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Annotated Bibliography on

Applications of Remote Sensing and GIS on Water Resources Management

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Introduction:

"Geographic Information Systems (GIS) are an effective tool for storing, managing, and displaying spatial data often encountered in water resources management. The application of GIS in water resources is constantly on the rise." (Tsihrintzis et al.)

This benefits WRC researchers.

This annotated bibliography contains articles' abstracts from 2020 – 2022.

E-resources used: Scopus.

Contact NSTIC to request full-text articles.

Articles Abstract:

1. Saravanan, S., Saranya, T., & Abijith, D. (2022). Application of frequency ratio, analytical hierarchy process, and multi-influencing factor methods for delineating groundwater potential zones. International Journal of Environmental Science and Technology, 19(12), 12211-12234

Abstract: Groundwater remains the primary source of freshwater for essential agricultural practice. Two billion people depend on groundwater as their essential source of water. Thus, fifty percent of the groundwater is used to produce food for the globe. Groundwater serves as the main strategic asset in periods of drought. Determining the groundwater potential zones highly facilitates the effective management of available water resources. The current study attempts to find out the potential zones for groundwater using remote sensing and geographical information system. This tool has become deliberate for groundwater potentiality modeling and mapping as it is highly efficient, accurate, and cost-effective. Satellite and conventional data sources include a total of nine parameters, such as rainfall, geology, geomorphology, lineament density, drainage density, soil, land use, slope, and topographic wetness index, which are considered for the identification of groundwater potential by using multicriteria decision-making approaches such as analytical hierarchy process (AHP), frequency ratio (FR), and multi-influencing factor (MIF). The study is applied to Tanjore District where the proposed methodology has not been attempted in earlier studies. The potential groundwater zones obtained were categorized into five classes: very low, low, moderate, high, and very high. The receiver operating characteristic curve was plotted, and the area under the curve was estimated for results, and the precision showed FR 88%, AHP 75%, and MIF 71%. The results will be valuable for controlling water supplies, land-use planning, and environmental management purposes for planners and engineers. © 2021, Islamic Azad University (IAU).

2. Revuelta-Acosta, J., Guerrero-Luis, E., Terrazas-Rodriguez, J., Gomez-Rodriguez, C., & Perea, G. A. (2022). Application of remote sensing tools to assess the land use and land cover change in coatzacoalcos, veracruz, mexico. Applied Sciences (Switzerland), 12(4)

Abstract: Land use and land cover (LULC) change has become an important research topic for global environmental change and sustainable development. As an important part of worldwide land conservation, sustainable development and management of water resources, developing countries must ensure the use of innovative technology and tools that support their various decision making systems. This study provides the most recent LULC change analysis for the last six years (2015–2021) of Coatzacoalcos, Veracruz, Mexico, one of the most important petrochemical cities in the world and host of the ongoing Interoceanic Corridor project. The analysis was carried out using Landsat 8 Operational Land Imager (OLI) satellite images, ancillary data and ground-based surveys and the Normalized Difference Vegetation Index (NDVI) to identify and to ameliorate the discrimination between four main macro-classes and fourteen classes. The LULC classification was performed using the maximum likelihood classifier (MLC) to produce maps for each year, as it was found to be the best approach when compared to minimum distance (MDM) and spectral angle mapping (SAM) methods. The macro-classes were water, built-up, vegetation and bare soil, whereas the classes were an improved classification within those. Our study achieved both user accuracy (UA) and producer accuracy (PA) above 90% for the proposed macro-classes and classes. The average Kappa coefficient for macro-classes was 0.93, while for classes it was 0.96, both comparable to previous studies. The results from the LULC analysis show that residential, industry and commercial areas slowed down their growth throughout the study period. These changes were associated with socio-economical drivers such as insecurity and lack of economic investments. Groves and trees presented steady behaviors, with small increments during the five-year period. Swamps, on the other hand, significantly degraded, being about 2% of the study area in 2015 and 0.93% in 2021. Dunes and medium and high vegetation densities (~ 80%) transitioned mostly to low vegetation densities. This behavior is associated with rainfall below the annual reference and increments of surface runoff due to the loss of vegetation cover. Lastly, the present study seeks to highlight the importance of remote sensing for a better understanding of the dynamics between human–nature interactions and to provide information to assist planners and decision-makers for more sustainable land development.

3. Humphrey, O. S., Osano, O., Aura, C. M., Marriott, A. L., Dowell, S. M., Blake, W. H., & Watts, M. J. (2022). Evaluating spatio-temporal soil erosion dynamics in the winam gulf catchment, kenya for enhanced decision making in the land-lake interface. Science of the Total Environment, 815

Abstract: Soil erosion accelerated by poor agricultural practices, land degradation, deprived infrastructure development and other anthropogenic activities has important implications for nutrient cycling, land and lake productivity, loss of livelihoods and ecosystem services, as well as socioeconomic disruption. Enhanced knowledge of dynamic factors influencing soil erosion is critical for policymakers engaged in land use decision-making. This study presents the first spatio-temporal assessment of soil erosion risk modelling in the Winam Gulf, Kenya using the Revised Universal Soil Loss Equation (RUSLE) within a geospatial framework at a monthly resolution between January 2017 and June 2020. Dynamic rainfall erosivity and land cover management factors were derived from existing datasets to determine their effect on average monthly soil loss by water erosion. By assessing soil erosion rates with enhanced temporal resolution, it is possible to provide greater knowledge regarding months that are particularly susceptible to soil erosion and can better inform future strategies for targeted mitigation measures. Whilst the pseudo monthly average soil loss was calculated (0.80 t ha−1 month−1), the application of this value would lead to misrepresentation of monthly soil loss throughout the year. Our results indicate that the highest erosion rates occur between February and April (average 0.95 t ha−1 month−1). In contrast, between May and August, there is a significantly reduced risk (average 0.72 t ha−1 month−1) due to the low rainfall erosivity and increased vegetation cover as a result of the long rainy season. The mean annual gross soil loss by water erosion in the Winam Gulf catchment amounts to 10.71 Mt year−1, with a mean soil loss rate of 9.63 t ha−1 year−1. These findings highlight the need to consider dynamic factors within the RUSLE model and can prove vital for identifying areas of high erosion risk for future targeted investigation and conservation action. © 2021

4. Daba, M. H., & You, S. (2022). Quantitatively assessing the future land-use/land-cover changes and their driving factors in the upper stream of the awash river based on the CA–Markov model and their implications for water resources management. Sustainability (Switzerland), 14(3)

Abstract: Despite the rapid economic and population growth, the risks related to the current dynamics of land use and land cover (LULC) have attracted a lot of attention in Ethiopia. Therefore, a complete investigation of past and future LULC changes is essential for sustainable water resources and landuse planning and management. Since the 1980s, LULC change has been detected in the upper stream of the Awash River basin. The main purpose of this research was to investigate the current dynamics of LULC and use the combined application of the cellular automata and the Markov chain (CA– Markov) model to simulate the year 2038 LULC in the future; key informant interviews, household surveys, focus group discussions, and field observations were used to assess the consequences and drivers of LULC changes in the upstream Awash basin (USAB). This research highlighted the importance of remote sensing (RS) and geographic information system (GIS) techniques for analyzing the LULC changes in the USAB. Multi-temporal cloud-free Landsat images of three sequential data sets for the periods (1984, 2000, and 2019) were employed to classify based on supervised classification and map LULC changes. Satellite imagery enhancement techniques were performed to improve and visualize the image for interpretation. ArcGIS10.4 and IDRISI software was used for LULC classification, data processing, and analyses. Based on Landsat 5 TM-GLS 1984, Landsat 7 ETM-GLS 2000, and Landsat 8 2019 OLI-TIRS, the supervised maximum likelihood image classification method was used to map the LULC dynamics. Landsat images from 1984, 2000, and 2019 were classified to simulate possible LULC in 2019 and 2038. The result reveals that the maximum area is covered by agricultural land and shrubland. It showed, to the areal extent, a substantial increase in agricultural land and urbanization and a decrease in shrubland, forest, grassland, and water. The LULC dynamics showed that those larger change rates were observed from forest and shrubland to agricultural areas. The results of the study show the radical changes in LULC during 1984–2019; the main reasons for this were agricultural expansion and urbanization. From 1984 to 2019, agriculture increased by 62%, urban area increased by 570.5%, and forest decreased by 88.7%. In the same year, the area of shrubland decreased by 68.6%, the area of water decreased by 65.5%, and the area of grassland decreased by 57.7%. In view of the greater increase in agricultural land and urbanization, as well as the decrease in shrubland, it means that the LULC of the region has changed. This research provides valuable information for water resources managers and land-use planners to make changes in the improvement of future LULC policies and development of sub-

basin management strategies in the context of sustainable water resources and land-use planning and management. © 2022 by the authors. Licensee MDPI, Basel, Switzerland.

5. Singh, A. (2022). Soil salinity: A global threat to sustainable development. Soil use and Management, 38(1), 39-67

Abstract: Soil is a vital resource for feeding the burgeoning global population, and it is also essential for realizing most of the 'United Nations Sustainable Development Goals (SDGs)'. For example, it is vital to realizing the 'Zero hunger (SDG2), Good health and well-being (SDG3), Clean water and sanitation (SDG6), and Life on land (SDG15)'. Excess salts present in the soil make it saline, and it poses a significant threat to agricultural production and environmental health. Soil salinity is an extensive problem and spreads over one billion hectares extended over 100 countries. This paper presents a comprehensive review of global soil salinity management through the applications of remote sensing and GIS. All possible sources of relevant and current literature were accessed and more than 260 publications were collected and carefully analysed, for this review. The rationale and severity of the salinity problem are provided. The impact of salinity on plant yield and the effect of climate change on soil salinity are detailed. The salinity indicators and salinity monitoring and mapping are provided, and the global cases of soil salinity management through remote sensing and GIS applications under different agro-hydro-climatic environments are discussed, followed by a summary of conclusions and challenges along with future research directions. The analysis of past investigations showed that remote sensing strategy might be a practical approach to adequately assess plant response such as evapotranspiration under diverse salinity environments, yet it additionally has various difficulties. The lower spatial and temporal resolution of imagery may reason errors because of subpixel heterogeneity. However, with the improvement of the better-resolution thermal infrared remote method, there is the possibility to spot spatial variations at a smaller scale. © 2021 British Society of Soil Science

6. Abdelhaleem, F. S., Basiouny, M., Ashour, E., & Mahmoud, A. (2021). Application of remote sensing and geographic information systems in irrigation water management under water scarcity conditions in fayoum, egypt. Journal of Environmental Management, 299

Abstract: Egypt suffers from severe water scarcity, which affects the sustainability of agricultural production. Therefore, the sustainable use of available water resources under water scarcity requires the adoption of water allocation policies favoring conservative and efficient use. Water management with free satellite data and geographical information system modeling capabilities can be a valuable approach for optimizing the benefits from the available water resources to meet the requirements for agricultural lands. This study aims to (i) detect and evaluate changes in agricultural areas because of urbanization and reclamation activities using Landsat data in 1999, 2009, and 2019 and (ii) update the irrigation water demand by monitoring the seasonal changes of agricultural area based on normalized difference vegetation index. Water management of Fayoum Governorate in Egypt is characterized by a non-uniform distribution flow over its canals; thus, two pilot areas are selected. The first site is the Sinnuris canal, the served areas of which represents the urbanization problem. The other site is the Gharaq canal, the served areas of which represents the urbanization and agricultural expansion situations. The results reveal that changes in agricultural areas considerably affect the uniformity of water management. Urbanization activities reduce the agricultural area by ~5.0% and 5.7% in Sinnuris and Gharaq served areas, respectively. However, the newly cultivated lands in Gharaq preserve an increase of 5.8% in the total agricultural area. The considerably changed water allocation strategies in these districts since Sinnuris has an excess of 1.5 m3/s of water supply, while the Gharaq area faced an irrigation shortage of 0.26 m3/s in 2019. As per the proposed approach, the decision-makers can readjust the water allocation plan to satisfy the water requirements for other demand areas. © 2021

7. Donoso, M. E., & Sarmiento, F. O. (2021). Changing mountain farmscapes: Vulnerability and migration drivers in the paute river watershed, southern ecuador. Journal of Mountain Science, 18(7), 1902-1919.

Abstract: Abrupt changes in land use/land cover have often characterized Andean rural landscapes. This is particularly notorious in the Paute River watershed in southern Ecuador. We seek to show how, under tenets of the global economy, rural mountain landscapes suffer constant modifications due to the agricultural practices of dwellers and migrants. Erosion of arable slopes takes center stage in analyzing vulnerability due to the high erodibility factor found in this watershed. By using remote sensing and GIS applications, we analyzed the potential erodibility

with intersections of rural development constraining of ecosystem services, including the production of water, food, and cultural values in the Paute River watershed. We found six sources of migratory flows and analyzed topographic and elevation effects in potential erodibility indexes of agroecological options to ameliorate the environmental stress. We identified factors associated with migration trends observed in the area and assessed vulnerability issues of resource management that could prevent deforestation, soil erosion, and acculturation amidst the pressures of development in the region. We conclude that sustainable development options can be implemented with a watershed management approach oriented to diminish emigration. This approach shall be integrative, inclusive, and respectful of the rich biocultural diversity heritage conservation of southern Ecuador.

8. Habeeb, N. J., & Weli, S. T. (2021). Combination of GIS with different technologies for water quality: An overview. HighTech and Innovation Journal, 2(3), 262-272.

Abstract: Water is one of the most important requirements in daily life, which represents the largest part of the Earth. As a result, economic, industrial, and social development in most countries has led to increased pollution of water resources. It is, therefore, necessary to monitor water quality continuously to prevent a future catastrophe that adversely affects the quality and quantity of water wealth. A Geographic Information System (GIS) is used in various fields to monitor and analyze data collected from different geographical locations. Integration of GIS and other technologies has become an indispensable tool. This gives us direct control over solution expansion, cost reduction, powerful complex case analysis, as well as increased accuracy and efficiency of geospatial data. In recent years, many combinations of GIS with different technologies such as remote sensing, wireless sensor networks, and internet of things approaches have been proposed due to the rapid progress of technology development in many applications. However, in the last several years, no review articles have been published about water quality using the integration of GIS and other technologies. Therefore, this paper investigates the status of continuous search in the field of GIS and its integration with other technologies (Remote Sensing, Internet of Things, Web, etc.) for water quality management and monitoring to maintain the water resources in a proper way. Finally, the integration of GIS with these technologies creates a

powerful platform for analyzing and processing big data and mapping geographic remotely in less time, at a lower cost, at a higher speed, with more accurate details, and in real time when compared to traditional geographic information systems. This paper also highlights future research trends on the cooperation of GIS with other technologies for matters that are related to water quality.

9. Ahmed, A., Ranasinghe-Arachchilage, C., Alrajhi, A., & Hewa, G. (2021). Comparison of multicriteria decision-making techniques for groundwater recharge potential zonation: Case study of the willochra basin, south australia. Water (Switzerland), 13(4)

Abstract: In semi-arid regions, groundwater resources play a crucial role in all economic, environmental, and social processes. However, the occurrence, movement, and recharge of these hidden and valuable resources vary from place to place. Therefore, better management practices and mapping of groundwater recharge potential zones are needed for the sustainable groundwater resources. For an example, groundwater resources in Willochra Basin are vitally important for drinking, irrigation, and stock use. This study shows the significance of the application of three decision-making approaches, including multi-influencing factor, analytical hierarchy process, and frequency ratio techniques in the identification of groundwater potential zones. A total of seven criteria, including lithology, slope, soil texture, land-use, rainfall, drainage density, and lineament density, were extracted from conventional and remote sensing data sources. The parameters and their assigned weights were integrated using Geographic Information System (GIS) software to generate recharge potential maps. The resultant maps were evaluated using the area under the curve method. The results showed that the southern regions of the Willochra Basin are more promising for groundwater recharge potential. The map produced using the frequency ratio model was the most efficient (84%), followed by the multi-influencing factor model (70%) and then the analytical hierarchy process technique (62%). The area under the curve method agreed when evaluated using published weights and rating values.

10. dos Santos, A. R., Anjinho, P. D. S., Neves, G. L., Barbosa, M. A. G. A., de Assis, L. C., & Mauad, F. F. (2021). Dynamics of environmental conservation: Evaluating the past for a sustainable future. International Journal of Applied Earth Observation and Geoinformation, 102

Abstract: The biodiversity of the Cerrado biome is endangered. Ensuring its quality requires maintaining its biogeophysical characteristics, and environmental studies must consider space-time scales and sustainable perspectives to balance environmental, economic, and social needs. This study evaluates environmental conservation in a hydrographic basin in Brazil's São Paulo state and proposes integrating two types of spatial analysis generally applied separately. The Land Change Modeler was used to model future land use by using artificial neural networks and CA-Markov. Environmental conservation levels were obtained through multicriteria evaluation for three scenarios, verified through field visits and the application of an ecological diversity protocol. Significant changes were noted, primarily related to anthropic disorders, with land use map values for 2028 indicating dominant trends in the anthropized area and silviculture. Priority areas for conservation are the reservoir, Brazilian Cerrado, wetlands, bodies of water, riparian forest, and silviculture. Fragmented natural vegetation was identified in regions with springs and high, but dispersed, values of environmental conservation. Mean and minimum values anticipated increase, indicating a tendency for degradation, which could be mitigated by incentive policies for preservation and conservation. Environmental management and inspection by public agencies are needed at reservoir sites used for recreation, tourism, and fishing. Finally, the study's integrated methods proved satisfactory for assessing conservation dynamics and providing data to inform strategic planning for effective land use management focused on sustaining natural resources. © 2021 The Authors

11. Dawood, F., Akhtar, M. M., & Ehsan, M. (2021). Evaluating urbanization impact on stressed aquifer of quetta valley, pakistan. Desalination and Water Treatment, 222, 103-113

Abstract: This research is focused on the land use/land cover (LU/LC) changes impacts on the groundwater table and urbanization trend of Quetta valley for a period of 10 y. The land cover changes are occurring locally, regionally, and worldwide, which results in the expansion of urbanization trend and groundwater table depletion. Population growth leads to fast change in land

use patterns, which increases the demand for basic needs. Urbanization and climatic impacts on depleting groundwater resources in Quetta need to assess and find a scientific solution using applications of the latest software. This study investigated the land cover changes in three categories, which were barren land, vegetation, built-up area by using maximum likelihood classification (MLC). Water table depletion was defined in five ranges from very low to very high by using the Kriging Method. It is inferred that the built-up area was increased the most in the last 10 y, that is, 2008–2018 as compared to other classes. The City area groundwater has been observed most of the depletion from 2008 to 2018. The selected Union Councils/Towns of Quetta District coming in the study area were City, Cantonment, Baleli, Kuchlak, Kachi Baig, Hanna, Shadenzai, and Saraghurgai were separated in polygons according to their boundaries to get the population density of each area. The Quetta city was found to be the most populated. It is imperative to inspect the land use change, water levels of current functional pumping wells, and population growth rate annually for its present management and future planning.

12. Yang, S., Wang, P., Wang, J., Lou, H., & Gong, T. (2021). River flow estimation method based on UAV aerial photogrammetry. National Remote Sensing Bulletin, 25(6), 1284-1293

Abstract: River discharge is the basis for water resources and ecological protection, and it is an essential part of the hydrological cycle. However, some large areas in the world lack hydrological data. How to obtain river hydrological data conveniently and accurately remains a hot topic in the prediction of ungauged basins, especially in small and medium rivers. Solving the problem of data acquisition in areas lacking traditional hydrological data is beneficial for the management of water resources and rapid prediction of water disasters. Remote sensing technology, which is a non-contact data acquisition method, has been applied in many fields. This technology breaks the limits of space in acquiring river discharge, especially in areas where obtaining basic data is difficult, and has become a preferred method of data acquisition.Therefore, this study tries to take advantage of low-altitude remote sensing in obtaining terrain data. The study combines high-density terrain data with classical Manning-Strickler formula to estimate the river discharge. This study is based on representative rivers in the Junggar Basin, which is the second largest inland basin in China.

The Kazanying section, Bortonggu section, Anji Sea section, Daheiyanzi section, and Rocha River section are selected as study sections. Combined with the Manning-Strickler formula, Digital Orthophoto Map (DOM) and Digital Surface Model (DSM) image data obtained by an Unmanned Aerial Vehicle (UAV) are used to calculate the theoretical river discharge. The Manning-Strickler formula needs four parameters to calculate discharge: cross-section area, hydraulic radius, hydraulic gradient, and roughness. Cross-section area and hydraulic radius are extracted in cross-section, which is combined with DSM and measured data; hydraulic radius reflects the slope of the river, which is calculated with DSM and DOM in Arc GIS; roughness, an empirical value that measures the level of obstruction of water flow in the river bed and embankment, is obtained by using DOM. On the basis of the values of these parameters, we calculated the discharge in Kazanying section, Bortonggu section, Anji Sea section, Daheiyanzi section, and Rocha River section. Their calculated values are 28.73 m3/s, 46.29 m3/s, 104.84 m3/s, 19.77 m3/s, and 6.83 m3/s, respectively. To verify the effectiveness and accuracy of the low-altitude remote sensing method in river flow calculation, we used traditional measurements to record the measured values of river discharge. This study selected 20% of the allowable error as the standard of Relative Accuracy (RA) and used the measured value to evaluate the calculated value. Root Mean Squared Error (RMSE) and Mean Percentage Error (MPE) are important methods of evaluating accuracy, which are used as criteria for evaluating overall reliability.According to the established evaluation method, the results in the five sections show that the average error is 10.74%, the maximum value is 28.48%, the minimum value is 1.43%, the RMSE is 4.82m3/s, and the MPE is 0.065. The reason why the maximum relative error occurs in the Bortonggu section is because the value of roughness is too small. The results of the accuracy analysis indicate that the method used in this study is reasonable and has a well applicability in the study area. Moreover, the results prove that the classic Manning-Strickler formula can be combined with low-altitude remote sensing data.To resolve the problem of river discharge monitoring in ungauged areas, this study developed a new method that integrates classic river discharge algorithms with low-altitude remote sensing. The advantages of UAV are fully exploited in this study, and the use of UAV complements the research gap in the acquisition of small and medium-sized river discharge through remote sensing data. Research results have significant values for the application of flow simulation methods in ungauged regions and also provide a new solution for rapid and convenient collection of hydrological information.

This study has unique advantages for water resources management and water disaster monitoring in key areas.

13. Singh, A. (2021). Soil salinization management for sustainable development: A review. Journal of Environmental Management, 277

Abstract: The expansion of irrigated agriculture is of paramount importance to feed the burgeoning global population. However, without proper management, this expansion can result in environmental problems of irrigation-induced soil salinization. A recent FAO estimate reported that a large portion of total global soil resources are degraded and this problem is persistently expanding. Many irrigated areas of the world are facing the twin problems of soil salinization and waterlogging and presently over 20% of the total global irrigated area is negatively affected by these problems. And, if left unattended, this problem could expand to over 50% of the total global irrigated areas by 2050. The proper management of the aforementioned soil salinization is imperative for achieving most of the Sustainable Development Goals (SDGs) of the United Nations. For example, soil salinization management is vital for achieving the 'Zero Hunger' (SDG2) and 'Life on Land' (SDG15) among other SDGs. This paper provides a comprehensive review of different measures used for managing the environmental problems of soil salinization. All the possible sources of related and up to date literature have been accessed and over 250 publications were collected and thoroughly analyzed for this review. The centrality of the environmental problems is provided. The background of the problems, managing rising water table to control soil salinization, the role of drainage frameworks, the conjunctive use of diverse water sources, utilization of numerical models, and the use of remote sensing and GIS systems are described. And the application of the aforementioned techniques and methods in various case study regions across the globe are discussed which is followed by discussion and research gaps. Derived from the literature analysis and based on the identified research gaps, some key recommendations for future research have been made which could be useful for the stakeholders. The literature analysis revealed that an all-inclusive approach for dealing with the aforesaid environmental problems has been barely considered in the previous studies. Similarly, the continuing impacts of growing salt-tolerant plants on soil characteristics and the environment in total have not been widely considered in the previous investigations. Likewise, better irrigation practices and

improved cropping systems along with the long-term environmental impacts of a particular approach has not been extensively covered in these studies. Also, previous studies have scarcely incorporated economic, social, and environmental aspects of the salinization problem altogether in their analysis. The analysis suggested that an inclusive feedback-supported simulation model for managing soil salinization should be considered in future research as the existing models scarcely considered some vital aspects of the problem. It is also suggested to enhance the sensing methods besides retrieval systems to facilitate direct detection of salinization and waterlogging parameters at large-scales. The existing time-lag between occurrence and recording of various data is also suggested to improve in the future scenario by the usage of information from multiple satellites that lessens the problems of spatial resolution by increasing the system efficiency. © 2020 Elsevier Ltd

14. Mansour, S., Kouz, T., Thaiki, M., Ouhadi, A., Mesmoudi, H., Hassani Zerrouk, M., Mourabit, T., Dakak, H., & Cherkaoui Dekkaki, H. (2021). Spatial assessment of the vulnerability of water resources against anthropogenic pollution using the DKPR model: A case of ghiss-nekkour basin, morocco. Arabian Journal of Geosciences, 14(8)

Abstract: Assessing the degree of vulnerability of surface water intended for drinking water supply has become a major necessity in water resource management and decision-making; it allows to identify high-risk areas and provide all the necessary measures for its protection. Specialized analysis techniques using geographic information systems (GIS) and remote sensing are increasingly being used to qualitatively assess this vulnerability. For his purpose, the aim of this study is to present the results of the application of the "DKPR" approach for evaluating of the degree of vulnerability that concerns water contamination of the Ghiss dam sub-watershed, a hydraulic structure under construction to ensure the supply of drinking water to the city of Al Hoceima and the surrounding centers, as well as the protection of the downstream area against floods generated during the Ghiss river floods. The latter drains agricultural plots, natural areas, uncultivated land, and rural settlements. The approach adopted involves four parameters: accessibility of the aquatic environment (D), soil and subsoil water functioning (K), watershed physiography (P), and rainfall erosivity (R). The final result is a map obtained by additionally combining the index maps of these four parameters. The overall vulnerability index obtained by

this combination varies in a range of values from 0 to 4 and is divided into five classes of vulnerability ranging from “very low” to “very high.” The results achieved show that the Ghiss dam sub-watershed is dominated by the moderate vulnerability class. It occupies 59.63% of the total area of the sub-watershed studied. © 2021, Saudi Society for Geosciences.

15. Fenjiro, I., Zouagui, A., & Manaouch, M. (2020). Assessment of soil erosion by RUSLE model using remote sensing and GIS - A case study of ziz upper basin southeast morocco. Forum Geografic, 19(2), 131-142

Abstract: Accelerated by inadequate human activities, water erosion can cause many environmental and socio-economic problems on -and off-site: loss of biodiversity, reduced productivity of agricultural land, siltation of dams, increased risk of flooding. The quantification of soil erosion is essential in the management and conservation of the soil and water resources. Modeling soil erosion can provide a lot of information to estimate soil loss and sediment yields at large-scale. In this study, the Revised Universal Soil Loss Equation (RUSLE) integrated into a GIS was used to quantify soil losses in the large upper watershed of Ziz (4435 km2) in southeastern of Morocco. The RUSLE parameters were estimated based on data from satellite imagery, DEM-SRTM and national watershed management plan studies. The results show that annual average of the potential soil erosion is 489.5 t. ha-1. yr-1 and the specific sediment yield is 36.4 t. ha-1. yr-1. The main sources of sediment are in the watershed upstream parts and some deposition zones are located before the catchment outlet. These soil losses contribute to the annual siltation of the Hassan Eddakhil dam by a rate of 3.5%. The application of principal components analysis to soil erosion factors shows an important influence of the soil erodibility factor (K) followed by the topographic factor (LS) then crop management factor (C). These modeling results will provide data within the Moroccan southeastern High Atlas that can constitute a road map for future soil erosion projects and it can be a useful tool for proposing soil conservation strategies.

16. Saravanan, S., Saranya, T., Jennifer, J. J., Singh, L., Selvaraj, A., & Abijith, D. (2020). Delineation of groundwater potential zone using analytical hierarchy process and GIS for gundihalla watershed, karnataka, india. Arabian Journal of Geosciences, 13(15)

Abstract: Remote sensing (RS) and geographical information system (GIS) have a wide range of applications in groundwater assessment, exploration, and resource management. Several other types of research targeting the water quality assessment in the study area have been done. However, the present work is the first attempt to delineate the groundwater potential zone using a different approach. This paper finds the way to identify the groundwater potential zone for Gundihalla watershed located in the hard rock region of Bellary district in Karnataka state. Various thematic layers such as geomorphology, lithology, land use and land cover (LULC), soil, drainage density, lineament density, rainfall, and slope were prepared for the study area. The various sub-criteria of each thematic layer were ranked based on their influence in the groundwater recharge, and each thematic layer was given a weightage, derived from the analytical hierarchy process (AHP). The overall groundwater potential map for the study areas is obtained by performing a weighted overlay analysis of all the thematic layers. The resultant groundwater potential zone (GWPZ) map is further categorized into five different groundwater potential: very good (76%) good (23.70%), moderate (23.30%), poor (18%), and very poor (16.40%). The obtained results were validated using groundwater fluctuation data for pre- and post-monsoon periods. The validation holds well for the methodology adopted. Thus, the results were utilized for carrying out water management through artificial recharge and further exploration approaches. © 2020, Saudi Society for Geosciences.

17. Ghaffar, A., ur Rahman, M. H., Ali, H. R., Haider, G., Ahmad, S., Fahad, S., & Ahmad, S. (2020). Modern concepts and techniques for better cotton production. Cotton production and uses: Agronomy, crop protection, and postharvest technologies (pp. 589-628)

Abstract: Sustainable cotton production in current environmental conditions is under threat due to climatic variability and shortage of ever-decreasing resources for agricultural crops. There is dire need to improve the cotton production to fulfill increasing demands of the ever increasing world population which will rise up to nine billion till 2050. Poor soil health, poor water quality and water shortage, insect pest complex, and unpredictable climatic patterns are predominant

problems to cotton production. Hence, there is a great challenge to manage cotton crop in a sustainable fashion without the degradation of soil, water, and environment due to climate variability. There are several factors associated with low production of cotton including improper sowing and picking, poor pesticide spraying approaches, inappropriate amount and time of irrigation, processing and ginning through inappropriate and primitive procedures, heat stress, lack of disease-and pest-tolerant varieties, improper nutrient management, improper disease management, and improper weed management. It is the need of the hour to adopt the modern technologies and applications for sustainable cotton production. There are severalmodern technologieswhich can increase the production of cotton and make the idea of sustainability feasible because of their site-specificmanagement of all agricultural inputs. GPS, GIS, and remote sensing technologies make the precise seeding of cotton seed, fertilizers, and pesticides. IPM, IWM, and INM are the welldeveloped modern concepts which not only reduce the cost of production but also mitigate the emission of greenhouse gases. For sustainable cotton production, implementation of these modern concepts is crucial so that the human beings will get benefits in the future. Therefore, this chapter will be focused on the recently developed technologies which can be sustainably utilized for the better management of cotton crop across the world. This chapter will explore the importance of Decision Support system (DSS) for sustainable cotton production; role of GPS, GIS, and remote sensing for identifying site-specific factors such as soil quality indicators; importance of transgenic cotton; impact of mechanical sowing and picking on sustainable cotton production; use of UAVs for nutrient and pesticide management; and impacts of modern concepts on increasing agronomic production and advancing global fiber and oil security.

18. Nguyen, T. T., Ngo, H. H., Guo, W., Nguyen, H. Q., Luu, C., Dang, K. B., Liu, Y., & Zhang, X. (2020). New approach of water quantity vulnerability assessment using satellite images and GIS-based model: An application to a case study in vietnam. Science of the Total Environment, 737

Abstract: Water deficiency due to climate change and the world's population growth increases the demand for the water industry to carry out vulnerability assessments. Although many studies have been done on climate change vulnerability assessment, a specific framework with sufficient

indicators for water vulnerability assessment is still lacking. This highlights the urgent need to devise an effective model framework in order to provide water managers and authorities with the level of water exposure, sensitivity, adaptive capacity and water vulnerability to formulate their responses in implementing water management strategies. The present study proposes a new approach for water quantity vulnerability assessment based on remote sensing satellite data and GIS ModelBuilder. The developed approach has three layers: (1) data acquisition mainly from remote sensing datasets and statistical sources; (2) calculation layer based on the integration of GIS-based model and the Intergovernmental Panel on Climate Change's vulnerability assessment framework; and (3) output layer including the indices of exposure, sensitivity, adaptive capacity and water vulnerability and spatial distribution of remote sensing indicators and these indices in provincial and regional scale. In total 27 indicators were incorporated for the case study in Vietnam based on their availability and reliability. Results show that the most water vulnerable is the South Central Coast of the country, followed by the Northwest area. The novel approach is based on reliable and updated spatial-temporal datasets (soil water stress, aridity index, water use efficiency, rain use efficiency and leaf area index), and the incorporation of the GIS-based model. This framework can then be applied effectively for water vulnerability assessment of other regions and countries. © 2020

19. Hashim, H. Q., & Sayl, K. N. (2020). The application of radial basis network model, GIS, and spectral reflectance band recognition for runoff calculation. International Journal of Design and Nature and Ecodynamics, 15(3), 441-447

Abstract: Runoff estimation in a watershed is very important for efficient management of scarce water resources. Soil information is essential information for runoff estimation. Data collecting and determination of soil textural classification for large territory using the traditional method, i.e. laboratory testing is time-consuming and costly. Therefore, this study suggested a model based on the combination of Radial Basis Neural Network (RBNN) model, Geographic Information System (GIS), Remote Sensing (RS) and field data to create a digital soil map. This model was studied as a case study in western Iraq, and it was tested using performance parameters. The findings of this model were further confirmed using the hydrological soil group developed by the United States Geological Survey (USGS). The adopted model has been successful in predicting the spatial

distribution of clay soil, followed by both silt and sand. It was also noted that the Root Mean Square Error (RMSE) for clay, silt and sand is 4.2 percent, 9.5 percent and 11.0 percent respectively, while the highest value was for the coefficient of clay soil correlation (0.749). Furthermore, there are only four samples out of 25 that have minor variations in the estimated and measured soil texture category defined by USGS. The methodology adopted in this study is therefore well practical for soil classification. Additionally, a broad scale will produce high-quality runoff measurement.

20. Adaktylou, N., Stratoulias, D., & Landenberger, R. (2020). Wildfire risk assessment based on geospatial open data: Application on chios, greece. ISPRS International Journal of Geo-Information, 9(9)

Abstract: Wildfires burn tens of thousands of hectares of forest, chaparral and grassland in Mediterranean countries every year, giving rise to landscape, ecologic, economic, and public safety concerns. On the Greek island of Chios and in many other Mediterranean landscapes, areas affected by fire are difficult to access and control due to rugged terrain, requiring wildfire preparedness and response plans that support fire fighting. This study utilized open source data and a weighted linear combination to extract factors that determine wildfire risk. Landsat satellite imagery and publicly available geospatial data were used to create a Geographic Information System and a multi-criteria analysis to develop a methodology for spatially modeling fire risk on Chios, a Greek island with frequent fire occurrence. This study focused on the static, structural component of the risk assessment to produce a spatial distribution of fire risk as a thematic map. Fire weather conditions were accounted for using Fuel Moisture Content, which reflected dryness of dead fuels and water deficit of live biomass. To assess the results, historic fire data representing actual occurrence of fire incidents were compared with probable fire locations predicted by our GIS model. It was found that there was a good agreement between the ground reference data and the results of the created fire risk model. The findings will help fire authorities identify areas of high risk for wildfire and plan the allocation of resources accordingly. This is because the outputs of the designed fire risk model are not complex or challenging to use in Chios, Greece and other landscapes.

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