothowar plateau of Pakistan and their impact on the socio economic development of resource poor farmers of arid rural areas who applied mini dam techniques for irrigation. By taking a sample of 6 mini dams out of 534 mini dams of Pothowar plateau and their benefiting farmers the study was carried out. Farmers were interviewed to collect information on impacts of mini dams. Performance of mini dams was estimated in two aspects. One aspect was their effects on income of farmers and increase of other non economic benefits like farm mechanization and increase in farm employees and other was the satisfaction level of farmers on this effect or increase. The success of dams in casting socio economic development of farmers was measured by satisfaction of farmers, which was dependent on 10 variables of two types i.e (A)-Increased Production and (B)- Estimate-able Changes.

Mini Dam is that dam which is built on small water drainage of rainy seasons, which is of temporary nature.
CLOUD SEEDING TECHNIQUES: SUCCESS AND FAILURE

Ashen Gomes and Chandima Gomes

Center for Electromagnetic and Lightning Protection, Universiti Putra Malaysia, Serdang 43400, Selangor, Malaysia

chandima@upm.edu.my

Abstract

Cloud seeding has been attempted in many regions for the last many decades with varying end purposes and varying rates of success. The basic need of the technique is to get water for human consumption, agriculture and hydroelectricity. Recently cloud seeding has been carried out in Malaysia for reducing the effects of haze due to forest fires in Indonesia. Thus, cloud seeding is required for a spectrum of environmental conditions ranging from arid climates to regions of quite high level of annual precipitation. In general, cloud seeding is a process that introduces particulates into a cloud, usually by the aid of airborne carriers in order to enhance the nucleation and subsequent growth of ice crystals and raindrops. Such forms of water may enhance the precipitation that brings water into ground level either as rain or snow. The most popular and older technique is to inject silver iodide crystals or pellets of dry ice into supercool water in already formed clouds, which is termed cold cloud seeding or glaciogenic seeding. More recent method is the warm cloud seeding or hygroscopic seeding where chlorides of common metals such as sodium, magnesium, calcium etc. are spread at cloud base level to promote the growth of cloud droplets by coalescence. The salts used in the later is much lower in cost than silver iodide. The method is also applicable to a higher spectrum of cloud conditions. The low rate of success of warm cloud seeding is the barrier that the technology promoters have to overcome. Not much research has been done to find the persistence of cloud seeding effects. If the effects continue for prolonged periods the process may affect the microphysical structure of the upper atmosphere and consequently the development of precipitation for a significant amount of time after the seeding has been completed. It is also of interest to investigate the studies done on pollutant particles on the precipitation process. Several studies have shown that urban and industrial air pollution may suppress the formation and vertical growth of convective clouds, thus such pollutants may reduce the precipitation. The pollutants may reduce the effectiveness of coalescence as well as both warm-rain and ice precipitation processes. Such observations demands deeper investigations into the post-seeding impacts on the cloud morphology. Due to the isolation of research done in this field of technology, a comprehensive and critical review on the topic has become a dire need at present to have a more sustainable progress in the technology. This paper serves the purpose of filling that knowledge gap.

Acknowledgements:

The authors would like to acknowledge the facilities and support rendered by the Centre for Electromagnetic and Lightning Protection, University Putra Malaysia in making this project a success.
RAIN WATER HARVESTING FOR AGRICULTURE DEVELOPMENT BASED ON GIS SPATIAL MODEL CASE STUDY: NORTH WESTERN COAST - EGYPT

Abdelaziz Belal *, Rashash A., Mohamed E.S., El-Shirbeny M.

.-Az INational Authority for Remote Sensing and Space Sciences, Cairo, Egypt

Mail address: 23 Joseph Tito Street, El-Nozha El-Gedida (P.O. Box : 1564 Alf Maskan)

email:belalabd@gmail.com.

Abstract

Water issue in Egypt is rapidly assuming alarming proportion and Egypt will be consuming 20 percent more water than it has. Water requirements of the agricultural sector represent the largest component of the total water demand in Egypt. Rain water harvesting involves the capture and storage of runoff rainwater, to sustaining and improving agricultural productivity. The current work uses a GIS-based model as a tool to optimize and identify suitable locations to implement Rain Water Harvesting (RWH) management. Soil characteristics, rainfall topographic elements and land use/land cover were used as indicators for the water harvesting model. Remote sensing data, GIS and Multi-criteria Analysis were applied to determine the suitable sites for RWH in Wadi Al-kheir area North Western Coast to get the benefit for agricultural development, which suffering of dry season in summer and flashfloods in winter that impact the agricultural system as well as natural disasters and economic losses. The results illustrated that 26 sites have been selected which located in down steam basin with gentle slope that have been divided in two class; main dams for reservoir water and secondary dams. Therefore the results could be helped the decision makers to manage water availability for agricultural irrigation and adopted the water stressed seasons in the study area, thereby increased agricultural productivity.

Keywords: RWH, Water Management, GIS and RS, North Western Coast.
Investigating the Effects of Obstacles’ Arrangement on the Development of Saline Density Current’s Front in Experimental Conditions

Hossein KhozeymehNezhad¹, Seyyed Mostafa Tabatabaei², Abolfazl Akbarpoor³, Peyman Varjavand⁴.

¹- Assistant Professor, University of Birjand
²- M.S.C in Water Resources Engineering, University of Birjand
³- Associate Professor, University of Birjand
⁴- Ph.D. in Hydraulic Structures, University of Tabriz

e-mail of corresponding author: hkhozeymeh@birjand.ac.ir

Abstract

Density currents are determined as the main factors threatening the water resources and dams’ reservoirs. As they can reduce both the volume of dam’s reservoir and the volume of flood control, they can also affect the quality of water so that they cause reduction in economic efficiency as well as efficiency of electricity production. In this research, the effects of six arrangements on the development speed of the front of density current were investigated. Because the factors such as bed slope and current’s concentration have influence on the development velocity of density current’s front, the experiments have been repetitively conducted on 0 %, 1 %, and 2 % slopes, and with two densities of 40 g/l and 80 g/l. In sum, 42 experiments have been carried out. The results show if there are obstacles in front of density currents, the speed of the front reduces consequently. The arrangement of obstacles are effective in improving the performance of obstacles. The similar convergent arrangements have the better yield in contrast to those of other arrangements. The increase in the value of slope leads in reduction in the effect of obstacles’ arrangement. Thus, the fundamental strategy is to control the density currents on the slopes in order to control the development of the density currents and to increase the performance of obstacles’ arrangement.

Keywords: Density Current, Obstacles’ Arrangement, Bed Slope, Dam Reservoirs, Water Resources Management.
<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Environmental planning of flash flood-vulnerable areas of the Eastern Desert of Egypt</td>
<td>238</td>
</tr>
<tr>
<td>2</td>
<td>Analyzing the Changing Climate: How Open Source Data and Information can be Helpful in Adaptation</td>
<td>239</td>
</tr>
<tr>
<td>3</td>
<td>Flash Flood Water Management Practices In Dera Ghazi Khan City (Pakistan): A Remote Sensing And Gis Prospective</td>
<td>240</td>
</tr>
<tr>
<td>4</td>
<td>Effects of climate change on river runoff and provide solutions to adapt to its effects(Case Study: Basin Tuyserkan Hamedan)</td>
<td>241</td>
</tr>
<tr>
<td>5</td>
<td>Geoinformatics In Mapping Of Flood Prone Area Of Tiruchirappalli City Tamilnadu Using Hec-Georas</td>
<td>242</td>
</tr>
<tr>
<td>6</td>
<td>Dynamic Variability Examination Of Mediterranean Frontogenesis And Teleconnection Between Fronts And Flood 2010</td>
<td>243</td>
</tr>
<tr>
<td>7</td>
<td>Impact Of Climate Change On Water Resources And Climate Parameters In Arid Zones, Cas Watershed Bechar (South West Of Algeria).</td>
<td>244</td>
</tr>
<tr>
<td>8</td>
<td>Exploiting Geographic Information Systems And Remote Sensing For Flash Floods In Oman</td>
<td>246</td>
</tr>
<tr>
<td>9</td>
<td>Correlation Among The Long Term Rainfall Pattern In Arid And Wet Regions In Mongolia</td>
<td>247</td>
</tr>
<tr>
<td>10</td>
<td>Assessment of climate variations in temperature and precipitation extreme events over Morocco</td>
<td>248</td>
</tr>
<tr>
<td>11</td>
<td>Coupled Stochastic-Geostatistical Modeling Of Drought Vulnerability In Arid Regions Of Southeastern Iran</td>
<td>249</td>
</tr>
<tr>
<td>12</td>
<td>Climate Change Impact Assessments of a Selected Area of Himalaya Glaciers of Pakistan using RS&amp;GIS</td>
<td>250</td>
</tr>
<tr>
<td>13</td>
<td>Contrast Strategies And Seasonal Indigenous Water Supply In A Plinth Area: Case Of Dassa-Zoumé Commune (Republic Of Benin, West Africa)</td>
<td>251</td>
</tr>
<tr>
<td>14</td>
<td>Assessment of hydrologic impacts of climate change in Mejerda basin in Tunisia, and Wadi Dayqah basin in the Sultanate of Oman</td>
<td>252</td>
</tr>
<tr>
<td>15</td>
<td>Transboundary Water Governance and Climate Change in the Hashemite Kingdom of Jordan</td>
<td>253</td>
</tr>
<tr>
<td>16</td>
<td>Water Monitoring in Lake Nasser using Satellite data</td>
<td>254</td>
</tr>
<tr>
<td>Page</td>
<td>Title</td>
<td>Pages</td>
</tr>
<tr>
<td>------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>17</td>
<td>Rainfall Runoff Modelling In Semi Arid Context: Comparison Of Different Runoff Production Function Effect On Basin Response (Skhira Basin, Tunisia)</td>
<td>255</td>
</tr>
<tr>
<td>18</td>
<td>Combining Principal Component Analysis And Varigorahpy To Study The Annual Pluviometry In The North Of Tunisia: Application In The Medjerda Basin</td>
<td>256</td>
</tr>
<tr>
<td>19</td>
<td>Rainfall-Runoff Modeling In Northern Tunisia: Multi Production Functions Comparison Using The Mercedes Model</td>
<td>257</td>
</tr>
<tr>
<td>20</td>
<td>A New Innovative Toll To Measure Soil Erosion</td>
<td>258</td>
</tr>
<tr>
<td>21</td>
<td>Climate Change Effects Of Rainfall On Simulated Flood Hydrograph In Urban Arid Volcanic Catchment In Madinah Western Saudi Arabia</td>
<td>259</td>
</tr>
<tr>
<td>22</td>
<td>Farmers Perception, Awarness, Adaptation And Mitigation Potential Of Climate Change In Arid Agro-Climatic Zone: A Case Study Of Anantapur District Of Andhra Pradesh State, India</td>
<td>260</td>
</tr>
<tr>
<td>23</td>
<td>The Impact of Catchment Management on Emergency Management of Flash-Flood</td>
<td>261</td>
</tr>
<tr>
<td>24</td>
<td>Debris Flood Control Approach for Urban River Restoration in an Arid Region</td>
<td>262</td>
</tr>
<tr>
<td>25</td>
<td>Spatial Distribution And Temporal Trends In Daily And Monthly Rainfall Concentration Indices In Algeria</td>
<td>263</td>
</tr>
<tr>
<td>26</td>
<td>Scenarios based climate projection for Oman water resources</td>
<td>264</td>
</tr>
<tr>
<td>27</td>
<td>Influence Of Ligands On Metal Speciation, Transport And Toxicity In A Tropical River During Wet (Monsoon) Period</td>
<td>265</td>
</tr>
<tr>
<td>28</td>
<td>Quantifying the Uncertainty of Semiarid Runoff Extremes Using Generalized Likelihood Uncertainty Estimation</td>
<td>266</td>
</tr>
<tr>
<td>29</td>
<td>Suspended Sediment Transport, Erosion And Deposition In A Semiarid Watershed, Wadi Sebdou, Nw Algeria (1973-2004)</td>
<td>267</td>
</tr>
<tr>
<td>30</td>
<td>Measuring The Impact And Economic Benefits Of Rainfall Enhancement In Multiple Use Water Catchments</td>
<td>268</td>
</tr>
<tr>
<td>31</td>
<td>Rainfall Enhancement in the Hajar Mountains, Oman</td>
<td>269</td>
</tr>
<tr>
<td>32</td>
<td>Observing actual evapotranspiration within a heterogeneous watershed: The case study of the Kamech site, Cap Bon Peninsula, Tunisia</td>
<td>270</td>
</tr>
<tr>
<td>33</td>
<td>Statistical Downscaling Of Iran Annual Precipitations Based On Various Scenarios Of Climate Change</td>
<td>271</td>
</tr>
<tr>
<td>34</td>
<td>Forecasting Mean Of Monthly Rainfall By Applying Time Series (case study: Baba – Amman, Bojnourd Pluviometer Station)</td>
<td>272</td>
</tr>
<tr>
<td>35</td>
<td>Performance Evaluation Of Classical And Data Mining Methods In Monthly Precipitation Missing Data Estimation In Arid Areas</td>
<td>273</td>
</tr>
<tr>
<td>36</td>
<td>Spatio - Temporal Variability Of Infiltration Pattern In Semi-Arid Watershed Of Karnataka, India</td>
<td>274</td>
</tr>
<tr>
<td>37</td>
<td>Observing Flash Flood In Arid And Semi-Arid Regions From Space: Wadi Watier Of Egypt As A Case Study</td>
<td>275</td>
</tr>
<tr>
<td>38</td>
<td>Recent Observed Climate Change over Oman</td>
<td>276</td>
</tr>
<tr>
<td>39</td>
<td>Reservoir Operation Using System Dynamic under Climate Change Impacts: A Case Study of Yamchi Reservoir, Iran</td>
<td>277</td>
</tr>
<tr>
<td>40</td>
<td>Uncertainty Analysis Of Radial Basis Function Artificial Neural Network Based Rainfall – Runoff Modeling</td>
<td>278</td>
</tr>
<tr>
<td>41</td>
<td>Effect Of Roughness On Water Speed In An Herbaceous Rectangular Canal</td>
<td>279</td>
</tr>
<tr>
<td>42</td>
<td>The Zonation Of Flash Flooding Disasters In Urban Catchment By Using Gis-Based Statistical Model And Remote Sensing Technology</td>
<td>280</td>
</tr>
<tr>
<td>43</td>
<td>An Evaluation Of The Impact Of Drought On A Shallow Groundwater Water Quality Under Semi Arid Climate (Case Of Plio-Quaternary Aquifer Of Essaouira, Morocco)</td>
<td>281</td>
</tr>
<tr>
<td>44</td>
<td>Integration Between Morphometric Parameters, Hydrologic Model And Geo-Informatics Techniques For Estimating Wadi Runoff (Case Study Wadi Halyia- Saudi Arabia)</td>
<td>282</td>
</tr>
<tr>
<td>45</td>
<td>Flash flood prone sub-basins mapping of ungauged arid basins based on the integration between morphometric parameters and GIS techniques (case study of wadi baysh basin-Saudi Arabia)</td>
<td>283</td>
</tr>
<tr>
<td>46</td>
<td>The Impact Of Including Different Ir Band On Rainfall Product Quality</td>
<td>284</td>
</tr>
<tr>
<td>47</td>
<td>Selecting Rainfall Temporal Pattern To Estimat Design Flash Flood: Gulf Of Suez Region</td>
<td>285</td>
</tr>
<tr>
<td>48</td>
<td>Development of intensity duration frequency curves for flood forecasting in the Kingdom of Saudi Arabia</td>
<td>286</td>
</tr>
<tr>
<td>49</td>
<td>Influence Of Bedrock And Climatic Control On Knickzone Development In Arid Watersheds</td>
<td>287</td>
</tr>
<tr>
<td>50</td>
<td>Glacial Changes in the Kashmir Alpine Himalayas under changing Climate and topography</td>
<td>288</td>
</tr>
<tr>
<td>51</td>
<td>Flood Hazard Zone Mapping And Vulnerability Assessment-A Case Study Of Coastal District Of Tamilnadu</td>
<td>289</td>
</tr>
<tr>
<td>52</td>
<td>Neuro-Chaotic hybrid model for Daily Rainfall-Runoff Forecasting In Saharan Watersheds</td>
<td>290</td>
</tr>
<tr>
<td>53</td>
<td>Rainfall Variability Analysis Using Trmm Precipitation Data Over Shipra Catchment Of Central India</td>
<td>291</td>
</tr>
<tr>
<td>54</td>
<td>Spatial And Temporal Variations Of Rainfall In Tessa Subwatershed Of Medjerda River In Tunisia</td>
<td>292</td>
</tr>
<tr>
<td>55</td>
<td>Evaluation Of Water Erosion Risk In Tunisian Semi Arid</td>
<td>293</td>
</tr>
<tr>
<td>57</td>
<td>Impact Of Climate Change On The Flow In Five Watershed Of The North West Of Algeria</td>
<td>295</td>
</tr>
<tr>
<td>No</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----</td>
<td>------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>58</td>
<td>Impact Of Climate Change On Water Resources In The Catchment Of The Wadi Mina (Northwest Algeria)</td>
<td>296</td>
</tr>
<tr>
<td>59</td>
<td>Assessment of the potential socio-economic impacts of climatic change and the existing adaptation measure in southern Jordan</td>
<td>297</td>
</tr>
<tr>
<td>60</td>
<td>Hydrometeorology of the Rajasthan desert rainfall</td>
<td>298</td>
</tr>
<tr>
<td>61</td>
<td>Environmental effects of As, B and other heavy elements of Isti Su hot spring, Western Azerbaijan, Iran</td>
<td>299</td>
</tr>
<tr>
<td>62</td>
<td>Assessment Of Climate Changes Impact On The Hydrological Properties Of Unconfined Aquifers; A Case Study From Samara’-Baiji Area, Iraq</td>
<td>300</td>
</tr>
<tr>
<td>63</td>
<td>Rainfall harvesting under climate change (El-Dabaa Region, Northwestern Coast, Egypt)</td>
<td>301</td>
</tr>
<tr>
<td>64</td>
<td>Urban Flood Modeling For Wadi Al-Aqiq, Madinah, Saudi Arabia</td>
<td>302</td>
</tr>
<tr>
<td>65</td>
<td>Water And Energy Use Efficiency Of Greenhouse And Nethouse Under Desert Conditions Of UAE</td>
<td>303</td>
</tr>
<tr>
<td>66</td>
<td>Socio-Economic Implications And Strategies Of Adaptation Facing The Floodings In The Low Valley Of Oueme In Dangbo (Republic Of Benin, West Of Africa)</td>
<td>304</td>
</tr>
<tr>
<td>67</td>
<td>Flash Floods as Natural Disaster in Jammu And Kashmir, India : Implications to Socio-Economic Settings</td>
<td>305</td>
</tr>
<tr>
<td>68</td>
<td>Spatial Patterns Of Water Quality In Garra River At Shahjahanpur, Ganga Basin, India</td>
<td>306</td>
</tr>
<tr>
<td>69</td>
<td>Variability And Trends Analysis Of Precipitation Over Time Using Mann-Kendall Test, Northern Ethiopia</td>
<td>307</td>
</tr>
<tr>
<td>70</td>
<td>Modelling of Water Distribution Piping Network in Steel Gate Water Distribution Zone of Dhanbad Municipality Corporation, Jharkhand, India</td>
<td>308</td>
</tr>
<tr>
<td>71</td>
<td>Statistical and Geostatistical analysis related to geographical parameters for spatio-temporal representation of rainfall in semi-arid environments. Case of Algeria.</td>
<td>309</td>
</tr>
<tr>
<td>72</td>
<td>Hydrological Response To Climate Change Of The Upper Blue Nile River Basin: Based On IPCC Fifth Assessment Report (AR5)</td>
<td>310</td>
</tr>
<tr>
<td>73</td>
<td>Impacts Of Climate Change And Upstream Anthropogenic Interventions On The Development Of Transboundary River Basins In Arid And Semi-Arid Areas</td>
<td>311</td>
</tr>
<tr>
<td>74</td>
<td>Climate Change Impacts On Aquifer Recharge In Semi-Arid Region, Southeast Of Spain: The Use Of Hydrobal Eco-Hydrological Model</td>
<td>312</td>
</tr>
<tr>
<td>75</td>
<td>Early Warning Information System (EWIS) To Mitigate The Climate Change Hazards In New Suez Canal Region, Egypt</td>
<td>313</td>
</tr>
<tr>
<td>76</td>
<td>Using The Arnoldus Indice To Map The Risks Of Rainfall Erosivity In The Tell Oran (Algeria)</td>
<td>314</td>
</tr>
<tr>
<td>77</td>
<td>The Assessment Of Climate Change Impact On Aparan Reservoir Hydrometeorological Regime</td>
<td>315</td>
</tr>
<tr>
<td>78</td>
<td>Assessment Of Global Change Impacts On Groundwater Resources In Souss- Massa</td>
<td>316</td>
</tr>
<tr>
<td>No.</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>79</td>
<td>Evaluation of Risk of Access to Water Resources Regarding the Process of Late half Century in Arid and Semi-Arid area</td>
<td>317</td>
</tr>
<tr>
<td>80</td>
<td>Modeling Hydrometeorology drying effect Maharloo Lake on the severity of aridity Shiraz semi-arid station in the southern half of the Iran</td>
<td>318</td>
</tr>
<tr>
<td>81</td>
<td>Study Of Coastal Changes From Kuala Besar To Kuala Sungai Pengkalan Datu, Kelantan, Malaysia Using Gis</td>
<td>319</td>
</tr>
<tr>
<td>82</td>
<td>Quantification Of Direct And Indirect Human Impacts On Surface Runoffs With Emphasis On Quantification Of Share Of Climate Change</td>
<td>320</td>
</tr>
<tr>
<td>83</td>
<td>Effect Of High Resolution Dem In Flood Inundation Modelling In Urban Areas Using Watershed Modeling System</td>
<td>321</td>
</tr>
<tr>
<td>84</td>
<td>Use Of The Remote Sensing In The Study Of Evolution Of A Saharan Wet Zone (South-Eastern Algeria)</td>
<td>322</td>
</tr>
<tr>
<td>85</td>
<td>Synoptic And Dynamic Aspects Of An Extreme Sources Sink During Springtime Saharan Dust Outbreak</td>
<td>323</td>
</tr>
<tr>
<td>86</td>
<td>Temporal And Spatial Evolution Of A Collapse Crater By Application Of Remote Sensing And Gis (Case Of The Well Okn32, Haoud Berkaoui, Southeast Algeria)</td>
<td>324</td>
</tr>
<tr>
<td>87</td>
<td>Soil Pollution By Petroleum Products: Algerian Case</td>
<td>325</td>
</tr>
<tr>
<td>88</td>
<td>Impact Of East-West Highway On The Hydrological Regime Of The National Park Of El Kala (Algeria)</td>
<td>326</td>
</tr>
<tr>
<td>89</td>
<td>Risk Assessment Of Climate Change Effects On Drought (Case Study: The Region Of Shahrood, Iran)</td>
<td>327</td>
</tr>
<tr>
<td>90</td>
<td>Civil society engagement in dealing with climate change in water sector: case of Morocco</td>
<td>328</td>
</tr>
<tr>
<td>91</td>
<td>Comparison Of Standardized Precipitation Index And Normalized Difference Vegetation Index Anomalies For Drought Analysis</td>
<td>329</td>
</tr>
<tr>
<td>92</td>
<td>Validation Of Stochastic Models For Drought Forecasting</td>
<td>330</td>
</tr>
<tr>
<td>93</td>
<td>Empirical Equations of Flood Analysis in Arid Zones</td>
<td>331</td>
</tr>
<tr>
<td>94</td>
<td>Climate change impacts on the water resources in the Macta basin; Algeria.</td>
<td>332</td>
</tr>
</tbody>
</table>
Environmental planning of flash flood-vulnerable areas of the Eastern Desert of Egypt

Mohammed El Bastawesy
Associate prof of environmental geology, the national authority for remote sensing and space sciences (NARSS), Egypt
Email: m.elbastawesy@narss.sci.eg

Abstract
The flood plain of the River Nile in Egypt is heavily populated and mainly composed of fertile fluvial sediments laid down into a relatively narrow gorge between the Eastern and the Western Desert. Locally, urban and agricultural areas are prone to infrequent flash floods from the numerous wadis dissecting the surrounding deserts into the Nile flood plain. The floors of these wadis have been encroached by different land use during the past few decades, including but not limited to, urban, cultivation, power plants and sanitation treatment facilities. Therefore, the impact of flash floods has been intensified by the interaction of different landuse and torrential flows. The environmental degradation induced by using some of the wadi floors for waste and sewage discharges is of particular significance here. Thus it was very crucial to assess the flash flood parameters for those wadis to determine the precaution measures to be taken to advert negative environmental consequences. Updated mapping of landuse and hydrological parameters have been accomplished using multitude of remote sensing data, field work, topographic survey and geophysical exploration. The hydrological parameters were estimated using the changes of spectral signatures of active channels on the satellite images acquired before and after flash floods, and the survey of cross-sectional areas and gradient of these channels. Then the application of open channel flow equations was used to map the time areas zones for the catchment given the hydrographic derivatives from the digital elevation models (DEM). Therefore, the optimal controlling strategies and engineering structures are recommended. The disposal of waste water from treatment facilities into the neighboring wadi beds has affected the quality of groundwater of these alluvium aquifers. Integrated management of water resources and utilization of the wadi systems are proposed to achieve the optimal sustainable development.
Analyzing the Changing Climate: How Open Source Data and Information can be Helpful in Adaptation

Burira Anam, Bilal Ahmad Munir, Iqra Ashraf

1Pakistan Meteorological Department (PMD), Aviation Division, H-8-II, Islamabad Pakistan
2Institute of GIS, School of Civil and Environmental Engineering, National University of Science and Technology, H-12 Islamabad Pakistan
3Water and Sanitation Agency (WASA), Civil Lines, Faisalabad Pakistan

e-mail bia.anam@gmail.com

Abstract

The intent of study is to highlight the importance of open source data and information in analyzing hydro-meteorological phenomena and trends to overcome the future threats. Use of advanced open source technologies for pre and post assessment of hazard is now becoming more important step for fund raisers and donors as to allocate the aid efficiently. NASA (TRMM, LANDSAT etc) data products and online server information is utilized to scrutinize precipitation, temperature trends for two decades (1990-2010) in Pakistan. The flood events and vulnerable areas are identified on the basis of collected information. The effects of changing meteorological parameter are analyzed on river streams by examining river width, braids-channel ratio, river sinuosity and riparian vegetation using remote sensing and GIS techniques. The results show changes in extreme values of hydro-meteorological parameters and physical evolution of rivers in Pakistan. Average and total precipitation with minimum and maximum temperatures are going through annual, biannual and seasonal changes more abruptly substantiating the extreme events to be more fluent. The demonstrated approach reflects the beneficial nature of open source information and data for the analysis and proper management of extreme events on large scale. The findings closure the approach to be viable for funding organizations in efficient geographical allocation of aid in affected areas.
FLASH FLOOD WATER MANAGEMENT PRACTICES IN DERA GHAZI KHAN CITY (PAKISTAN): A REMOTE SENSING AND GIS PROSPECTIVE

Bilal Ahmad Munir¹, Javed Iqbal²

¹Pakistan Meteorological Department (PMD), Aviation Division, H-8-II Islamabad Pakistan
²Institute of GIS, School of Civil and Environmental Engineering, National University of Science and Technology, H-12 Islamabad Pakistan

E-mail: bilalahmedmunir35@gmail.com

Abstract

Flash flood hazard of Wador hill torrent has distressed human activities in almost every part of Dera Ghazi Khan (D.G. Khan) City, Pakistan. In order to mitigate such hazards, and to utilize the flash flood water in such water deficit area, the study identifies potential suitable sites for dam construction with quantitative assessment resulting in capacity determination of the designed dams. The developed methodology also incorporates the designing of downslope water conveyance system in Storm Water Management Model’s (SWMM) environment. The efficacy of the dams was analyzed using SWMM model’s runoff and transport module by integrating meteorological and topographic factors with the utilization of Curve Number (CN) method for runoff generation and modeling. Two sites were identified as suitable for dam construction with sufficient collective designed capacity of approximately 27 million cubic meters to accumulate the flashy peaks. Number of channels designed results in systematic waterways to flow from the dam site to the outlet point (D.G. Khan Canal). The findings may be useful to make precaution measures for the severe weather conditions and for the future prescriptions about the effects associated with water related problems.
Effects of climate change on river runoff and provide solutions to adapt to its effects (Case Study: Basin Tuyserkan Hamedan)

S. Poormohammadi1*, M.H. Rahimian2

1-PhD in Watershed Science and Engineering in water resources institute and Expert of National Cloud Seeding Research Center, Ministry Of Energy, Yazd, Iran. 2- PhD student of science and water engineering, Isfahan University of Technology

Email: s.poormohammadi@gmail.com,
Tel: +9838250551-2, Fax: +9835108251403

Abstract

Climate change in addition to the direct impact on climate parameter, indirectly on the economy, society, agriculture and ...was impacted and will cause consequences such as floods, drought, migration, poverty and associated. Thus it is necessary to determine the mechanisms and more prepared to reduce the negative consequences of climate change phenomenon is essential to seems to be. Because of the importance of the climate change phenomenon on water resources in rivers, scrutiny of river behavior and specially river discharge in the future periods affected by climate change is essential to water resource management and finding solutions for adaptation and mitigation to climate change. Goal of this reaserch is investigation of climate change impact on watershed runoff of Tuyserkan river and appropriate solutions to reduce the impact of these changes. For this purpose, hydrometric and meteorological data and so soil characteristics and topography of the area, were collected. Using the soil moisture accounting algorithm was implemented to continuous rainfall-runoff model for sub basin of Tuyserkan plain upstream. Then using 15 general circulation model and LARS-WG model and using the beta distribution function were simulated rainfall under A1B and B1 scenarios. Rainfall-runoff model was run using future rainfall amounts and volume of runoff in each of sub basin was presented in the future period of 2011-2030. Finally, with 10% increase assuming of rainfall by cloud seeding technique was estimated for river runoff. The results showed that the decrease in rainfall due to climate change will reduce runoff volume of each sub basin. As of 40.5 million cubic meters in base period will be to 34.9 and 35.8 million cubic meters under scenarios A1B and B1. The results showed that the 10% increase in precipitation from cloud seeding, about 2 million cubic meters of runoff volume declined due to climate change will be compensated.

Key Word: climate change, river runoff, cloud seeding
GEOINFORMATICS IN MAPPING OF FLOOD PRONE AREA OF TIRUCHIRAPPALLI CITY TAMILNADU USING HEC-GEORAS

Saravanan, S1, Sivaranjani, S2. And Kasiviswanathan S3.
Assistant Professor National Institute of Technology Tiruchirappalli, India.
PG student, Bharathidasan University, Tiruchirappalli, India.
Post-doctoral fellow, department of Civil Engineering, Schulich School of Engineering, University of Calgary,Canada.
ssaravananirs@gmail.com

Abstract

Flood and drought are probably the most recurring and frequently occurring natural hazards in the world. India is one of the worst flood-affected countries in the world. Flooding causes significant socioeconomic damage, and therefore emphasis has been placed on accurately delineating flood plain boundaries for the purpose of assessing the damages, emergency flood fighting measures, flood forecasting and warning system and flood control policies such as zoning bylaws, building codes. With the advent of computers and Geographic Information Systems (GIS) technology is used to develop automated methods for quantifying the spatial variability of flood hazard. The purpose of this paper is to illustrate the flood plain mapping and Flood inundation zone of Tiruchirappalli city located on the bank of Cauvery and confluence point of Koraiyar River. The problem of flood in Tamil Nadu is well known and every year it becomes a recurring problem and especially in Tiruchirappalli due to the rapid urbanization.

In this study, a GIS based hydrological and Hydraulic model was developed for simulation of flood and its inundated area mapping by using HEC- GeoRAS. The thirty meter ASTER digital elevation model (DEM) and filled collected elevation points are used to derive the digital terrain model. The hydrological corrected DEM was developed using a combination of bathymetry point data in the stream channels, and detailed contour data for the remaining floodplain area. In order to improve the representation of the stream channel geometry, it was differentiated from the floodplain by manually locating the left and right channel banks for each cross-section. In this study, three roughness values were assigned for each cross-section, namely the left and right over bank areas and the main channel. Land use and soil information are created using ArcGIS software and surface runoff was determined by SCS_CN method. Flood plain modeling is carried out using HEC-RAS 1D hydraulic routing procedure for channel flow and 2D over flood plain to enable simulation of flood water depth and its extent. Three flood events during the 2005 and one from 2010 are considered in the study. By simulating the land surface, water surface by using cross section details of the river and surface terrain, it could be able to determine the extent and depth of the flood. The flood risk maps are generated by damage based on the flooding depth and for various return periods. The resulting output model provides a good representation of the general landscape and contains additional detail within the stream channel and building details. Overall, the results of the research indicate that GIS is an effective tool for floodplain mapping and analysis also helps in damage assessment and assessing the impact of flood.

Key Words: DEM, Flood plain analysis, GIS, HEC- GeoRAS, TIN.
DYNAMIC VARIABILITY EXAMINATION OF MEDITERRANEAN FRONTOGENESIS AND TELECONNECTION BETWEEN FRONTS AND FLOOD 2010

Iqra Ashraf 3, Bilal Ahmad Munir 1, Hafiz Ali Imran 2

3 Institute of GIS, School of Civil and Environmental Engineering, National University of Sciences and Technology, Islamabad Pakistan. e-mail: caution_i_trap@hotmail.com

1 Pakistan Meteorological Department (PMD), Aviation Division, H-8-II Islamabad Pakistan. e-mail: bilalahmedmunir35@gmail.com

Environmental Protection and Agriculture Food Production, University of Hohenheim, Stuttgart Germany. e-mail: hfz.ali.imran@hotmail.com

Abstract

An improved scheme for the detection of Mediterranean frontal activities is proposed, based on the identification of cloud pattern, thermal gradient and water content of air masses using Meteosat-7 satellite imagery. Owing to highly variable nature of fronts, spatial shift occurring over 1.5 years are analyzed. Full disc imagery of Meteosat-7 satellite is used for the analysis over vast geographical distribution of Eurasia. The study examined the fundamental characteristics of fronts and effects associated with Mediterranean fronts with the analysis for the flood event of 2010 in Pakistan. The results show seasonal as well as annual change in the range of lower and upper latitudinal limits of frontogenesis. Seasons of winter 2011 shows an increase in speed whereas a decrease is observed in summer. The identification process has shown a frontal span over northern areas of Pakistan during flood event of 2010 accentuating the monsoonal rainfall intensity all over the country. The result of this analysis can be used to estimate the behavior of the mid-latitudes global circulations. The anticipated outcome of this research study is the identification of abrupt nature of frontal processes.
IMPACT OF CLIMATE CHANGE ON WATER RESOURCES
AND CLIMATE PARAMETERS IN ARID ZONES, CAS
WATERSHED BECHAR (SOUTH WEST OF ALGERIA).

Boufeldja. Samira
Doctoral student of Tahri Mohamed Bechar, Algeria
samiraboufeldj@yahoo.fr

Abstract

Climate change and variability issues for some time are placed at the center of concerns scientists and policy makers in the world. Because of their immediate and lasting impact on the natural environment and man. Algeria is a country with low water resources. The dual demographic and economic growth has resulted in increased water demand and unsustainable pressure on this resource. The expected climate change for Algeria, have direct and indirect negative impact on the water resource potential, both in quantity than quality perspective, the water needs and the efficiency of use of this resource different uses. Algeria is a country with low water resources. The dual demographic and economic growth has resulted in increased water demand and unsustainable pressure on this resource. The expected climate change for Algeria, have direct and indirect negative impact on the water resource potential, both in quantity than quality perspective, the water needs and the efficiency of use of this resource different uses. The study area (watershed of Oued Bechar) is located South West of Algeria rating of Moroccan borders. To better address this issue, we adopted the following methodology:
- Development of specific cards rainbow gis gathers knowledge about the watershed and river characteristics and shape.
- Insight into the geological features, to fully understand the behavior of the formations and the possibility of formation of aquifers.
- Analysis of rainfall and know the variation in time of runs a century detected the deficit and surplus periods by the indices tested and break in the time series.
- Climatological study to interpret the type of climate prevailing in the study area, and provides a quantitative reproduction of the water cycle based on climate characters.
- And finally a hydrometric study, hydrogeological evaluation aims runoff in the watershed.
- La study area (watershed Bechar) is located in South West Algeria. This basin extends over an area of 6037 km² and drained by a river system characterized by a main wadi Wadi es Bechar (221km).

The geological study demonstrates physiographic variability and lithological sequence of courses begins with the Precambrian and Quaternary ended. On rough formations that have the ability to be Carboniferous aquifer are Gré and Turonian. The dominant climate in the
Bachar BV is a hyper-arid climate, Saharan temperate winter and dry. Characterized by a high temperature range and a considerable deficit. The time series of precipitation know Pettitt test of visual disturbances shows breaks in the law of probability. The slick to Turonian great potential in Bechar BV, it influences climate change poses a problem in recharging. Piezometric monitoring finds that the fluctuations are low, it is the result of the synclinal form of the web. The global warming theory is true in Bechar station, where changes in temperature follows a progressive function. Despite the study period is short warming is real and more precipitation data is moderately sufficient to demonstrate the change in the probability distribution of the time series, confirming months or more climate variability. Several methods have been used, The index of Nicholson showed fluctuations in rainfall and hydrological regimes under wet, normal and dry periods for rain. Wet years lie generally between dry years she kept laying three to four years, Pui give way to dry periods from 1913-1939, 1968-1986, and 1996-2005 with the exception of some years. After this illustration of the existence of fluctuations using Nicholson indices, statistical methods allowed that there are breaks which correspond to a change in the average amount of rainfall. Cutoff dates is synchronous to that of surplus years. As 1912,1940, 1942 and 2008 In making the calculation of average annual rainfall of either side breaks, the reduction in rainfall after rupture is between 13 and 24% and there is a clear impact on the flow of the wadi Bechar, decreasing reaching 14% in Bechar wadi. The watershed is Bechar Rich hydrated unit formations and holds great potential. The tablecloth Turonian is the most important because of its quantitative and qualitative capacity was therefore groundwater arises penny light of studies for some time. Research results show that the permeability is about 0002 m² / s and a coefficient of 0.127 emmagasinement. In the end the area is subjected under the effect of global warming, whatever the degree of weak or strong influence, and water resources management policy must take this action is considered.
EXPLOITING GEOGRAPHIC INFORMATION SYSTEMS AND REMOTE SENSING FOR FLASH FLOODS IN OMAN

Anthony Ijeh

University of Buraimi, P.O. Box: 890, Postal Code: 512, Buraimi, Sultanate of Oman

anthony.i@uob.edu.om

Abstract

Abstract—Purpose—Oman is subject to major flash flooding which records show has occurred in Oman in since 1989 to date. Whenever major flash floods occur in Oman lives are lost and infrastructure worth millions of Omani Rials is destroyed. The purpose of this paper is to present findings from exploitation of Geo-Information Systems and Sensor technologies to mitigate risks to Oman’s population caused by flash floods in Oman. 

Design/methodology/approach—The studies approach uses system integration to adopt behavioural patterns inherent in Geo-Information Systems and Sensor technologies to provide a solution to flash flood challenges facing Oman’s population. Findings—Preliminary findings from simulation of the framework suggest that the integrated system is able to mitigate the risks caused by flash flood facing Oman’s population. Research limitations/implications—Findings are based on simulation of the framework and not testing in a live environment. Future research could explore testing in a live environment. Practical implications—The implication of the findings is that it lays a foundation for academics and practitioners to develop a suitable prototype for mitigating flash flood risks to Oman’s population. Originality/value—The value of the paper is that it presents a novel solution to flash floods which are a major national challenge facing Oman’s population.

Acknowledgements: The study and publication were made possible through a research grant from the College of Business, University of Buraimi, Sultanate of Oman. The author also acknowledges the Centre for Geo-Information Studies, University of East London, England.
CORRELATION AMONG THE LONG TERM RAINFALL PATTERN IN ARID AND WET REGIONS IN MONGOLIA

Myagmar Doljinsurena\textsuperscript{1} and Chandima Gomes\textsuperscript{2*}

\textsuperscript{1}Institute of Meteorology, Hydrology and Environment, Ulaanbaatar, Mongolia

\textsuperscript{2*}Center for Electromagnetic and Lightning Protection, Universiti Putra Malaysia

*chandima@upm.edu.my

Abstract

Mongolia is a landlocked country in Central Asia bordering Russia in North and China in other directions. The country lies between latitudes 41° N and 52° N; longitudes 87° E and 120° E and has land area of 1,564,116 km\textsuperscript{2}. Being a continental land block, Mongolia has an average altitude of 1500 m above mean sea level; starting from high mountains in the north and ending up with Gobi desert in the south which is located at much lower altitudes. The country can basically be divided into four zones; western, central, eastern and southern; for the convenience of meteorological data analysis. It has been observed qualitatively for the last few decades that arid region of the country undergoes drier periods than usual when wet zone experiences wetter conditions. This study has been carried out to validate this observation quantitatively by analyzing long term rainfall data. The country could conveniently be divided into four zones by mean annual rainfall; Zone with 0-100 mm (A), 101-200 mm (B), 201-300 mm (C) and > 301 mm (D). Rainfall data for 30 years (1985-2014), collected at 118 observational centers have been analyzed. For each year, mean annual rainfall of each zone has been divided by the mean annual rainfall of the country to find a relative fraction (RF) of rainfall for the pertinent zone. Variation of RF for the four zones and the country-wide mean annual rainfall over the 30 years have been plotted against the year. Our analysis shows that in most of the cases when the RF for the wet zone (D) takes a high value the same for the arid zone (A) takes a low value. In many years, the RFs of wet and semi-wet zones (D and C) show similar trends and the arid and semi-arid zones (A and B) show opposite trend. This opposing trends of the wet/semi-wet zones and arid/semi-arid zones is highly significant in 2003 the year prior to that recorded the lowest mean annual rainfall of the country. There is no statistically significant correlation between the mean annual rainfall and the RF of any of the zones. The observed climate patterns have more dependence on the local and regional conditions than that on the global variations. The outcomes of this study depicts that in steppe climate, once wet zones get high rainfall fractions, it could be expected that the arid and semi-arid zones may get lower rainfall fractions, thus, agricultural and water resource management planning should be done accordingly to avoid unexpected shortfalls or excesses.

Acknowledgements:

The authors would like to acknowledge the facilities and support rendered by the NAMEM, IMHE of Mongolia and the Centre for Electromagnetic and Lightning Protection, University Putra Malaysia in making this project a success.
Assessment of climate variations in temperature and precipitation extreme events over Morocco

S. Filahi¹,², L. Mouhir¹, Y. Tramblay³,

¹ Laboratory of Process Engineering and Environment, Faculty of Sciences and Techniques, University of Hassan II, PO Box 146, Mohammedia, Morocco.
² Direction de la Météorologie Nationale, Casablanca, Morocco.
³ IRD - HydroSciences Montpellier, UMR5569, Montpellier, France

e-mail of corresponding author: sa.filahi@gmail.com

Abstract

Morocco is located between the arid regions of the Western Sahara and the moderate Mediterranean and Atlantic regions. The climate of Morocco is mostly semi-arid with warm to hot, dry summers, occasional droughts, and mild, relatively wet winters. We provide a summary of Morocco’s climate extreme trends during the last four decades. Indices were computed based on a newly available daily set of observations of temperature and total precipitation using a consistent approach recommended by the Expert Team on Climate Change Detection and Indices. Trends in these indices were calculated at 20 weather stations from 1970 to 2012. Twelve indices were considered to detect trends in temperature. A large number of stations have significant trends and confirm an increase in temperature, showing increased warming during spring and summer seasons. The results also show a decrease in the number of cold days and nights and an increase in the number of warm days and nights. Increasing trends have been found in the absolute warmest and coldest temperatures of the year. A clear increase is detected for tropical nights and diurnal temperature range. Eight indices for precipitation were also analyzed. In general, the trends for the precipitation indices are much less significant than for temperature indices and show more mixed spatial patterns of change. Heavy precipitation events do not exhibit significant trends except at a few locations in the north and central parts of Morocco, with a general tendency towards drier conditions.

In order to evaluate the ability of RCM to reproduce indices of extremes events in Morocco we use in this study four different RCMs and four different GCMs participating in EuroCORDEX (KNMI, IPSL and CLM) and MedCORDEX (CNRM).
COUPLED STOCHASTIC-GEOSTATISTICAL MODELING OF DROUGHT VULNERABILITY IN ARID REGIONS OF SOUTHEASTERN IRAN

Arash Malekian¹, Ali Salajegheh¹, Masoud Salari²
¹University of Tehran, Iran
²Islamic Azad University- Hormoz Branch, Iran
mas.salaril@gmail.com

Abstract

Drought, a manifestation of climatic fluctuations associated with large-scale anomalies in the planetary circulation of the atmosphere, is a threatening global and local problem. Efficient management strategies of drought should include rules and regulations to reduce the effects of droughts by preparing for potential disaster maps. One of widely used methodologies for temporal drought assessment is the Standardized Precipitation Index, which is used to quantify the rainfall deficit for several time scales. Spatial treatment of the droughts is mostly achieved by spatial analysis techniques such as geostatistics. Geostatistics is concerned with “the study of phenomena that fluctuate in space and/or time and offers a collection of tools aimed at understanding and modeling spatial variability. Meanwhile, drought has a stochastic nature and therefore, the future states of any stochastic process at a particular location, cannot be predicted with certainty. In stochastic approach, Markov analysis techniques can be applied to a wide variety of applications where system states need to be taken into account. Spatio-temporal characteristics of droughts for an arid and semi-arid region in southeastern Iran using coupled geostatistical and Markov chain approaches were analyzed in this research. Among all meteorological stations located in different parts of the region, suitable stations with appropriate records were selected. A first order Markov Chain approach was used in this research to deal with uncertain nature of drought and the matrix of transition probabilities was calculated based on SPI method. Then, the corresponding return period of droughts classes obtained for each station was calculated and spatial continuity was obtained based on the resulted variograms in each case. Contouring maps requires the use of some type of interpolation procedure. Geostatistical approach and non-geostatistical interpolation techniques were used at this stage to prepare iso- probability and iso- intensity maps of drought in the region. Finally, the methods were compared based on statistical indices. The Kriging method which is based on geostatistics approach resulted in lower errors in all drought classes and then was selected as the most accurate method for prepare iso- vulnerability maps. The calculated maps show that susceptibility of the southern and southwestern parts of the region to droughts and water shortage which is a very useful tool for planners and decision makers to prioritize the region based on its susceptibility to drought as well as to implement relevant measures in order to mitigate the effects of droughts.
Climate Change Impact Assessments of a Selected Area of Himalaya Glaciers of Pakistan using RS&GIS

Hafiz Ali Imran, Bilal Ahmed Munir, Zafar Iqbal Zafar, Shahid Pervez
Student, MSc Environmental Protection and Agricultural Food Production,
University of Hohenheim, Stuttgart, Germany.
(hfz.ali.imran@hotmail.com)

Abstract

Quantification and evaluation of glaciers cover and its depletion rate take part a vital role for the land use planning, natural resource management and for the formulation of viable land use reforms. In the following study, satellite imagery was used within geographic information system (GIS) to map and quantify the glaciers extent in the selected region of northern area of Pakistan from where most of agricultural land of Pakistan irrigated. Images of Landsat TM, ETM+ and Aster DEM were processed and visually interpreted to derive land use/cover for the years 2000, 2010 and 2014. The output maps were analyzed by using GIS and cross-tabulated to quantify land cover changes for the selected period. In the later part of the research the Markov chain method was used to predict future glacier change, based on the past changes during time period of 2000-2014. Results from this study showed that the prediction of glacier cover dependent over the time interval of the multi-temporal satellite imagery from which the probability of change was derived. The trends of glacier extent changes in the study area dependent over climatic condition, such as temperature, rainfall, aspect, slop etc. In the last part of this research identified a relation between change in climatic conditions and snow cover area over time period. Trend between snow cover area and amount of rainfall showed inverse relation on the other hand temperature showed conflicting trend in this case study.

Keywords: Remote sensing, GIS, Cross Tabulation, Markov chain method, Glacier

Acknowledgements:

I give thanks and praise to Almighty Allah who has granted me courage and strength for successfully completing this research project. I wish to thankful to my friend Bilal Ahmed Munir and my professor Mr. Shahid Pervez who inform me about this conference. Finally I thankful to my university administrations that provide me an excellent research environment and all other facilities.
CONTRAST STRATEGIES AND SEASONAL INDIGENOUS WATER SUPPLY IN A PLINTH AREA: CASE OF DASSA-ZOUMÉ COMMUNE (REPUBLIC OF BENIN, WEST AFRICA)

Léocadie ODOULAMI, René Ayéman ZODEKON

Laboratoire Pierre PAGNEY, Climat, Eau, Ecosystème et Développement (LACEEDE)/DGAT/FLASH/Université d’Abomey-Calavi (UAC), 03BP1122 Cotonou, République du Bénin (Afrique de l’Ouest), leocadieo@yahoo.com ; radeckrenezodekon@yahoo.fr

Abstract

The water supply of the population is strongly influenced by the phenomenon of seasonal contrast in the commune of Dassa-Zoumè. This study analyzes the endogenous water supply strategies of the population against those contrasts in the commune. The data used in this research are annual averages of rainfall and temperatures collected in ASECNA (Agency for the Safety of Navigation in Africa and Madagascar) for the period 1982-2012. The observations, documentary research, questionnaire surveys in 5% of households and the interview guide were performed. It results from the statistical processing and analysis of data collected an increase of average temperatures and declining of rainfall from 353.9 mm in 1995 to 1514.18 mm in 2010, a reduction of rainy season, a prolongation of the dry season. In response to these climate changes, 52% of households use well water, 22% water drilling, 9% water alveolar pots and 17% use surface water. Other strategies are needed to address this challenge: the optimal water management available, the application of IWRM, water purification and wastewater reuse, use of impluviums.

Key words: Benin, commune of Dassa-Zoumé, plinth area, seasonal contrast, water supply strategies.
Assessment of hydrologic impacts of climate change in Mejerda basin in Tunisia, and Wadi Dayqah basin in the Sultanate of Oman

Ihab Jnad
Arab Center for the Studies of Arid Zones and Dry Lands (ACSAD)
Ihjnad@yahoo.com

Abstract
Most of the Arab region is located in arid zone and therefore water is a limiting resource for development and a change in available water supply could have major implications in most sectors of the economy. The Regional Initiative for the Assessment of the Impact of Climate Change on Water Resources and Socio-Economic Vulnerability in the Arab Region (RICCAR) was launched to develop climate change assessment methodologies and provide a common knowledge base for policy formulation on climate change at the regional level. Current climate modelling scenarios performed within RICCAR suggest that there will be significant climate change impacts in Arab region. Higher temperatures and decreased precipitation may lead to decreased water supplies and increased water demand. This may cause deterioration in the quality of freshwater bodies, putting further strain on the already fragile balance between supply and demand in most of the Arab countries. This study evaluates the impacts of possible future climate change scenarios on water resources in two basins: 1) Mejerda basin in Tunisia, and 2) Wadi Dayqah basin in the Sultanate of Oman. The response of streamflow in both basins was examined to long-term climate change by coupling regional climate model (RCM) to the hydrologic model. The Hydrologic Engineering Center’s Hydrologic Modeling System version 4 (HEC-HMS 4) is used for the hydrological modelling of both study area. Some of the meteorological variables obtained from the RCM corresponding to global emissions scenario RCP4.5 and RCP8.5 were used as input to the HEC-HMS model. After model calibration and validation with observed data, it was run for the two future periods: 2046–2065, and 2081–2100 for each of the investigated basins. The impacts of climate change on the basins hydrology are assessed by comparing the present and future streamflow and the evapotranspiration estimates. Hydrological impact assessment over Mejerda basin showed a projected decrease in annual runoff in the mid and the end of the century. Since Mejerda is a main source of water in northern Tunisia, the predicted decrease of the river flow, may have a considerable consequences and be a cause of major concern. It may, in fact, have strong implications in the water resources management strategies and policies to be designed for Tunisia. In Wadi Dayqah - Sultanate of Oman, the situation is more optimistic, The results of Hydrological impact assessment over the basin indicate that the projected change in temperature and precipitation will cause an increase in runoff, groundwater recharge and soil moisture content.

Keywords: Climate change, water resources, HEC-HMS, Wadi Dayqah, Mejerda
Transboundary Water Governance and Climate Change in the Hashemite Kingdom of Jordan

Tayel El-Hasana, c, Haseen Khan b, Mufeed Batarsehc, Osama Mohaweshd, Anwer Jiriec

a Prince Faisal Center for Dead Sea, Environmental and Energy Research, Mutah University, Karak, Jordan
b Water Resources Management Division, Department of Environment and Conservation, St. John’s NL, Canada
c Department of Chemistry, Faculty of Science, Mutah University, Karak, Jordan
d Department of Plant Production, Faculty of Agriculture, Mutah University, Karak, Jordan

Abstract

The main water resources in Jordan are classified as transboundary resources. The most important surface water body is Jordan River, which is under a severe pressure due to extended drought and Jordan River tributaries diversion especially in the Israeli side, beside the recently raised pollution affects. There is also a need for remote monitoring capability within the Jordan basin due to the fact the Jordan River forms a border that has been highly militarized. This research is needed to develop the capacity of Jordan to monitor the Jordan River basin on a real time basis against any natural or anthropogenic environmental threats and climate change. Therefore, four stations Baptism, Wadi A-Mujeib Dam, Dead Sea and Mutah University were chosen for installing the real time water quality, quantity and climate change instrumentations. The main purpose of the study is to develop a methodology and protocol to detect and predict undesirable changes in the quality and quantity of water in a real time manner using the Earth Observation System (EOS). This will allow better management and governance of the Jordan River activities. The results show successful implementation and smooth flow of data to two command centres. This study fit well with NATO ultimate goals of as a sponsor agent through the frameworks of security; environmental management of water resources and prevent disputes related to the scarcity of water resources.

Keywords: Transboundary, Jordan River, Real-time monitoring, Climate change, Water Governance
Water Monitoring in Lake Nasser using Satellite data

Mohammed A. El-Shirbeny*\textsuperscript{a}, Khaled A. Abu-Taleb\textsuperscript{a}, Nasser H. Saleh\textsuperscript{a}, Abd-Elraouf M. Ali\textsuperscript{a}

\textsuperscript{a}National Authority for Remote Sensing and Space Sciences (Egypt)
23 Joseph Tito St., El-Nozha El-Gedida, Cairo, Egypt.
E-mail: mshirbeny@yahoo.com

Abstract

Limited water resources and scarcity of water in Egypt is the main challenge for agricultural horizontal expanding policies and strategies. Water is a vital resource for both human needs and activates and natural ecosystems requirements. In arid and semi-arid regions, irrigated agriculture is the major consumptive user of water and although water management techniques are improved a dramatic reduction in food production still appears as a result. The most fresh water losses are from plant transpiration and evaporation from various surfaces. Nasser Lake Evaporation losses are a round 10 billion cubic meter yearly. The lake is a 550 km long and 35 km across at its widest point. It covers a total surface area of 5,250 km\textsuperscript{2} and has a storage capacity of some 132 km\textsuperscript{3} of water. A 10-days temporal resolution over a 21year period, from 26 Sep. 1992 to 8 Jan. 2014 used to monitor the relative variations in surface water level in Lake Nasser. The relative lake height variations computed from TOPEX/POSEIDON, Jason-1 and Jason-2/OSTM altimetry. Evaporation rate affected by area of water surface and climate conditions so, Landsat8 satellite data used to monitor the area of Lake Nasser at flood and drought seasons. The main objective of this paper is monitoring the relative variations in surface water level in Nasser Lake and monitoring area of Lake Nasser in various conditions at flood and drought seasons.

Keywords: Water scarcity, radar data, Lake Nasser, Flooding and drought.
RAINFALL RUNOFF MODELLING IN SEMI ARID CONTEXT: COMPARISON OF DIFFERENT RUNOFF PRODUCTION FUNCTION EFFECT ON BASIN RESPONSE (SKHIRA BASIN, TUNISIA)

Hana Gharbi¹; Sameh Chargui¹,²; Mohamed Slimani ¹
1 National Agronomic Institute of Tunisia, 43 Avenue Charles Nicolle, Mahrajène, 1082, Tunis, Tunisia.
2 Georesources Laboratory, Water Research and Technology Centre, Borj Cedria Ecopark, PO Box 273 Soliman 8020, Tunisia. chargui_sameh@yahoo.fr

Abstract

Available data in arid and semi arid region are often not sufficient as a basis for decision making in water resource management. In addition, assessment of hydrological response in small and large river basins is fundamental for regional climate and hydrology studies. As consequent, a rainfall runoff modeling was done to explore basins responses and a developed geomorphology-based transfer function, was applied.

Studied Area is Skhira basin, situated in semi arid region. It’ is known with its high rainfall variability and considered as a pilot basin for studying water resources in central Tunisia. The research objective of the study is to compare different production functions in a rainfall runoff model and to choose the appropriate one which is more convenient for semi arid context. Four production functions were used to determinate the net rainfall. Results were combined with a spatialized geomorphological based transfer function developed under MATLAB software.

The comparison of simulated and observed flows, at basin outlet, show the pertinence of “Constant Slope at the Origin” production function in our study context.

Key words: rainfall-runoff modeling; net rainfall; production function; semi arid region.
COMBINING PRINCIPAL COMPONENT ANALYSIS AND VARIGORAHPY TO STUDY THE ANNUAL PLUVIOMETRY IN THE NORTH OF TUNISIA: APPLICATION IN THE MEDJERDA BASIN

Khouloud Gader¹, Ahlem Gara¹, Slimani Mohamed¹
¹National Institute of Agronomy in Tunisia, 1082 City of Mahrajene, Tunisia

Abstract

Tunisia is a semi-arid country with scarce water resources and a diverse climate which increases the spatial and temporal variability of rainfall. The objective of this work is to study the characteristics of the spatial and temporal variability of annual precipitations and the regionalization of the rain in the catchment of Medjerda, and to seek the factors (elevation, latitude, longitude, proximity of the sea, direction the speed of the wind…), that influence this variability. In order to study the space-time variability of the annual rainfall, we used the principal component analysis (PCA) and the variography. The analysis showed the existence of the six groups of stations that have similar behaviors including the representation of groups of stations with similar behavior has proved the existence of a large spatial variability as a result of several factors (relief, depression and the effect of the sea). The variogram analysis shows that a bounded variogram models the variation in annual rainfall in the catchment of Medjerda which shows that rainfall fluctuation is characterized by an increase until a given distance. The influence of altitude on the geographical distribution of rainfall is varied. There is an increase in rainfall depending on altitude at stations exposed to rain flows. Anyway, the altitude is not always the most important factor in the geographical distribution of annual precipitation. Other factors, such as the terrain position relative to the sea, the morphology of the orography, also play an important role. The results can improve understanding of rainfall and thus help better manage uncertainty and risks randomness of rainfall.

Keywords: space and temporal variability, Annual precipitations, PCA, geostatistics.
RAINFALL-RUNOFF MODELING IN NORTHERN TUNISIA: MULTI PRODUCTION FUNCTIONS COMPARISON USING THE MERCEDES MODEL

AHLEM GARA*1, KHOULOUD GADER1, MOHAMED BERGAOUI2
1National Institute of Agronomy in Tunisia, 1082 City of Mahrajene, Tunisia
2 High School of Rural Equipment Engineering, Road of Kef, Medjez el Beb Tunisia

ahlem_gara@yahoo.fr

Abstract

The aim of this paper is to understand and to model the hydrological behavior of a sub-watershed of the Medjerda basin in the North of Tunisia, through a distributed hydrological model, MERCEDES basing on calibrating few number of parameters and a multi-production functions comparison, for simulation of the flash floods that often occur in this area causing then important damages on the downstream cities. 11 events rain-flow for an hour time-scale, with variable durations, seasons and behaviors, were selected as well as cartographic data with 5 m mesh dimensions were prepared by the ATHYS platform to be integrated in the modeling procedure that will be articulated on fixing the transfer function, as the simple Lag and Route function, and comparing between the simulations of three different conceptual production functions such as Girard, SCS and Reservoir 1. Modeling is unrolled in first stage by a manual calibration followed by an automatic calibration on the basis of the parameters founded manually for the seasons of autumn, winter and spring for the different production functions, and in second stage by the applications of the average parameters obtained for each season and each production function on the episodes chosen for the validation procedure. The results got by the calibration and the validation procedures referring to the evaluating criteria proved the excellent aptitude of the model to reproduce the autumnal episodes and of an acceptable aptitude to reproduce the winter events whereas the spring episodes were difficult to predict. By the correlation between the calculated and observed volumes and maximum flows, we could conclude that the function giving the nearest simulation to reality is the SCS function, the function Reservoir 1 is classified in the second place and lastly the Girard function. The phase of calibration and validation is supplemented by a multicriterion analysis of sensitivity, which proved important influence of the space distribution of rainfall and the geographic parameters, the size and the sampling rate of the space discretization of the basin, the time-step of the hydro-pluviometric data and the choice of the type of calibration. Basing on the results of simulations by the episodes chosen for the various scenarios, we could conclude that the model simulates in a satisfactory way the autumnal episodes, and simulates the winter and spring episodes rather well, with a trend underestimate the maximum flows for the important floods, but with a good capacity to reproduce streamed volumes.

Keywords: flash floods, Rain-Flow models, ATHYS, production function, Medjerda.

Acknowledgements: I would like to express my deep gratefulness to professor Christophe Bouvier, the conceptor of the ATHYS platform for his immense help in realizing this research study.
A NEW INNOVATIVE TOLL TO MEASURE SOIL EROSION

G.N. Zaimis*,
V. Iakovoglou¹, P. Koutalakis¹, K. Ioannou¹, I. Kosmadakis², T. Laopoulos² and P. Tsardaklis²
¹Laboratory of Management and Control of Mountainous Waters (Lab of MCMW), Department of Forestry and Natural Environment Management, Eastern Macedonia and Thrace Institute of Technology (EMaTTECH), 1st km Drama, Mikrohoriou, Drama, Greece 66100
²Electronics Lab., Physics Department, Aristotle University of Thessaloniki, Greece, 52124
*Corresponding author: E-mail: zaimesgeorge@gmail.com,

Abstract

Excessive soil erosion is a very serious environmental problem that can lead to land degradation. This is primarily due to unsustainable anthropogenic activities such as agriculture, urban environments, logging etc. Climate change is also expected to exacerbate soil erosion problems. Climate change is causing more extreme events. Such events include more intense precipitation compared to precipitation events of the past that will lead to higher surface runoff, higher sediment transport capacity and increased surface soil erosion. The Mediterranean region due to the sparse vegetation, topography and because it has been inhabited for thousands of years already has high soil erosion rates compared to the rest of Europe. In addition, wildfires that are common and part of Mediterranean ecosystems also lead to very high erosion rates, especially after the first year of the wildfire, if appropriate conservation measures are not taken. These fact along with potential climate change impacts clearly indicate that new tools need to utilized to be able to mitigate effectively and efficiently soil erosion in the Mediterranean. This study focuses on soil erosion in Greece where no holistic and systematic management plans have been developed despite the fact that more 1/4 of the country suffers from severe soil erosion. The selected study area was Thasos Island because of the diversity in topography (flat areas and steep slopes), the different types of vegetation that exist in a overall small area. In addition, the island has suffered frequent wildfire events during the last 3 decades. The specific watershed selected was Kallirahi torrent that had a wildfire in August of 2013 and its impact are still evident. The sensor that we developed is based on ultrasonic technology that will allow to detect ground changes continuously with an accuracy of up to 1 mm. Most soil erosion techniques do not measure continuously. The will also measure precipitation, soil and sir temperature and soil moisture. The sensor is called the Automated Soil Erosion Monitoring System (ASEMS). One sensor was install in area with tree cover while the other had no overstory. Preliminary results show that the sensor can provide very accurate data.

Acknowledgements: This work was supported by the General Secretariat of Research and Technology (GSRT) under the framework of the programme "Aristeia II." The content of this publication are the sole responsibility of the authors.
CLIMATE CHANGE EFFECTS OF RAINFALL ON SIMULATED FLOOD HYDROGRAPH IN URBAN ARID VOLCANIC CATCHMENT IN MADINAH WESTERN SAUDI ARABIA

Alahmadi Fahad1,2, Norhan Abd Rahman1
Department of Hydraulic and Hydrology, Faculty of Civil Engineering, Universiti Teknologi Malaysia, Skudai Campus, 81310 Johor Bahru Johor, Malaysia
Madinah Water Directorate, Madinah, Kingdom of Saudi Arabia
e-mail: f3@dr.com

Abstract

Urban flash flood in arid regions can be categorized as local with sudden rise produced by intensive rainfall storm, long detailed observed urban runoff record is still does not exist in most of the arid regions, this will increase the uncertainty of the climate change impacts on flash flood in arid regions, In this paper, the climate change of rainfall will be used to assess its impact on computed flood hydrograph in urban arid volcanic catchment at Upper Wadi Bathan (103 km³) in Madinah, Western Saudi Arabia. Peak over Threshold (PoT) series of 45 years of observed rainfall data was used to predict the design storm of 100 years return period using Pearson Type III (PE3) distribution. The effect of climate change on rainfall using A2 emission scenario shows the increase of rainfall depth with 40.3%, the two scenarios of rainfall are used to compute the flood hydrograph. SCS Curve Number method is used to compute the effective rainfall while direct runoff hydrograph is computed using Clark approach based on the equation developed by Arizona Department of Transportation (ADoT) for arid regions. Comparison of the resultant computed flood hydrographs showed an increase with around 62% in both flood volume and flood peak discharge.
FARMERS PERCEPTION, AWARENESS, ADAPTATION AND MITIGATION POTENTIAL OF CLIMATE CHANGE IN ARID AGRO-CLIMATIC ZONE: A CASE STUDY OF ANANTAPUR DISTRICT OF ANDHRA PRADESH STATE, INDIA

Sandeep Kumar Patakamuri, Krishnaveni. M
Centre for Water Resources, Anna University, Chennai, India-600 025

deeumails2006@gmail.com

Abstract

Water scarcity due to climatic changes poses a great threat to agricultural productivity and thereby food security. In the regions dominated by rainfed agriculture, management of water scarcity demands the understanding of stakeholder’s perception, awareness, existing adaptation practices and mitigation potential. Anantapur district of Andhra Pradesh state, India is declared as the second most backward and drought prone district in the country. The district is dominated by shallow red soils with more than 78 percent coverage and the remaining area is covered by black soils.

In the present study, questionnaire is designed in three categories to understand the farmer’s awareness, adaptation and mitigation potential to climate change. A total of 124 respondents were interviewed from 21 villages selected from 14 taluks (sub-districts). The sample selection is made in a way to incorporate farmers based on their land holding size, age groups, economic level. Also, efforts were taken to maintain the gender balance in sampling. Ancillary data like land use, precipitation, temperature, demographics, infrastructure and employment are collected from Anantapur Statistical and planning department to support and cross check the findings of the survey.

The study shows that majority of farmers are experiencing the climate change. However, the farmers are not aware of the causes and science of climate change. It is observed that the farmers are trying to cope up with the changing climate by shifting the agriculture and irrigation patterns, selecting new variety of seeds etc. Some of the governmental policies found to be helping the farmers by providing subsidies to change their irrigation practices, providing community crop insurances in case of crop failures. Another important finding is that, a majority of respondents have expressed the need for mitigating climate change. It is found that there is a serious requirement of capacity building among the farmers to mitigate and adapt climate change.
The Impact of Catchment Management on Emergency Management of Flash-Flood

Mohammad Ebrahim Banihabib\textsuperscript{1*} and Azar Arabi\textsuperscript{2}

\textsuperscript{1*} Corresponding author, Associate professor, University college of Aburaihan, University of Tehran, Pakdasht, Tehran, Iran, Email: banihabib@ut.ac.ir
\textsuperscript{2} M.Sc. Irrigation and Drainage Engineering, University of Tehran, Iran

Abstract

Flash floods cause damages and needs emergency actions especially in urban areas. Flood Forecasting and Flood Warning Systems (FFFWS) can be used for reducing flood damages and saving lives in areas vulnerable to flooding. However, researches are needed to evaluate the effect of urbanization and the significance of Implementing Catchment-Management Plan (ICMP) on FFFWS. This paper describes a framework proposed to assess the impact of ICMP on Expected Lead Time (ELT) of flash-flood warning and it is applied for an urbanized steep catchment in an arid region, north of metropolitan city, Tehran, Iran. The model is well calibrated and validated before and after ICMP by 4 observed flood. The results show that ICMP reduces mainly flood risk only in low-return periods (about 30\%) than in high-return periods. Finally, this paper demonstrated the efficiency of ICPM in increasing emergency time for evacuation from possible inundated areas except in extreme floods events.
Debris Flood Control Approach for Urban River Restoration in an Arid Region

Mohammad Ebrahim Banihabib1* and Farimah Jamali2

1* Corresponding author, Associate professor, University college of Aburaihan, University of Tehran, Pakdasht, Tehran, Iran, Email: banihabib@ut.ac.ir
2 M.Sc. Water Resources Engineering, University of Tehran, Iran

Abstract

Debris flood is a kind of flash flood which occurs in arid regions. Debris flood control approach should be considered in restoring urban rivers and improving environmental conditions in these regions. Restoration of the rivers is now is part of Tehran Municipality plans to achieve five-year program adopted for capital city, Tehran. In this context, the present article reviews the potential of occurrence of debris floods in the Vardavard River in the West of Tehran. To assess the impact debris flood on river restoration its hydraulic, flood hydrograph and sedimentation are studied considering the physiographic features Vardavard River. Also, field study is done on the river after the flood event 28 July 1394 and the effects of debris on the river inundation was evaluated. The result shows high-concentration of sediment in debris flood increases flood peak flow and hydraulic roughness. This study shows that due to the steep slope of the mountain Basin of Vardavard River, peak of debris flood can be increased up to 2.1 times of usual floods and thus it should be considered in the river restoration. Finally, slit dam is suggested to control debris flood and restore the river. This research shows importance of debris flood studies in river restoration of arid regions and proposes an approached to control it.
SPATIAL DISTRIBUTION AND TEMPORAL TRENDS IN DAILY AND MONTHLY RAINFALL CONCENTRATION INDICES IN ALGERIA

Abderrahmane Nekkache GHENIM, Abdesselam MEGNOUNIF
University of Tlemcen, Faculty of Technology, BP 230 Tlemcen, 13000 Algeria
anghenim@yahoo.fr & megnounif_aslam@yahoo.fr

Abstract:

One of the most important aspects of climate change that requires thorough investigation is the time distribution of rainfall and its historical changes. Rainfall is the most important climatic variable since it gives rise to opposite phenomena such as drought and floods. Understanding rainfall variations on various timescales and their correlations is important for assessment of flood risk and utilization of water resources. For several decades, as a result of climate change, rainfall experienced across the entire globe significant changes. Along with the decline in rainfall recorded mainly in the southern part of the Mediterranean, a significant decrease in the number of rainy days and a significant increase in the precipitation intensity values have been identified.

In Algeria, despite a significant deficit rainfall estimated at over 20%, the occurrence of precipitation in very limited time intervals is the source of several devastating floods and spectacular soil erosion followed a very rapid siltation of dams. Indeed, a very high rainfall concentration, represented by a large percentage of the total annual rainfall in a few days of rain, is the origin of several environmental disasters, a decline in agricultural production and a significant impact on water resources. Thus, knowledge of the temporal distribution of heavy rainfall is needed to assess the amount of runoff and soil loss. For these reasons, it is important to analyze the statistical structure of rainfall rates based on daily and monthly rainfall data set. In this study, the spatial and temporal patterns of precipitation concentration in Algeria were investigated using two indices: the precipitation concentration index (PCI) and the concentration index (CI) for measuring seasonality and daily heterogeneity using monthly and daily precipitation series, respectively.

In particular, the trends of PCI and CI were tested by the Mann–Kendall method, and relationship among PCI, CI and percentage of rainfall contributed by the rainiest days was analyzed by the linear correlation analysis. The results show a significant seasonality of the rainfall distribution and very heterogeneous temporal distribution of the daily rainfall mainly in the south part of the country. Positive trends in the PCI and CI were found at most stations, although none of the PCI trends were statistically significant. Daily heterogeneity of the rainfall in a year is highly correlated with the heavy rainfall amount of the 15% rainiest days, and seasonality in rainfall distribution over a year can be partly explained by the daily rainfall heterogeneity.
Scenarios based climate projection for Oman water resources

Sultan Al-Yahyai, Yassine Charabi, Said Al-Sarmi, Juma Al-Maskari
s.alyahyai@gmail.com, yassine@squ.edu.om, s.alsarmi@met.gov.om, j.almaskari@met.gov.om

1Information Technology Department, Mazoon Electricity Company
2Department of Geography, Sultan Qaboos University
3Directorate General of Meteorology, Public Authority for Civil Aviation, Oman

Abstract:

Oman is characterized by its arid climate. This is natural, in view of its location along the Tropic of Cancer, in a zone dominated by the subsident limbs of the Northern Hemisphere Hadley Cell circulation. However, the coastal position of Oman at the south-eastern end of the Arabian Peninsula, plus its high mountain range (Hajar Mountains) in the north both help to induce quite significant annual mean rainfall in a few favored areas.

Changes in rainfall and other forms of precipitation will be one of the most critical factors determining the overall impact of climate change. Rainfall is much more difficult to predict than temperature. Global researches showed that water vapor will increases by 7% for every degree centigrade of warming. How this will translate into changes in global precipitation is less clear cut but the total volume of precipitation is likely to increase by 1-2% per degree of warming.

This paper investigates the effect of climate change on the water resources and rainfall in Oman. It presents climate projection based on different Representative Concentration Pathways (RCPs) namely RCP2.6, RCP4.5, RCP6.0 and RCP8.5. The climate projection was based on Hadley Centre Global Environment Model version 2 (HadGEM2) downscaled to 1km resolution. It was projected that slight dryness will take place over Hajar Mountains based on RCP 2.6. The effect of the dryness is projected to cover wider areas based on the other RCPs scenarios except Dhofar region. RCP 8.5 projected wetter climate over Dhofar region during the period of 2061-2080.

Keywords: Oman, Climate Projection, Rainfall, RCPs
INFLUENCE OF LIGANDS ON METAL SPECIATION, TRANSPORT AND TOXICITY IN A TROPICAL RIVER DURING WET (MONSOON) PERIOD

Manish Kumar* and Anindita Gogoi1

1Department of Environmental Science, Tezpur University, Napaam, Assam, India
*Corresponding author
E-mail: manish.env@gmail.com

Abstract

Distribution of Copper (Cu), Lead (Pb) and Zinc (Zn) between the dissolved and particulate phase along with their chemical speciation and covariance with different water quality parameters from upstream to downstream of a tropical river (Brahmaputra) was carried out during wet (monsoon) periods in July 2014. Ten samples were collected along the river stretch and analyzed for total metal by acid-digestion of unfiltered samples while for dissolved fraction samples filtered with 0.45µm was used. Various physico-chemical properties of water were also analyzed and used as input for geochemical speciation modeling using MINTEQA2 to establish the distribution of the metal as free ions, organic and inorganic complexes. The results obtained from model calculations indicated that free ions (anions and cations) and carbonates were dominant in the inorganic fractions and that Cu, Pb and Zn concentrations were negligible in the anionic inorganic fractions. Due to high sediment load in the river during monsoon, metals were found substantially higher in the particulate fractions than that of dissolved form. Partition coefficient for Cu (3.1 ~6.1), Pb (3.4~6.5) and Zn (3.5~6.9), demonstrates the strong adsorption ability of suspended matter on the metals. Q-mode hierarchical cluster analysis (HCA) of sampling locations efficiently illustrated different groups formation mainly governed by quality parameters rather than the influence of river course. R-mode results imply the dominance of affinities of different metals for different ligands as well as natural alignment of ligands among themselves. The health risk index (HRI) values were less than 1 for dissolved metal in water for Cu, Pb and Zn while it was greater than 1 for total metal in water for Pb and Cu indicating potential human health risk. The study aptly demonstrated that binding of metals with naturally occurring dissolved organic matter or suspended particulate matter may affect the metal bioavailability in the tropical river during wet periods when sediment load is significantly high. The combination of empirical, computational and statistical relationship between different ionic species and different fractions of metals can provide greater confidence in identifying the resemblance among the different locations of a river.

Keywords: Speciation, Heavy metals, Cluster analyses, MINTEQA2, Brahmaputra River, CDI, HRI, India

Acknowledgements:

We thankfully acknowledge the financial assistance provided under the ongoing UGC major project and Kurita Water and Environment Foundation (KWEF, Japan) research grant award (ID: 14P009).
Quantifying the Uncertainty of Semiarid Runoff Extremes Using Generalized Likelihood Uncertainty Estimation

Mohsen Pourreza Bilondi¹, S. Zahra Samadi², Bijan Ghahraman³, Ali-Mohammad Akhoond-Ali⁴

1. Department of Water Engineering, University of Birjand, Birjand, Iran.
2. Department of Civil and Environmental Engineering, University of South Carolina, Columbia, South Carolina 29208, USA.
3. Department of Water Engineering, Ferdowsi University of Mashhad, Mashhad, Iran.
4. Faculty of Water Sciences Engineering, Shahid Chamran University, Ahwaz, Iran.
*Corresponding author Email: Mohsen.pourreza@birjand.ac.ir

Abstract

Uncertainty frameworks are promised to handle spatial variability of hydrological extremes in heterogeneous watershed systems. This paper aims to address the question of how the parameter and total uncertainty in the calibration of a mixed conceptual and physical based rainfall-runoff model (AFFDEF) can effectively influence on flood forecasting of a semiarid catchment i.e., Abolabbas sub-watershed (284 km²), in Iran. Uncertainty quantification was demonstrated by evaluating the generalized likelihood uncertainty estimation (GLUE) method to quantify parameter uncertainty during four potential semiarid flash floods. Analysis suggests that flow parameters in different flood events have non-unique posterior distributions. Further, parameter uncertainty in a distributed hydrology model was heavily dominated by error and biases in antecedent soil moisture condition that might lead to large storage effects of relatively dry and deep vadose zones in semiarid catchment. Overall, multiplying parameter for the infiltration reservoir capacity and multiplying parameter for the interception reservoir capacity along with contributing area threshold were identified the key model parameters and more influential on flash flood simulation. Results further revealed that uncertainty was satisfactorily quantified for the event with heavy rainfall amount (>40 mm) and longer duration (>8 hr) while shorter duration and lowermost rainfall event contributed to the weakest performances.

Keywords: Parameter Uncertainty, Semiarid Flash Flood Simulation, the Generalized Likelihood Uncertainty Estimation.
SUSPENDED SEDIMENT TRANSPORT, EROSION AND DEPOSITION IN A SEMIARID WATERSHED, WADI SEBDOU, NW ALGERIA (1973-2004)

Abdesselam Megnounif, Abderrahmane-Nekkache Ghenim
Institution or Company, full address including country (10 pt, centered)

e-mail of corresponding author (10 pt, centered, italic, 18 pt after)
Laboratoire EOLE, Université Aboubakr Belkaid, BP. 230, Tlemcen 13000, Algeria.
megnounif_aslam@yahoo.fr

Abstract
In streams, sediment transport is mostly related to the capacity of the river to transport the available material. However, the availability of hill-slopes material and the presence of significant temporary storage of sediment in the stream system cause scatter between discharge and suspended sediment load. So, the C–Q pattern is a function of the abundance of sediment furniture, and distance from active sediment sources to the basin outlet. The shape of the relationship between sediment concentration (C) and water discharge (Q) during flood events of a 31-years period (1973-2004) was analyzed at the outlet of the Wadi Sebdou basin (256 km²) in northwest Algeria, using a new graphical analysis method based on features of hysteresis loops. Each flood was decomposed as successive stages -each of which being characterized by a sediment rating curve- and used to quantify the contribution of diverse sediment sources within the basin. Seven common classes of hydrological events (single valued and six hysteresis loops: clockwise, counter-clockwise, eight-shaped, single valued plus one loop, either clockwise or counter-clockwise, and single valued plus at least two loops) were explored. The study reveals that the ratio of suspended sediment load derived from active sediment source varies considerably from one flood to another depending on many factors, such as seasonality and antecedent type of flood. However, sediment supply from locally derived sources (or “base load”) was high and reached 77% of total sediment yield for the study period, and was attributed to weathering of bed material or gullies. The remainder portion was derived from hill-slopes, re-suspension of fresh fine deposits in the river bed, or bank collapse.
MEASURING THE IMPACT AND ECONOMIC BENEFITS OF RAINFALL ENHANCEMENT IN MULTIPLE USE WATER CATCHMENTS

Stephen Beare1, Ray Chambers2, Scott Peak3
1Analytecon, 218 Tullouch Road, Berry, NSW 2535, Australia.
2National Institute for Applied Statistics Australia, University of Wollongong, Wollongong, Australia.
3Australian Rain Technologies, 23 Hickson Road, Millers Point, NSW 2000 Australia.
Corresponding Author: Scott Peak (peak@australianrain.com.au)

Abstract
Most regions facing or soon to face physical water scarcity are also facing increased competition for water resources between agriculture and expanding industrial and urban water needs. Other water scarce regions depend heavily on groundwater systems that are being heavily mined, with extraction rates well in excess of recharge rates, most notably the Arabian Peninsula. Addressing this growing imbalance between water supplies and growing demand presents a challenge that needs to address overall water use in an integrated way. Alternative water sources and management options such as desalinisation, groundwater storage, recycling and rainfall enhancement are amongst the options to improve the balance by expanding supplies, reducing evaporative and other losses and maintaining water quality. However, the cost of developing alternative sources with capacity to deliver the physical volumes of water required will be a significant issue in the growing number of water scarce regions. Hence, low cost, easily adopted and small footprint technologies may be attractive options even though there is uncertainty as how effective they may be in a particular environment. One such alternative water technology is the Atlant rainfall enhancement system that has been recently trialled in Australia and Oman. In this paper the Atlant system is described and the results from randomised field trials in Australia are presented. The statistical methods used to identify a rainfall enhancement signal amidst the large spatial and temporal variation in natural rainfall are discussed. The 2009 trial is used as a case study to estimate the economic benefits and consider the risks and returns to an investment in the Atlant technology. A similar assessment of a trial of the Atlant technology conducted in 2013 in Hajar Mountains is also discussed. Such analysis can be applied to investment decisions on rainfall enhancement technologies more generally.
RAINFALL ENHANCEMENT IN THE HAJAR MOUNTAINS, OMAN

Ray Chambers¹, Stephen Beare², Scott Peak³, Mohammed Al-Kalbani⁴

¹National Institute for Applied Statistics Australia, University of Wollongong, Wollongong, Australia.
²Analytecon, 218 Tullouch Road, Berry, NSW 2535, Australia.
³Australian Rain Technologies, 23 Hickson Road, Millers Point, NSW 2000 Australia.
⁴Trading and Investment Establishment, 118. Alharthi Complex Muscat, Sultanate of Oman.

Corresponding Author: Scott Peak (peak@australianrain.com.au)

Abstract

Oman is one of most water-stressed countries in the world, faced with declining reserves of fresh groundwater and the prospect of decreased natural rainfall due to climate change. A technology that can increase natural rainfall and mitigate the current and future imbalance between Oman’s demand and availability of water resources is of major interest. A rainfall enhancement trial using a ground-based ionisation technology was conducted in the Hajar Mountains in western Oman over a period of 170 days (May to October) in 2013. This period was chosen to capture the reported high incidence of convective storms over the Hajar Mountains with consistently suitable microphysical conditions for rainfall enhancement operations. Two ionisation emitters were used to target the Batinah/Dakhliyah Region of Oman. Data for the trial were obtained from 120 rain gauges and two automatic weather stations installed for the trial, as well as data from 11 weather stations operated by the Oman Directorate General of Meteorology and Air Navigation and the daily upper air sounding at Muscat International airport. The trial employed a crossover design with the two ion emitters operated in a pre-determined randomised alternating schedule. Statistical analysis of the trial data was carried out using spatio-temporal models that used meteorological and spatio-temporal covariates to capture natural rainfall variation, enabling prediction of the level of rainfall that would have occurred if the ionisation emitters had not been operated. This methodology used dynamically defined target and control areas corresponding to two 30 km wide ‘corridors’ placed symmetrically about each emitter site and oriented downwind along the axis defined by the steering wind direction. Overall, a positive and significant rainfall enhancement effect attributable to the operation of the emitters was observed. The trial was continued in 2014 and 2015, expanding the trial area to include six ion emitters and 150 rain gauges. Results from these years will also be discussed.
OBSERVING ACTUAL EVAPOTRANSPIRATION WITHIN A HETEROGENEOUS WATERSHED: THE CASE STUDY OF THE KAMECH SITE, CAP BON PENINSULA, TUNISIA

Zitouna-Chebbi R. 1*, Chakhar A. 2, Marniche-Benz Abdallah M. 2, Jacob F. 2, Prévot L. 3
1 INRGREF- LR VENC, Carthage University, BP10 El Menzah IV, Tunis, Tunisia
2 IRD - UMR LISAH, Montpellier, France, 2 rue des sports El Menzah 1, Tunis, Tunisia
3 INRA - UMR LISAH, 2 place Viala, F-34060, Montpellier, France
* Corresponding author: rimzitouna@gmail.com

Abstract

Long-term observation of actual evapotranspiration (ET) helps to understand water cycle and therefore to improve water management. This is important in semi-arid regions where ET is the main component of water cycle, and water resources are increasingly scarce. The eddy covariance (EC) method is widely used to provide long-term observations of ET. However, missing data are inherent to EC measurements. Several gap-filling methods have been proposed, but heterogeneous watersheds have received very little attention. The objective of this study is to obtain complete ET chronicles from EC measurements collected within a heterogeneous watershed.

The experiment was conducted within the agricultural watershed Kamech, Northeast Tunisia. Kamech is one of the experimental sites of the OMERE French environmental observatory, and it is typified by spatial heterogeneities in relation to hilly topography, pedology and land use. An EC flux tower has been operating since 2011. The sonic anemometer and the open-path analyzer are setup at 9.6 m height, and raw data are collected at 20 Hz. Data collected in 2011 and 2012 were post-processed, corrected and quality controlled, to obtain reliable data of latent and sensible heat fluxes at the hourly timescale.

The software REddyProc was used along with local climatic data to fill gaps for the chronicles of latent and sensible heat fluxes. It is shown that gap filling errors increase from 9 to 22% in relative when missing data increase from 10 to 30%. Discriminating wind sectors slightly improved gap filling at the hourly timescale but not at the daily timescale.

We conclude that gap filling was suitable to obtain daily and monthly ET within our heterogeneous watershed. We could obtain daily chronicles of ET over 2011 and 2012.

Acknowledgements:

The author’s thanks (1) the Environmental Research Observatory OMERE (http://www.umr-lisah.fr/omere) and the data used are available according to its data policy; (2) the MISTRALS/SICMED program; (3) French National Research Agency (ANR) TRANSMED program through the ALMIRA project (contract ANR-12-TMED-0003) for their financial support provided for this study.
STATISTICAL DOWNSCALING OF IRAN ANNUAL PRECIPITATIONS BASED ON VARIOUS SCENARIOS OF CLIMATE CHANGE

Peyman Mahmoudi, Sayed Keramat Hashemi-Ana
Department of Physical Geography, Geography and Regional Planning Faculty, University of Sistan and Baluchestan, Zahedan, Iran
p_mahmoudi@gep.usb.ac.ir

Abstract
The predicted changes of precipitation, resulting from climate change and global warming, are highly important in evaluating the potential impacts of climate change on different areas such as water, agriculture, and surface water management. As the most important climatic element, precipitation has always been of great complexity in Iran. These complexities, which mostly result from the geographical location of this vast territory, caused precipitation not to have a uniformly temporal and spatial distribution. Investigating the annual pattern of precipitation in Iran for the upcoming decades, this study was, therefore, conducted to work on the statistical downscaling of precipitation in this country. For this purpose, daily precipitation data were collected from 45 synoptic stations in Iran in the basic period (1981-2010) based on LARS-WG model format. Then they were downscaled in order to be equalized to the data of Atmospheric-Ocean General Circulation Model (AOGCM) in terms of coordinates and scales. After that, emission scenarios (A2, A1B, and B1) were scrutinized along with HADCM3 model for the changes of precipitation pertaining to the decades in 2040-2070 and 2070-2099 in Iran. The results indicated that the simulated precipitation decreased considerably in most areas of the country under the most overcast status (2080s) and the most optimistic scenario (B1) in comparison with the observed status, despite point increase in some areas. Decreased precipitation is more severe and considerable in humid areas such as northwest in comparison with arid and semi-arid lands located in central, eastern and southeastern areas. Generally, the entire areas located in Iran will experience a decrease in precipitation in both upcoming decades, and an arid climatic future is predicted for this country.

Keywords: Downscaling, Atmospheric-Ocean General Circulation Model, LARS-WG, Global Warming, Iran
FORECASTING MEAN OF MONTHLY RAINFALL BY APPLYING TIME SERIES (CASE STUDY: BABA – AMMAN, BOJNOURD PLUVIOMETER STATION)

Ghezelsofloo, A.A1, Azimi, R.*2, Kianian, M.K. 3, Zakeri, D. 4
1. Assistant professor of IAUM, Mashhad, Iran
2*. Corresponding author: PhD student, Faculty of Range Land and Watershed Management Gorgan University of Agricultural Sciences and Natural Resources, Gorgan, Iran
3. Academic member of Desert studies faculty, Semnan University, Semnan, Iran
4. PhD student, Faculty of natural resources, Isfahan University of Technology (IUT), Isfahan, Iran.

Abstract

The limitation of water recourses caused to obtain water for agricultural and non-agricultural requirement is occurred. Rain is considered as the most particles of renewable resources. Rainfall forecast and evaluates the value of them in every month or year and for every region or basin area as the most meteorological parameters is most important in water recourses. For prediction of rainfall, we can use times series. The aim of this research is study of the best rainfall estimation model. By applying monthly rainfall in 30 years period (1350-1380) by using of MINITAB software estimated the last 10 years of monthly rainfall period (1381-1391) in Baba - Amman Bojnourd pluviometer station in North Khorasran. With comparing the estimated value of monthly rainfall with real corresponding values determined the patterns which have been most parameters and their autoregressive mean is more than one, for next year’s different values will be estimated. These different are districted in many years. This is exceeded than autoregressive mean. Coefficient determination between real values and forecast values in case study station is 0.64.

Keywords: AIC test, Rainfall forecast, SARIMA model
PERFORMANCE EVALUATION OF CLASSICAL AND DATA MINING METHODS IN MONTHLY PRECIPITATION MISSING DATA ESTIMATION IN ARID AREAS

Mohammad Taghi Sattari and Ali RezaazadehJoudi
Department of Water Engineering, Faculty of Agriculture, University of Tabriz, Tabriz, Iran
mtsattar@gmail.com
Msc, Water Civil Engineering, Young Researchers and Elite Club, Maragheh branch, Islamic azad university, Maragheh, iran.

Abstract
Precipitation is one of the most important factors in hydrological cycle. Monthly precipitation data are one of the basic elements in hydrological and meteorological studies, especially in arid regions. Without complete and reliable data sets interpretation of hydrological models results is impossible.
In this paper, for evaluating classical and data mining methods performance in filling gaps of monthly rainfall data, six weather stations located in arid regions at Southern of Iran were selected. In the first stage by using Normal standard homogeneity test and Mann-Kendall trend test the homogeneity and trend of data in six stations assessed. In second stage based on the correlation between stations, the Khash station selected as a target station for filling gap data. In the third stage a portion of Khash station monthly rainfall data considered randomly as a missed data. Finally by using classical and data mining sets of methods applied for estimating missed data. In this study five classic statistical methods including Normal Ratio, Inverse Distance, UK traditional method, multiple linear regression, Multiple Imputations, and three modern data mining methods including Multilayer perceptron, Support vector regression and K-Nearest neighbors, used for estimating missing precipitations data. The comparison of results indicate that the higher performance of Normal ratio method among the classic statistical methods and higher performance of K-NN method among the modern data mining methods. According to simplicity of Normal ratio method, application of this method in estimation of missing values of precipitation in similar climates is suggested.

Key words: Missing precipitation data, Normal Ratio, Inverse Distance, K-NN, Support vector regression,
SPATIO - TEMPORAL VARIABILITY OF INFILTRATION PATTERN IN SEMI-ARID WATERSHED OF KARNATAKA, INDIA

Ibrahim-Bathis K, Syed Ashfaq Ahmed

Department of Applied Geology, Kuvempu University, Shankaraghatta, Karnataka-577451, INDIA
Email: ibrahimbathis@gmail.com

Abstract

The present research study investigated the hydrogeological determinants to assess the sensitivity of each factor to the infiltration pattern and to map the regional groundwater potential zone for the semi-arid watershed in Karnataka, India using a geographic information system (GIS) and Satellite remote sensing. Infiltration variability in the area is evaluated and high infiltration and Groundwater potential zone are demarcated by incorporating the eight highly impacting hydrogeological and meteorological thematic layer such as land use, geomorphology, lithology, slope, soil, drainage density, lineament map and rainfall. These thematic layers were prepared from the remote sensing satellite images (CartoDEM, IRS P6 LISS III, Landsat 8 and High-resolution satellite images from Google Earth), SOI toposheet, ground truth data and available secondary data. ArcGIS software was utilized to manipulate these data sets in the spatial domain. Weightage are assigned to the individual class for each thematic map according to their characteristic and interrelationship with Groundwater and infiltration depth. Then the each layer are integrated and categorized as groundwater zone into five different classes from Nil or Poor condition to good or excellent groundwater condition according the gained weightage value. Classifications are done as the higher the value gained as excellent zone and least gained value as Nil. Only 15 percentage of the total land area shows rich in groundwater resource. More than 70 percentage of the total land area are good to moderate groundwater resource. The region is frequent to drought, the agricultural and other economic activities are highly dependent on a monsoon rain. The groundwater is a most precious source of water for both the domestic, agriculture and other economic activities in the study area. The abnormality of the monsoonal rain in the region causes the agricultural failure, and the formers are forced to explore the groundwater resource to the agricultural irrigation. The present groundwater potential zone map and infiltration pattern map may apply to find and locate the groundwater resource for the both domestic and agricultural purposes.

Keywords: Remote sensing, GIS, Hydrogeology, infiltration, Groundwater potential map
OBSERVING FLASH FLOOD IN ARID AND SEMI-ARID REGIONS FROM SPACE: WADI WATIER OF EGYPT AS A CASE STUDY

Islam Sabry Al Zayed
Water Resources Research Institute (WRRI), National Water Research Center (NWRC),
13621 Delta Barrage, Egypt
eng_islam_sabry@yahoo.com

Abstract

Traditional observing methods are not able to capture the flash-flood events especially in arid and semi-arid areas, where the development of these events take place on both space and time scales. There is a need for monitoring these events using remote sensing (RS) techniques to permit the assessment of flood severity. This paper aims at identifying flash-flood potential areas by RS and Geographic Information System (GIS) techniques by taking the watershed of Wadi Watier in Egypt as a case study. Different sets of information from satellite data, namely Rainfall Estimate (RFE), Tropical Rainfall Measuring Mission (TRMM), Shuttle Radar Topography Mission (SRTM), Landsat and Moderate Resolution Imaging Spectroradiometer (MODIS), are collated for pre-, during and post- eight flash-flood events for the period of 2000-2015. The RFE and TRMM products are used to observe the spatio-temporal variability of rainy events. Detecting the locations of water storage areas and flooded sub-catchments is performed using Landsat and MODIS satellite images. The SRTM data is used as input for topography processing. Availability of spatial land characteristics and precipitation data of a watershed could be used for improving hydrologic models. The latest version of Watershed Modeling System (WMS 10) software is utilized, based on the RS inputs, to understand the active sub-watersheds. The results indicate the location of water storage structure where flood water has retained. A map identifying the most active streams is developed. In conclusion, many water management solutions can be proposed from satellite image perspective for areas where data are scarce.

Keywords:
Flash-flood; Remote Sensing; GIS; Catchment characteristic; Surface hydrology.
RECENT OBSERVED CLIMATE CHANGE OVER OMAN

Said Al-Sarmi 1, Sultan Al-Yahyai 2, Juma Al-Maskari3, Yassine Charabi4

1,3Directorate General of Meteorology, Public Authority for Civil Aviation, Oman
2Information Technology Department, Mazoon Electricity Company, Oman
4Department of Geography, Sultan Qaboos University, Oman

s.alsarmi@gmail.com, s.alyahyai@gmail.com, j.almaskari@met.gov.om, yassine@squ.edu.om

Abstract

We have examined trends in temperature and precipitation parameters for the Sultanate of Oman during the period 1980-2013. The data set has been carefully quality controlled and checked for homogeneity. Although of low density (8 stations), a clear picture of climate change in Oman has emerged. The general pattern of Oman’s mean annual temperature trend is one of warming, with all stations, subregions and all Oman average show statistically significant warming at 0.05 level. The highest statistically significant mean annual warming trends are found in Khasab and Sohar stations (0.5°Cdecade⁻¹). Seasonally the warming is widespread and consistent over most of the year except in winter time. The trends are higher in magnitude over the non-monsoonal region relative to the monsoonal region. The increase in the mean annual maximum temperature in Oman is less widespread relative to the mean annual temperature with only 2 stations reported statistically significant increase. Khasab station reported the highest statistically significant trend of 1.6°Cdecade⁻¹. For minimum temperature, all stations, subregions and all Oman average show statistically significant warming trends, with the highest annual trends observed in Sohar station (1.1°Cdecade⁻¹). Both Saiq and Thumrait stations reported 0.6°Cdecade⁻¹. The total annual precipitation trends values show only 2 stations with statistically significant trends. Both stations show negative trends: (Saiq = -74.0 mm decade⁻¹ and Salalah= -10.8 mm decade⁻¹. Most of the remaining stations trends are negative and not statistically significant. The results of this work provide clear evidences that Oman climate has changed during the last three decades.
Reservoir Operation Using System Dynamic under Climate Change Impacts: A Case Study of Yamchi Reservoir, Iran

Mahdi Zarghami, Mohammad Reza Fotookian, Nasim Safari
University of Tabriz, Iran
mzarghami@tabrizu.ac.ir

Abstract
System dynamics (SD) is an effective approach for understanding the dynamic behavior of complex systems. This research proposes a decision support system under uncertainty for Yamchi basin in semi-arid region of Iran. The paper consists these steps: Firstly, the potential impacts of future climate change on the streamflow is predicted. To do so, general circulation model of HadCM3 under scenario A2 is downscaled by using LARS-WG weather generator. The average temperature, based for 2011-2030, will increase by 2.68 °C and precipitation will decrease by 0.53 mm. Secondly, this worsening impact of climate change is used to generate the future runoffs data by using the artificial neural networks. Thirdly the SD model is employed to assess the operation of reservoir using Vensim software. Simulation results demonstrate that the water shortage in different sectors (including agriculture, domestic, industry and environmental demands) will enormously increased in the case of business as usual strategy. By using the model and providing new hedging rules especially for agriculture demand, the vulnerability of reservoir operation is reduced. The methodology is evaluated by using different modeling tests which motivates using the methodology for other arid/semi arid regions.
UNCERTAINTY ANALYSIS OF RADIAL BASIS FUNCTION ARTIFICIAL NEURAL NETWORK BASED RAINFALL – RUNOFF MODELING

R. Soundhara Raja Pandian¹, K. S. Kasiviswanathan², C. Christopher Columbus¹, Avinash Agarwal³

¹ Department of Computer Science Engineering, PSN College of Engineering and Technology, Tirunelveli - 627152, India
² Department of Civil Engineering, Schulich School of Engineering, University of Calgary, 2500 University Drive NW, Calgary T2N 1N4, Canada
³ Surface water division, National Institute of Hydrology, Roorkee-247667, India

rsrp.iitm@gmail.com

Abstract

Understanding the complex nature of rainfall-runoff process has opened many folds of modeling technique. It is still a challenging task in hydrologic modeling keeping in view of analyzing the inherent variability or uncertainty along with improvement in model performance, simplicity and less data requirements. Among several modeling approaches, the data driven based models has gained significant attention owing to its improved predictions. In this series, Radial Basis Function Artificial Neural Networks (RBFANN) are widely used in many non-linear hydrological approximations due to model capability of input-output mapping through clustering. Despite the improved prediction of RBFANN, the quantification of uncertainty is still lacking. Hence the main focus of the present study is to carry out the uncertainty analysis of RBFANN based rainfall-runoff model. The proposed modeling approach is demonstrated using the daily rainfall and runoff data collected from Vamsadhara river basin, India. In contrast to conventional deterministic approach, a stochastic RBFANN with varying spread (i.e. parameter of RBFANN) value was explored to quantify the prediction uncertainty of model output. In addition, the model was compared with static RBFANN which used a constant spread value to show the improvement in the proposed approach. The results indicated that despite the performance of stochastic RBFANN and static RBFANN models were similar, the stochastic RBFANN modeling approach produced prediction interval that indicate the level of uncertainty. Overall, the quantification of prediction uncertainty of RBFANN provides the valuable information, and it is useful to the modeler while these models are applied in practical applications.
EFFECT OF ROUGHNESS ON WATER SPEED IN AN HERBACEOUS RECTANGULAR CANAL

Laid MECHRI¹, Djamel BOUTOUTAOU¹, Sofiane SAGGAÏ¹, ², Mohamed Lakhdar SAKER³

¹Laboratory of Exploitation and Valorization of Natural Resources in Arid Zones (EVRNZA). University KasdiMerbah Ouargla, Algeria
²Laboratory of Water and Environment Engineering in Saharan Milieu (GEEMS). University KasdiMerbah Ouargla, Algeria
³Laboratory of Ecosystem Protection in Arid and Semiarid Regions (PEZAS). University KasdiMerbah Ouargla, Algeria

E-mail of corresponding author: meclaid@yahoo.fr

Abstract

Drainage is an operation, which consists in favoring artificially the evacuation of water in excess in a ground. Besides the agricultural reasons, drainage in basin of Ouargla and valley of OuedRhig has another role, which is groundwater drawdown that does not stop upwelling because of overexploitation of deep groundwater and sewage discharges that damage environment.

These last years and for the reason of non-maintenance, function of drains of these regions is affected by anthropological actions such as: use of these drains as discharge and elimination of some scold; and natural actions which affect geometrical shape of drains and its characteristics such as: degradation of banks and bed of canal by erosion, sludge deposit or vegetation growth. This situation caused an accumulation of harmful salts and oppression of palm trees of the regions and by consequence hindrance of agricultural development.

Appearance of vegetation on several sections of drop pipes constitutes one of the most severe problems. This presence was observed at several emplacement what represents an obstacle, which troubles flow by reducing the section and slowing down the water speed.

The present communication aims at studying by an experimental way, the effect of one of canal parameters that is its roughness due to reed stalks, on water speed. For that, experiments were realized in laboratory and in field on an herbaceous canal.

Obtained results showed that the presence of reed stalks contributes in increasing roughness, decreasing water speed and by consequence a bad evacuation (the accumulation of water in the upstream). Results also allowed to establish a relation between the water speed and the size of reed stalks and the found model can be used in: (I) sizing an agricultural drain, (ii) forecast on the state of functioning of canals, and (iii) forecast of it gone back groundwater upwelling.

Keywords: herbaceous canal, water speed, roughness, reed stalks, Algeria.
THE ZONATION OF FLASH FLOODING DISASTERS IN URBAN CATCHMENT BY USING GIS-BASED STATISTICAL MODEL AND REMOTE SENSING TECHNOLOGY

Presenting Author, Himan Shahabi
Department of geomorphology, Faculty of Natural Resources, University of Kurdistan, Sanandaj, Iran

*e-mail of corresponding author: himanshahabi@gmail.com*

Abstract:

Rapid urbanization growth and the tendency to settle down on locations with access to vital resources have led communities to live on the areas exposed to natural hazards. A large number of cities of the world are threatened by urban floods, which act very rapidly and in a devastating manner. This study has been examination and evaluation flash flooding of Darband-Golabdarre catchment and impact it on Tehran city, Iran with attention parameters that are effective like: elevation surface, drainage network, land use, land cover extracted from CN, minimum, maximum and mean of annual precipitation, slop and slope aspect by using Spatial Multi-Criteria Evaluation (SMCE) the zonation. SMCE has potential for assessment of all elements and an effective factor of flood seismicity is presented jointly with good and rational results. Therefore, in order to flood zonation in the area and classification of land use map and also to land cover map was used from Landsat ETM+ in 2008. The results are showing that because of grading and numerous constructing, this catchments barrier was damaged with neighboring catchments and it has emanated with them so when flood started there is no guaranty that it flow the direction of drainage of this study area. Therefore the most probability for flooding in Tehran is in Manzarieh and Jamaran that are highest region in this city but most of the north-south avenue in Tehran in eastern part of it were plunge in flooding.

Key words: Flash Flood disasters, Flooding Zonation, GIS-based statistical model, Remote sensing, Urban catchment.
AN EVALUATION OF THE IMPACT OF DROUGHT ON A SHALLOW GROUNDWATER WATER QUALITY UNDER SEMI ARID CLIMATE (CASE OF PLIO-QUATERNARY AQUIFER OF ESSAOUIRA, MOROCCO)

Ahmed. FEKRI

1: Geology department, laboratory of geology applied, geomatic and environment, faculty of sciences Ben M’sik, Casablanca, Morocco

E-mail: ahmedfekri13@gmail.com

Abstract:

The drought usually produces a decline in groundwater level and it increases its electric conductivity. The aim of this study is to determine to which extent the drought is able to impact and modify the physico-chemical parameters characteristics of groundwater?

The exploitation of the plio-quaternary aquifer to supply the Essaouira city with drinkable water, combined with the drought, produced an important drawdown. Between 1991 and 1995 the annual rainfalls average decreased by 38% and the Ksob river flow deficit was about 67%. The study of the hydro-chemical evolution of Essaouira aquifer has been carried out in a comparative analysis of data obtained in two surveys in 1991 (Fekri, 1993) and in 1995 (Menani, 2001). The seventeen wells chosen are those sampled in both campaigns. Taking into account the geology of this aquifer and its flow system, the wells of north part and south are processed separately.

The northern part recharge depends mainly on the Ksob river flow, whereas the southern part recharge depends only on the rain water. The comparison of the chemical water profile of the two campaigns shows a change of water type. This change is due to the mode of recharge which depends primarily on Ksob River: during the dry season the base flow of this river stems from springs located upstream and which have a bicarbonate type; while on flood season surface water crosses salt Triassic rocks and leach essentially chloride and sodium. This Ksob River functioning mode, thus, allows a recharge of the aquifer by bicarbonate water type during the dry season, and chloride water type during the flood season. The decrease of flow during the flood period deprives the aquifer of chloride water type, favoring bicarbonate water type recharge.

Key words: impact -drought- shallow aquifer- hydrochemistry.
INTEGRATION BETWEEN MORPHOMETRIC PARAMETERS, HYDROLOGIC MODEL AND GEO-INFORMATICS TECHNIQUES FOR ESTIMATING WADI RUNOFF (CASE STUDY WADI HALYIA- SAUDI ARABIA)

Presenting author: Milad Masoud
Jalal Basahi, Milad Masoud, Syed Zaidi
Water Research Center-King Abdulaziz University, P.O. Box 80208-Jeddah 21589-Saudi Arabia
mhmasoud@kau.edu.sa

Abstract
Surface runoff which accumulates due to the flash flood in arid and semi-arid regions is the only recharge resource of surface water and groundwater. Runoff estimation in arid and semi-arid areas is very difficult because of hydrologic data scarcity. Flash floods are considered catastrophic phenomena posing a major hazardous threat to cities, villages and their infrastructures. This study deals with the evaluation of flash flood hazard and runoff estimation in the ungauged Wadi Halyia basin and its sub-basins depending on the integration between detailed physiographic features, geo-informatics techniques and hydrologic models.

ASTER data was used to prepare a digital elevation model (DEM) with 30 m resolution and geographical information system (GIS) was used in the evaluation of linear, areal and relief aspects of the morphometric parameters. The prevailing parameters such as basin area, flow accumulation, flow direction and stream ordering are prepared using ArcHydro Tool. Surface Tool in ArcGIS-10 software and ASTER (DEM) were used to create different thematic maps such as DEM, slope aspect, hill shade maps. Thirty seven morphometric parameters were estimated and interlinked to produce nine effective parameters for evaluation of the flash flood hazard in the study area.

Based on the effective morphometric parameters that have a direct effect on flood prone area and control the hydrologic behavior of the basin, flash flood hazard of Halyia basin and its sub-basins were identified and classified into three categories (High, medium and low hazard degree). Runoff estimation was done using Watershed Modeling System (WMS) based on the physiographic features of the study basin. This study provides details on flash flood prone area (Wadi Halyia basin) and the mitigation measures. This study also helps to plan rainwater harvesting and watershed management in flash flood alert zones.
Flash flood prone sub-basins mapping of ungauged arid basins based on the integration between morphometric parameters and GIS techniques (case study of wadi baysh basin-Saudi Arabia)

J. Basahi and M. Masoud

Water Research Centre – King Abdulaziz University – Jeddah – Saudi Arabia

Abstract
Mapping and evaluation of flash flood for the basins in arid and semi-arid regions is an extremely important but difficult task because of the scarcity of data and hydrological measurements. The main objective of this study is to evaluate and mapping of the flash floods depending on the integration of the physiographic features and GIS techniques. Physiographic features of the basin are critical controlling factors on hydrologic response behavior, which widely used in hydrologic studies and catchment modeling. Flash flood is an indicator and in the same time a final result of catchment characteristics that depend on the physiographic features. In this study an approach for hydrological behavior evaluation of ungauged basin that can be applied in arid and semi-arid regions which enduring a lack of hydrologic data.

Wadi Baysh basin was selected for this study, because it is the biggest basin in the south west region in the Kingdom of Saudi Arabia. Wadi Baysh basin which has stream order reaches to 8th order, composed of 3 sub-basins of 7th order, 10 sub-basins of 6th order and 32 basins of 5th order. This study deals with the hydrological study of large sub-basins of 6th order such as Sabya, Wusa, Qura, Dafa, Dhiba, Al Atf, Al Khayi, Bishah, Archan and Amoud sub-basins.

Thirty five morphometric parameters were measured, calculated and interlinked to produce nine effective parameters that determine the degree of flash flood hazard in the study area. This study depends on ASTER data of digital elevation model (DEM) with 30 m resolution, topographic maps (1:50,000), geologic maps (1:250,000). Flash flood hazards were analyzed based on nine morphometric parameters that have considerable effect on hydrologic behavior of study basins. These parameters have a direct influence on flooding prone area by influencing the time of concentration.
THE IMPACT OF INCLUDING DIFFERENT IR BAND ON RAINFALL PRODUCT QUALITY

Doaa Amin 1, Mohamed Elshamy 2, Ashraf El-Mostafa3, Yehia Kamal3, and Mohamed Nour Eldein3

1Water Resources Research Institute (WRRI), National Water Research Center (NWRC), Ministry of Water Resources & Irrigation, Egypt
3Irrigation and Hydraulic Department Faculty of engineering - Ain Shams University, Egypt.

doaa_amin74@yahoo.com, meame_69@yahoo.com, elmoustafa010@yahoo.co.uk, kyehia002@hotmail.com, mhmdnour2@gmail.com

Abstract

Rainfall is probably the most important input to hydrologic models and the most uncertain one as well. No single standard of accuracy exists to assess new measurement or estimation methods in general, and over the Nile basin in particular, due to the lack of adequate surface-based rainfall monitoring networks. Using satellite imagery provides a solution to develop rainfall estimation over the Nile basin in light of the shortage of the rainfall gauge data.

The Nile Forecast System (NFS) is a hydro-meteorological forecasting system developed in 1992. The NFS rainfall estimation algorithm is based on the Cold Cloud Duration (CCD) technique which depends on the thermal Infrared (IR) 10.8μm band. This algorithm was improved in 2009 to take advantage of the METEOSAT Second Generation (MSG) satellite which provides more IR bands. The Improved NFS algorithm uses the multi-spectral IR technique which depends on the CCD and the brightness indices of other IR bands (9.7, 12.0, and 13.4μm).

In this study, the methodology depends on the Monte Carlo Method is used to generate random sets of the three band weights in order to find the optimal set. To handle the multi-criteria nature of the calibration problem, 3 error criteria (RMSE, MAE, and R2) are used to calibrate the merging weights in order to obtain the optimal merging weights for each of Nile sub-basins.

The optimal sets of weights were applied to the same calibration period (1st Jan. 2010 – 31st Dec. 2012) to assess the added value of optimizing the weights and were then validated using another period (1st Jan. 2013 - 30th Sep. 2013). The results showed that merging the different rainfall estimates using the optimum band weights improves the final rainfall estimates over all Nile Sub-basins for both the calibration and validation periods. The Atbara basin showed a slight disimprovement for the validation period compared to the calibration period but overall, the quality of the rainfall product has been greatly improved.

Acknowledgements

I would like to thank my colleagues in the Nile Forecast Center in the Ministry of Water Resources and Irrigation, with special thanks for Mr. Taha Kassem.
SELECTING RAINFALL TEMPORAL PATTERN TO ESTIMATE DESIGN FLASH FLOOD: GULF OF SUEZ REGION

Ahmed Adel Saleh
e-mail: Nnorahmed1@gmail.com

Abstract
The time distribution of the design storm (i.e., hyetograph) is an essential input for any hydrological model. It is commonly assumed as a simple geometric shape (uniform or triangle), or as a curve developed based on local conditions in the United States (SCS). This work compares different synthetic and historical hyetographs to ensure consider local and arid conditions.

The work started by selecting “Wadi Araba” as a representative watershed where a long detailed rain records are available. These data were analyzed to draw hyetographs of historical heavy storms. Then, a hydrological model was built to simulate different of a flash flooding storms patterns (two synthetic hyetographs (uniform and SCS-II) and two historical hyetographs) for 25, 50 and 100 years return periods. Finally, the resultant flood peaks were compared.

Results show flood peak of 160 m$^3$/s for a 100 years storm with a historical-based hyetograph, while it is 140 m$^3$/s for the same return period using a SCS-II temporal pattern. On the other hand, changing the hyetograph does not make significant differences among compared hydrographs for the 25 and 50 years return period storms.

Therefore, two main conclusions are met; first, for designing a flood protection work with long return periods in arid regions, the SCS Hyetographs do not cause the worst scenario therefore if SCS is used, a reasonable increase percentage is required to the simulated peak flow. Further, for structures with short return requirements, selecting any synthetic hyetographs does not affect much on the estimated peak flow.
Development of intensity duration frequency curves for flood forecasting in the Kingdom of Saudi Arabia

Hatem A. Ewea  hewea1136@gmail.com
Amro M. Elfeki1 elfeki_amr@yahoo.co.uk

Department of Hydrology and Water Resources Management, Faculty of Meteorology, Environment and Arid Land Agriculture, King Abdulaziz University, Jeddah, Saudi Arabia

ABSTRACT

This paper presents the derivations of the intensity-duration-frequency (IDF) curves for the Kingdom of Saudi Arabia. Such curves were obtained based on rainfall events measured in meteorological stations distributed throughout the Saudi Kingdom. For 20-28 years period, 2027 rainfall storms of durations ranging from 10 minutes to 24 hours were collected and analyzed. Thirteen representative IDF curves covering 13 distinct regions of the Kingdom have been developed.

The resulting IDF curves for each region are usually used to develop design storms that used in the estimations of runoff peaks and volumes for urban/rural watersheds of different sizes. For rigorous, efficient and safe size of hydraulic structures in Kingdom of Saudi Arabia, the study recommends using these curves.

Key words: rainfall, intensity-duration- frequency (idf) curves, design storm, Kingdom of Saudi Arabia, arid zone.
INFLUENCE OF BEDROCK AND CLIMATIC CONTROL ON KNICKZONE DEVELOPMENT IN ARID WATERSHEDS

Ali. P Yunus

Graduate School of Frontier Sciences, The University of Tokyo, Kashiwanoha, Japan 277 0883
yunusp@csis.u-tokyo.ac.jp

ABSTRACT

Knickzones in the form of waterfalls often occur in bedrock rivers and are one of the most visually arresting indicators of channel adjustments to either regional or local perturbations. Causative factors influencing knickzone origin have been interpreted in many studies. Less attention is directed towards the fluvial systems in well-developed arid-semi arid mountain escarpments and highlands in the Arabian Peninsula. This work analysis knickzones in Western Arabian Peninsula using changing rate of river gradient at different scales. A total of 5121 km length of longitudinal river profiles extracted from a digital elevation model (DEM) and 325 knickzones were identified, the measured length of entire identified knickzones is 83.76 km. Results suggest knickzone frequency and knickzone density vary according to bedrock types defined in the region. Knickzone frequencies along channels underlain by volcanic rocks are found twice more than those found along the crystalline channels. Comparative analysis of knickzone frequencies from other regions indicate climatic control for their development. The results thus indicate that focused knickzone analysis using a DEM has the potential to provide insight into the tempo of landscape development.
Glacial Changes in the Kashmir Alpine Himalayas under changing Climate and topography

Khalid Omar Murtaza* and Shakil A Romshoo**
Department of Earth Sciences, University of Kashmir, Srinagar, India
(*Research Scholar, **Head and Prof. Department of Earth Sciences)
Email: komurtaza@gmail.com; shakilrom@kashmiruniversity.ac.in

ABSTRACT

This paper describes the spatial pattern of glacier fluctuations (glacier area, equilibrium line altitude (ELA), accumulation area ratio (AAR), and specific mass balance (SMB)) in the Lidder watershed, Kashmir Himalaya between 1980 and 2013 at decadal time interval using Landsat satellite time series data (1980, 1992, 2001, 2010, and 2013). The observed glacier fluctuations of the nine benchmark glaciers were related with the topographic and climatic variables (temperature and precipitation) in order to understand their influence on glacier changes. From analysis of the satellite data, it is observed that the glacial area has shrunk by 5.20 km² or 17%, while as ELA has shifted upward ranging from 80 m to 300 m, a decrease in AAR ranging from 0.07 to 0.32, and SMB change ranging from a maximum of -77.21 cm water equivalent to -16 cm water equivalent. Analysis of the annual average air temperature showed a significant upward trend during the last 33 years in the area. A slight but insignificant decrease in precipitation was also observed in the region. However, the proportion of snow is decreasing and correspondingly, the proportion of rains is increasing. It is observed that the topographic-climatic setting plays a key role in the glacier recession and dynamics observed in the area. Further, it is believed that if glacier volume loss continued for the next few decades, may adversely affect the streamflows, domestic water supplies, agriculture, energy production, tourism and other dependent sectors in the region.

Keywords: Glaciers, Mass balance, Equilibrium Line Altitude, Accumulation area ratio, Climate Change

Acknowledgements: The research work was conducted as part of the Department of Science and Technology (DST), Government of India sponsored national research project titled “Himalayan Cryosphere: Science and Society” The financial assistance received from the Department under the project to accomplish this research is thankfully acknowledged.
Abstract

Natural hazards are being inevitable effects from beginning of the world. It can be slowly change into disasters with respect to time and characters of the events. The disasters have become serious impacts on socio-economic of the nations. The natural disaster made by changing climate. The hydrometeorology disasters will occur frequently and leads to heavy damages of structures, lose of human life, and lose of agriculture among others. The Flood hazard can occur by overflowing of water along the river. The loss of socio economic by flood can happen by lack of knowledge about events, appropriate infrastructure and adaptation strategies. The Aim of this study is to map flood hazard zone by adapting weighted overlay method in GIS. The very high to low vulnerable zone were identified by creating buffer zone along the rivers in the Hazard Zone. The maximum likelihood algorithm has been applied to generate Land use map by using LISS-III image. The high vulnerable feature were identified. The Flood hazard zone map can be used for assessment of agriculture loss, infrastructure vulnerable for policy makers and claim of insurance.

Keywords: Flood Hazard, GIS, Land Use, Weighted Overlay.
NEURO-CHAOTIC HYBRID MODEL FOR DAILY RAINFALL-RUNOFF FORECASTING IN SAHARAN WATERSHEDS

M. Chettih, K. Chorfi and K. Mouattah
Research Laboratory of Water Resources, Soil and Environment, Department of Civil Engineering, Faculty of Technology, Amar Telidji University, P.O. Box 37.G, Laghouat 03000, Algeria.
e-mail: m.chettih@lagh-univ.dz

Abstract
The non-linearity, non-stationary behavior and multiscale nature of hydrological regimes and especially the Saharan hydrology required the use of specific tools of nonlinear dynamic systems.
The applications of nonlinear dynamics and chaos theory to systems and hydrological processes have gained considerable and very particular attention by researchers during recent years.
The chaotic analysis of hydrological series revealed the presence of chaotic structures. Hence, a Chaotic Neural Network model was proposed for daily rainfall-runoff forecasting.
The approach is based on the combination of the series generated by the reconstruction of the phase space according to the method of Takens, to an artificial neural network. The results are very encouraging and open the prospects for other intelligent hybrid models taking into account the long dependency and multiscale effect.
RAINFALL VARIABILITY ANALYSIS USING TRMM PRECIPITATION DATA OVER SHIPRA CATCHMENT OF CENTRAL INDIA

Ankit Gupta 1*, Aamir Lone 2, Maya Kumari 2, B K Rao 1

1 Indian Institute of Soil & Water Conservation, RC, Vasad-388306 (Gujarat), India
2 AIGIRS, Amity University Uttar Pradesh, Sector-125, Noida-201301, India

Email Id: ankitgupta18may@gmail.com *

Abstract

Measuring rainfall using traditional methods has very much gaps and errors due to manual readings which are the most indirect factors for climate analysis. Error in data increases the variability and causes uncertainty while using it in simulation modeling & for future climate projection. Rain gauge stations are not able to cope with the pressure of working all day & night and recording weather data, resulting gaps of several days or many. Accurate precipitation measurement is necessary now a days for future prediction and analysis. TRMM, the world’s foremost satellite for the study of precipitation is used in this study to achieve good accuracy level. The integration of Geographical Information System and Remote Sensing acts as an effective tool for extracting precipitation from satellite data. The objective of this work is to extract the precipitation data from TRMM NetCDF files for fifteen years from 1998 to 2012 and analyse that over Shipra catchment of Ganga Basin, India for finding out the rainfall variability. The Shipra River is entirely located in Malwa plateau with two major tributaries viz., The Khan River and The Saraswati River. Catchment has been delineated with the help of spatial analyst tools of ArcGIS, which covers small parts of Indore, Dewas, Ujjain and Ratlam districts of Madhya Pradesh. TRMM data is in NetCDF format i.e. “Network Common Data Form” which cannot be directly used for further processing. Thus for precipitation extraction for 6148 NetCDF files, ArcPy i.e. ArcGIS Python has been used. The study demonstrate that the catchment has highly variable trend in rainfall. It has been noticed that maximum and minimum rainfall in the catchment is 1429 mm and 573 mm per year respectively while catchment receives 1001 mm annual rainfall for fifteen years. The study also results in high variability in the year 2008 with decrease in rainfall all over the catchment although rainfall was found very less in the year 2000 and high in the year 2006 followed by the year 2011. This work also results that downstream portion of the study area always in deficit rainfall condition but with high runoff. Most of the area in the catchment is very good for ground water recharge due to the slope characteristics.

Keywords: Shipra River, TRMM, NetCDF, Rainfall Variability, Interpolation.

Acknowledgements:

The first author would like to acknowledge the Amity Institute of Geo-Informatics & Remote Sensing (AIGIRS), Amity University Uttar Pradesh, Noida, India to access their labs and would like to thank Dr. P.R. Bhatnagar, Head, ICAR-Indian Institute of Soil and Water Conservation, Research Centre, Vasad (Gujarat) and other scientists to support this work.
SPATIAL AND TEMPORAL VARIATIONS OF RAINFALL IN TESSA SUBWATERSHED OF MEDJERDA RIVER IN TUNISIA

Sahar Abidi¹, olfa Hajji¹ and Hamadi Habaieb²

¹PhD student in Water resources, Agronomy National Institute of Tunisia.
²Professor and General Director, National Research Institute of Rural Engineering; Water and Forest, Tunisia.

sahar.abidi@yahoo.fr

Abstract
Flooding problem raised seriously in the watershed of Medjerda in North Tunisia indeed flood risk factors still exists for some cities. Rainfall is the first reason for the inundation of the area. During the study of the inundation problem of Medjerda River, we found that the sub-catchment of Tessa have a part. Tessa watershed is characterized by irregular precipitations, semi-arid climate and relatively high relief. The study of rainfall distribution pattern and its temporal variations is very important for efficient management of water resource. In order to discuss spatial and temporal variations in rainfall, 13 rain gauge stations have been chosen to collect data for the years 1984 to 2014. Three scales of analysis are developed; monthly, seasonal and annual. The missed data are reconstructed by the mean ponderation method. We tested the homogeneity of the series by the Pettitt, Buiscand and SNHT test via XlStat software. The ruptures are detected in the months of June, July, August and October, in the season of autumn and spring of the years 1994/1995 and 2000/2001. In order to establish the spatial distribution of rainfall patterns and to detect homogeneous areas with similar rainfall evolution, two interpolations methods are used: isohyet and Thiessen polygons via the software ArcGIS. This interpolation method allows one to capitalize on the spatial correlation between neighboring observations to predict attribute values at un-sampled locations.

This paper shows that GIS is a suitable tool for the analysis of rainfall data. In fact the analysis results illustrate an alternation of wet and dry episodes with very marked excess rainfall, a gradual increase in rainfall. These rainfall fluctuations have contributed to weakening the natural environment. We defined the rainfall pattern of the watershed is a temperate continental regime.

Keywords: Rainfall variability, Tessa watershed, homogenous tests, spatial interpolation, GIS.

Acknowledgements:
I would like to express my gratitude to all those who gave me the possibility to complete this article. I address my deep recognition to Professor Hamadi Habaieb (INAT) for all the efforts which it exempted during this work. I want to thank my colleague Olfa Hajji (INAT) for his help in writing and finalizing this article.
EVALUATION OF WATER EROSION RISK IN TUNISIAN SEMI ARID

Olfa HAJJI¹, Sahar ABIDI¹, Taoufik HERMASSI², Ikram MEKNI³
Agronomy Institute-Tunis, Rural Engineering Water and Forest Department, Tunisia.
²National research Institute of rural engineering, Water and Forests, Tunisia.
³Higher Engineering and Rural Equipment School, Hydraulics and Environment Medjez El Bab, Tunisia.
Email: olfa.hajji@yahoo.fr

Abstract

Soil erosion is a serious threat for the agropedological heritage. Water erosion affects, in Tunisia, nearly 3 million hectares of agricultural land, and constitutes a threat to the sustainability of small lakes in the hilly regions. Indeed, this phenomenon is answered in central Tunisia, particularly in our study area "El Gouazine watershed" because it contains several favorable conditions for his release because of the semi-arid Mediterranean climate and its physical characteristics and specific anthropogenic.

The objective of this final project study is the determination and application of a methodology for quantitative assessment of water erosion and the development of erosion map using Geographic Information Systems (GIS) in the watershed of El Gouazine to properly plan the management actions to be taken and to protect priority areas risk vis-à-vis erosion.

Application of USLE, MUSLE, RUSLE and FAO/GIS approach’s combines the main factors of erosion adapted according to the Tunisian conditions based on the principle of the combination of its main factors related to the natural environment and equipped. To this end, the layering on rainfall, soils, topography, vegetation cover and amenities, provides synthetic card distribution rate to erosion in t/ha/year from results we can conclude that the hilly lake is characterized by low erosion with siltation rate of the order of about 1,8 t/ha/year.

The evolution of water and soil conservation works has led to a remarkable reduction in soil loss of about 50% at the El Gouazine basin which proves the effectiveness of erosion developments since 1996.

In the end, a comparative analysis of the four methods determines the validity of methods RUSLE and USLE in our watershed unlike MUSLE and FAO methods. Furthermore, the results obtained show that the RUSLE model, adapted to the conditions of the watersheds, provides the best results of estimation.

Keywords: USLE, MUSLE, RUSLE, FAO, Water erosion, modeling, GIS, Tunisia, watershed El Gouazine.
A COMPARISON OF HYDROLOGICAL MODELS UNDER POTENTIAL IMPACTS OF CLIMATE CHANGE ON THE WATER RESOURCES OF MEGECH RIVER CATCHMENT, ABBAY BASIN, ETHIOPIA

Endalkachew Abebe¹ and Asfaw Kebede ²

¹Lecturer, Department of Soil and Water Resource Management, Woldia University, Woldia, Ethiopia. Email: endalkabebe@yahoo.com.

²Assistant Professor, School of Natural Resource and Environmental Engineering, Institute of Technology, Haramaya University, Dire Dawa, Ethiopia. Email: asfaw649@gmail.com.

The abstract

This study was aimed to compare the uncertainty of two hydrological models in discharge modeling and their performance and catchment hydrological response to climate change in Megech river catchment. In this study, large scale regional climate model (REMO) output was downscaled statistically to metrological variables at a daily resolution using SDSM model version 5.11. According to the projected climate data the maximum temperature likely to have an increasing trend +0.57°C while the minimum temperature showed a decreasing trends -0.61°C. There was no clear trend for precipitation, both increasing and decreasing trend observed in the catchment. The two hydrological models, HBV-Light and GR4J, were successfully calibrated (1991-1995) and validated (1998-2000) using current climatic inputs and observed river flows. The overall performances of the two models were good at monthly time scale both on calibration and validation (NSE=0.91 for HBV and NSE=0.88 for GR4J). Future discharge (2015-2050) was simulated using statistically downscaled 20 ensembles climate scenario data for both A1B and B1 scenarios. Both model results showed a reduction of the peak discharge in August and September. The total annual discharge for future period (2015-2050) showed a decreasing trend for HBV-Light simulation and an increasing trend for GR4J simulation. More studies using different hydrological models on different catchments need to be carried out in order to provide more general conclusions about the reliability of the model output.
The Abstract

The climate change matter set in at the forefront of the news and public opinions’ concerns for a long time. These climate changes have negatively affected the water reserves which necessary for any social and economic development. In Algeria, the deficit of this blue gold becomes worrying, confirming various expertises starting from assumptions and using different methodologies which all have concluded that our country will be confronted to this shortage in the next coming years.

To better work out the importance of those impacts, we have analyzed the average water flows of five basins of Algerian northwest, in the Central Maghreb, over the reference period (1970-200) and we have compared them to those that could result from the changes in the main climatic stress (temperature and rains). The methodology used rests on the model GR2M in order to make simulations on the flows of five basins of the Central and West of Algeria in view of the climate changes by the years 2025 and 2050. The results obtained show a coming decrease in the flows, of the order of 15%, from January to April for the basins of the Central and Chéliff, and which will exceed 25% for the basins of the West. For the first months of the warm season, the aforementioned decrease, for 2050 and for the pessimistic scenario, will be more than 40%.
IMPACT OF CLIMATE CHANGE ON WATER RESOURCES IN THE CATCHMENT OF THE WADI MINA (NORTHWEST ALGERIA)

Mohamed MEDDI
Laboratoire génie de l’Eau et Environnement, École Nationale Supérieure de l’Hydraulique. Blida. Algeria
m.meddi@ensh.dz

The Abstract:
The watershed of Wadi Mina is part of the larger basin of Wadi Chelif. It is located about 300 km west of Algiers, between 0 ° 20 ’and 1 ° 10’ East and 34 ° 40 ’and 35 ° 40’ North, draining an area of 4 900 km² at the station of the Sidi M'Hamed Ben Aouda dam, which is intended to supply drinking water to the city of Relizane, and the development of agriculture in the region. The reduction of rainfall since some decades led to a decrease in the amount of water stored in the dam, and has adversely affected the water needs of the people. Through this work, we study the impact of climate change on surface water resources for tributaries and main stream watersheds. We chose two gauging stations in regard of the availability of water and climate data: liquid flow rates, rainfall and temperatures at a monthly step. Both stations are: Wadi Al Abtal and Sidi Djilali AEK. We used the GR2M conceptual model from the Cemagref in France, with two calibration parameters at the monthly time step. It has given satisfactory results for the calibration and validation phases. Wesimulated flows with the hypothesis of climate change for 2020 and 2050, and for two scenarios: pessimistic and optimistic. Climate predictions were taken from a UKHI model (United Kingdom Meteorological Office High Resolution). After calibration and validation of the model, the hydrological responses of basins, in the case of climate change for 2020 and 2050, were compared with the reference series (1970-2000). For the basin of Wadi Mina at the station of Wadi Al Abtal (main stream), which drains 87% of the watershed, and the pessimistic scenario, the largest decrease was observed in autumn and summer(-13.5%) in 2020 and -20% in 2050, followed by the spring season with a 7% reduction by 2020 and 11% in 2050. In winter a slight decrease of about 3.6% by 2020 and 6% in 2050 was observed. For the optimistic scenario, in autumn, spring and summer reduced rates are 16.9%, 11.7% and 8.5% in 2020 and 43.8%, 27% and 18.5% in 2050. For the winter season, the reduction is similar to the pessimistic scenario for both horizons. For the Wadi Haddad, it was observed a significant reduction in the hot season for the pessimistic scenario of about 15% and 18% in autumn and summer respectively in 2020, and 22% and 17% in 2050. In winter and spring, the decreases are smaller in the range of 4% and 9% in 2020 and 6% and 7% in 2050. For the optimistic scenario, higher reductions are recorded in autumn and summer where they can reach 15% and 18% respectively in 2020 and 31% and 23% in 2050. In winter and spring these decreases are relatively small between 6 and 13%. We note that the impact will produce a negative effect on water resources in the region. These resources are already limited. Projects must be done to overcome the shortcomings that may cause the reduction of water resources.
Assessment of the potential socio-economic impacts of climatic change and the existing adaptation measure in southern Jordan

Noor Al-Deen Al Farajat
Current Position: water officer-Aqaba Special Economic Zone Authority –ASEZA)
Aqaba - Jordan
e.mail: nfarajat@aseza.jo

Abstract
Due to the some natural disasters that Jordan has faced such as drought and water deficiency which are related to climatic change it becomes very important to assess the socio economic impacts of these impacts.
This research proposal deals with the socioeconomic impacts of the climatic change in the southern part of Jordan, the objective of the proposal is to analyze and quantify the nature of environmental socioeconomic impacts that result from the drought and scarcity of water resources, the proposal will be carried out through survey and review of climatic records, reports and studies in the southern part of Jordan including water resources, Studies and figures on population growth, annual crops productivity, reduction of fertile soils, change in life style and jobs and jobs opportunities.
the findings of the study will be functioned to check the sustainability of the master plans in the governorates of Ma’an and Aqaba performed by local authorities, in terms of land use planning, future projects, supply of energy and water and services, etc.
Hydrometeorology of the Rajasthan desert rainfall

Dr P R. Rakhecha
Former Dy. Director (hydrometeorology), Indian Institute of Tropical Meteorology, Pune, India
Email: rakhechapukhraj@gmail.com

Abstract
The west Rajasthan comprising of 10 districts (Bikaner, Hanumangarh, Jaisalmer, Churu, Barmer, Ganganagar, Nagaur, Pali, Jodhpur and Jalore) with an area of 195091 sq.km is characterized by a desert environment. Extremely low and erratic rainfall, hot summers with very high temperatures going as high as 50°C, low humidity and high evaporation which is many times the rainfall are some of the noteworthy climatological features of the area. Nevertheless, unlike other desert regions of the world, the Rajasthan desert is unique in the sense that it occasionally receives heavy spells of rain in association with monsoon depressions that move across the country from the Bay of Bengal & the Arabian Sea. There have been instances when stations in this region recorded rainfalls of the order of 250-500 mm in a single day. Sanchor (24°45'N, 71°46'E), a station in the Jalore district recorded the highest one day rainfall of 512 mm on 16 September, 1893. Statistics of the rainfall data for the period 1871 to 1995 were used for rainfall analysis and assessment of water received in the desert area. It was found that the average annual rainfall recorded for the last 125 years was 294 mm and mostly occurred from July to September rainy season. The highest & lowest annual rainfalls for the same period were 722 mm in 1917 & 37 mm in 1918 the next year. Moreover, in the 7, 17 & 52 rainy seasons in the 125 years, the total annual rainfall exceeded 500 mm, 400 mm & 300 mm respectively. There were years during which heavy rainfall resulted in the formation of runoff water in the rivers. For example, in the August, 1973, a severe rainstorm occurred over west Rajasthan which caused flooding in the Luni, Sukri, Badi & Jowai rivers. Large areas in the districts of Jaisalmer, Barmer, Pali & Jalore were marooned for days together. Some stations received in one day rain amounts exceeding their respective mean annual rainfall. Jaisalmer recorded 200 mm of rain on 16 August, 1973 while its mean annual rainfall is about 200 mm. The rainstorm was in some ways unique in the history of the desert region of Rajasthan. Such instances of heavy rainfall are of great importance in the context of desert hydrology. The main purpose of this paper is to present some aspects of hydrometeorology of the Rajasthan desert rainfall as a contribution to the better understanding of the water wealth of the desert area of Rajasthan.
Environmental effects of As, B and other heavy elements of Isti Su hot spring, Western Azerbaijan, Iran

Mohammad Yazdi, Gohar Farajpour and Pedram Navi

1Department of Geology, Shahid Beheshti University, Iran
2Geological Survey and Mineral Exploration of Iran

E-mail of corresponding author: m-yazdi@sbu.ac.ir

Abstract

The Isti Su hot spring is located in the 67 km of Salmas, Western Azerbaijan, Iran. The area is a part of Sanandaj-Sirjan geological zone which is host of many hot spring of Iran. The host rocks of the area are sedimentary and metamorphic rocks of Cambrian to Recent age which are interrupted by several granite and ophiolite bodies. Several hot springs have been formed in the vicinity of these plutonic to sub volcanic bodies. Some of these hot springs, because of having some chemical materials, hold a particular color, odor or taste and they are used enormously in the fields of health and tourism. The Isti Su hot spring is one of the most typical hot springs of the Salams region. A total of 8 thermal water samples were collected from the area. In order to investigate the seasonal changes of field and chemical parameters and to trace element concentrations in dry and wet seasons, springs were sampled twice in May and November. Temperature, pH and electrical conductivity (EC) of the water samples were measured on-site. Water samples were collected into 250-ml polyethylene containers. All water samples were collected as two filtered batches. 2.5 ml ultrapure Merck HNO₃ was added into one of the batches for cation analyses. The other batch taken for anion analyses was untreated. Water analyses were performed using standard methods in the "Geological Survey of Iran" Laboratories. Temperatures range from 26.3 °C to 38.5 °C. The PH values in the samples were between 6.4 and 7.5. TDS contents range from 9200 to 1790 mgL⁻¹. The Cl-SO₄-HCO₃ triangular diagram shows that the samples are HCO₃ and Cl type. The geochemical analysis results show that the Ar, Li, Fe, Hg, Na, and Cr are not more than WHO’s standard level. As and B is two time more than WHO’s standard level. The main aim of the research was to investigate geological features, geochemical composition and environmental impacts (especially As and B) of this hot spring. One of the worlds’s As anomaly sources are hot springs and geothermal waters. In addition, B is derived from geothermal sources, and is leached from many varieties of rocks. Normally, As and B concentrations in the hydrothermal and geothermal solutions for water rise higher than its standard level for water. WHO’s recommended As level in drinking water is 0.01 mg/l. Open skin scars, gangrene, malignant cancers and environmental problems are among the results of high concentrations of As and B. The high content of As and B in the water of this hot spring can be harmful environment and peoples of the area.

Keywords: hydrogeochemistry, environmental impact, hot spring, Salams, Iran
ASSESSMENT OF CLIMATE CHANGES IMPACT ON THE HYDROLOGICAL PROPERTIES OF UNCONFIED AQUIFERS; A CASE STUDY FROM SAMARA’-BAIJI AREA, IRAQ

Sa’ad Zeki A.Kader Al-Mashaikie¹, Moutaz A.Sttar Al-Dabbas¹ Raad M. Al-Khafaji²

¹Dept. Of Geology, College of Sciences, University of Baghdad, Al-Jadriyah, Baghdad, Iraq E-mail: geozakee13@yahoo.com

²College of Education (Ibn Al-Haitham), University of Baghdad., Baghdad, Iraq

Abstract

The climatic data of rainfall and temperature degrees obtained from meteorological stations in Tikrit and Baiji districts for more than forty (40) years were examined and evaluated. The results show actual evidences in the climatic changes, which are indicated by remarkable decreases in the average means of annual rainfall, with increases of the average mean of annual temperatures. The carbon dioxide in the atmosphere seems to be the main factor controlling the climate changes. The impact of the climatic change on the groundwater was obvious in decreasing the water table as observed and studied in the unconfined aquifer in Samara- Baiji area. The unconfined aquifer in this basin represents the shallow underground water aquifer, which is recharged mainly from rain water. Since this source is scarce, the aquifer gains its water slowly in a rate less than the rate of losing by both evaporation and abstraction wells. The designed model and the water budget calculations confirm this state that the aquifer is worn out within the year 2020. The recommended solution to prevent more depletion and to protect the groundwater from deterioration is to stop drilling wells in the area, which is exposed to heavy withdrawal. It must be taking in consideration to leave an acceptable distance between the new drilling wells (at least 750 m).

Keywords: Climate change, Temperature, Rainfall, Groundwater Modeling, Samara-Baiji, Iraq.
RAINFALL HARVESTING UNDER CLIMATE CHANGE
(EL-DABAA REGION, NORTHWESTERN COAST, EGYPT).

Abdelaty, E. F(1), Abd El-Hady, A. M.(2), Bahnassy, M. H(3), and Mourd, A.Y(4)
(1,2,4) Faculty of Agriculture, Damanhour University, Department of Natural Resources and Agricultural Engineering, El-Goumhor Street, P.O. Box 22516 Damanhour, Behera, Egypt.
(3) Faculty of Agriculture, University of Alexandria, El-Shatby, Department of Soil and Water Sciences, Aflaton Street, Alexandria, Egypt. (1) Email: emad.fawzy@damanhour.edu.eg

ABSTRACT
Geographical Information System (GIS) provides a framework watershed analysis. GIS enables to extract the digital elevation model (DEM) that represents steps of mapping of water drainage basins and accumulative drainage streams. Climate variability and predictability have the potential to provide critical planning support for farmers, ranchers, agricultural production and natural resource managers. El-Dabaa area was selected to represent Egypt northwestern coast region that has an average annual water rainfall of 120 mm/yr to 155 mm/yr. Water is one of the main requirements for healthy plant growth. Most arid and semi-arid regions, however, suffer from insufficient and unreliable rainfall. When it rains in semi-arid areas, the rainstorms are usually heavy. The prevailing soils generally cannot absorb the amount of water which falls in such a short time. As a result rainfall in semi-arid areas is often accompanied by a large amount of surface runoff.

The main objective was use the limited amount of rainfall available as efficiently as possible to support the sustainable agricultural development.

The resulted watersheds are 14 watershed, the basins area ranged between 8.6 km2 (1.4 % from total area) to 136.8 km2 (23 % from total area). the study area has twenty eight locations to build water reservoirs as a technique of water harvest (average amount forecasted in future period (2011 -2030)) these water reservoirs may supply the population by 2604325 m3 / year (more than two millions m3 of water) it can used in plantation and grazing activities.

Keywords: GIS, DEM, Watershed, Rainfall harvest, Climate change.
URBAN FLOOD MODELING FOR WADI AL-AQIQ, MADINAH, SAUDI ARABIA

Norhan Abd Rahman 1,2, Saud Taher 2, Kamarul Azlan Mohd Nasir 1
Fahad Alahamdi 1,3 and Zulkifli Yusop 1
1 Department of Hydraulics and Hydrology
Faculty of Civil Engineering, Universiti Teknologi Malaysia,
Skudai Campus, 81310 Johor Bahru, Johor, Malaysia
Email: norhan0123@yahoo.co.uk
2 Department of Civil Engineering, College of Engineering,
Taibah University, Madinah, Kingdom of Saudi Arabia
3 Madinah Water Directorates,
Madinah, Kingdom of Saudi Arabia

Abstract
Madinah City like other urban centers has experienced several devastating floods for the past 40 years, the most recent being the 2005 flood that took human lives and destroyed properties and infrastructures. For Madinah City, the study will evaluate on the suitability of the modeling approaches, which will help with the model selection for the city’s immediate solution to the flooding problem. The study will focus on affected area within the 450 km² surroundings covering mainly downstream of Wadi Al-Aqiq within the city limit. The study will also examine the impact of flow from all the Wadi Al-Aqiq tributaries which cover 5000 km² of area. The objectives of this study were to estimate the flood peak discharge, inflow hydrograph, hydraulic and flood map at the study area based on annual maxima series of rainfall data. The SCS type II is selected for disaggregation of rainfall design. The research methodology has the following tasks; rainfall analysis, flood simulations through hydrological and hydraulic modeling in conjunction with digital elevation modeling to generate flood plain maps. The HEC-HMS model will analyze the hydrologic behavior (rainfall-runoff process) for the whole catchments of Wadi Al-Aqiq. The HEC-HMS, modified Talbot and Nouh models were applied to estimate design flood for various return period. Initial and constant rate loss method was applied to determine the hydrologic loss and the excess rainfall was transformed using the Clark’s Unit Hydrograph for HEC-HMS simulation model. The hydrodynamic software, the Info-Works Integrated Catchments Modeling (ICM) is for hydraulic and flood simulation. The research outcome will be the introduction of a planning tool for the non-structural flood protection that relies on the established flood maps in Al-Madinah and other places in arid region.

Keywords: rainfall-runoff, HEC-HMS model, disaggregation rainfall, Wadi Al-Aqiq, Madinah
WATER AND ENERGY USE EFFICIENCY OF GREENHOUSE AND NETHOUSE UNDER DESERT CONDITIONS OF UAE

Hirich Abdelaziz and Choukr-Allah Redouane
International Center for Biosaline Agriculture, Dubai, UAE
h.aziz@biosaline.org.ae; hirich_aziz@yahoo.fr

Abstract

The GCC countries are considered one of the most water scarce region in the world, and facing over the coming years the most severe intensification of water scarcity in history. The protected agriculture in the GCC countries is close to 13000 ha and due to hot climate conditions the greenhouses are cooled which lead to high energy and water consumption. This research aims to compare between a high technology greenhouse equipped by cooling-pad and sun screen system and a low technology net house equipped by a mist system in terms of water and energy use efficiency. 2 crops were cultivated, cherry tomato under greenhouse and cucumber under net house. Greenhouse presented the highest water consumption used for cooling process. In fact, cooling consumes 3.5 times more water than the required irrigation water for cherry tomato. However the fogging system in the net house was consuming less water, about 75% of consumed irrigation water used for cucumber. Data related to energy were tremendously high where cooled greenhouse consumed 32 times the energy used for fogging system in the net house.

Data indicate that 1 m$^3$ of irrigation water produced about 16 kg of cucumber (Zeco Variety) and 10 kg of cherry tomato (Sarah variety). However difference between net house and greenhouse was obvious in terms of cooling water productivity where 1 m$^3$ of cooling water produced more than 21 kg of cucumber (Zeco variety) and only 3 kg of cherry tomato (Sarah variety). To produce 1 kg of cucumber (Zeco variety) we needed about 112 Watt-hour, however to produce 1 kg of cherry tomato (Sarah variety) we needed 6210 Watt-hour. These results indicates that cooling cost in the total production cost is much higher and heavier under greenhouse resulting in high production cost and loss of competitiveness of the local product in the market where imported products seems to be more competitive than local produced products. For a cropping period of 8 months for cherry tomato and 4 months for cucumber the projected water and energy use per hectare for cooling is raising more questions about the sustainability of cooled greenhouse in the GCC region, the most region affected by water scarcity in the world. However net house system seems to be more sustainable and could contribute significantly in water and energy saving. Further research is needed to explore more options for cooling using alternative water resources as saline and treated wastewater and to upgrade the existing greenhouse to be more efficient in terms of water and energy use.
SOCIO-ECONOMIC IMPLICATIONS AND STRATEGIES OF ADAPTATION FACING THE FLOODINGS IN THE LOW VALLEY OF OUÉME IN DANGBO (REPUBLIC OF BENIN, WEST OF AFRICA)

Brice Saturnin DANSOU, Léocadie ODOULAMI & Ginette TOVOEDO
Laboratoire Pierre PAGNEY, Climat, Eau, Ecosystème et Développement LACEEDE)/DGAT/FLASH/Université d’Abomey-Calavi (UAC). 03BP: 1122 Cotonou, République du Bénin (Afrique de l’Ouest), bdansou86@gmail.com, leocadieo@yahoo.com

Abstract:

The low valley of the Ouémé is confronted to the damaging risks of flooding to the environment and to the socio-economic activities. This work has for objective to study the socio-economic effects and the strategies of adaptation developed facing the floodings in the Commune of Dangbo. To reach this objective, the data hydrometric and rainfall of the station of Bonou on the period 1971-2010 as well as those structural on the adaptive measures have been collected at the time of the documentary research and the works of the land investigations by 4% of the households of the Commune.

The gotten results show on the economic plan, the arrival of the high waters and the yearly rises in the water level has as very negative consequences that positive on the main economic activities that are agriculture, the fishing,.... in the same way, the dwellings constructed for most in precarious materials and sometimes some whole villages are taken away creating the crumbling of the families thus.

Face this situation, the endogenous strategies as the elevation of the precarious dwellings on stilt, the precocious harvest in the fields,… are insufficient. It is recommended to the local actors to develop initiatives of backing of the strategies in work in the Commune.

Acknowledgements: The Communal authorities and all households surveyed
Flash Floods as Natural Disaster in Jammu And Kashmir, India: Implications to Socio-Economic Settings

Jayaraju, N. Dept of Geology, , Y.V.University, KADAPA – 516003, AP, India

E-mail: nadimikeri@gmail.com

Abstract

The spate of floods on September 10&11, 2014, lashing half a dozen states in the north and east of India has raised doubts — once again — about India’s capability to forecast monsoons and launch rescue and rehabilitation operations to assist the affected in time. Recurring floods in many parts of the country are surprising as India Meteorological Department (IMD) estimates show that total rainfall till the middle of last week is about a fifth lower than the normal rains. But this has not prevented the rash of floods from inundating vast spaces in various regions. What is more startling is that current floods are occurring in regions where the shortage in rainfall has been the highest so far, namely northwest India where cumulative rainfall is 29% short and east and northeast India where rainfall is 23% below normal. The primary reason for the floods is heavy rainfall in the Himalayan region, including in Nepal, which has caused the rivers to flood in the Gangetic plain and in other regions. The main worry is that weather forecasting authorities have been unable to provide any meaningful warnings in many of the places — warnings which could have alerted district administrations to launch rescue and rehabilitation operations or evacuate people out of the danger zones. Experts however say that environmental changes have made weather patterns move away from the normal and made them less predictable. Extreme weather patterns have been occurring with increasing frequency putting authorities in a quandary. This is going to cause hardship to farmers and have an impact on agricultural production. It is now for the government to step in and ensure that the meteorological authorities develop the capabilities to warn people of any dangers and ensure that loss of life and livelihoods is minimized. With over 6 lakh people still stranded in what is being called as the worst floods in over a century in Jammu and Kashmir, an analysis done by Centre for Science and Environment (CSE) has warned that India may face more such calamities in future. India will be hit more and more by extreme rainfall events, says the study. Researchers at CSE found that heavy (>100mm/day) and very heavy (>150mm/day) rainfall events in India have increased over the past 50-60 years. India will get more rainfall but in a much shorter duration, say the results, also predicting extreme precipitation during monsoons. The study stressed that such extreme weather conditions are being induced by climate change. The Kashmir floods are a grim reminder that climate change is now hitting India harder. In the last 10 years, several extreme rainfall events have rocked the country, this being the latest calamity in the series. A team of CSE researchers compiled a list of the natural calamities that have recently hit the nation, including the Mumbai floods in 2005, the Leh cloudburst in 2010 and the Uttarakhand floods in 2013. Studying the Jammu and Kashmir calamity in retrospect of these tragedies, the researchers said that unplanned development, especially on riverbanks, worsened the situation. In the last 100 years, more than 50 per cent of the lakes, ponds and wetlands of Srinagar have been encroached upon for constructing buildings and roads. In fact, Jammu & Kashmir does not have a flood forecasting system. The present paper attempts to investigate the socio-economic impact of the flood affected Jammu & Kashmir, India.
SPATIAL PATTERNS OF WATER QUALITY IN GARRA RIVER AT SHAHJAHANPUR, GANGA BASIN, INDIA

Mohd Yawar Ali Khan¹, Babra Khan²
¹Department of Earth Sciences, Indian Institute of Technology Roorkee, Roorkee-247667, India
²Department of Geography, Gandhi Faizam College, Rohilkhand University, Shahjahanpur-242001, India
Email:myawar.akhan@gmail.com

Abstract

Water pollution is one of the most significant problems in India. This problem of poor water quality is also faced by many Himalayan Rivers which flowing through in the Ganga Plains of India. Garra river, tributary of River Ganga, flows through major industrial area of Shahjahanpur district of Uttar Pradesh and one of the source for supplying water for life, production and irrigation especially in the dry season, has also faced water quality problems with industrial development and urban growth along the river. In this study, water quality along the total stretch of the river Garra in Shahjahanpur was analyzed on the basis of spatial variation, including various physiochemical characteristics. This takes into consideration the chemical and physical characteristics, as well as heavy metals. A correlation matrix was created, followed by PCA analysis to assess the data accuracy. The data was accurate, reliable and the finding was then compared to existing WHO guidelines. The results established the existence of marked pollution along the Garra section in Shahjahanpur district, which can be accredited to wastewater discharges of urban and animal husbandry origin in particular.
VARIABILITY AND TRENDS ANALYSIS OF PRECIPITATION OVER TIME USING MANN-KENDALL TEST, NORTHERN ETHIOPIA

Gebremedhin Kiros 1,2*, Amba Shetty1, Lakshman Nandagiri1

1 Department of Applied Mechanics & Hydraulics, National Institute of Technology Karnataka, Surathkal, Mangalore P.O. Srinivasnagar - 575 025, India
2 Department of Soil Resources and Watershed Management, Aksum University, Shire campus: Shire Endasellassie P. O. Box -314, Ethiopia.

*Corresponding author Email: k.gebremedhin@yahoo.com
Mobile No.: +917899493937

Abstract

This study is focused on temporal and spatial trend analysis of precipitation records for stations in the Geba River basin Northern Ethiopia located in semi-arid environments. The data sources used for the study were the precipitation data collected from the Ethiopian Meteorological Agency from seven stations for the period of 1971 to 2013. The non-parametric Mann-Kendall trend analysis was applied in determining the significant trends in the rainfall climatology. The results revealed that though there is a mix of positive and negative trends but none of them showed statistically significant trend except one station showed a statistically significant increasing trend in annual precipitation in the study area. Moreover, results revealed that among the seasons, an increase in precipitation was observed in two stations in the wet season which however statistically significant was not noticeable. Despite these stations are not statistically significant at 95% confidence level weak decline in the rainy season’s precipitation for four stations, and one station did not showed any trend at all. Furthermore, there is no positive or negative statistically significant trend in the dry season in the study area.

Key Words: Climate Change; Geba River Basin; Northern Ethiopia; Mann-Kendall; Non-Parametric Test; Precipitation; Trend Analysis
Modelling of Water Distribution Piping Network in Steel Gate Water Distribution Zone of Dhanbad Municipality Corporation, Jharkhand, India

Nitish Kumar Gautam and Shibayan Sarkar

Department of Mechanical Engineering, Indian School of Mines Dhanbad, Jharkhand – 826004, India

nitish08m50@gmail.com

Abstract

Every year residents of Dhanbad Municipal Corporation (DMC), Jharkhand, India suffer water scarcity in summer season. This happens due to power scarcity in summer season, extensive population explosion in present decade, and water loss in terms of mechanical damage, leakage or illegal water connection in the water distribution network (WDN). Field survey shows that water loss is a significant issue of this WDN. In connection to this Steel gate zone is found the most vulnerable area of the WDN and therefore this area is considered as the study area. In this study, 1:50000 Survey of India (SOI) Topomap and GPS data are used to generate the existing WDN Network in ArcGIS software first, then it is transferred to HAMMER software. Finally Transient flow analysis of existing WDN is performed using HAMMER Software to assess the capability of WDN to fulfil the increasing water demand corresponding to the increasing population in this DMC area. Further, vulnerable area within the WDN due to leakage is identified, and pressure difference occurring due to leakage is accounted. Thereafter necessary precautionary measure for this network is prescribed.

Acknowledgements: Authors would like to acknowledge the Authority of Dhanbad Municipality, Jharkhand, India for providing data from different offices and giving permission to access the Water Treatment Plant that is essential for this study.
Statistical and Geostatistical analysis related to geographical parameters for spatio-temporal representation of rainfall in semi-arid environments. Case of Algeria.

Bachir Hakim 1, a*, Semar Ahcene2, Mazari Azzedine3

1 Hydraulics Department, Superior National School of Agronomics (ENSA), Avenue Pasteur, Hassan Badi El Harrach, Algiers, Algeria.

*a Research Division in Bioclimatology and agricultural hydraulic, National Institute of Agronomic Research of Algeria (INRAA), CRP. Mahdi Boualem, Baraki, Algiers, Algeria.

2 Laboratory of Applied Geology, Department of Soil Science. Superior National School of Agronomics (ENSA)

3 Research Division of Agri-food Technology, National Institute of Agronomic Research of Algeria (INRAA) CRP. Mahdi Boualem, Baraki, Algiers, Algeria.

* Corresponding Author E-mail address: akm7.62@hotmail.fr / hakm7.62@gmail.com

Abstract

The economic challenges related to the fields of agriculture and industry, conduct us to adopt the best suited method to represent the rain on the spatial and temporal plan especially in areas characterized by heterogeneous rainfall distribution additionally to drought periods. The methods of analysis and estimation of rainfall, using a number of tools (statistics, geo-statistics and digital mapping), provides us opportunity to represent the average inter-yearly rainfall fields in the eastern high plateaus region of Algeria. Average annual Rainfall data in the study area from 1986 to 2008 was collected from 65 rain-gauging stations that are not fairly distributed across the region with a somewhat lower spatial density in the Eastern part. In this study, we propose an approach for a rainfall characterization in study area based on two combined methods (kriging interpolation and multiple linear regression) including direct relationship between geographical parameters (longitude, latitude and altitude). Statistical results shows that rainfall varied between 127 mm and 752.2 mm and the average of 365mm with a coefficient of variation of 0.33 and standard deviation of 122.33 mm. This proposed approach allows optimizing the estimation of rainfall and indicates that yearly rainfall structure obey mainly to a North/South gradient. Latitude is the most influential geographical parameter with coefficient of 261.25 contrary to the altitude (0.04) and longitude (17.06) which have a non-significant effect on precipitation. In addition, other factors such as vegetation, temperature and air masses movement affects negatively the rainfall structure. Moreover, Rain bands ranging from 350 to 450 mm dominate the study area with a total area of 7050 square kilometers. The proposed approach provides a useful tool that can be easily applied to other climatic parameters needed for climatology investigation and for environmental and agronomic studies.

Keywords: Average yearly rainfall, Multiple linear regressions, Geographical parameters, geostatistic, GIS.

Acknowledgments

The authors' special thanks go to Algerian institutions: National Meteorological Office, National Agency for Water Resources and National Institute of Maps and Remote Sensing for providing the climatic data and maps for this study. Furthermore, the authors are thankful to the National Institute of soil, irrigation and drainage and National Institute of Agronomic Research of Algeria for a logistics support.
HYDROLOGICAL RESPONSE TO CLIMATE CHANGE OF THE UPPER BLUE NILE RIVER BASIN: BASED ON IPCC FIFTH ASSESSMENT REPORT (AR5)

Sintayehu Legesse Gebre*1, Fulco Ludwig2
1Department of Natural Resources Management, Jimma University, P.o.box 307, Ethiopia. Email: sintayehulegesse@gmail.com
2Department of Earth System Science, Wageningen University, P.o.box 47 6700AA, The Netherlands.

Abstract
Climate change is likely to affect the hydrology and water resources availability of upper Blue Nile River basin. Different water resource development projects are currently existed and under construction in the region. In order to understand the future impacts of climate change, we assessed the hydrological response of climate change of four catchments (Gilgel Abay, Gumer, Ribb, and Megech) of the upper Blue Nile River basin using new emission scenarios based on IPCC fifth assessment report (AR5). Five biased corrected 50 kms by 50 kms resolution GCMs (Global Circulation Model) output of RCP 4.5 and RCP 8.5 emission scenarios were used. The future projection period were divided in to two future horizons of 2030’s (2035-2064) and 2070’s (2071-2100). The Hydrologic Engineering Center-Hydrological Modelling System (HEC-HMS) was calibrated and validated for stream flow simulation. All the five GCMs projection showed that, maximum and minimum temperature increases in all months and seasons in the upper Blue Nile basin. The change in magnitude in RCP 8.5 emission is more than RCP 4.5 scenario as expected. There is considerable average monthly and seasonal precipitation change variability in magnitude and direction. Runoff is expected to increase in the future, at 2030’s average annual runoff projection change may increase up to +55.7% for RCP 4.5 and up to +74.8% for RCP 8.5 scenarios. At 2070’s average annual runoff percentage change increase by +73.5% and by +127.4% for RCP 4.5 and RCP 8.5 emission scenarios, respectively. Hence, the increase in flow volume in the basin may have a significant contribution for the sustainability of existed and undergoing water development projects. Moreover; it will help for small scale farmer holders to harness water for their crop productivity. However, a precaution of mitigation and adaptation measures ought to be developed for possible flooding in the flood plains area of the River basin.

Keyword: Blue Nile, GCM, HEC-HMS, RCP, Scenario

Acknowledgements The authors gratefully appreciate Dr.Iwan Supit (Wageningen University, ESS department) for providing NETCDF GCMs Climate data. Our gratitude also extends to Ethiopian Ministry of Water and Energy (MoWE), and Ethiopian National Meteorology Service Agency (NMSA) for providing hydro meteorological data
IMPACTS OF CLIMATE CHANGE AND UPSTREAM ANTHROPOGENIC INTERVENTIONS ON THE DEVELOPMENT OF TRANSBOUNDARY RIVER BASINS IN ARID AND SEMI-ARID AREAS

Furat A. M. Al-Faraj, PhD
School of Computing, Science and Engineering, The University of Salford, Salford, Greater Manchester M5 4WT, UK
e-mail: F.A.M.Al-Faraj@edu.salford.ac.uk

Abstract:
This study aims at exploring the collective effects of climate change and man-made changes upstream on the current and future foreseen development of transboundary river basins in arid and semi-arid regions. The Diyala watershed of about 32,000 km² shared between Iraq and Iran was chosen as an example case study. The Standardised Drought Index, the Reconnaissance Drought Index, and the streamflow Drought Index coupled with the current and future foreseeable human-induced river regulations upstream were used to examine the collective natural-artificial impacts. Results exhibit that the joint impacts of recent basin-wide extended droughts and the river regulation arrangements upstream have destructively affected the development of the lower basin, including the security of the irrigated agriculture, domestic and industrial water demands, and encouraged the displacement and tribal conflicts. A disaster was considerably marked between 1999 and 2015. The size and magnitude of disaster are anticipated to increase in the foreseeable future when the under construction and future planned water withdrawal facilities put into operation. A close examination of the climate trends reveals that the whole basin points to be drier, with a drop in precipitation and increase in temperature and potential evapotranspiration rates. The average rise in temperature and potential evapotranspiration over the period of (1998-2014) compared to (1981-1997), was +8% and +5%, respectively. The corresponding decrease in precipitation was −23%. The middle and lower parts of the basin have detrimentally suffered from the combined impacts of recent prolonged droughts and river regulations upstream. The two successive droughts of (1999-2001) and (2008-2009) have hindered the socio-economic activities and deteriorated the environmental system. The continuation of the current insecure condition has considerably intensified the disaster. Such complex situation will leave the portion of the basin lies in the downstream country with a sharp level of vulnerability and fragility against the collective impact. The actual experiences of prolonged droughts coupled with artificial regulations upstream would energetic to deepening our understanding and practices of how to respond and adapt to such conditions, and how this might vary between different drought-exposed areas.

Acknowledgements:
The author would like to thank the Directorate-General of the operation and maintenance of dams and reservoirs in Kurdistan Region, Iraq for their full support in providing the hydro-meteorological data.
CLIMATE CHANGE IMPACTS ON AQUIFER RECHARGE IN SEMI-ARID REGION, SOUTHEAST OF SPAIN: THE USE OF HYDROBAL ECO-HYDROLOGICAL MODEL

Issam Touhami¹, Esteban Chirino², José Miguel Andreu³, Juan Rafael Sánchez², Hassane Moutahir², and Juan Bellot²

¹Laboratory of Management and Valorization of Forest Resources, National Research Institute for Rural Engineering, Water and Forestry, INRGREF. BP 10, 2080, Ariana, University of Carthage, Tunisia
²Department of Ecology, University of Alicante, Apdo.99, 03080 -Alicante, Spain
³Department of Earth Sciences and Environment. University of Alicante, Apdo. 99. 03080 - Alicante, Spain

issam_touhami@yahoo.fr

Abstract:

Predictions of climate change have a high interest in semiarid regions like the province of Alicante (SE Spain). It is expected that the decrease of precipitation and the increase of air temperature according to climate change forecasts, could impact on the recharge to aquifers. In this context, the aim of this study was to explore the possible impact of climate changes forecasts on recharge in a small aquifer southeastern Spain. Air temperature and precipitation data in two climate change scenarios, B2-low and A2-high have been coupled to HYDROBAL model. The HYDROBAL software is a useful eco-hydrological model with daily resolution for assessing water balances in different vegetation types in a semiarid region of south-eastern Spain. Based on two models, hydrobal and DISRUM (raster model), it calculates water balance on two scales (vegetation plots and watershed). Over the latter period (2071-2099), we expect reduced average annual groundwater recharge, of up to 17% (49 mm), if compared to the baseline period (1961-1990).

Acknowledgements:

The European Commission (PRACTICE project), the Spanish Government through the Ministry of Economy and Competitiveness (ECOBAL project, CGL2011-30531-C02-01 and SURVIVE project, CGL 2011-30531-C02-02), the Consolider program INGENIO 2010 (GRACCIE project, CSD2007-00067), and the Generalitat Valenciana (FEEDBACKS-PROMETEO; ACOMP/2010/272 and GV07/143).
EARLY WARNING INFORMATION SYSTEM (EWIS) TO MITIGATE THE CLIMATE CHANGE HAZARDS IN NEW SUEZ CANAL REGION, EGYPT

El-Sayed E. Omran
Soil and Water Department, Suez Canal University, 41522 Ismailia, Egypt
e-mail: ee.omran@gmail.com

Abstract:
Advancement in technology and communications has given way to very sophisticated early warning systems for environmental monitoring. Remote sensing and GIS have proven to be a good tool for monitoring most environmental hazards. Three hazards are identified in New Suez Canal region in which water table is the most important one. Early warning information systems (EWISs) for water table, which proposed in this study, are the integration of five main elements: risk, hazard and vulnerability assessment analysis; hazard detection and prediction; formulation of warning messages; dissemination of warning messages; and community response. A prototype of actual near real-time EWIS for water table rising management was implemented using different sensors. A system of remote sensors would measure water level hazard in local wells which would register when the water level increase above a pre-identified level. The sensor would send this information back to the server. The server would recognize when a critical number of wells increased above the pre-identified level, indicating an imminent challenge to the water table. When water level increase above a critical level (a certain threshold), the sensor would share this information with a centralized monitoring server. At this point, the data is processed within the Geographical Information Systems (GIS) using a simulation programme. Subsequently, the early warning panel would be up hosted to the website, whereby such information would be made accessible to the public and authorities involved. An alert would be issued to relevant authorities, triggering and enabling a water management response. SWOT analysis has been used to assess the current situation for the proposed EWIS in Egypt. The results of SWOT analysis proved that there are a lot of resources (strengths) that could utilize better future opportunities. There is also some threats in the future that may restrain its improvement process. Many obstacles exist in efforts at establishing EWISs and most need to be ad-dressed to enhance the creation of fully integrated and effectively operational EWISs.
USING THE ARNOLDUS INDICE TO MAP THE RISKS OF RAINFALL EROSIVITY IN THE TELL ORAN (ALGERIA)

Maamar-Kouadri K(1,2), Kouri L(2) and Chebouti Y(1)

National Institute of Forestry Research, BP 60 El Harrach Baraki, Algiers, Algeria
Laboratory Biodiversity and Conservation of Water and Soil, University of Mostaganem. Algeria.

corresponding author Maamar_kader@yahoo.fr

ABSTRACT

The Tell Oran is exposed to a major problem that is water erosion, resulting from several factors such as erratic rainfall in stormy character, deforestation, relief, use and soil type. These soils are often increasingly degraded and sediments derived from the erosion contribute to siltation of dams in the region. Understanding the risk of erosion requires knowledge of the rain factor that influence. To determine the rainfall erosivity in time and space, we have chosen to index Arnoldus. The values of the index Arnoldus obtained vary between 24 at El-Aricha station to 50 at the Mostaganem station. The rainfall erosivity map according Arnoldus index shows that the Tell Oran is covered by three classes of rainfall erosivity: High [40-50] of coastline, medium and large [30-40] in the center and low [20-30] to the southwest. In our region, spatially, the erosivity of rainfall increases from south to north and from west to east, while temporally, erosivity is high during the fall season and winter. The development of the erosivity of rainfall enabled map to identify areas susceptible to water erosion.

Key words: Tell Oran, rainfall erosivity, sediments, map, siltation, dams.
THE ASSESSMENT OF CLIMATE CHANGE IMPACT ON APARAN RESERVOIR HYDROMETEOROLOGICAL REGIME

Azizyan L.V., Misakyan A.E, Danielyan A.G., Azizyan H.H.

Ministry of Territorial Administration and Emergency Situations of RA Armenian State Hydrometeorological and Monitoring Service,
54 Leo str, 0002 Yerevan, RA
E-mail: levon_azizyan@yahoo.com

Abstract

Armenia is among the countries that have limited water resources and in arid climate conditions most of the regions' lands need for artificial irrigation, provision of which is made due to the water resources stored in reservoirs. The work is dedicated to the one of the Armenian major strategically significant reservoirs as Aparan and analysis of its hydrological regime. In the global climate change conditions is of a great importance to estimate the volume of water in the reservoir, the rivers water volume that are flowing to the reservoir and possible maximum fullness forecasts, because they provide an opportunity to develop a schedule for their use during the year, and a number of water-related issues. For hydrological regime analysis are also necessary meteorological regime study, for determining the role of meteorological factors in the hydrological regime formation, in the calculation of the basic elements of water and heat balances. In this work, with statistical (regression) method, proposed by the IPCC, based on CO2 emissions RCP8,5 (A2) and RCP6,0 (B2) scenarios, was assessed air temperature and precipitation changes in the basin, water inflow to the reservoirs through the rivers and maximum fullness vulnerability in climate change conditions. In the reservoir watershed was implemented seasonal and annual precipitation reassessment. For the implementation of this work used long-term hydrometeorological observation data, as well as thematic material analysis.

Keywords: Reservoirs, climate change, inflow, vulnerability, precipitation
ASSESSMENT OF GLOBAL CHANGE IMPACTS ON GROUNDWATER RESOURCES IN SOUSS- MASSA BASIN

Seif-Ennasr Marieme¹, Choukr-Allah Redouane², Hirich Abdelaziz³, Nrhira Abdessadek⁴

¹ Faculty of sciences, Ibn Zohr University, Agadir, Morocco, seif.ennasr.marieme@gmail.com
² Agronomic and Veterinary Medicine Hassan II Institute, Complex of Horticulture, Agadir, Morocco, redouane53@yahoo.fr
³ International Center for Biosaline Agriculture, Dubai, United Arab Emirates, h.aziz@biosaline.org.ae
⁴ Souss-Massa-Drâa River Basin Agency, Agadir, Morocco, anrhira@gmail.com

Abstract:
Souss Massa region is considered the most productive and adaptive region in terms of horticulture crops in Morocco since it provides about 90% of vegetables exportation at national level. In the last decades this region has suffered from water scarcity problem aggravated by climate change and agricultural intensification leading to water table lowering, groundwater salinization and pumping costs increase. The objective of this study is to assess the global change impacts on groundwater management by developing many scenarios combining cropping system, climate change, political interventions and irrigation strategies, practices and technologies.

Climate change scenario suggested that the region will be subjected to increase in temperature and decline in rainfall. As a result of global change the groundwater quality degrades more and more due to agricultural pollution and sea water intrusion. Many strategies and scenarios are already or will be implemented such as cropping system scenarios which are corresponding to change in production pattern especially adopting the soilless system and new crops and varieties. The political interventions and strategies which the government has implemented and willing to setup as the Public Private Partnership projects (the project of using desalination for irrigation in Chtouka zone, modern irrigation district in El Guerdane zone, aquifer contract) in order to reduce the global change impacts are also developed as political scenarios. Scenarios related to irrigation strategies especially at field scale which are conversion of surface to drip irrigation, using weather stations network in irrigation scheduling, reusing wastewater and installing discharge meters in pumping stations were taken in consideration in this assessment.
Evaluation of Risk of Access to Water Resources Regarding the Process of Late half Century in Arid and Semi- Arid area

Gholamreza Roshan1*, esmaeil shahkooeei1, Abdolazim Ghanghermeh1

1. Department of Geography, Golestan University, Shahid Beheshti, 49138-15759 Gorgan, Iran
Corresponding author: Department of Geography, Faculty of Human Science, Golestan University, Gorgan, Iran
Email: r.rowshan@yahoo.com ; ghr.roshan@gu.ac.ir

Abstract

One of the main apprehensions of the arid and semi-arid areas is the accessibility of water resources out of droughts. Drought is a natural diverse phenomenon which is remarkable along with lack of water resources available in a wide geographical area in a period of time. Iran is known as a country that its main section is located in dry areas and the experience of drought is known as one of the obvious characteristics of these areas. So this study decides, by monitoring and pursuing of late half century droughts (1965 to 2014), to present the first step in controlling the accessibility to water resources in sixteen arid and semi-arid stations of Iran. One of the new factors of estimating drought is the reconnaissance drought index (RDI) which estimates drought on the basis of two variables, say, rainfall, evaporation and potential perspiration and its estimating process including calculating primary amount, normalized RDI that its high ability of this index in monitoring droughts caused them to be used in this study. In the present research, in order to investigate the process of changing rainfalls and droughts, the nonmetric Man Kendal has been applied. The result of this research shows that the maximum excess level of RDI index belong to normal territory that this situation is more obvious especially for winter, autumn and spring seasons. On the other hand, the least amount of RDI index was about hot summer season. The research finding show that the maximum vulnerability of droughts with respect to the procedure changes relates to Zahedan, Yazd and Bam in the hot summer season respectively; and in a sense the most vulnerable stations is in terms of getting access to water resources of the above mentioned stations, panorama of global warming effect upon getting drier in arid and semi-arid regions of the middle east, water crisis for all future decades, these regions lead to a major environmental challenge. Thus, as a solution, the use of virtual water for disparate financial and agricultural sections is suggested; thereby the pressure of exploitation from restricted water resources is diminished.

Keywords: risk management, reconnaissance drought index (RDI), Mann Kendal test, water requirement, Iran arid and semi-arid regions
Modeling Hydrometeorology drying effect Maharloo Lake on the severity of aridity Shiraz semi-arid station in the southern half of the Iran

Gholamreza Roshan\textsuperscript{1*}, Saeed Negahban\textsuperscript{2}, Sultan AL-Yahyai\textsuperscript{3}

1. Corresponding author: Department of Geography, Faculty of Human Science, Golestan University, Gorgan, Iran
   Email: r.rowshan@yahoo.com ; ghr.roshan@gu.ac.ir
2. Department of Geography, Faculty of Human Science, Shiraz University, Shiraz, Iran
3. Mazoon Electricity Company, Information Technology Department, Oman, Muscat

Abstract
With the proliferation of regional climate simulation software, various scenarios such as the impact of high water or a dry lake situation were able to be conducted through computer simulation. Maharloo Lake as one of the great lakes located at southwestern Iran near Shiraz station is currently facing the threat of drought. It is worth noting that the lake dryness could affect the surrounding areas including the changes in Aridity Index (AI) component and indirectly affect the quality of access to water resources over the region. In this study, TAPM software was used to simulate, high-water scenario (the real condition of the lake) and drying lake scenario. In addition, the aridity index for Shiraz city which is located in the vicinity of the lake was changed. Actual daily data (1965-2014), monthly aridity index trend of the city was collected and analyzed for verification purposes. According to the long-term observations, it was shown that there is a declining trend for the aridity index among different months. Significant increase of about $r = 0.26$ can be seen during November only. Based on dry scenario, it was found that at most months with increasing temperature and decreasing precipitation will come from the other side. During summer, the lake experienced a significant decrease in rainfall. The Simulation showed an increasing AI values for both scenarios during all months of the year. More significant increase was seen during cold season. Increasing AI value implies wetter conditions in the region. This can affect Maharloo Lake and indirectly affect that access to water resources over the region. On the other hand, global warming and its opposite effects on arid and semi-dry areas like Lake Maharloo and Shiraz station, it is expected that Maharloo Lake will experience a drying condition, decrease precipitation and increase in temperature.

Keywords: Regional climate model, Mesoclimatic Models, global warming, aridity index, TAPM, Maharlu Lake.
STUDY OF COASTAL CHANGES FROM KUALA BESAR TO KUALA SUNGAI PENGKALAN DATU, KELANTAN, MALAYSIA USING GIS

Mohammad Muqtada Ali Khan, Ahmad Bin CheAb Salam, Noor Hafizzah Mohd Jais, Dony Adriansyah Nazaruddin and Hafzan Eva Mansor

Department of Geoscience, Faculty of Earth Science, Universiti Malaysia Kelantan, Campus Jeli, Locked Bag No. 100, 17600 Jeli, Kelantan, Malaysia

muqtadakhan@gmail.com, ahmad.salam03@gmail.com

Abstract

Peninsular Malaysia is experiencing a rapid coastal changes due to several factors within the coastal environment that drive coastal erosion and accretion. This study evaluates the factors that contribute to coastal changes along Kuala Besar to Kula Sungai, Pengkalan Datu, Malaysia and also analyses the impact of coastal changes in this region. Geographic Information System (GIS) is used to analyze coastal changes with the help of encoding and digitization of Landsat 7 satellite images of coastal areas for years 2000, 2005, and 2012. The layers of coastal for these three years have been overlaid to see the changes in coastal areas in terms of coastline, coastal area, alienated land and sinuosity index. As a result, the study area recorded/showed 4 meters per year in the rate of erosion which results from a combination of natural factors and that is aggravated by human action. Results of the analysis have contributed towards an improved understanding of coastal erosion in Malaysia and particularly shoreline changes in the Malaysian coastal zone.

Key words: Coastal, Changes, Kelantan, Malaysia

Acknowledgements:

The authors are thankful to faculty of Earth Science, Universiti Malaysia Kelantan, Campus Jeli, for providing facilities to carry out this work.
Abstract
Human activities in the recent years have led to production of greenhouse gases and thus the occurrence of the climate change phenomenon. These impacts are called indirect effects of human activities on water resources. However other human activities such as land use change, construction of dams, interbasin water transfer, etc. have also major direct effects on hydrological cycle as well. To manage water resources properly, there is a need for assessing the shares of these two effects on hydrological cycle. In this study, the shares of direct and indirect human impacts on surface runoffs in four sub-basins of Karkheh River basin in southwest Iran were estimated. Firstly, the breakpoint (beginning year of the direct effects of human activities on runoff) were determined using three methods, namely ordered clustering, Pettitt test and double mass curve. The break point was utilized to divide the historical records into two subsets of reference and recent periods. Then the shares of climate change and direct effects of human activities on runoff reduction from the reference period to the recent period were estimated utilizing climate elasticity (with non-parametric and Budyko hypothesis approaches), linear regression and fixing-changing methods. In the fixing changing method, GUO monthly water balance model was utilized. The three methods were used in both annual and seasonal scales. Because of low correlation between climatic variables and runoff, the results obtained for dry season were classified as unreliable. The direct effects of human activities was recognized as the key factor in runoff reduction in annual scale as well as in the wet season. Moreover, climate elasticity method with the non-parametric approach, fixing-changing and linear regression had the best performances in determining the shares of direct and indirect human interventions on runoff reduction. Also among Budyko hypothesis-based functions, Schreiber’s results were closer to the results obtained from other methods.

Acknowledgements:
This study has been partially supported by the Center for Water and Agriculture Strategic Studies affiliated to the Iran Chamber of Commerce, Industries, Mines and Agriculture (ICCIMA). Technical contribution of Dr. Mohsen Nasseri is hereby acknowledged.
EFFECT OF HIGH RESOLUTION DEM IN FLOOD INUNDATION MODELLING IN URBAN AREAS USING WATERSHED MODELING SYSTEM

Kuswantoro Marko¹,², Amro Elfeki², Nassir Alamri², Anis Chaabani²

¹Department of Geography, Faculty of Mathematics and Natural Science, University of Indonesia, 16424

²Department of Hydrology and Water Resource Management, Faculty of Meteorology, Environment, and Arid Land Agriculture, King Abdulaziz University, Jeddah-Saudi Arabia

kuswantoro@ui.ac.id

Abstract

DEM 90m is a low resolution DEM where the important topographic features and properties were not incorporated explicitly. This DEM can be easily obtained by downloading in many websites. Such DEM's are particularly useful for flood simulation in rural areas. In urban areas, some features such as roads, embankments, buildings, river banks, fences, and dykes have great effect on flood propagation. These features may be found and extracted from Light Detection and Ranging (LiDAR) data. Unfortunately, LiDAR data is huge and expensive that could not be obtained easily. This study deals with a high resolution DEM that is obtained by adjusting the 90m DEM. The approach is aiming to simulate the effects of the high resolution DEM in flood depth and flood extent in urban areas, particularly. The integration of GIS, and the coupled WMS and HEC-RAS software could find out the solution how to simulate the flood inundation when there is no high resolution DEM. Three different grid cell sizes, i.e., 30m, 20m, and 10m were incorporated with urban features, i.e., buildings, streets, fences and embankments, were used in flood inundation modelling. The results showed that the higher resolution of grid cell sizes (DEM) has affected in increasing the average of flood depth and decreasing the flood extent. Although the changing of the grid cell sizes does not affect to its elevation values, this approach is helpful to do flood simulations in urban areas that the high resolution DEM availability is limited. In addition, WMS is a powerful software for flood modeling either in rural or urban areas.

Keywords: high resolution DEM, urban areas, flood inundation, WMS
USE OF THE REMOTE SENSING IN THE STUDY OF EVOLUTION OF A SAHARAN WET ZONE (SOUTH-EASTERN ALGERIA)

MEDJANI Fethi¹, DJIDEL Mohamed¹, LABAR Sofiane², C. Mei-Ling HAMILTON³, DJORFI Samir⁴

¹ Laboratoire de Géologie du Sahara, Université Kasdi Merbah Ouargla, BP 511 Ouargla, Algérie.
² Institut des sciences de la nature et de la vie, Université d’El-Taref, Algérie.
³ Environmental Geochemist & Educator, P. O Box 10271 Bakersfield, CA USA 93389
⁴ Faculté des Sciences, Université Badji Mokhtar, Annaba, BP 12 El Hajar 23200 Annaba, Algérie.

medjanifethi@yahoo.fr

Abstract

The variations of the water surfaces reflect mainly changes in the precipitation, evaporation and the human activities affected directly lakes and their catchment. These fluctuations constitute a sensitive indicator of the climate and the changes of the human activity on a local and regional level.

In this work, we study the various changes of the states of water surface in the sebkha "Safioune" by using the data of remote sensing, climatic, hydrological and the truths-ground for the realization of the evolution maps of the states of wet surfaces and to identify the factors of influence from a diachronic analysis of a series of images OLI-TIRS of Landsat-8 in a summer period of year 2013.

The analysis of the results of seasonal changes of this wet zone ends in a mapping showing a supply by rejections and drainage waters. These alimentation favors a sustainability of these surface waters in such hyper deficit climate. Which can create an ecosystem with fauna and flora diversity?
SYNOPTIC AND DYNAMIC ASPECTS OF AN EXTREME SOURCES SINK DURING SPRINGTIME SAHARAN DUST OUTBREAK

A. Benlefki¹, B.Douaiba¹, A.Azzi¹, A. Khorsi²

¹ Faculty of Mechanical Engineering, University of Sciences and Technology of Oran, Oran, Algeria
² School in Science and Technology of Oran, Algeria

Abdelkrim.benlefki@gmail.com

Abstract

A numerical investigation of sources sink of four dust particles including clay, small silt, large silt and sand caused by the generation of large dust storms in North Africa, and weather conditions favorable the desert life cycle during springtime, were performed by using a regional meteorological model (Eta) coupled with the module describing the cycle of desert dust (DREAM).

The analysis of this natural phenomenon is based on a study of synaptic and dynamic conditions; its focuses on temporal monitoring of the dust cloud, which helped to clarify its trajectory, its spatial extension and appearance progress.

Indeed, the results obtained by the simulation of synoptic, dry and wet depositions of fourths particles showed a fairly good numerical approach to modeling of emissions and sources sink of aerosols desert, this due to a good agreement founded between the simulation pattern and the evolution of the phenomenon recorded on some weather stations situated in the Sahara, confirmed the information provided by satellite images, while the surface observations show that the event was accompanied by unusual weather conditions across large parts of North Africa including low temperatures, strong winds over the Sahara and extreme precipitation in Libya.
Abstract

In the region of Haoud Berkaoui a collapse crater, located 30 km from the town of Ouargla (southeast Algeria) at the oil well "OKN32" in 1981, and is topographic and geological in continuous modification. This collapse formed a cavity which widens from year to year resulting in the appearance of cracks in the entire region. Indeed, the collapse of the two drilling oil wells is caused mainly by a high flow rate of fossil water Albian (Q = 2000 m$^3$.h$^{-1}$) and high temperature (60°C). These waters have gradually dissolves salt layers in contact. The impact of this industrial disaster is related to the pollution of the water table rise to the surface through the salt layer in the middle of the crater, a high salt content (density = 1.16 kg.l$^{-1}$). The second is related to the geology and the topography of the region.

Studies and considerable national and international tools have been used to monitor and control the development and possibly predict the steps and the most adequate means to slow and/or stop the phenomenon. Visual monitoring, installation of topographic and seismic monitoring networks are among the means that have been used since the incident. However, they are limited in space (one-time) and time (average estimate) why the use of satellite imagery can be a most effective way by providing highly diversified information on topography, the evolution of the crater, the radius of influence, the salt index of the region, etc ... 

In this context and in response to this problem, this work aims to monitor the collapse crater and the radius of influence by application of remote sensing and GIS. To achieve this, we used 02 different dates satellite images taken from Google Earth. Treatment of these images with the ArcGIS software to create a database at a geographic information system (GIS) and mapping its spatiotemporal evolution. The results show that the phenomenon is in development on the geo-mechanically surface terrain with an extension of the crack network of a 60m north with an extension of crater by a continuation landslides (600 m$^2$). The monitoring of the fracturing network says its participation in the surficial aquifer drainage and water eruption Albian OKN32 gushing at the well and the formation of large volumes of voids by dissolving the salt.
SOIL POLLUTION BY PETROLIUM PRODUCTS: ALGERIAN CASE

Amina BELABBAS¹,Djamel BOUTOUTAOU¹
¹Laboratory of Exploitation and Valorization of Natural Resources in Arid Zones (EVRNZA), University Kasdi Merbah Ouargla, Algeria
belabbasamina02@gmail.com
boutoutaoudjamel@yahoo.fr

Abstract:
Contamination of soil by petroleum products is a current problem in several countries in the world. In Algeria, this negative phenomenon is highly remarked in Saharan region. Numerous studies at the University of Ouargla that we will review in this paper, have tried to find an effective solution to eliminate the hydrocarbons in the soil. Among techniques of elimination, there are "biodegradation" by the microorganisms (bacteria), which is a natural process.

Presence of aboriginal strain Bacillus megaterium has leads to a strong degradation of pollutants. This strain chosen for its generation time of short is performing as seen the best yields of elimination of hydrocarbons assessed at 98.43 % in 28 days of experimentation on sample bioaugmente and biostimule by biosurfactant, 98.22% in 35 days on sample and bioaugmentebiostimule by urea, and 86.1 % 35 days in the sample and bioaugmentebiostimule by nutrient solution.

Rate of biodegradation of crude oil by strain Pseudomonas aeruginosa is higher in the presence of biosurfactant(53.03 %) that in his absence (35.27 %). In addition, the rate of hydrocarbons mobilized after washing soil containing 62.70 g of hydrocarbons per kilogram of soil by centrifugation is of 50.21 % and 76.13 %. The aboriginal strain of "Pseudomonas aeruginosa" isolated is therefore capable of producing a biosurfactant, which has great capacity in remobilization of hydrocarbons and acceleration of their biodegradation.

Keywords: Soil, hydrocarbon, biodegradability, bioremediation, Bacterium
IMPACT OF EAST-WEST HIGHWAY ON THE HYDROLOGICAL REGIME OF THE NATIONAL PARK OF EL KALA (ALGERIA)

Ninouh Tarek
laboratory LGCA university of Tebessa Algeria
minouh@hotmail.com

Abstract

Algeria is home to a variety of national parks, and one of the most diverse and beautiful parks is El Kala National Park, which is located in the extreme northeast of the country.

This Park as become famous for its variety of ecosystems that consists of an marine ecosystem, breathtaking mountains, dense woodlands, picturesque forests and numerous lakes. With having such a wide variety of habitats, the park is home to approximately eighty seven thousand animals and birds of which many are on the endangered list. At present urbanization on the outskirts of the park and the building of The East-West Highway is threatening the survival of the park.

The environmental impact of roads include many effects such as on noise, water pollution, habitat destruction/disturbance and local air quality, and the wider effects which may include climate change from vehicle emissions.

The hydraulic study of the El Kala area revealed increasing levels of some valleys and extended wet plains due to the completion of the highway project.

The aim of this research is to evaluate the impact of the completion of the East-West highway project and hydrogeological hazards anticipated by the increase of wet areas after heavy earthworks which carried out in the region of El Kala.

Keywords: Impact, highway, Risk, hydrological, flood.
RISK ASSESSMENT OF CLIMATE CHANGE EFFECTS ON DROUGHT (CASE STUDY: THE REGION OF SHAHROOD, IRAN)

M. Delghandi\textsuperscript{a}, A. Izady\textsuperscript{b}

\textsuperscript{a}Department of Soil and Water, Shahrood University, Shahrood, Iran
\textsuperscript{b}Water Research Center, Sultan Qaboos University, Muscat, Oman
*Corresponding author email: delghandi@gmail.com

Abstract
Climate change is anticipated to cause negative impacts on drought. The aim of this study was to assess the impact of climate change on drought severity in a semi-arid Shahrood region, Iran. The Standardized Precipitation Index (SPI) was adopted for the estimation of drought severity. Thirteen GCMs and two greenhouse gases emission (GHG) scenarios (A2 and B1) were selected to generate precipitation-based climate change scenarios for baseline (1971 to 2000) and two future (2015-2044 and 2070-2099) periods. These scenarios were generated considering cumulative probability distribution function (CDF) and LARS-WG model under three risk levels, 0.25, 0.50 and 0.75, for the future periods. Precipitation time series were used to estimate SPI in different time scales including 1, 3, 6, and 12- months for the baseline and future periods. The results show the drought is decreased in scenarios with high level risk for the future periods in comparison with the baseline period. However, it is increased in scenarios with low level risk. There is no significant difference between the results of two GHG scenarios.

Keywords: Climate Change, Drought, Greenhouse gases emission, Scenario.
CIVIL SOCIETY ENGAGEMENT IN DEALING WITH CLIMATE CHANGE IN WATER SECTOR: CASE OF MOROCCO

Dr. Khadija Darmame, Visiting Lecturer, Ibn Zohr University, Geography Department, Agadir, Morocco.
No.64, Endeavour House, 47, Cuba Street, London, E14 8GZ, UK
Kdarmame@gmail.com

Abstract

During last three decades, Morocco witnessed frequent and intense drought along devastated floods. This situation will be critical in the future as it indicates the Second National Communication on Climate Change (CC) in Morocco. It predicts an increase of average temperature of 0.6°C, 1.8°C and 3.2°C, respectively, for the years 2015, 2045 and 2075, and a decline in rainfall average, which will be around -6 PC, and PC -13 -19 PC. This variation in climate has negative impacts on natural resources mainly water shortage, which is affecting small farmers and poor communities. The Kingdom has signed and ratified the main international conventions on the environment and has adopted since the 80’s many policies, plans and strategies based on a comprehensive and integrated vision. In 2012, Morocco went a step further and adopted the National Charter for Environment and Sustainable Development that constitutes the cornerstone of Moroccan environmental policy. Its principles include: the participation of Civil Society Organisations (CSO’s) in the formulation and implementation of policies, strategies and programmes related to water scarcity and CC (Article 2); the Government commitments to ensure the participation of CSO’s in decision making for environmental and sustainable development affairs, and guarantees the right to access environmental information (Article 19). My contribution will look at the existing national experiences, and how CSO’s has been involved. I will present the case of successful story in southern Morocco on drawing attention to adaptation to CC for “resilient oases”. The oases in southern east of Morocco suffer from sever water shortage scarcity, intense floods, the overuse of ground water resources by the agro-business, and industrial waste pollution. The population is dependent on agriculture and ecotourism, and has no choice that coping with natural alias and social vulnerability. Many programs, funded by donors and implemented alongside governmental institutions, have been developed since 2009 in the oases of Guelmim, Foum Lahsen, Tata, Foum Zguid, Dades, Ouarzazzate and Skoura. A network of associations dealing in particular with CC awareness was established with financial and technical support from UNDP and GIZ in April 2014. The RepDom (Réseau National de Plaidoyer et de développement durable des Oasis du Maroc ) is dedicated entirely to the question of adaptation to CC with an ambitious objectives and action plan. The RepDom’s members are from all backgrounds: academic, politician, journalists, farmers, etc. All stakeholders were involved in what would be a participatory approach (government, donors, media CS and private sector).
COMPARISON OF STANDARDIZED PRECIPITATION INDEX AND NORMALIZED DIFFERENCE VEGETATION INDEX ANOMALIES FOR DROUGHT ANALYSIS

Adeogun, B. K\textsuperscript{1}, Ismail, A.\textsuperscript{1} and Nwude, M.O\textsuperscript{2}.
\textsuperscript{1}Department of Water Resources and Environmental Engineering, Ahmadu Bello University, Zaria, Nigeria
\textsuperscript{2}National Water Resources Institute, Kaduna, Nigeria
e-mail of corresponding author: adeogunbk@gmail.com

Abstract

Drought is a creeping natural phenomenon adversely affecting arid and semi-arid regions and it’s being analyzed using drought indices. This paper compared the analysis of drought in Nigerian Sudano-Sahelian Region using Standardized Precipitation Index (SPI), derived from ground based rainfall data, and Normalized Difference Vegetation Index (NDVI), obtained from satellites. Monthly SPI were derived from the region’s monthly rainfall records from 1979 to 2008 using SPI program while monthly NDVI anomalies were obtained from the pixels extracted from vegetation imageries of the study area for the same period using VGT Extract software. Past drought occurrences were identified and compared by the indices on yearly and monthly scales. The results indicated that the two indices show similar drought spatio temporal pattern however, most monthly drought events identified by NDVI were lagged behind those of SPI for a period of 3 to 6 months. The findings show that SPI is a better index for near real time drought analysis and it is recommended that its derivation should be based on effective rainfall satellite imageries.

Key words: Standardized Precipitation Index, Normalized Difference Vegetation Index, Anomaly, Satellite Imageries, Effective Rainfall, Arid and Semi-arid Regions
VALIDATION OF STOCHASTIC MODELS FOR DROUGHT FORECASTING

Adeogun, B. K\textsuperscript{1}, Nwude, M.O.\textsuperscript{2} and Otun J.A.

\textsuperscript{1}Department of Water Resources and Environmental Engineering, Ahmadu Bello University, Zaria, Nigeria
\textsuperscript{2}National Water Resources Institute, Kaduna, Nigeria
e-mail of corresponding author: adeogunbk@gmail.com

Abstract

Drought forecasting is necessary for effective drought management because it gives enough room for early preparedness. In this regard, forecasting tools’ performance should be tested over a drought period for reliability. Hence, this research aimed at validating existing predictive models for drought forecasting in Nigerian Sudano-Sahelian Region. XLSTAT program was used to forecast future monthly Standardized Precipitation Index (SPI\textsubscript{1}) and Temperature using models developed for the study area in the literature. The period of forecast were from the year 2009 to 2012 and the drought severity forecasts for the region, derived from the SPI\textsubscript{1}, were compared to observed drought events during the forecast period. The results showed droughts of different severities at Sokoto, Katsina, Guzau and Maiduguri Stations in the region, from 2009 even before the drought became evident as a result of famine in the following year, 2010 and then, 2012, as reported in the literature. Since the models were able to identified droughts, known as natural creeping phenomena, at early stages; they are recommended for drought early warning systems in the region.

Key words: Drought Forecasting, Early preparedness Sudano-Sahelian Region, Standard Precipitation Index, Predictive Models, Drought Management.
Empirical Equations of Flood Analysis in Arid Zones

Mohammad Albishi¹, Jarbou Bahrawi², and Amro Elfeki²

¹Water Research Center, King Abdulaziz University, Jeddah, Saudi Arabia
²Department of Hydrology and Water Resource Management, Faculty of Meteorology, Environment, and Arid Land Agriculture, King Abdulaziz University, Jeddah, Saudi Arabia
maalbeshi@kau.edu.sa

Abstract

Water resources all over the world are facing several problems such as scarcity, pollution, climate change, global warming, etc. Arid zones especially suffer from either severe drought or severe floods. Recently in November 2009 and January 2011 in Jeddah city there were extreme flood events that cause much damage in the city. Also, in May 2014 in Makkah Al-Mokarramah a sever flood events occured. Analysis of these events were difficult because of lacking flood measurements data and rainfall-runoff models that are suited for arid regions. Researchers in the field of hydrology are developing rainfall-runoff models for storm runoff predictions since 1932. However, it is noticeable that most research papers, books and theses are considering studies in temperate regions, while arid zones are lacking such studies.

The main objective of this paper is to derive a mathematical model called Ari-Zo to predict flood peaks and time of concentration from rainfall storms in arid zones. The data used in this paper relied on storm measurements registered at Al-Lith and Yiba basins and their sub-catchments located in southwestern part of Saudi Arabia. The stream flow data method has been used to derive the unit hydrograph in Ari-Zo model. The study developed several mathematical relationships between the hydrological variables and the regional topography. The mathematical equations obtained from this study are the discharge peaking factor, time of concentration and time to peak. The model results are compared with the results of the SCS method and showed substantial differences.
CLIMATE CHANGE IMPACTS ON THE WATER RESOURCES IN THE MACTA BASIN; ALGERIA.

Dt. AMRANI Rachid

– Hassiba ben bouali of Chlef university- Algeria "www.univ-chlef.dz"
– Lab n°06 " Crop Production & Sustainable Valorization of Natural Resources” Djilali bounaama of Khemis Miliana University - Algeria "www.univ-km.dz"

Email: r.amrani@univ-dbkm.dz

Abstract
Algeria is a country with suffering much from the crisis of water, to us days. The climate changes in particular the disturbances of the pluviometric modes, are the fundamental factors that caused imbalance between the supply and water users.

The drought is noticed a climatic risk increased in the North-West of Algeria. She has repeated much for several years in this zone dominated by the semi arid climate. Like the case of the Macta basin (14389 km²). During the dry years, the dotations per capita decreased and arrive at situations of shortages serious.

With an aim of better managing the existing availabilities to satisfy the needs for the population, we base on a study of diagnostic current hydrous potentialities and the forecasts of offer which can give us the ideas of measurements which is necessary to take in the event of crisis.

The method of the adopted analysis is the critic of the satisfaction rate. Last we let us be determined by the relationship between the quota of each person of the contributions out of water of the basin and the recommended national average water quota.

It is for that we devote two part one on the distinction of the dry and wet years during the study period and the other on the evaluation of resources out of water in order to deduce the assessments from managements overdrawn and surplus on the whole of the study area.

Acknowledgements: Annual throughputs; Hydrous potentialities; Macta basin; Management of water; Pluviometer; satisfaction Rate; water quota (dotation).
<table>
<thead>
<tr>
<th>No.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Evaluation of Rain Gauge Network in Arid Regions: A Comparison between Ground Stations and TRMM Data</td>
</tr>
<tr>
<td>2</td>
<td>Water Resources Availability, Scarcity and Managing Drought in the Arab Countries: A review.</td>
</tr>
<tr>
<td>4</td>
<td>Statistical Methods For The Evaluation Of Water Quality</td>
</tr>
<tr>
<td>5</td>
<td>Model Development for a Flood Early Warning System Using Remote Sensing Data, Case Study: Sohar Catchment</td>
</tr>
<tr>
<td>6</td>
<td>Web-Based Watershed Information Systems – Advantages For Decision Support Systems</td>
</tr>
<tr>
<td>7</td>
<td>Role of Resilience in integrated water resources management in arid and semi-arid regions</td>
</tr>
<tr>
<td>8</td>
<td>Analytic Network Process Model for Assessment of Water Management in Arid Zones</td>
</tr>
<tr>
<td>9</td>
<td>Socio-Hydrological Framework Of Farmers-Drought Feedback: Darfur As A Case Study</td>
</tr>
<tr>
<td>10</td>
<td>Typology of produced and distributed drinking water. Case study: Agadir Region - Morocco</td>
</tr>
<tr>
<td>11</td>
<td>Novel Wetland And Water Body Change Detection Using Multi Temporal Hyperspectral Imagery</td>
</tr>
<tr>
<td>12</td>
<td>Study Of The Impact Of The Breach Of Bougous Dam On The Mexa Dam</td>
</tr>
<tr>
<td>13</td>
<td>Assessment Of Surface And Ground Water Quality For Drinking And Irrigation Use: A Case Study Of Coal And Limestone Storage Area, Tamabil, Sylhet</td>
</tr>
<tr>
<td>14</td>
<td>Community Driven Initiative In Water Sustainability In Arid Region Of Gujarat</td>
</tr>
<tr>
<td>No.</td>
<td>Title</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>15</td>
<td>Downscaling Of Remotely Sensed Daily Evapotranspiration For Better Water Resources Management In Arid Ecosystems</td>
</tr>
<tr>
<td>16</td>
<td>Management challenges of emanating leachate from moroccan msw, through the study of seasons effect on these flow's variation at the landfill site of oujda city (Eastern Morocco).</td>
</tr>
<tr>
<td>17</td>
<td>Groundwater Upwelling In The Oasis Of Ouargla</td>
</tr>
<tr>
<td>18</td>
<td>Agricultural Water Demand And Use Management In The Arid Areas: Lessons Learnt From Iran</td>
</tr>
<tr>
<td>19</td>
<td>GEOSAWIS, A Geoplatform For Sharing Water Data, Between Researchers And Administrations</td>
</tr>
<tr>
<td>20</td>
<td>Geological Assessment Of Water-Based Tourism In Jeli District, Kelantan, Malaysia</td>
</tr>
<tr>
<td>21</td>
<td>Using The Soil And Water Assessment Tool (SWAT) To Assess Land Use Impact On Water Resources In Semi Arid Basin Of Yellow River, China</td>
</tr>
<tr>
<td>23</td>
<td>Assessment Of Dependency And People Perception On Piped Water Supply Around A Dumpsite</td>
</tr>
<tr>
<td>24</td>
<td>Spatial Patterns Of Land Use In Fragmented Semi-Arid Landscapes: The Case Of Lebna Catchment (CAP BON, TUNISIA)</td>
</tr>
<tr>
<td>25</td>
<td>Environmental And Socioeconomic Issues Of Groundwater Overuse: The Case Of Haouaria Region In Tunisia</td>
</tr>
<tr>
<td>26</td>
<td>Feasibility Of Managed Aquifer Recharge In Managing A Coastal Aquifer For Urban Purposes: Case Study Of Samail Lower Catchment Aquifer, Oman</td>
</tr>
<tr>
<td>27</td>
<td>Carbon-based fluorescent nanoparticle for Groundwater recharge</td>
</tr>
</tbody>
</table>
Evaluation of Rain Gauge Network in Arid Regions: A Comparison between Ground Stations and TRMM Data

Mohammed Haggag 1, 2, *
1 Department of Irrigation & Hydraulics, Faculty of Engineering, Cairo University
12613, Giza, Egypt
2 Resources and Environment Department, Dar Alhandaasah Shair & Partners, Muscat, Oman
*mohammed.abou-elhaggag@dargroup.com

The Abstract:

Arid and semi-arid regions are particularly suffering from the lack of adequate rain-gauge networks. A Rain-gauge network is often used to provide estimates of areal average rainfall or point rainfalls at un-gauged locations. The level of accuracy a network can achieve depends on the number and location of gauges in the network. World Meteorological Organization (WMO) standards specify a certain number of required rainfall gauges to achieve an acceptable areal accuracy. However, the location of such gauges is not determined a priori by WMO standards. A methodology that is based on the use of geostatistical techniques (Ordinary Kriging and Semivariogram analysis) is proposed in this study to evaluate existing rainfall networks to obtain the optimum number and locations of the rain-gauges which can provide the necessary rainfall information based on maximum daily and average annual rainfall data. The Geostatistical Analyst extension of ArcGIS 9.3 is used to carry out the analysis. The accuracy of a rainfall estimate in an ungauged location is the probability that estimation error falls within a desired range. Based on this criterion, the percentage of the total area with acceptable accuracy of the rainfall network configuration can be calculated. A sequential algorithm is then used to prioritize the existing rain-gauges in order to identify the base/non-base gauges which allow for augmenting/optimizing the existing network by adding new rain-gauges, removing non-base gauges, or relocating the non-base gauges to other locations to improve the area of acceptable accuracy of the rainfall network. The methodology is applied to a case study in Northern Oman for an existing rainfall network that consists of 34 rainfall gauges with a record that extends from 1992-2009. Based on the semivariogram analysis, it was obtained that daily rainfall data have higher spatial variability compared to average annual rainfall data. Consequently, specifying a number of rainfall gauges is not enough to fully characterize the areal distribution of rainfall. The proposed approach demonstrates that the percentage of area with acceptable accuracy can be increased from 77.72% to 90.50% using an augmented network based on the annual rainfall data and from 57.10% to 82.60% based on the maximum daily rainfall data. The methodology is then applied to the same case study using the Tropical Rainfall Measurements Mission (TRMM) rainfall estimates in order to evaluate the adequacy of using the satellite rainfall estimates as an input to rainfall network design in ungauged zones or zones with few rainfall stations. The results show that the TRMM data give good estimation of observed average annual rainfall over the study area; however, it gives poor estimation of the observed maximum daily rainfall.

Keywords: Rainfall network, geostatistical techniques, sequential algorithm, Oman, TRMM
Water Resources Availability, Scarcity and Managing Drought in the Arab Countries: A review.

Yousef Nazzal *, William Humber** and P.P.Patel

- *Dept. Applied Sciences and Math., College os Sciences, Abu Dhabi University , UAE
- ** Office of Eco Seneca Initiatives (OESi), Centre for the Built Environment, Seneca College, 1750 Finch Avenue East, Toronto, M2J 2X5, Canada.

Abstract:

Water resources used unsuatanability in the Arab Countries. Water availability and scarcity is the dominant issues in the Arab Countries and predicted to become scarcer in the near future. This due to the continuing increase in agriculture activities, increase pollutions, population –economic growth. Many of the Arab countries fall under the water poverty line and the annual water availability in the Arab region reached to 953 m3 per capita per year. Integrated water resources management is a process could be used to promote the coordination, development and management of water, land and related resources in the Arab Countries. This would maximize the positive economic and social results in the Arab Countries. The present study will deal with water resources, problems, and management strategies in the Arab Countries. The paper will analyze how these strategies could help the Arab Countries to achieve sustainable development, and minimize water scarcity.

Keywords: Water resources, Water availability, Water scarcity, Water uses, Management, Arab Countries.
WATER SCARCITY IN ARID REGIONS: A CRITICAL DISCOURSE ANALYSIS OF COMPETING AND CONTESTED FRAMINGS OF THE WATER SCARCITY ISSUE IN THE CASE OF JORDAN

Hussam Hussein
Water Security Research Centre and Tyndall Centre for Climate Change Research, School of International Development, University of East Anglia, Norwich, UK
h.hussein@uea.ac.uk

Abstract
The Arab region is often described as an arid or semi-arid region, with low precipitation. Over two thirds of the renewable surface water in the Arab region is of transboundary nature. Water scarcity is often framed as a matter of national security, underlying the necessity of developing more and new water resources by engineers through mega-projects aiming at increasing the water resources in the country. What emerges, is that the social scientific aspects of social water studies are overlooked, and water scarcity issues are rarely addressed from an interdisciplinary perspective. Nevertheless, an interdisciplinary approach would be key in understanding people’s perceptions of water scarcity, the suggested solutions, and why certain solutions are strongly supported and others are neglected.

Considering Jordan as a case study, this paper is pioneering the social issue of water scarcity, investigating it through a critical discourse analysis. It aims at unpacking the discourse of water scarcity, identifying the actors, interests, and ways in which contested framings of the discourse of water scarcity are constructed. Only by understanding the power struggle around and within the discourse, this paper will be capable of investigating the suggested solutions to the issue of water scarcity, showing the interests behind each solution, who benefits, and why. In this way, it will show how different framings of the issue of water scarcity drive towards different solutions to what is framed as a problem of water scarcity. What emerges from this analysis is the presence of the competing narratives of physical water scarcity and of socio-economic water scarcity, blaming respectively the limited water resources and the mismanagement of the water resources. These framings drive towards mega-projects and engineering solutions versus market oriented or conservation oriented solutions. In so doing, with a social sciences approach, this research contributes with empirical findings to the literature on transboundary water management in the Arab region, pushing the boundaries of the literature in social transboundary water management.
STATISTICAL METHODS FOR THE EVALUATION OF WATER QUALITY

Ahmed DOUAIK
Research Unit on Environment and Conservation of Natural Resources, Regional Center of Rabat, National Institute of Agricultural Research, Rabat, Morocco.
Email: ahmed_douaik@yahoo.com

Abstract

Water is the base of life on the earth since it is necessary to all the living beings. Both quantity and quality are important. Water quantity is becoming scarce due to increasing domestic, industrial, and agricultural uses resulting from the ever increasing world population. This water scarcity is exacerbated by the climatic change, particularly in the arid and semi-arid parts of the world. Consequently, water quality is deteriorated. Information on water quality and its evolution is important for the implementation of sustainable water resource management strategies. Water quality is evaluated by measuring physical, chemical, biological, and bacteriological parameters. Since it is impossible to measure these parameters for the whole water bodies (the population), observations are made at a fixed number of sampling points (the sample) at different spatial sites and/or different temporal occasions (for monitoring). Any inferences (generalizations) drawn from the data (the sample) are uncertain and statistical methods handle this uncertainty both during the sampling design and the interpretation of results (data analysis). Therefore, it is essential to develop an appropriate statistical methodology in designing sampling and analyzing water quality data in order to draw valid conclusions and hence provide useful advices in water management.

Examples of needs for statistical analysis of water quality data are: determine mean level of a water quality parameter with a specified precision; identify temporal trend with a fixed probability and forecast it in the future; verify whether a standard has been met at least a critical proportion of the time, with a specified level of confidence; combine different water quality parameters into a single number called water quality index. Water quality data are large and multivariate with spatial and temporal components. However, before any formal statistical analysis, water quality data should be subjected to exploratory data analysis using univariate and bivariate descriptive statistics (mean, median, correlation, etc.) and graphical tools (histogram, boxplot, scatterplot, etc.). The next step is the application of multivariate statistical methods (principal component analysis, cluster analysis, discriminant analysis, etc.) in order to determine the driving background processes, identify groups of similar sampling points and understand how they are distinguished. In case of spatial sampling (many sites), geostatistical methods, that consider the likely spatial dependence or autocorrelation, can be used to interpolate the water quality parameters to the non-sampled sites and to evaluate the risk that the unobserved water quality parameter at a non-sampled location is higher or lower than a given threshold. If measurements are repeated in time (monitoring), statistical methods of time series, considering temporal dependence or autocorrelation, can be applied to determine the different components of the water quality data series (trend, periodicity, etc.), to forecast its behavior in the future, and to optimize the monitoring network. In this contribution, the main statistical methods for water quality data analysis will be reviewed, their main principles will be shortly discussed, and their applications will be illustrated with examples.
MODEL DEVELOPMENT FOR A FLOOD EARLY WARNING SYSTEM USING REMOTE SENSING DATA, CASE STUDY: SOHAR CATCHMENT

Eyad Abushandi
Civil Engineering Department, Faculty of Engineering
Sohar University, Sultanate of Oman
Email: eshandi@soharuni.edu.om
eabushandi@gmail.com

Abstract
With the focus on water resources and flood management in Oman, particularly, Sohar, the main goal of this paper is to produce flood early warning system for arid flood prone areas. Although there are many hydrologic models developed to simulate flood events around the world, little work has been developed for arid regions. The great challenge for modelling such events is the scarcity of hydrologic data. Geographic Information System (GIS) and Remote Sensing offer great advantages to the practice of simulating and predicting flood impacts. In this research, physics based distributed model, Gridded Surface Subsurface Hydrologic Analysis (GSSHA) developed by the US Army Corps of Engineers is applied into Sohar catchment area. The parameters for this model include rainfall, roughness, infiltration, and anticipated soil moisture condition. The required input datasets for the model have been collected from satellite imagery products such as Digital Elevation Model (DEM), Enhanced Landsat Thematic Mapper (ETM+), and recently distributed gauge-calibrated version of Global Satellite Mapping of Precipitation (GSMaP_RNL_Gauge). Calibration of GSMaP_RNL_Gauge was conducting using available weather stations data. The results show the potential of using such model and data for Sohar area. However model validation is required to decrease uncertainty in order to improve decision making process.

Keywords: GSSHA, Remote Sensing, arid region, GIS, Sohar
WEB-BASED WATERSHED INFORMATION SYSTEMS – ADVANTAGES FOR DECISION SUPPORT SYSTEMS

Guleda Onkal Engin1, Ibrahim Demir2, Ahmet Adiller1, Meltem Çelen3, Ahmet Dogan4, Gamze Varank1, Seref Naci Engin5
Yildiz Technical University, Environmental Engineering Department, 34220 Esenler, Istanbul, Turkey
University of Iowa, Iowa Flood Center, IIHR – Hydroscience & Engineering, Iowa City, IA, USA
Yildiz Technical University, Control and Automation Engineering Department, 34220 Esenler, Istanbul, Turkey
Gebze Technical University, Environmental Engineering Department, 41400 Gebze Kocaeli, Turkey
gengin@yildiz.edu.tr

Abstract
The need for information systems, which can be constituted at watershed or country level, arise from the necessity of evaluation of the collected data and information in water resources management. However, this is not the only reason for constructing such systems, as decision support systems can be integrated with these information systems in order to maintain the balance between water demands and environmental pressures to water resources. Additionally, these systems would allow water users to be informed about the water related issues in their residential areas. While the development of information systems began in 1960s, the watershed information system applications were initiated only at the beginning of 1990s. The web-based watershed information system, which is a step beyond, was introduced at the beginning of this century allowing people to participate and be informed about environmental issues in their water catchments. Although, the first known applications of public participation in environmental issues are the Environmental Impact Assessment meetings in Turkey, as required by the related legislation published in as early as 1993, the procedure of effective contribution of related stakeholders and public participation is still in its infancy. It is obvious that the benefits of web based watershed information systems would be two-fold, as both the water users and the decision makers would take advantage of these systems. This paper would rather deal with the decision makers’ side. The benefits of better understanding of complex watersheds and evaluation of alternative management approaches using web-based watershed information systems will be discussed thoroughly.
Role of Resilience in integrated water resources management in arid and semi-arid regions

Farhad Yazdandoost, Sogol Moradian

Department of Civil Engineering, K N Toosi University of Technology, 1346 Vali Asr Ave., Tehran, 19697, Iran
yazdandoost@kntu.ac.ir

Abstract
Resistance is defined as the ability of a system to withstand a disturbance without any reaction, and resilience as the ability of a system to recover easily from a reaction to a disturbance. These concepts are often applied to risk management by adopting a systems approach. The system may be defined as the socio-economic and physical characteristics of the basin where disturbances may affect the normal socio-economic and natural functioning of society and ecosystems. To make the resilience concept more tangible, indicators are defined and to quantify resilience, the aspects which give insight into the reaction of systems are studied and quantified. These aspects were taken as; “Amplitude”: The magnitude of the reaction, “Graduality”: The increase of reactions with increasingly severe conditions and “Recovery Rate”. The resilience of a system is presumed to be larger when the amplitude is smaller, the graduality is larger or/and the recovery rate is larger.

A toolbox has been developed to investigate the role of resilient risk management on decision/policy making in semi-arid basins facing water scarcity. The toolbox comprises an allocation model, namely the Water Evaluation and Planning System (WEAP) model, as the central engine where water management scenarios and the effect of proposed developments on water resources may be investigated in an integrated manner based on sustainability criteria encompassing socio-economic and environmental characteristics of the basin.

The toolbox has been utilised for the case of Lake Urmia basin. Lake Urmia, one of the largest saltwater lakes on earth and a highly endangered ecosystem, is on the brink of desiccation. Considering no significant trend in the drought pattern, Lake Urmia's observed physiographic changes may be attributed to the adverse effects of unsustainable development plans and excessive irrigation projects in the basin. To combat this potential catastrophe, the authorities have taken rapid action in drastically curbing dam construction and utilisation and to reduce the overall agricultural allocation by 40% in Lake Urmia basin. The results obtained from the proposed toolbox indicates that adopting a resilient risk management approach would imply that, for instance for the critically important issue of agriculture with possible grave social implications, the same outcomes for the lake’s water demand may be reached through far less reduction than the proposed 40%.
Analytic Network Process Model for Assessment of Water Management in Arid Zones

Mohammad Ebrahim Banihabib* Arash Noori and Mohammad Hadi Shabestari

* Corresponding author, Associate professor, University college of Aburaihan, University of Tehran, Pakdasht, Tehran, Iran, Email: banihabib@ut.ac.ir

M.Sc. Water Resources Engineering, University of Tehran, Iran

Abstract

SWOT model was used for strategic planning in various area of research effectively. However, it is necessary to determine the priority of strategies by multi-criteria decision making (MCDM) models. Among MCDMs, in this research, analytic network process (ANP) is proposed for determining best water resources management (WRM) strategy in arid zone. Since the ANP considers the relationship between decision factors, it can be used to reflect the impact of WRM strategies on each other. In this research, the WRM strategies are obtained by SWOT. For this purpose, the strengths, weaknesses, opportunities and threats of Iran central desert basin were obtained by brainstorming and finally 9 strategies were obtained. These strategies were ranked by ANP based on sustainable development criteria. The strategy of “development of modern system for urban and agriculture water distribution and improvement of existing systems” has been ranked first, after that respectively “intelligent virtual water import” and “reallocating more water supply to industries and services” strategies were placed on 2th and 3th rank and the strategy of “inter-basin water transferring from nearby basins” obtained the lowest ranking, this strategy comes from aggressive strategies according to SWOT table. The results show interest of experts to solve the challenge of water scarcity in long term and relying on the strengths of the region instead of solving challenges rapidly which probably causes damage to the environment and natural resources.
SOcio-Hydrological Framework of Farmers-Drought Feedback: Darfur as a Case Study

Nadir Ahmed Elagib¹, Ammar Ahmed Musa², Hussein M. Sulieman³

¹Institute for Technology and Resources Management in the Tropics and Subtropics (ITT), Technische Hochschule Köln, Betzdorferstr. 2, 50679 Cologne, Germany
²elagib@hotmail.com
³Environment, Health & Safety Department, King Fahd University of Petroleum and Minerals (KFUPM), Dhahran 31261, Saudi Arabia, Faculty of Agricultural and Environmental Sciences, University of Gadarif, P.O. Box 449, 32211 Gadarif, Sudan

Abstract:

Building on the definition of socio-hydrology as the science of coupled human-water systems (Sivapalan et al. 2012, Sivapalan et al. 2014), this paper attempts to conceptualize key socio-hydrological feedback loops between farmers and drought phenomena. To this end, two-fold aspects are considered. The first one is the understanding of farmers’ perception of the major drought conditions, i.e. changes in patterns of rainfall and increase in temperature, in the region in comparison to observed trends and variability (meteorological records). The second aspect is identifying the type of concordant adjustments in the farming practices those farmers have made in response to drought conditions. The basis of establishing the socio-hydrological framework is a survey composed of 100 farmers in the Darfur region in western Sudan. Being currently under profound socio-political unrest, this region is known to be one of the most resource- and food-insecure regions of the world. As farming is practiced under arid and semi-arid rain-fed conditions, drought risk in the region is found to significantly reduce the levels of crop yield (Elagib 2014, 2015). The questionnaire will be discussed in the context of a prototype cause-effect approach to defining the framework of drivers, pressures, state, impacts and responses (DPSIR) in the farmer-drought system. Accordingly, the DPSIR elements are respectively identified as the household characteristics and the perception of indicators of meteorological drought (D), the main barriers/challenges constraining the ability to cope with drought stress (P), the reasons (S) behind the decline in crop productivity (I) and the mitigation/adaptation measures taken in the face of drought (R).
Abstract:

The National Office of Electricity and Drinking Water (ONEE) mobilize the groundwater and/or surface resources and also sea water to respond to the drinking water needs that continue to increase. However the water quality present a varied appearance because of origin and anthropogenic influences.

In order to continuously produce and distribute drinking water responding to the requirements of food safety and to ensure consumer confidence and health authorities, the ONEE initiated a water quality control program based on Moroccan standards, the WHO guidelines, international standards and best practice rules.

This study aims to determine the water typology used for drinking water supply at the Agadir region through the use of central and regional analytical databases available at ONEE, during the period 2003-2015, according to appropriate technical and regulatory context. Mapping the quality water is also prepared using GIS Quality ONEE and/or based on specific software. The area in question is located in the south of Morocco, occupies an area of 139,739 km2 and is characterized by a semi arid to arid climate.

The results of the study in question contributed to the mastery of water quality and served to the manager to:

- Establish a unified analytical database between the central and regional levels.
- have a global status and trends in the quality of water resources,
- better manage and improve the operation of the production units and distribution of drinking water,
- integrate new adequate specific processing operations if necessary
- implement an appropriate action plan for the fight against eutrophication of dam reservoirs mobilized for the production of drinking water.

Key words: Typology, Surface water, Groundwater, Eutrophication, Cartography, GIS Quality, ONEE
NOVEL WETLAND AND WATER BODY CHANGE DETECTION USING MULTI TEMPORAL HYPERSPECTRAL IMAGERY

Mahdi Hasanlou, Seyd Teymoor Seydi

University of Tehran, College of Engineering, School of Surveying and Geospatial Engineering.,
Tehran, Iran

hasanlou@ut.ac.ir, seydi.teymoor@ut.ac.ir

Abstract:

Wetlands and water bodies are transitional lands between terrestrial and aquatic ecosystems that provide many advantages including water quality maintenance, flood water retention, wildlife habitat, and soil erosion control. The Earth has always been under the influence of population growth and human activities. This process causes the changes in land cover type especially in wetlands and water bodies’ area. One best way for monitoring these changes is using remotely sense images. Satellite remote sensing has several advantages for monitoring wetland resources, especially for large geographic areas. Thus, for optimal management of the use of resources like wetlands and water bodies, it is necessary to be aware of these changes. Change detection and attribution of wetlands and water bodies change over time present additional challenges for correctly analyzing remote sensing imagery. In this regards, for better identifying change in multi temporal images we use hyperspectral images. Hyperspectral images currently have potential applications in many scientific areas due to their high spectral resolution and consequently their good information contents. Nevertheless, selecting suitable and adequate features/bands from this data is crucial for any analysis and especially for the change detection algorithms. The objective of this study is to propose procedure for automatic determining land surface changes within semi-arid wetland and surrounding upland areas using genetically band selection based on image algebra change detection algorithms by incorporating EO-1 Hyperion satellite hyperspectral imagery. The study area are Horolazim and Shadegan wetlands in south west of Iran in Khuzestan province. The most critical water resources of the province, are depleted and contain unprecedented levels of toxic waste. The lack of moisture in drying plains allows dust to rise before winds carry it away. In this study we used multi temporal hyperspectral images for monitoring the change occurred in these area. Results of this study showed that by incorporating genetic algorithm procedure for band selection, suitable bands were selected and by using multi ratio index for change detection we can automatically reveal the change maps in wetland and water bodies. Also, the results reveal the superiority of the implemented method to extract change map with overall accuracy by a margin of nearly 85% using multi temporal hyperspectral imagery.

Keywords:
Feature/band selection, genetic algorithm, hyperspectral change detection, image ratio, wetland, water body
STUDY OF THE IMPACT OF THE BREACH OF BOUGOUS DAM ON THE MEXA DAM

Lakhdar DJEMILI
Professor, Department of Hydraulics, Faculty of Engineering, University Badji Mokhtar, Annaba, Algeria
l_djemili@hotmail.com

Hamza BOUCHAHED
PhD Student, National School of Hydraulics Blida, Algeria

Oussama DERDOUS
PhD student, Department of Hydraulics, Faculty of Engineering, University Badji Mokhtar, Annaba, Algeria

Abstract:
The implementation of Bougous dam at 5 km upstream of the Mexa dam is an advantage to compensate capacity and protect the later against sediment transport, but on the other hand, it poses a threat in the event of a possible break.
Indeed, a breaking wave propagation study for the determination of characteristic points downstream of the dam (Mexa Dam and potential items) was performed using the HEC-RAS software. The results of calculations have established cartographic materials showing flood zones and flood the limits of field, very useful information for the authorities.
ASSESSMENT OF SURFACE AND GROUND WATER QUALITY FOR DRINKING AND IRRIGATION USE: A CASE STUDY OF COAL AND LIMESTONE STORAGE AREA, TAMABIL, SYLHET

M. Farhad Howladar and Mubarak Hossen
Department of Petroleum & Mining Engineering, Shahjalal University of Science and Technology, Sylhet-3114, Bangladesh,
E-mail: farhadpme@gmail.com, farhad-pme@sust.edu

Abstract
In this study, the surface and groundwater quality have been analyzed for evaluating drinking and irrigation uses around the coal and limestone storage area, Tamabil, Sylhet. The evaluations of water around the area have been carried out under different methods and techniques. Primarily, the 30 representative samples were collected from various stations to evaluate water chemistry in laboratory then data were presented and justified statistically including correlation coefficient matrix (r). The water classification related diagrams and indices such as Gibbs diagram, Wilcox diagram, US salinity diagram, Doneen’s diagram, TH, Na%, SAR, RSC, MH, PI and Ion-exchange processes were estimated for understanding the suitability of irrigation uses. The results shows that the concentrations of major ions are within the tolerable limit for irrigation and drinking utilization where intensity order of cations and anions concentration are Ca\(^{2+}\) > Na\(^{+}\) > Mg\(^{2+}\) > K\(^{+}\) > Fe\(^{3+}\) and SO\(_4\)\(^{-2}\) > HCO\(_3\) > CO\(_3\) > Cl\(^{-}\), respectively. In addition, intensity contour map clearly shows that the concentrations of all parameters are high at close to coal and limestone storage yard whereas lower concentration observed with increasing distance from the yard. The statistical analysis such standard deviation, deviational coefficient and correlation coefficient shows a usual deviation with good positive correlation among most of the ions of water reflecting homogeneous good-quality water resources around the area. However, the Gibbs diagram suggests the evolution of water chemistry influenced by the contact between rock-water and precipitation dominated processes in the area. The estimated values of TDS, Na\%, EC, SAR, PI, MH, and TH with different diagrams replicate good to permissible limit for agricultural uses of water. The high values of Na\%, EC, KR and MH for some stations restrict its use for agricultural purpose. Thus, this study recommended that the necessary precautions and watchful activity have to be taken to import and store coal and limestone to protect the water from contamination and safe use for present and future.
COMMUNITY DRIVEN INITIATIVE IN WATER SUSTAINABILITY IN ARID REGION OF GUJARAT STATE, INDIA- A STUDY

Pradip Kumar Sengupta
Jadavpur Centre for Study of Earth Science, 356/12 N S C Bose Road, Kolkata 700047, India
sengupta_pradip@yahoo.com

Abstract

The district of Kachchh in the state of Gujarat is one of the most arid regions of India. The difficulties in procuring fresh water is even more pronounced in the Rann, i.e. the salty, marsh land that borders the northern, north western and north eastern Kachchh. Water Management through community driven initiatives has long been recognised as critical for rural water supply services delivery which eventually sustain when appropriate levels of support from government and other entities are provided. Scientific intervention and capacity building of rural community in taking informed decision are the key process-focused social hydrological approach for water sustainability. This paper examines the institutional and organisational arrangements governing water resources management, especially through a social hydrological approaches. In the context of wide social variations “user” and “community” tended to be de-homogenised to accommodate variations arising due to historical legacies, class, caste, gender and occupation. This paper discusses how a natural water crisis in the Kachchh region of Gujarat is being combated through creating community water assets, information centres for community empowerment and appropriate mobilisation of government fund through social initiatives. This paper argues that, in arid and semi arid regions community should be sensitized and encouraged to adapt first to utilization of water as per local availability, evolving water self-reliance through surface and groundwater sharing and management and exploring demand-driven drinking water governance.
Abstract

Daily evapotranspiration is a major component in water resources management plans. In arid ecosystems, the quest for efficient water budget is always hardly to achieved due to insufficient irrigational water and high evapotranspiration rates. Therefore, monitoring of daily evapotranspiration is a keystone practice for sustainable water resources management especially in arid environments. Remote Sensing Techniques offered a great help to estimate the daily evapotranspiration in a regional scale. Existing open source algorithms proved to estimate daily evapotranspiration in arid environments comprehensively. The only deficiency of these algorithms is course scale of the used remote sensing data. Consequently, adequate downscaling algorithm is a compulsory step to rationalize an effective water resources management plans. Daily evapotranspiration was fairly estimated using AATSR in conjunction with MERIS data acquired in April 2015 with one kilometer spatial resolution and 3 days temporal resolution under SEBS model. Output thematic map was then resampled to match OLI data spatially enhanced to 15 meter resolution acquired in April 2015, then adjusted with downscaling algorithm. Spatially enhanced OLI data was used to estimate daily evapotranspiration through NDVI adjustments. OLI results were validated against reference evapotranspiration ground truth values using standardized Penman-Monteith method with $R^2$ of 0.879. Linear regression was established between estimated daily evapotranspiration values conducted from AATSR and OLI respectively with $R^2$ of 0.819. The findings of the current research are successfully fulfilled to downscale daily evapotranspiration values estimated from AATSR data into fine spatial resolution of OLI data and with temporal resolution of 3 days only. Research verdicts are necessary inputs for well informed decision making process regarding sustainable water resources management.

Keywords: Arid Environments, AATSR data, MERIS data, OLI data, Remote Sensing, SEBS, Water Resources Management.
MANAGEMENT CHALLENGES OF EMANATING LEACHATE FROM MOROCCAN MSW, THROUGH THE STUDY OF SEASONS EFFECT ON THESE FLOW'S VARIATION AT THE LANDFILL SITE OF OUJDA CITY (EASTERN MOROCCO).

Mourad ARABI\textsuperscript{1,2}, Houda BOUZIANE\textsuperscript{1,2}, Mohammed SBAA\textsuperscript{1,2}

\texttt{mourad.arabi.svi@gmail.com, h.bouziane@ump.ma, mohsbaa@yahoo.fr}

\textsuperscript{1} - Oriental Centre of Water Sciences and Technologies for (COSTE)

\textsuperscript{2} - Water, Environment and Ecology Sciences Laboratory (LS3E). Department of Biology, Faculty of Sciences, Mohammed Premier University - Oujda.

ABSTRACT:

Population growth and socio economic development of MOROCCO have pushed the production rate of solid wastes to very large values. Indeed, this production is a daily average of 0.75kg/person/Day, representing a nationally annual production equal to 10.925 Tons/day. These waste streams rich in organic matter and water continue to create difficulties in biogas extraction optimization and leachate treatment.

As an historical turning point in the field of integrated management of solid waste, the opening of landfill site of Oujda city saw light in 2005. Thus, the flow of waste received at the landfill site, has reached 138,000 tons during 2014. As for volumes of leachate, the Landfill Site generates a daily average of 126.32 m\textsuperscript{3} of leachate, and produces average annual volume into biogas which is estimated at over 10 million Nm\textsuperscript{3}, with minimal fraction of 56\% methane gas.

This study aims to characterize the solid waste of the Oujda city along the four seasons of the year, and to calculate the flow of leachate products using leaching columns.

This information is of critical importance for the sustainable management of the biogas pumping and leachate at the landfill center of the city of Oujda.

Keywords: Municipal solid waste, leachate, biogas, valorization, treatment, columns.
GROUNDWATER UPWELLING IN THE OASIS OF OUARGLA

Sofiane SAGGAİ1,2, OumElkheir BACHI3,
1Laboratory of Exploitation and Valorization of Natural Resources in Arid Zones (EVRNZA). University KasdiMerbah Ouargla, Algeria
2Laboratory of Water and Environment Engineering in Saharan Milieu (GEEMS). University KasdiMerbah Ouargla, Algeria
3Laboratory of Saharan Bio-Resources: preservation and valorization (BRS). University KasdiMerbah Ouargla, Algeria

E-mail of corresponding author: sofianeaero@yahoo.fr & saggai.so@univ-ouargla.dz

Abstract

Oases were always symbols of rare and precious water management. Ingenuity of techniques and complexity of social orders prove it. For a long time, the Saharan people learnt to manage the shortage. However, the discovery of the deep aquifers in Sahara during hydrocarbon prospecting in the second half of the twentieth century and modern techniques upset many hydric resources in arid areas. This raised the emergency of new issue in numerous oases nowadays. This issue is paradoxically related to excess of water and the bad control of this water, which become plentiful.

In the oasis of Ouargla, which is one of urban conglomerations of Algerian Sahara. In this region, there is phenomenon of bad exploitation and/or overexploitation of continental intercalary deep aquifers and complex terminal deep aquifers that contain waters of bad quality (salty and hot). This phenomenon combines with the discharge of drained waters, urban residual waters and non-treated industrial waters are together responsible, of the degradation in the water quality coming from groundwater and its upwelling. This situation has led to: (i) the degradation of the palm grove, (ii) the deterioration of houses, and iii) the deterioration of the environment.

The present paper gives in detail the causes of the upwelling of the groundwater in this region, the quality of waters of this groundwater and the consequences of this phenomenon, with an exposure of some solutions envisaged and/or adopted to remedy this problem.

Key words: upwelling, groundwater, water quality, deep aquifers, Oasis, Ouargla.
AGRICULTURAL WATER DEMAND AND USE MANAGEMENT IN THE ARID AREAS: LESSONS LEARNT FROM IRAN

Nader Heydari
Associate Professor, Irrigation and Drainage Department, Iranian Agricultural Engineering Research Institute (AERI), P.O.Box 31585-845, Karaj, Iran.
Email: nrheydari@yahoo.com

Abstract

Water scarcity in the world, especially in the arid to semi-arid regions e.g. Iran country, is a main challenging issue considering supply of water require for agricultural production and supply of food for the growing population. In recent decade increase in water demand and use because of population growth, and shortfalls in precipitation because of climate change is becoming a critical issue of the Iran country. Its adverse impacts are evident from continuously depletion of ground water, soil and water salinity, and other environmental hazards, e.g. drying of rivers, wetlands, and natural lakes. However the government and scientific body of the nation in the water and agriculture related sectors are attempting to overcome to this challenge. Many executive actions, research studies, and policies and strategies are set in this regard. Some activities were relatively effective. However despite many efforts there are still many weak points, gaps, and other issues and actions which should be continued or monitored in future. This paper provides a vision from the situation of water management and water productivity in Iran, as an arid country, and discusses the main problems, challenges, and measures in regard to water management in this country. It also elaborates the plans and actions which are conducted to overcome water shortage problems e.g., efficient use of water and improving agricultural water productivity (WP) in the country. At last it provides some experiences, and key measures of water demand and use management in Iran (both in hardware and software aspects), as experiences and lessons learnt for other similar countries in the arid regions.

Keywords: Water Demand, Water Use, Agriculture, Arid areas, Iran
GEOSAWIS, A GEOPLATFORM FOR SHARING WATER DATA, BETWEEN RESEARCHERS AND ADMINISTRATIONS

Aniss MOUMEN (1, *), Narjiss SATOUR (2), Mohamed EL BOUHADIOUI (1), Mohamed BEN-DAOUD (3), Mohamed NEHMADOU (4), Abdelaziz HIMOUDI (2), Fouad NAFIS (5)

1 Department of Geology, Faculty of Sciences, Ibn Tofail University, Kenitra, Morocco
2 Department of Geology, Faculty of Sciences, University Mohamed V, Rabat, Morocco
3 Department of Biology, Faculty of Sciences, Moulay Ismail University, Meknes, Morocco
4 Department of Geology, Faculty of Sciences, Ibn Zohr University, Agadir, Morocco
5 Mohammadia School of Engineers, University Mohamed V, Rabat, Morocco

(* Email: amoumen@gmail.com)

Abstract:
In Morocco, the 2011 constitution define the right of “Freedom Access to public Information” to all citizens. This is a very important evolution which can have a positive impact to scientific research progress. However, pending the adoption of the 31-13 bill which defines how citizens can exercise this right. Morocco will face a second obstacle, how can we allow access to this information when without a mechanism to archive, store, and document, make available, distribute and share this information? Then, how can we ensure the reuse of such data by users?

The National Water Information System in Morocco is still in project phase since 1995. This system provides the creation of a common database between different stakeholders by interconnecting internal databases at each administration, in 2015 version of water bill, we find a chapter about “Water Information System” that institutionalized this vision. For researchers, NWIS project provides an opening to use water data produced by administration, which are an important recognition and a contribution to scientific research in Morocco.

In this work we present a geospatial prototype for sharing and reuse water data and metadata, between scientific community and Water Department. We present all possible use case, conceptual diagrams, various scenarios and real results. This prototype is resulting from cooperation with Water Department and Scientific Association for Water Information Systems (SAWIS).

Key words: Water data, Metadata, OGC Standards, Web Services, Morocco.

Acknowledgements:
This work is a result of a partnership between Moroccan Water Delegate Minister and SAWIS association. The authors thank all partners and users.
GEOLOGICAL ASSESSMENT OF WATER-BASED TOURISM IN JELI DISTRICT, KELANTAN, MALAYSIA

Dony Adriansyah Nazaruddin1*, Sofea Rasheeqa Fazil1, Zurfarahin Zulkarnain1, Kausilia Raman1, Muhammad Muqtada Ali Khan1

1Geoscience Programme, Faculty of Earth Science, Universiti Malaysia Kelantan, UMK Jeli Campus, Locked Bag No.100, 17600 Jeli, Kelantan, Malaysia
E-mail of corresponding author: dony_geology@yahoo.com.my

ABSTRACT

Water-based tourism is an important part of nature-based tourism, and its features vary from one site to others. Jeli district in the state of Kelantan, Malaysia, is rich of water resources with attractive geological and geomorphological features such as lake, river, waterfall, and hot spring. This study discusses the geological assessment of potential water-based tourism sites in the district, by selecting four (4) destinations i.e. Pergau Lake, Jeli Hot Spring, Rual River, and Lata Renyok Waterfall as case studies. Geological mapping and in-situ water quality measurements in these sites have been conducted in mid of 2014 (June – July 2014, during the dry season). These sites contain some interesting geological and geomorphological features such as granitic mountainous and hilly areas (in Pergau Lake), exotic hot water spring in a small valley (in Jeli Hot Spring), beautiful landscape and features of a river valley (in Rual River), and wonderful cascading waterfall in the alternating bright and dark-coloured rocks (in Lata Renyok Waterfall). In the assessment, these sites have some geodiversity values: scientific (and educational), aesthetic, recreational, cultural, economic, and functional values. The in-situ water quality analysis shows that these sites have different water quality classes based on the Interim National Water Quality Standard (INWQS) for Malaysia i.e. Class I for Lata Renyok Waterfall, Class III for Rual River, and Class IV for Pergau Lake and Jeli Hot Spring. All localities are potential water-based tourism attractions in the district which have some specific tourism and recreational activities e.g. swimming and bathing (in Lata Renyok Waterfall and Rual River), fishing (in Lata Renyok Waterfall, Rual River, and Pergau Lake), rafting, boating, and kayaking/canoeing (in Pergau Lake), and hot water therapy and skin treatment (in Jeli Hot Spring). It is recommended that all these localities should be conserved and developed properly as a model of sustainable water-based tourism destinations in Malaysia.

Keywords: Geological assessment, water-based tourism, geodiversity values, water quality analysis, Jeli district.

Acknowledgements:

The authors would like to appreciate the local authority (Jeli District Council), local communities as well as visitors in Jeli district for their great cooperation during conducting this research.
USSING THE SOIL AND WATER ASSESMENT TOOL (SWAT) TO ASSESS LAND USE IMPACT ON WATER RESOURCES IN SEMI ARID BASIN OF YELLOW RIVER, CHINA

Muhammad Saifullah a,*, Zhijia Li a, Qiaoling Li a, Sarfraz Hashim a and Muhammad Zaman b

a College of Hydrology and Water Resources, Hohai University, Nanjing 210098, China
b College of Hydraulics and Hydropower engineering, Hohai University, Nanjing 210098, China
* Corresponding author: College of Hydrology and Water resources, Hohai University, Nanjing 210098, China.
E-mail address: saif@hhu.edu.cn

Abstract

Climate and land use changes are the two primary factors that affect basin hydrology, and thus estimation of their impact is of great importance for sustainable development at a catchment scale. In this study, we investigated the long term changes in precipitation, evapotranspiration and runoff, from 1981-2011 in the semi-arid basin of the Yellow river by Mann-Kendall test. In a case study, hydrologic modeling was conducted using land use maps from three time period (1990, 2000 and 2010) for the semi-arid basin (2856 km²) in China using the Soil and Water Assessment Tool (SWAT), changes in streamflow across three simulation conducting the land use maps from 2011 to 1981 were found to related land use changes. The major land use changes that affected the water resources of semi-arid basin area were related to the farmland, forest and urban area during 1981 to 2010. The SWAT model was calibrated and validated on annual and monthly time scale. The Ens and R² were greater than 0.75. The curve number increased due to urbanization. Land use changes have negative impact for the ecological health of the river system.

Acknowledgements
The study was supported by Higher Education commission of Pakistan; the special program for scholars for Engineering Faculty Development. The author would also thanks for positive suggestions from reviewers and editors.

Gowhar Meraj 1,2 and Shakil A. Romshoo 1

1Department of Earth Sciences, University of Kashmir, Hazratbal Srinagar Kashmir, Jammu and Kashmir, India 190006
2Department of Environmental Science, University of Kashmir, Hazratbal Srinagar Kashmir, Jammu and Kashmir, India 190006

E-mail of corresponding author: gowharmeraj@gmail.com

Abstract
September 2014 floods in the Kashmir valley spread huge devastation in every living corner of the region. The magnitude of this event crossed all bounds of the recorded history of floods in the region in terms of discharge as well as loss of life and property. The event generated a scientific consensus for an alarming need of a robust flood mitigation strategy for the Kashmir region. In the present work, we have tried to assess the peak of concentration or basin lag time of the 24 watersheds of the Jhelum basin by analysing their quantitative morphometric indices and land cover information both derived from satellite imagery. Using analytical hierarchical process (AHP) based multicriteria analysis we prioritized the watersheds of the Jhelum basin into four categories: low, medium, high and very high depending upon their runoff characteristics. The results revealed that Madhumati, Sind, Arin and Lidder watersheds of the Jhelum basin have very small basin lag times that make them the fastest discharge loading watersheds of the basin. We finally propose construction of hydraulic structures, such as piano key weirs that have established efficacy in extending the peak concentration, in these watersheds, so that in the eventuality of any future extreme weather phenomenon over Jhelum basin, water does not rush at once into the river as was witnessed in the southern watersheds of the Jhelum basin during the September 2014 floods.

Acknowledgements:
This research work has been accomplished under a research grant provided by the Department of Science and Technology, Government of India (DST-GOI) for the project titled “Integrated Flood vulnerability Assessment for Flood Risk Management and Disaster Mitigation”. The authors express their gratitude to the funding agency for the financial assistance.
ASSESSMENT OF DEPENDENCY AND PEOPLE PERCEPTION ON PIPED WATER SUPPLY AROUND A DUMPSITE

T. K. Padmini *, K. Parameswari **
* **Department of Civil Engineering, Sathyabama University, Chennai, India
e-mail: padminitk@gmail.com

Abstract
The groundwater resources of many cities are rendered unfit as a result of contamination both from point and non-point sources. Point sources of groundwater contamination include accidental spills, dumpsites, underground storage tanks and radioactive waste disposal sites. Presently piped water supply is a major source of water supply in urban and peri – urban areas to satisfy the basic needs of middle and lower socio economic status groups. Perungudi is one of the largest dumpsite and it is surrounded by mainly two villages Perungudi and Okkium Thuraipakkam which are reported to be contaminated. As the groundwater is unfit for drinking purpose these villages mainly depends on piped water supply. Hence this study aims to assess the percentage dependency of piped water supply, people perceptions on piped water quality, its availability and precautionary measures for the usage of drinking purpose. The study data is based on socio economic status and distance from the dumpsite. The interview schedule has been conducted in the study villages based on the socio economic status such as low, middle and high along with the distance from the dumpsite and the data has been analyzed using SPSS software. As a finding, management measures have been suggested for a better living standard of the people.
Abstract
Within semi-arid Mediterranean agrosystems with smallholdings, such as the Lebna catchment in northeastern Tunisia, actual and sustainable uses of water and soil resources are driven by multiple factors including cropping systems and livestock production. The efficient use of water resources, the improvement of agricultural productivity and the preservation of soil resources require innovative strategies from the field to the governance territory scales. This paper attempts to characterize farmers' strategies for cropping system management, by analyzing land use and crops rotation.

The study has been conducted over the Lebna catchment that is typified by (1) hilly topography and rainfed / traditional agriculture, and (2) a network of hill reservoirs along with a dam at the outlet. We conducted interviews with farmers about land use diversity and structures, by considering 20 farms. We characterized field boundaries and farm extensions with global positioning system data. We also gathered outcomes from previous geological and soil surveys to produce a digital elevation model and a soil map. All these observations were gathered within a geographical information system (GIS).

Data analysis provided the following outcomes. First, crops are mainly located within plains and valleys, whereas pastures and shrubs are established over steep and shallow soils. Second, the cropping dominant pattern (e.g., wheat) is regularly distributed, whereas the cropping sub-patterns (legumes, fodder) are irregularly distributed. Third, farmer criteria for crop repartition are related to (1) the land cropping suitability (e.g., slope and soil depth are considered as important physical factors), (2) the impact of the neighborhood (in accordance to grazing opportunities, tillage and harvest work) and (3) the rules of crop sequences.

This exploratory study will help in a close future to establish indicators that enable the mapping of land use and crop successions at the catchment scale.

Acknowledgements: Financial support for this study was provided by the ANR TRANSMED project « Adapting Landscape Mosaics of Mediterranean Rainfed Agrosystems for a sustainable management of crop production, water and soil resources: the ALMIRA project ».
ENVIRONMENTAL AND SOCIOECONOMIC ISSUES OF GROUNDWATER OVERUSE: THE CASE OF HAOUARIA REGION IN TUNISIA

Mekki I. a*, Ghazouani W.b, Closas A.b, Amami H.a, Molle F.b
a Institut National de Recherche en Génie Rural, Eaux et Forêts, B.P. 10, Rue Hedi Karray, 2080 Ariana, Tunisia
b International Water Management Institute, c/o ICARDA, P.O.Box 2416, Cairo, Egypt
*E-mail of corresponding author: insaf.mekki@laposte.net

Abstract

Avoiding the negative effects of the intensive use of groundwater resources is challenging, especially when the interactions and feedback mechanisms between biophysical and socioeconomic processes are complex and also users, management, and regulatory bodies are spatially and administratively distributed. The plain of Haouaria, characterized by a semi-arid climate in Northeastern Tunisia, has known an important development of groundwater abstraction, favored by the multiplication of pumping accessing the underlying shallow and deep aquifers. As the economic activities linked to such development are threatened by the degradation of groundwater resources, the aim of this paper is to analyze the current situation of groundwater resources of the plain of Haouaria. By adopting a multi-actor analysis, the study built on semi-directive surveys with the various groundwater users and archive data in order to understand the technical, institutional and agricultural practices driving groundwater development. The paper starts by setting up the historical context of groundwater development and consequently the main adaptations of the various users to the dynamic evolution of the water resources. Then, the paper identifies the main constraints and responses across actors (public and private) to better understand the interactions between water resources and human activities. This analysis enables the understanding of the reciprocal effects between water resources and actors and distinguishes patterns of behaviour, their divergent interests and perceptions of the resource. The results showed the impact of market crops (mainly tomato and potato) and the forest south of the plain on the degradation of resources. The results also showed the limitations posed by the lack of collective actions observed among farmers, the insecurity of land tenure and the shortage of workforce in the fields but also the cost of energy use for water pumping. To finalize, the paper explores some management options that can lead to a more environmentally and socioeconomically sustainable system formed by the aquifers and all the actors.

Acknowledgements: Financial support for this study was provided by the USAID-funded regional project « Groundwater Governance in the Arab World: Taking Stock and Addressing the Challenges ».
FEASIBILITY OF MANAGED AQUIFER RECHARGE IN MANAGING A COASTAL AQUIFER FOR URBAN PURPOSES: CASE STUDY OF SAMAIL LOWER CATCHMENT AQUIFER, OMAN

Ali Al-Maktoumi1, Mustafa El-Rawy2 and Slim Zekri1, Osman Abdalla1
1Sultan Qaboos University, P.O.BOX 34, Alkhoud 123 Muscat, Oman
2Faculty of Engineering, Minia University, Minia 61111, Egypt

Corresponding author: ali.almaktoumi10@gmail.com

Abstract
Most of the water stressed countries such as the Sultanate of Oman are vulnerable to the potential adverse impacts of climate change, the most significant of which are increased average temperatures, less and more erratic precipitation, sea level rise, and desertification. The combined effect of existing adverse conditions and likely impacts of future climate change will make water management even more difficult than what it is today. Managed Aquifer Recharge (MAR) is practiced widely to store water during periods of surpluses and withdraw during deficits from an aquifer. In Muscat, there will be a surplus of >100,000 m3/day of treated waste water (TWW) during winter months in the coming few years. The aquifer along the northern coast of Oman (Lower Samail Catchment) is conducive for MAR. Data show that TWW volumes will increase from 7.6 Mm3 in 2003 to 70.9 Mm3 in 2035 in Muscat only.

This work assesses, using MODFLOW 2005 numerical code, the impact of MAR using treated wastewater on better management of the unconfined coastal aquifer of Samail Lower Catchment (SLC)-Oman, for better urban water supply. Specifically, aiming to maximize withdrawals from the domestic wells with minimize salt water intrusion. The model operates with a number of constrains that minimize the loss to the sea and injected water must not reach the captured zone of urban supply wells. The injection wells located downstream the domestic well-field zone. The results of different managerial scenarios show that MAR produces a hydraulic barrier that decelerates the seawater intrusion which allows higher abstraction of water from the aquifer for urban supply. MAR along with redistribution/relocation of public wells allows abstraction of 2 times the current abstraction rate (around 6 Mm3/year to 12 Mm3/year) without significantly deteriorating the aquifer water quality. This means that MAR would increase the capacity of the aquifer to respond to further stresses during emergency events where larger volume of water is needed.

Keywords: Managed Aquifer Recharge, Oman, Climate Change, Treated Effluent, MODFLOW 2005.

Acknowledgements:
This study was supported by a grant from USAID-FABRI, project contract: AID-OAA-TO-11-00049 (project code:1001626 – 104). Authors also acknowledge support from Sultan Qaboos University, Oman.
Carbon-based fluorescent nanoparticle for Groundwater recharge

CSIR-National Geophysical Research Institute
Uppal Road, Hyderabad  500 007
Taufique warsi, V.Satish kumar, R.Rangarajan, Rama Ranjan Bhattacharjee, D. Murlidharan
Email: taufiquewarsi@gmail.com, Ph: +91 40 2701 2602

Abstract
Carbon –based nanoparticles have been widely used due to their small size and unique physical and chemical properties. In order to use Carbon based Nano-particle as a tracer number of lab experiments has been carried out, to conduct this experiment variable size of PVC pipes and different types of soil has taken and Leachates measurements of Tritium and Nano particle were collected for further analysis. Using the Liquid scintillation counter and Fluorescence spectrometer, counting of Tritium and fluorescence of Nano tracer was taken respectively, Experiment was carried out very precisely for continuous sample collection. After processing and analysing both Tritium and Nano tracer it’s been proved that both the peaks are coming almost at the same time. These Nano tracers are designed in a manner that they don’t stick with soil, don’t have hydrophobic properties and can be measured in very minute amount up to ppm and ppb, so the successful experiment gave a very effective alternate tracer for groundwater recharge and detection of subsurface micro fracture and major fracture, whereas piston flow Tritium method is only valid for soft rock and weathered zone in hard rock, Tritium is unable to detect fractures. So Nano tracer is very much advantageous over Tritium and can be widely used for Groundwater purposes.

Key words: Nano tracer, Tritium, fluorescent, Groundwater.
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Health Risk Assessment Of Heavy Metals In Groundwater Of Hyderabad District, Sindh- Pakistan</td>
<td>363</td>
</tr>
<tr>
<td>2</td>
<td>Chemical Assessment of Abandoned Hakra River on Quality of Groundwater in Thar Desert, Sindh</td>
<td>364</td>
</tr>
<tr>
<td>3</td>
<td>Correlation Of Chemical Quality Of Water Bodies In Aridzone, Sindh-Pakistan</td>
<td>365</td>
</tr>
<tr>
<td>4</td>
<td>Assessment Of Water Scarcity In Libya</td>
<td>366</td>
</tr>
<tr>
<td>5</td>
<td>Irrigation Water Pricing, Cost Recovery, And Farm Surplus.</td>
<td>367</td>
</tr>
<tr>
<td>6</td>
<td>Evaluation Of Subsurface Drip Irrigation System For Date Palm Trees</td>
<td>368</td>
</tr>
<tr>
<td>7</td>
<td>Groundwater Depletion In North Africa Desert Adopted Form Space Gravimetry And Hydrological Models</td>
<td>369</td>
</tr>
<tr>
<td>8</td>
<td>Assessment of Crop Water Requirement for Sugar Cane Using GIS and Remote Sensing Techniques</td>
<td>370</td>
</tr>
<tr>
<td>9</td>
<td>Water Consumption Patterns In Eastern Uae</td>
<td>371</td>
</tr>
<tr>
<td>10</td>
<td>Groundwater Quality And Its Suitability For Domestic And Agricultural Use In Upper Plain Of Cheliff, Algeria</td>
<td>372</td>
</tr>
<tr>
<td>11</td>
<td>The Role of Supplementary Irrigation for Food Production in a Semi-Arid Country Palestine</td>
<td>373</td>
</tr>
<tr>
<td>12</td>
<td>Agricultural Water Use In The Us, Climate Smart Agriculture And Technologies For Adaptations To Water Deficits</td>
<td>375</td>
</tr>
<tr>
<td>13</td>
<td>Energy Water Relationship in the GCC Countries</td>
<td>376</td>
</tr>
<tr>
<td>14</td>
<td>Tracking agricultural land-use changes in the Lake Urmia basin using multi-temporal multi-spectral Landsat imageries</td>
<td>377</td>
</tr>
<tr>
<td>15</td>
<td>Groundwater-Energy Nexus In Oman</td>
<td>378</td>
</tr>
<tr>
<td>16</td>
<td>A New Comprehensive Environmental Method to Evaluate Water Quantity Factor of Tehran Megacity</td>
<td>379</td>
</tr>
<tr>
<td>17</td>
<td>Application of magnetic water technology, a novel tool for improving chick-pea crop productivity and water use efficiency in newly reclaimed sandy soil</td>
<td>380</td>
</tr>
<tr>
<td>18</td>
<td>On-Farm Water Management using Remote Sensing and GIS Techniques</td>
<td>381</td>
</tr>
<tr>
<td>19</td>
<td>Fuzzy Logic, Kalman Filter And Box Jenkins Techniques For Monthly Streamflows Predictio In Northern Algeria</td>
<td>382</td>
</tr>
<tr>
<td>20</td>
<td>Cartographic And Hydrological Study Of The Watershed Of Medjerda Through The Satellite Images For Ends Of Spatialized Hydrological Modeling</td>
<td>383</td>
</tr>
<tr>
<td>21</td>
<td>Hydrological Modeling Of Sediment Transport In The Semi-Arid Region, Case Of Soubella Watershed In Algeria</td>
<td>384</td>
</tr>
<tr>
<td>22</td>
<td>Third Nail On The Cross: A Study On River-Response To Bridge Construction Over The River Jalangi, West Bengal, India</td>
<td>385</td>
</tr>
<tr>
<td>23</td>
<td>Overcoming Water Scarcity In South Australia</td>
<td>386</td>
</tr>
</tbody>
</table>
Abstract

A systematic study was carried out to examine the characteristics in quality of groundwater of Hyderabad district. The field study was carried out with the collection of total of 96 samples during 2011 to 2012. The object of current study was to examine the heavy metals Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn, Fe, and As concentration in Hyderabad Rural, Hyderabad city. The study examined the potential health risk to population caused by consumption of heavy metals. The health risk assessment, chronic daily intake (CDI) and hazard quotient (HQ) were calculated on the bases of heavy metal concentration. The CDI observed in decreasing order of Hyderabad rural for metal contents Fe > Zn > Mn > Cu > Ni > Pb > Cd > Cr > Co > As; in the samples of Hyderabad city Fe > Mn > Zn > Cr > Ni > Co > Pb > Cu > Cd > As; and reference water (RfW) Fe > Zn > Cr > Cd > Pb > Ni > Co > As. The HQ indices of Hyderabad rural observed in decreasing order for metal ions Cd > Co > Cu > Ni > Fe > Pb > Mn > Zn > As > Cr and Hyderabad city Co > Cd > Ni > Mn > Zn > Pb > Cu > Fe > Cr > As. The results indicated health risk on consumption of the groundwater.
Chemical Assessment of Abandoned Hakra River on Quality of Groundwater in Thar Desert, Sindh

Institute of Advanced Research Studies in Chemical Sciences (IARSCS/HTCRL), University of Sindh, Jamshoro
*Corresponding Author: tmj.iarscs@usindh.edu.pk

Abstract
Present studies focused on chemical quality of groundwater in prehistoric flows of Hakra river in desert of Tharparkar district, Sindh-Pakistan. The samples more than 1000 were collected from wells, handpumps, borewell were analyzed for water temperature, electrical conductance, TDS, salinity and pH and major cations (Ca$^{2+}$, Mg$^{2+}$, K$^+$, Na$^+$) and anions (Cl$^-$, HCO$_3^-$, SO$_4^{2-}$) by electric probe, flame atomic absorption spectroscopy, uv/visible spectrometric and volumetric methods. The order of relative abundance was detected for major cations was Na$^+$ > Ca$^{2+}$ > Mg$^{2+}$ > K$^+$ and anions Cl$^-$ > HCO$_3^-$ > SO$_4^{2-}$. The values of positive correlation in the number of pairs showed the origin of transport from same lithology. The factor analysis (FA) was applied to water quality and the first two factors identified were responsible for approximately 80% of total variance. The hierarchical cluster analysis was made using the ward method for group relationship and Pearson correlation coefficient derived for parametric relationship, percent sodium (% Sodium), Langelier saturation index (LSI), sodium adsorption ratio (SAR), residual sodium carbonate (RSC), and permeability index (PI) were made for quality of data and identifying the suitability of water for drinking, industrial and agricultural purposes. The residual sodium carbonate and sodium adsorption ratio indicated for more than 30% water were suitable for irrigation purposes. The groundwater showed spatial variations among physico-chemical parameters and results were compared with WHO guidelines for drinking water.
CORRELATION OF CHEMICAL QUALITY OF WATER BODIES IN ARIDZONE, SINDH-PAKISTAN

T.M.Jahangir*, A.A. Khaskheli, M.Y.Khuhawar
Institute of Advanced Research Studies in Chemical Sciences (IARSCS/HTCRL), University of Sindh, Jamshoro
*Corresponding Author: tmj.iarscs@usindh.edu.pk

Abstract

This work is the beginning of correlating the springs water with groundwater of adjoining areas. The water of springs submerged at high tide, approximately 3.6m³/hour of springs water intermixing seawater. Management needs the water quality could be exploited for agriculture, fishing and small industry. The chemical assessment was carried for the year with four seasons. In view of electrical conductance springs, groundwater (n=83) and the sea water ranged between 5280-5830, 694-7660 and 50300-55000 µs/cm respectively.

Water quality correlates 14 groundwater with 2 springs by electrical conductance. The quality of water compared with field electrical conductance and estimation of total ion strength through speciation of common ion contents in water. Statistically significant differences among water quality parameters are discussed.

Water quality of three bodies exhibited for different variables ranged for temperature 28-30.6°C, ORP -65.1 - +119.8 mv, dissolved oxygen 0.45- 8.3 mg/L, pH 6.81-8.4, total dissolved solids 340-3761mg/L, salinity 0.3-4.2g/L, chlorides 80-1245mg/L, Sulphate 40-350 mg/L, nitrate 0.12- 11.7 mg/L, total phosphate 0.04-8.72 mg/L, alkalinity 48-450 mg/L. Hardness 140-800 mg/L, Na 53-487 mg/L, K 10-194 mg/L, Ca 39-450 mg/L, Mg 21-250 mg/L, Fe 0.07-3.2 mg/L, Cu 0.008-0.094 mg/L and Mn 0.002-0.09 mg/L. The majority of samples (approx. 55%) crossed the WHO permissible limits for drinking water.
ASSESSMENT OF WATER SCARCITY IN LIBYA

Imbayyah Alwirfili
Tripoli University, Ain Zara, Tripoli, Libya
Imbayyah@gmail.com

Abstract
Considers Libya from most countries of the world lack in water resources where Libya within the dry and semi-dry climate and rainfall estimated 56 mm/yr and there are no sources of surface water like rivers and lakes. Libya relies nearly 95% on groundwater and more than 80% of those waters non-renewable. It will be using the indicator "Falkenmark" to assess the extent of water scarcity in the country is perhaps the most widely used measure of water stress. By estimating the sources of supply and available water.

Lies the importance of water estimates to know to what extent the attrition of the solutions in terms of policy-making integrated water and create and develop sustainable water sources.

Privet research, graduate research in Tripoli University
Irrigation water pricing, cost recovery, and farm surplus.
Abdelhafidh H.\textsuperscript{1}; Bachta M.S.\textsuperscript{2}; Zaibet L.\textsuperscript{2}

1. Ecole supérieure d’Agriculture de Mograne
2. Instutut National d’Agromie de Tunis.

Abstract
Tunisia has invested heavily in irrigation schemes to secure and increase agriculture water supply. The management of irrigation systems is provided by the local users associations (GDA). These GDA assimilated to a natural monopoly and made water available to farmers at operational cost (marginal cost). The water price does not allow the budgetary balance and lead to a chronic deficit. In addition, it does not reflect the scarcity of the resource to the users. Low water prices contributed to irrigated area extension, agricultural water demand increase, and misallocation of the resource among users and uses. Low cost recovery and poor maintenance caused infrastructure deterioration and low water distribution efficiency and irrigation performance.

This water pricing scheme reached its limits to ensure adequate financial balance and to control water demand. The purpose of this paper was to identify a new irrigated water pricing system which ensure the maximization of social welfare and the GDA budgetary balance. To achieve this goal, we supposed that irrigated water price increase will be necessary. The question was how and by how much the tariff will be increased? and what will be the impact of pricing reforms on farmers surplus?

We have estimated the peak and the peak off irrigated demand functions (respectively for dry and wet seasons) in the first time, and the total water cost functions for irrigation in second time. Then we maximised the social surplus given a budget equilibrium constraint.

The main results show that water price elasticity of irrigation water are respectively -0.3 and -0.59 for the peak and peak-off demand. In wet season the deviations of water price from the operational cost range from 11 to 15% and the prices range from 0.1 to 0.135DT/m\textsuperscript{3}. In dry season the price markup range from 50 to 75% and prices range from 0.125 to 0.254 DT/m\textsuperscript{3}.

On the other side the farms surplus has decreased by 8% and the gain in budget balance exceeds the farms surplus decrease by 16%. The COFP (the opportunity cost of public funds) in the case of subziding the GDAs was 8%.

The global demand has decreased by 11% to move from 836174 to 745700 m\textsuperscript{3}/year. This decrease is the result of an increase of the peak-off demand by 93% and a decrease of the peak demand by 24%.

Key words: irrigation water pricing, demand function, cost function, Tunisia, ground water resources, budgetary balance, surplus, elasticity.
EVALUATION OF SUBSURFACE DRIP IRRIGATION SYSTEM FOR DATE PALM TREES

Hamdan Al-Wahaibi, Hamed Al-Kasbi, Zaher Al-Salmani and Badria Al-Hosni
Ministry of Agriculture and Fisheries
Directorate General of Agriculture and Livestock Research, Oman
hamdanssw@hotmail.com

Abstract
Date palm represents about 80% of the total area cultivated by fruit trees in Oman. There are about 8.5 Million date palm trees and the majority are irrigated using flood irrigation and less than 10% are irrigated by bubbler irrigation system. These irrigation methods need an evaluation in terms of water productivity in comparison with other irrigation systems such as drip and subsurface system. Subsurface drip irrigation (SDI) has been proved as a water saving method that increase both crop production and water-use efficiency (WUE). The objectives of the experiment were to study the effect of irrigation systems and different irrigation regimes on the date palm production and water use efficiency. The experiment was conducted in 2013 in Al-Kamil Research Station, Al'Sharqiya region. It consists of four irrigation treatments with three replications each of 3 date palm trees. (Total number of trees was 36). The applied irrigation treatments were (T1: 100 % ETc using bubbler irrigation, T2: 100% ETc using Subsurface drip irrigation, T3: 75 % ETc Subsurface irrigation system, T4: 50 % ETc Subsurface irrigation system). Irrigation scheduling was developed based on crop evapotranspiration (ETc = ETo x Kc), ETo was calculated by Penman-Monteith equation on CROPWAT program using climatic data from Al-Kamil weather station. Crop coefficient was taken to be 0.90 (FAO, 1991). The preliminary results indicated that date palm production was higher at 100% for both bubbler and subsurface drip irrigation systems and it decreased as water quantity reduced to 75% and 50% of ETo. Date palm trees irrigated with 50% of ETo using subsurface drip irrigation system gave the higher water use efficiency.
GROUNDWATER DEPLETION IN NORTH AFRICA DESERT ADOPTED FORM SPACE GRAVIMETRY AND HYDROLOGICAL MODELS

Ashraf rateb1*, Chung-Yen Kuo1, Lei Wang2, Kuo-En Ching1, C.K. Shum3

1Department of Geomatics, National Cheng Kung University, Taiwan amrateb85@gmail.com
2Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, USA
3Division of Geodetic Science, School of Earth Sciences, Ohio State University, USA

Abstract

The Sahara Aquifer System (SAS), one of the largest aquifer systems in the world, is represented by the Nubian aquifer systems in Egypt, Libya, Sudan and Chad and Intracratonic basins (Mesozoic basins) in Libya, Algeria, Tunisia, Mali, and Mauritania. The aquifers recharged during the old climatic wet conditions and maintained the groundwater networks that are now the only fresh water source in this arid zone. Determining the groundwater storage variations and understanding the hydrological cycle in Sahara is a vital task for human resource management. In this study, monthly gravity fields derived from Gravity Recovery and Climate Experiment (GRACE) covering January 2003 to January 2015 were used to estimate the total water storage variations in Sahara. The modeled surface storages are derived from Noah Global Land Data Assimilation System (GLDAS) model covering the same time span of GRACE solutions and is represented by spherical harmonics. In order to reduce the leakage effect and bias errors, a localization method, called Slepian function, approximates the sparsely hydrological aquifer storage variations with merits of localization over the study area by transforming both sets of spherical coefficients into Slepian coefficients. The results show that the groundwater changes in Sahara desert are depleting with a significant rate of \(-0.9 \pm 0.27 \text{ cm/yr}\) and the total depletion is about 15.3621 \(\text{Gt}\) in the time span of the study. The human contributions are the major factor for the depleting groundwater storage in arid zones in general. In this region, the rainfall rate is only 0.5 \(\text{cm/yr}\) that is not highly correlated with the estimated water storage. Consequently, the groundwater storage is not recharged by the rainfall that raise an alarm for the sustainable management of the groundwater extractions in Sharaa countries.
Assessment of Crop Water Requirement for Sugar Cane Using GIS and Remote Sensing Techniques

A.A.HASSABALLA*; M.A.EL-MESBAH; Murtada Satti; Mohammed Merghani; Mohammed Mubarak
University of Khartoum, Faculty of Engineering, Department of Agricultural and Biological engineering, Sudan
E-mail: halimhasbo@gmail.com

Abstract

Crop water requirement (CWR) is considered as the most important and effective task that should be taken into account when scheduling an agricultural schemes. However, the calculation of CWR is very demanding because it encounters the assessment of so much volume of hydrological and environmental parameters such as net radiation, wind speed, air temperature, relative humidity,.....etc. Which makes it very difficult to assess as well as it consumes so much time to cover landscape scale farming. Remote sensing on the other hand became a very effective source for monitoring estimating most of the agricultural and hydrological parameters and environmental conditions as well. The study intended to use one of the most effective remote sensing’s algorithm that is widely used to extract the CWR which is the energy balance algorithm. The extraction of CWR based fundamentally on the assessment of the crop Evapotranspiration (ET). To achieve the extraction of ET using remote sensing techniques (RS), Fifteen images (open-source images) from LANDSAT 8 satellite were acquired from the educational website of the united states geological and survey department (USGS) in order to assess the CWR of the sugarcane at New Halfa factory for the season of 2013-2014. The normalized difference vegetation index (NDVI) and the land surface temperature (Ts) were then extracted from the optical and thermal satellite images. From NDVI and Ts , ET was calculated as a residual of the latent heat flux in mm/day. Finally the CWR (cubic meters/faddan) was calculated for each image pixel taking into account image specification (pixel size) and then compared to the applied CWR in m³/faddan per day from the operational unit in New Halfa's sugar factory. The resultant CWR were found to be 24.685, 26.37, 38.4616, and 26.4213 m³/faddan-day from LANDSAT 8 and 26.685, 42.165, 36.7746 and 28.393 m³/faddan-day from the operational unit throughout January, May, September and December respectively.

In order to validate the applied algorithm, ET data were collected from agricultural meteorology department (Khartoum) in addition to ET calculated from CROPWAT 8 software (Penman-Montieth formula). The estimated ET from LANDSAT 8 were correlated against the aforementioned ET in order to examine the seasonal trend of ET which produced acceptable results.

Acknowledgment

The authors acknowledge the support given by University of Khartoum in pursuing this study. The authors also gratefully acknowledge the assistances provided by both Sudanese Sugar Company and the Agro-meteorological Department (Sudan) for accessing the relevant data sources.
WATER CONSUMPTION PATTERNS IN EASTERN UAE

Mohamed M. Mohamed and Munjed Maraqa
Civil and Environmental Engineering Department, United Arab Emirates University, P.O. Box: 17555, Al-Ain, Abu-Dhabi, UAE.
Email: m.mohamed@uaeu.ac.ae; Phone: +971-3-7135163

Abstract:
Desalination is the main source of drinking water in Abu Dhabi Emirate. Yet, the emirate has a high per capita water consumption rate that exceeds similar rate values in many developed countries. While the high rate of water consumption is recognized in the Emirate, factors that contribute to this high rate are not well-defined. Identification of these factors and their contribution will assist in setting plans for water conservation and thus better water management. This is necessary for the Emirate, and the country as a whole, for sustainable resources development. In this paper, we conducted an in-depth investigation of the factors that affect the bulk and domestic rate of water consumption in Al-Ain city; the second major city in Abu Dhabi Emirate. In order to identify variations in the rate of domestic water consumption in Al-Ain, a survey is designed and distributed to different populated zones within the city. Data collected include water consumption, number of residents, area of the house/apartment, availability of a garden and its area, water availability, electricity consumption, pressurized water tanks, water price, and availability of water meters. Statistical correlation between these factors and the rate of water consumption are investigated and a functional relationship was developed. It was found that the average rate of domestic water consumption in Al-Ain City is 964 liter/cap/d, which is very high relative to the world domestic water consumption rate. Results also show strong correlation between water and electricity consumption rates.

Acknowledgements:
The authors would like to express their sincere appreciation to the College of Engineering at the United Arab Emirates University for the financial support of this project under fund grant # 1635-07-01-10.
GROUNDWATER QUALITY AND ITS SUITABILITY FOR DOMESTIC AND AGRICULTURAL USE IN UPPER PLAIN OF CHELIFF, ALGERIA

Abdelkader Bouderbala

Faculty of Earth sciences, University of Khmis Miliana, Algeria
e-mail: bouderbala.aek@gmail.com

Abstract
An evaluation of groundwater quality in the plain of upper cheliff has been made to understand the current hydrochemical status, and to assess its suitability for drinking and irrigation. Groundwater samples were collected in dry-water and wet-water periods in the year 2012. They were analyzed for major cations and anions and compared with drinking and irrigation specification standards.

The interpretation of hydrochemical data indicates the dominance of groundwater types: Cl-Ca, Cl-Mg, HCO3-Mg and HCO3-Ca. the Mineralization processes is mostly determined by the lithology of the aquifer (exchange water-rock), by anthropogenic factors (discharges of urban sewage, use of fertilizers) and also by evaporation (climate semi-arid of the study area).

This study also shows that the majority of concentrations of chemical elements exceed the standards of WHO, where the nitrate contents for example exceeds the value of 50 mg/l, as a result the various sources of pollution.

The results can help the public and decision-makers to identify and to evaluate groundwater quality in upper Cheliff plain, Algeria, for more precautions of this vulnerable resource to the anthropogenic pollution.

Keywords
The Role of Supplementary Irrigation for Food Production in a Semi-Arid Country Palestine

Eng. Mohammed Yousef Sbeih  
Irrigation Project Coordinator  
Ramallah, West Bank  
Palestine  
Email: sbeih2005@yahoo.com

Abstract:

Palestine consists of the West Bank and the Gaza Strip. The proclaimed state of Palestine has a land area of 6,657km².

Water is always considered as an essential factor of life and development in arid and semi-arid countries. In Palestine the total per capita water consumption is 139m³. The total available water for Irrigation is 239 MCM which is responsible for irrigating only 330,000 dunums out of 2,314.000 dunums cultivated that can be irrigated if water is available i.e. 5% of the total cultivated land. The average rainfall is 450mm and unfortunately there isn’t any water harvesting structures i.e. dams, most of this rainwater flowing towards the Dead Sea or the Mediterranean Sea as waste. So harvesting this water in individual farmer land and using this water for supplementary irrigation to irrigate olive trees, almonds, grapes and cereals will be of a great impact on the Palestinian land for feed production. It should be noted that there are few farmers who practice supplementary irrigation for production of vegetables that are planted in summer as individual initiative. The quantity and quality of production that they have is extremely tangible.

Since most of the land in Palestine is planted by olive, grape, and cereals, supplementary irrigation should be introduced and practiced where the production of wheat via irrigation by treated wastewater was three times that under rain fed planting project implemented in a pilot project. Reuse of treated wastewater for irrigation as supplementary irrigation will increase the irrigated area in Palestine and will replace the fresh water that can be used for domestic purposes.

The Need for Supplementary Irrigation in Palestine:

As it was mentioned before, Palestine is a semi-arid country, where the average rainfall is 450mm. The availability of water is questionable. Furthermore, the availability of water for agriculture is reducing in a tangible way due to the followings:

1. The normal increase in growth rate, the population of the country is increasing, so the demand for domestic water is also increasing. This will affect the availability of water for agriculture.
2. Since rainwater is the only source of water, the quantity of rainwater (rainfall) has been decreasing in the recent years.
3. There is a huge conflict on water issues at this stage between the Palestinians and the Israelis since Israel occupied Palestine. It should be mentioned here that during early negotiations in the peace process, four main issues have been delayed since 1992; they are Jerusalem, refugees, water and borders. Still after 8 years of negotiations, there hasn’t been any significant movement on these issues. So the quantity of water that can be available for the Palestinians will probably not be increased.
4. The quality of ground water wells especially in Gaza and Jericho becomes saline and shortly it cannot be safely available for agriculture. From the above, it seems that extra availability of water for additional irrigated area or even to sustain the irrigated area is not an easy task.

Total cultivated area in the West Bank is 2,100.00 dunums, but the irrigated area is 110,000 dunums. From the small experience (pilot project) for this field as well as other country experience i.e. Syria. It has been proven that the production of crops under supplementary irrigation is 3 times higher than under rain fed crop, in addition to the increase in the quality of the product. So if supplementary irrigation has been practiced we can easily increase the production of rained crops to three times or twice. This will play a major role in providing food for the people and even exports can take place and the net income of the country will be increased.

**Keywords:** Palestine, Irrigation, Economics, Supplementary, Irrigation, AridCountry, Food Production
AGRICULTURAL WATER USE IN THE US, CLIMATE SMART AGRICULTURE AND TECHNOLOGIES FOR ADAPTATIONS TO WATER DEFICITS

Ashok Alva and Gautam Kumar

1 USDA, 1500 N Central Ave., Sidney, MT, USA; and 2 Village Shop, Gurgaon, India Ashok.alva@ars.usda.gov

Abstract

The water withdrawals for agriculture across the United States account for 25 to 50%, unlike in the dry regions of the world this proportion can be >75 to 90%. About 57% of the total irrigated acreage in the US is in six states, with the rest distributed in the remaining states. Western states represent the high percent of farmland under irrigation, i.e. 25 – 40% with some areas >40%. Surface water accounts for a larger portion of total irrigation water withdrawals in the western states, unlike the mid-western and the southern states where groundwater is the major source of irrigation water. The northeastern states show mixed trend, with both surface and groundwater contributing for irrigation water withdrawals. Real time, automated measurement of soil water, temperature, and electrical conductivity in the soil profile, within and below the root zone, is critical component of best management of nutrients and irrigation aimed to optimize nutrient and water uptake efficiency and minimize potential leaching of nutrients and water below the root zone. A case study described in this paper was conducted in a potato (cv. Umatilla Russet) and corn field on Quincy fine sand (mixed, mesic, Xeric torripsamments) under center pivot irrigation in eastern Washington State. Annual precipitation in this region is about 160 mm with only 20% received during the growing season, i.e. May through August. Therefore, careful management of irrigation is critical for economical production of any crop. Sensors were used for automated monitoring of soil water content, temperature, and electrical conductivity on a real-time basis at various depths in the soil profile to represent root zone (0 – 60 cm) and below the root zone (80 cm). The utility of the soil water data for developing the irrigation set points to maintain the soil water content in the root zone within the management allowed deficit (MAD) to mitigate any impact of water stress while minimizing the water percolation below the root zone will be discussed. Similar technologies using user friendly but low cost sensors have been tested in small farms in India (Punjab and Haryana) over the past year. The sensors use capacitance to determine volumetric water content in the root zone (20 – 30 cm). Farmers were advised on the soil water threshold values to be maintained for different crops (spinach, okra, cauliflower, bitter gourd, and rice). While these sensors resulted in initial high adoption of 80% of advisories, the efficacy was reduced after a short period. A new intervention, where the sensors automatically control irrigation set points is now being tested. Initial feedback suggests that farmers have a higher level of confidence in the automation, leading to higher and longer adoption rates. This intervention is now being tested in only a few sites; will be expanded across three more states in India.
Energy Water Relationship in the GCC Countries

Mohamed Darwish and Basem Shomar
Qatar Environment and Energy Research Institute (QEERI), HBKU, Qatar Foundation, College of Science and Engineering, HBKU, Doha, Qatar
darwish738@gmail.com, madarwish@qf.org.qa

Abstract
The Gulf Cooperation Council (GCC) countries face severe natural fresh water scarcity, while having wealth from rich prime fuel energy resources. The fuel energy revenues are utilized to solve the GCC water shortage problems. Prime energy is used to solve the scarcity water problem in the GCC. The energy and water status in the GCC are presented. This paper determines the energy consumed to secure the unconventional water resources, namely: desalting seawater (DW) and reclaimed treated wastewater (WW). Energy consumed for conveyance of DW, WW, and reclaimed WW to their points of use are presented, with examples. Examples of energy consumed by Seawater reverse osmosis and thermal desalination systems, and transporting the desalted seawater from shores to inland cities are presented with examples Saudi Arabia East coast to the Riyadh city. Also examples of energy consumed to treat municipal wastewater for disposal and reuse are presented with case studies from Qatar and Kuwait. The paper shows that satisfying the water needs drains the energy resources in unsustainable way. While the water in GCC is very scarce, water consumptions are among the highest in the world.
Tracking agricultural land-use changes in the Lake Urmia basin using multi-temporal multi-spectral Landsat imageries

Nasim Fazel\textsuperscript{1}, Kaveh Madani\textsuperscript{2}, Hamid Norouzi\textsuperscript{3}, Bjorn Klove\textsuperscript{1}

\textsuperscript{1}Water Resources and Environmental Engineering Research Group, University of Oulu, Oulu, Finland
\textsuperscript{2}Centre for Environmental Policy, Imperial College London, London, UK
\textsuperscript{3}Department of Construction Management & Civil Engineering Technology, New York City College of Technology, CUNY

\texttt{Nasim.fazel@oulu.fi}

Abstract

The aggressive development policies and desire for achieving food security have resulted in increasing cropland areas without considering the environmental impacts of such changes in the Lake Urmia basin of Iran. Lake Urmia, once one of the largest hypersaline lakes in the world, has lost 90\% of its area and 85\% of its volume. The expansion of irrigated agriculture that consumes over 90\% of available water resources of the basin is blamed for the lake’s desiccation. Nevertheless, reliable data regarding the extent of land use changes is missing. This study assesses the changes and transition rates of agricultural land-use in an 18-year time span from 2006-2014. Five multi-spectral Landsat imageries were classified by the use of supervised maximum likelihood algorithm and analyzed to compute the extent and rate of changes in agricultural land-use in the lake basin. The results suggest that rainfed and dry-farm agriculture has increased by 30\% and the irrigated area has increased by 24\% through converting pastures to croplands. About 14\% of the croplands has been converted to orchards particularly in southern and western parts of the lake and the total orchards area has increased by 23\%. These findings are expected help analyze how the expansion of agriculture and the in-farm transition have affected water resources consumption in the lake’s basin and level of inflows to the lake.
GROUNDWATER-ENERGY NEXUS IN OMAN

Juman Al-Saqlawi¹, Ardalan Izadi², Slim Zekri³, Farhad Yazadandoost⁴, Kaveh Madani⁵

¹Centre for Environmental Policy, Imperial College, London, United Kingdom, j.al-saqlawi12@imperial.ac.uk
²Faculty of Civil Engineering, K.N, Toosi University of Technology, Tehran, Iran, a.izadi@mail.kntu.ac.ir
³Department of Natural Resource Economics, ¹Sultan Qaboos University Muscat, Oman, Slim@squ.edu.om
⁴Faculty of Civil Engineering, K.N, Toosi University of Technology, Tehran, Iran, yazdandoost@kntu.ac.ir
⁵Centre for Environmental Policy, Imperial College, London, United Kingdom, k.madani@imperial.ac.uk

Abstract

Water and energy are the essential resources for food production and security in arid areas of the world, where irrigation is necessary. Where surface water is not available, energy use increases to pump groundwater. This can further increase as a result of unsustainable groundwater withdrawal resulting in declining groundwater levels. While the effects of food production and agriculture on the energy sector are substantial, the water-energy nexus in agriculture has not received enough attention from academics and decision makers. Using 3 years of data collected from smart water-energy meters in Oman, this study tries to illustrate the groundwater-energy nexus in Oman. Additionally, and explore opportunities for reduction in energy cost of water withdrawal through peak shaving, real-time monitoring of groundwater use, controlling groundwater withdrawal, and improved farming practices using smart irrigation and fertigation sensors. Finally, the study suggests various strategies that can be adopted by Oman for sustainable groundwater use with reduced energy consumption and cost.
A New Comprehensive Environmental Method to Evaluate Water Quantity Factor of Tehran Megacity

Hajar Sarmadi$^1$, Mohamad Taghi Aghababaie$^2$, Maryam Yousefi$^3$

$^1$Water and Environmental Expert, Esfahan Regional Water Co, Ministry of Energy, Iran
$^2$Tehran Municipality, Iran
$^3$Irrigation and drainage Expert, IWRM Co, Ministry of Energy, Iran

Abstract

One of the most important factors of urbanization is healthy water supplement. Tehran as a megacity suffers from not only overcrowding but also lack of water. Tehran water supplements are both groundwater and surface resources. Surface water resources are including Karaj, Lar, Latian, Taleghan Dams and Tehran-Karaj Plan is its groundwater resources. Therefore Tehran-Karaj Plan is considered as target area in this study. The target area is located between $51^\circ\ 05'$ and $51^\circ\ 10'$ longitude and $35^\circ\ 02'$ and $35^\circ\ 57'$ latitude with approximately $2704\text{Km}^2$. The Urban Rivers are originated from Alborz Mountains and received urban runoff and also secondary effluent of Tehran Wastewater Treatment Plants which ultimately collected in Bande Alikhan in the southern part of Tehran.

The evaluation of Tehran water quantity by DPSIR Model is considered in this paper. Driving forces, Pressures and the characteristics of water quantity will represent and their effects on the city will also investigate.

Key Words: Water Quantity, Tehran Megacity, DPSIR Model, State of Environment (SoE)
Application of magnetic water technology, a novel tool for improving chick-pea crop productivity and water use efficiency in newly reclaimed sandy soil

Hozayn M. and Abd El Monem A.A.

Field Crop Research and Botany Depts, Agriculture and Biology Div., National Research Centre, El Buhouth St.( Former El-Tahrir St.),12622 Dokki, Giza, Egypt.

Biology Dept., Fac. of Sci., Tabuk Univ., Branch Tayma, Saudi Arabia

1e-mail of corresponding author: m_hozien4@yahoo.com

Abstract
Producing more food from less water is important, particularly in arid and semi-arid regions which suffer from water scarcity including Egypt. Regarding the positive results under greenhouse conditions, utilization of magnetic water technology is considered as a promising technique to improve water use efficiency and crop productivity. In Egypt, chick-pea share other pulses crops especially faba bean and lentil as a main sources of protein for a large sector of Egyptian people. Its annual domestically is insufficient to meet demand, which necessitates the import of substantial amount to meet the rapidly increasing population and rise in price of animal protein. Moreover, the area planted of chick-pea crop is decreasing due to competition from other winter crops, especially wheat and clover. Moreover, its yield is generally poor and unstable from year to year especially under newly reclaimed soil. So, agriculture researchers take an interest not only traditional agricultural practices i.e., cultivation methods, fertilizers, weed control, etc. but also uncommon factors that improvement productivity of crops like magnetic water treatments. Two field trials using Lentil (var. Giza-3) were conducted at Research and Production Station, National Research Centre, Alemam Malek village, Al Nubaria district, Al Behaira Governorate, Egypt in 2009/10 and 2010/11 winter seasons to study and evaluate the effects of magnetizing irrigation water on water use efficiency and chick-pea productivity. Results indicated that, irrigation chick-pea plants with water passed through magnetic device (Magnetron, 2 inch, production by Magnetic Technologies L.C.C., Russia, branch United Arab Emirates) induced positive significant effect on all studied parameters i.e., growth, pigments, yield, yield components, nutrition value and amino acids in yielded seeds and water use efficiency compared to irrigation with normal water. The percent of increase in seed, straw and biological yields per fed. (fed=4200 m2) were 28.36, 28.13 and 26.83%, respectively compared with normal water (average over both seasons). Magnetic water treatment could be used to improve productivity of lentil and water under newly reclaimed sandy soil condition.

Keywords: Chickpea, magnetized water, growth, chemical constitute, yield

Acknowledgements: This work was funded by The National Research Centre through the project entitled “Utilization of magnetic water technology for improving field crops under normal and environmental stress in newly reclaimed sandy soil. Project No. 9050102 (In-house projects strategy 2010-2013). The principal investigator Prof. Dr. Mahmoud Hozayn.
On-Farm Water Management using Remote Sensing and GIS Techniques

Mohammed A. El-Shirbeny\textsuperscript{a}, Abd-Elraouf M. Ali\textsuperscript{a}
\textsuperscript{a}National Authority for Remote Sensing and Space Sciences (NARSS), Egypt.
23 Joseph Tito St., El-Nozha El-Gedida, Cairo, Egypt. Tel. +201003609645; fax +20226225800; E-mail: mshirbeny@yahoo.com and m.elshirbeny@narss.sci.eg

Abstract
With increasing population pressure throughout the world and the need for increased agricultural production there is a definite need for improved management of the world's agricultural resources. El-Salhia project is located at the South Western of Ismaillia city and to the East southern of El-Kassaseen city. Pivot central sprinkler irrigation system NO 56 which cultivated with wheat was chosen. Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST) will extract from Landsat satellite data. Water Deficit Index (WDI) uses both surface temperature minus air temperature and a vegetation index to estimate the relative water status. Reference Evapotranspiration (ETo) is estimating from meteorological data according to Penman-Montieth method. ETo depending completely on meteorological data (Temperature, Relative humidity, Wind speed and Solar radiation). NDVI used to calculate Crop Coefficient (Kc) based on landsat data. When vegetation covers soil 100%, all water losses are transpiration. Actual Evapotranspiration (ETa) was estimated according to WDI and ETc. Field Soil texture, Organic matter, TDR, Infra-red thermometer, LAI and actual yield measurements were done where 47 systematic sample points were detected. The main objective of the current study is rationalization of irrigation water under Pivot central sprinkler irrigation system.

Keywords: Land Surface Temperature (LST), Normalized Deferece Vegetation Index (NDVI), Reference Evapotranspiration (ETo), Crop Coefficient (Kc), Water Deficit Index (WDI), and Pivot central sprinkler irrigation system.
FUZZY LOGIC, KALMAN FILTER AND BOX JENKINS TECHNIQUES FOR MONTHLY STREAMFLOWS PREDICTION IN NORTHERN ALGERIA

Khadidja Boukharouba, Ahmed Kettab

University of Biskra, Faculty of SESNV, department of Biology, El Hadjeb, Biskra, Algeria

b_malikadz@yahoo.com

Abstract:

Analyzing streamflow records can give significant ideas for both past and future characteristics of streamflows. Therefore, recording and analyzing streamflow measurements have highly important roles in water resource management, planning and design. Unfortunately, hydrological processes, such as streamflows, are very complex because they are dependant of many hydro-physiographic parameters, additionally, they vary with time and space. To cope with these difficulties, three different techniques have been applied to the modeling and prediction of the monthly streamflow data in Northern Algeria: 1) the adaptive prediction approach of Kalman filtering (KF) which has the advantage to provide with the prediction error covariance, 2) the Artificial Intelligence approach of Fuzzy logic (FL), which is one of the most efficient tools for prediction, in addition to 3) the conventional time series approach of Box-Jenkins (BJ), which has the limitation of working under the stationarity hypothesis and needs all the available data. The obtained results show the superiority of Fuzzy logic model, followed by Kalman filter then the Box-Jenkins one. The best model is sought using the performance measures including mean square error and determination coefficient.

Key words: Fuzzy Logic, Kalman filter, Box-Jenkins, Prediction, streamflows.
CARTOGRAPHIC AND HYDROLOGICAL STUDY OF THE WATERSHED OF MEDJERDA THROUGH THE SATELLITE IMAGES FOR ENDS OF SPATIALIZED HYDROLOGICAL MODELING

AHLEM GARA*1, KHOULOUD GADER1, MOHAMED RAOUF MAHJOUB2,

1National Institute of Agronomy in Tunisia, 1082 City of Mahrajene, Tunisia
2 High School of Rural Equipment Engineering, Road of Kef, Medjez el Beb Tunisia
ahlem_gara@yahoo.fr

Abstract:
Using the remotely sensed images combined with the GIS tools provide us recent, and larger variety of data that we can exploit in environment protection, the understanding of the actual situation of the study areas and being data input and tools of decision-making aid for spatialized hydrological modeling. The catchment area of the Medjerda river is a basin of total surface of approximately 23700 km² bordered between Algeria and Tunisia. It is the only permanent hydrosystem in Tunisia with a very important space variability. In this context, we focuses on showing the contribution of the remote-sensing through the images of the satellites AsterGDEM and Landsat8 with a resolution of 30 meters for the realization of the cartography as well as the essential concepts of physiography and morphometric parameters for any work of spatialized hydrological modeling, using the software ArcGIS 10 and Global Mapper V15. The maps extracted are the map of the Digital Terrain Model as well as the various derived maps (slope, altitude, stream network, sub-watersheds) besides the map of the of Land Use System, obtained after the visible analyses of the calculated remote sensing indexes (NDVI, NDWI and BI), and basing on a supervised classification of soil occupancy using the maximum likelihood method and with a rejection fraction of 0.1, in which, an equal probability weight was affected. The choice of the selected date of Landsat images was based in order to reduce the number of LUS types (6 types) for a large basin, because the satellite mission is carried out after the harvest of the plants. The other map extracted from these satellite images is the map of lineament, showing then the repercussions on the surface of the geological phenomena of different magnitudes such. Besides the remote sensing data, we present other collected data of the soil types obtained from the CRDA of Tunisia in order to finally obtain the map of vulnerability to water erosion of the catchment area of Medjerda by the superposition of all the already elaborated maps, showing then three classes: strong, average and weak vulnerability, being the next step in this study in order to highlight the critical area on which we will focus using the hydrological modeling procedure.

Using the software of Global Mapper V15, we was able to obtain a detailed hypsometric curve leading to the calculating of the most important physiographic and morphometric parameters of the study area, basing on it, we can understand the conception of the Medjerda basin.

Keywords: Medjerda basin, cartography, hydrology, satellite images
HYDROLOGICAL MODELING OF SEDIMENT TRANSPORT IN THE SEMI-ARID REGION, CASE OF SOUBELLA WATERSHED IN ALGERIA

Hasbaia Mahmoud, Paquier André2 And Herizi Toufik1
1. Mohamed Boudiaf university of M’sila, PO Box 166 Ichebilia 28000 M’sila, Algeria
   Mahmoud.hasbaia@univ-msila.dz, hasbaia_moud@yahoo.fr
2. Irstea, UR HHLY, 5 rue de la Doua, CS 70077, 69626 Villeurbanne Cedex, Lyon, France.

Abstract:

This paper summarizes the major hydrologic studies of the sediment transport in Algeria through a case study of Soubella watershed in Hodna basin (Algeria). Since the 70s, the Algerian Agency of Water Resources (ANRH) has installed a large number of gauging stations, which allowed carrying out many studies about sediment transport. The major contributions aimed principally to model and to estimate the suspended sediment transport. Through these studies, we summarize and we compare the most used statistical models in Algeria to estimate the sediment yields and we can conclude that the sediment-rating curve is the best significant model for all the basins presented herein moreover, it is the large discussed model. Wadi Soubella watershed (183.5 km²) is characterized by an aggressive, irregular and violent rainfall, the mean annual precipitation is 288.5 mm (associated with Cv = 33% observed during 27 hydrological years 1973-2003). The results show a high specific suspended sediment yields (126 t km-2 year-1) associated with a higher interannual variability (Cv = 61%). Over the 20 years of this study the most part of the total solid flux is observed in two months September (45.12%) and October (24.13%). Thus, the early autumn floods are responsible for the major part of the solid transport. In Soubella watershed, the sediment-rating curve explains more 75% of the variance for the whole data (pairs Q-C) at the instantaneous, monthly and seasonally scale. For the annual scale, this law explains 70 % of the variance. A significant regressive relationship (logarithmic) between the sediment rating curve coefficients (a, b) is obtained at the monthly scale for wadi S

Acknowledgements:

The authors would like to thank the staff of the Algerian Agency of Water Resources (ANRH) for providing several sets of experimental data

oubella and other wadis in Algeria.
THIRD NAIL ON THE CROSS: A STUDY ON RIVER-RESPONSE TO BRIDGE CONSTRUCTION OVER THE RIVER JALANGI, WEST BENGAL, INDIA

B. C. Das
- P. G. Department of Geography, Krishnagar Govt. College, Nadia, India, e-mail: drbalaidaskgc@gmail.com

Abstract

River Jalangi is one of the three ‘Nadia Rivers’ of West Bengal, India on left bank of which Krishnagar, the head quarter of the district of Nadia, is located. National Highway -34 (NH-34) and Sealdah-Lalgola railway track under Eastern Railway across the river Jalangi was laid over two bridges. Third bridge, the New Railway Bridge (NRB) was constructed in 2012 over the river for laying the second track of rail. But unlike Old Railway Bridge (ORB) and Dwijendra Lal Roy Road Bridge (DLRB), NRB was designed in such a way that it created a huge obstacle to the flow of the river and made a great change in the channel morphology.

Channel asymmetry at downstream before NRB was 0.150123 which is 0.356951 after NRB, an increase in asymmetry of 2.40 times. At a station channel asymmetry before and after NRB was -0.02719 and -0.572241248 respectively which is an increase of 21.04775 times. Construction of the New Railway Bridge (NRB) is pierced the 3rd nail to crucify the river bringing changes in channel morphology and hydraulics. Bed asymmetry at a station before and after NRB was -0.20145 and -0.55074 respectively indicating a change of 2.73 times. For downstream bed asymmetry these were 0.20192 and 0.290638 respectively and change was 1.44 times. Flow asymmetry at a station as counted before and after NRB was -0.02719 and -0.64953492 respectively, a change of 23.89 times. Due to construction of the NRB, mainly because of its mid-channel dais, left bank-line at downstream has been retreated 7 meter swallowing 1125 cubic meters of soil. Channel asymmetry were computed by the equation A* (Knighton, 1981) and bed asymmetry by the equation developed by Das and Islam (2015).
Overcoming Water Scarcity In South Australia

Gabriel Negreiros Salomao
salomao.gn@gmail.com

Abstract

Water scarcity is increasing year by year and it is affecting a considerable number of regions around the world. Australia may be considered a continent of extremes in relation to distribution and availability of water resources. There is a relative excess of water in the north where the demographic concentration is low and water scarcity in the south where the population are demographically concentrated. For this reason, the competition for water for urban/domestic, irrigators, mining and industrial users are becoming fiercer as a function of population growth and economic activity. Among the alternatives to supply water demand, underground water is considered a viable alternative, mainly for the human consumption due to the volume that this resource can be stored in aquifers as well as the mechanism of purification that aquifers can offer. A superficial analysis in SA Water reports between 2007 and 2013 has revealed that the increased demand of groundwater is not occurring in South Australia State. However, it does not mean that it should not forward actions to protect, conserve and use of groundwater in order to minimize the problem of scarcity that already sets in the state of South Australia and other nation states.