Effects Of Ground Water Quality Due To Usage Of Treated Sewage & Its Impacts On Agricultural Land Using GIS: A Case Study Of Jaspur STP

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Abstract- *Increasing concern in recent years in India is on the issue of long-term prospects of irrigation and the consequences of continuing current water management practices on the sustainability of irrigation systems which have been created with huge financial investments. The selective studies mentioned in this study describe the application of advanced technologies namely Remote Sensing and Geographic Information System, which has been demonstrated recently, in many irrigation systems in India to address the various issues relevant to sustainable management of irrigation systems. The primary agricultural information at disaggregated level derived from the analysis of high resolution satellite data has formed the basic input in all these studies.*

In this study the impact of STP treated water on agriculture in Kalol & Daskroi taluka will be analysed using RS & GIS data. Changes in agricultural land irrigated area and implementing in cropping system will be studied.

At the same time hydro geochemical investigation was carried out in the Kalol & Daskroi taluka, to understand the geochemistry of the groundwater and to assess the overall physic-chemical characteristics.

Keywords- Ground Water, Waters Quality, Agriculture, Remote Sensing, GIS, STP.

I. INTRODUCTION

The management of urban wastewater in India today poses serious challenges in the face of rapid urbanization. The treatment facilities in Gujarat, as elsewhere in India, for sewage are highly insufficient and untreated sewage is rapidly polluting the streams, sea creeks, and water bodies, where it is disposed. Concurrently, it has been observed that wastewater irrigation is commonplace in peri-urban areas of Gujarat. Instances from field visits support the growing use of wastewater for irrigation due to scarcity of fresh water sources for irrigation. The wastewater has become an important resource for agriculture, especially for increasingly urbanized and water scarce states like Gujarat.

Agriculture in Gujarat is characterized by natural disparities such as (i) drought prone areas and lowest annual rainfall amounting to only about 345 mm at the North Westend of the states; and assured and highest annual rainfall amounting to about 2500 mm at the South-East end; (ii) well drained deep fertile soils of central Gujarat and shallow and undulating soils with poor fertility in hilly rocky areas in the east; (iii) moisture starved degraded areas and low lying waterlogged and saline areas; (iv) areas prone to frequent scarcity and areas prone to frequent cyclone or floods or locusts (GoG, 2012a). Thus, output of agricultural sector in Gujarat has been largely dependent on south-west monsoon. The state frequently experiences erratic behavior of the south-west monsoon, which can partly be attributed to geographic situation.

As per Central Pollution Control Board (CPCB) rules, a city or town's municipality or Water Authority (WAs) is responsible for collecting and treating 100 percent of the sewage generated within its jurisdiction. At present, a majority of the WAs in the country neither have the installed capacity nor the collection networks to undertake sewage recycling. A 2010 Centre for Science and Environment (CSE) report puts installed treatment capacity at only 19 per cent of total sewage generation and even this limited capacity reportedly runs at 72 percent utilization (CSE 2010). A 2007 CPCB sample survey of existing Sewage Treatment Plants (STPs) classified the performance of only 10 per cent as 'good' with 54 per cent falling into the 'poor' and 'very poor' categories (CPCB 2009). The CSE also brought out 'Excreta Matters' as their 7th Citizens' Report on the state of India's Environment in the year 2012 (CSE 2012). This study captures the water supply, water generation, water treatment and ultimately, wastewater disposal in urban areas across the nation. The findings are that the water, which is supplied to cities, are demand based and the official records under represent actual supply. This underrepresented water supply does not have sewage collection network or sufficient treatment systems of sewage.

Groundwater is one of the nation's most important natural resources. Groundwater systems are dynamic and can adjust continually to short-and long-term changes in climate, groundwater withdrawal, and land use. The balance between charging and discharging of aquifers controls the groundwater level. Without a well-functioning water supply, it is difficult to imagine a productive human activity be it agriculture or livestock. The quality of water is of almost the same importance to quantity in any water supply planning. Natural and anthropogenic effects, including local climate, geology, and irrigation practices influence water quality. The chemical character of any groundwater determines its quality and utilization. The quality is a function of the physical, chemical, and biological parameters, and could be subjective since it depends on a particular intended use. Further, it is important to understand the change in quality due to rock water interaction or any type of anthropogenic influence.

Water quality analysis is one of the more important issues in groundwater studies.

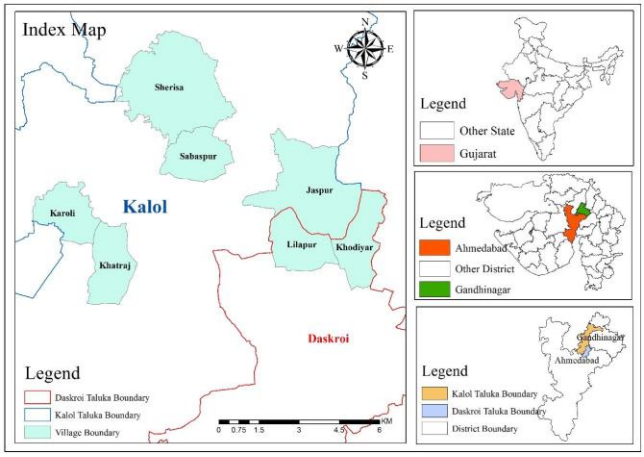
Groundwater chemical composition, intended for the irrigation, presents one of the major problems in the alpine Himalayan zone, considering its effect on deterioration of water quality and lowering of the agricultural output. This problem is often related to the nature of geological formations and climatic factors. Several studies were carried out on this topic around the world.

The variety and extent of groundwater chemical composition could also be influenced by natural processes such as evaporation, cation exchange, dissociation of minerals, mixing of water, rock weathering, and human activities. The coastal aquifer in India and various parts of the world are also reportedly badly affected by the over-exploitation due to high 3 population growth and large scale industrialization in the coastal zones which threatens the coastal freshwater resources globally, rendering groundwater non-drinkable. Besides this, the presence of arsenic in surface water and groundwater resources in many countries has also caused adverse effects on human health. The geochemistry of soil and the geological history of rocks has a significant impact on the chemical contamination of groundwater. Therefore, any groundwater suitability assessment for agriculture should include them chemical composition.

The objective of the research is to understand the groundwater quality through detail hydrochemistry in the study area, to determine the various classifications of groundwater, prepare the spatial distribution map of the various physical-chemical parameters using the GIS and delineation of groundwater quality zones in the study area.

GENERAL DETAIL/STATISTICS OF DOMAIN

In my Study I have selected major three villages where STP treated water is used for irrigation purposes. Because of the effectiveness the selected villages are near to the Sewage Treatment Plant & the villages are continuously using the STP treated water from last two to three decades. Some of the Agricultural Land using Sewage water as a primary source of water from last five decades.



The major villages are Khodiyar, Lilapur, Jaspur, Sabaspur, Sherisa, Karoli & Khatraj. From that Jaspur, Sabaspur, Sherisa, Karoli & Khatraj comes under Kalol Taluka & Khodiyar & Lilapur comes under Ahmedabad, Daskroi taluka. For my study the irrigation land and its mapping is required, for that some satellite maps & images are below to show the selected villages.

Aim of the study: The aim of the study is to see impact on Groundwater water quality where treated wastewater used for irrigation on Agricultural Land for long period (Two to Three decades) and do comparative analysis of Groundwater Parameters of Study area.

Objectives of the study:

To identify the villages using STP treated water for agricultural purpose.

Selection of villages where treated sewage water is used or not from the selected domain. (By doing Field visit & Interviews with farmers)

To collected treated water samples from STP for lab analysis.

Visit the villages for sample collection where STP treated water & bore-well water used for irrigation purposes.

To analyse the parameters like pH, TDS and Total Hardness of STP treated water & Bore-well used in agricultural area in different Villages.

Comparative analysis of groundwater parameters of selected villages (Khodiyar, Lilapur, Jaspur, Sabaspur, Sherisa, Karoli & Khatraj).

II. LITERATUR SURVEY

Literature review is one of the most vital chapter of this theses. Research papers / Review published by technocrats after extensive study, experiments and research on "Effects Of Ground Water Quality Due To Usage Of Treated Sewage & Its Impacts On Agricultural Land Using GIS: A Case Study Of Jaspur STP" were thoroughly studied and used as reference in this theses.

1 Application of remote sensing methods in agriculture [1]

Authors: Marek Wójtowicz, Andrzej Wójtowicz, Jan Piekarczyk

With advances in satellite, airborne and ground based remote sensing, reflectance data are increasingly being used in agriculture. This paper reviews various remote sensing methods

designed to optimize profitability of agricultural crop production and protect the environment. The paper presents examples of the use of remote sensing data in crop yield forecasting, assessing nutritional requirements of plants and nutrient content in soil, determining plant water demand and weed control.

2 Assessment of land suitability and capability by integrating remote sensing and GIS for agriculture in Chamarajanagar district, Karnataka, India [2]

Authors: Mohamed A.E. AbdelRahman, A. Natarajan, Rajendra Hegde

To reduce the human influence on natural resources and to identify an appropriate land use, it is essential to carry out scientific land evaluations. Such kind of analysis allows identifying the main limiting factors for the agricultural production and enables decision makers to develop crop managements able to increase the land productivity. Objectives of this study were to develop a GIS based approach for land use suitability assessment which will assist land managers and land use planners to identify areas with physical constraints for a range of nominated land uses. Georeferenced soil survey data and field work observations have been integrated in a GIS based land use suitability assessment for agricultural planning in Chamarajanagar district, Karnataka, India. Also, GIS has been used to match the suitability for main crops based on the requirements of the crops and the quality and characteristics of land. Different land quality parameters, viz.

3 Agriculture as a funding source of ISIS: A GIS and remote sensing analysis [3]

Authors: Hadi H. Jaafar, Eckart Woertz

Agriculture is an important source of income for the Islamic State in Syria and Iraq (ISIS), which currently rules over large parts of the breadbaskets of the two countries. It has received limited attention compared to other sources of ISIS revenues such as oil, looting, ransom, foreign donations and various forms of taxation. We estimate winter crops production of wheat and barley in ISIS-controlled areas in both Syria and Iraq for the years 2014–2015 and irrigated summer crops production (cotton) in Northeast Syria. We show Khamar Harsh Jayeshkumar Page 22 (160810717004) that remote sensing can give a credible estimation of agricultural production in the absence of statistics. With evidence from MODIS Aqua and Terra Satellites as well as Landsat imagery, we find that agricultural production in ISIS-controlled Syrian and Iraqi zones has been sustained in 2014 and 2015, despite the detrimental impact of conflict. After a drought in 2014 production was able to capitalize on improved rainfalls in 2015. First indications show that the winter grain harvest of 2016 in Iraqi territories of ISIS was significantly above pre-conflict mean and below pre-conflict mean in its Syrian territories. We also show how water flows along the Euphrates have impacted production. We estimate the revenue that ISIS can derive from wheat and barley production and the likely magnitude of an exportable surplus.

4 Irrigation in Developing Countries Using Wastewater [4]

Authors: Blanca Jiménez

Wastewater is an important source of water and nutrients for irrigation in developing countries, particularly but not restricted to those located in arid and semi-arid areas. The use of wastewater is widespread and represents around 10 percent of the total irrigated surface worldwide, although varying widely at local levels. While the use of wastewater has positive effects for farmers, mainly related to their income level, it also has negative effects on human health and the environment. The negative effects impact not only farmers but also a wide range of people. Because wastewater reuse is currently necessary, it is important for governments to put in place wise but feasible management practices, such as the ones discussed in this paper, to improve the benefits while reducing

and controlling the drawbacks. In order to implement sustainable reuse of wastewater and to contribute to food security, reuse projects need to be planned and constructed for the long term and based on local needs.

5 Impact of irrigation water quality on human health: A case study in India [5]

Authors: Jeena T. Srinivasan, V. Ratna Reddy

Untreated or partially treated wastewater, which is a negative externality of urban water use, is widely used for irrigation in water scarce regions in several countries including India. While the nutrients contained in the wastewater is considered as beneficial to agriculture, the contaminants present in it pose environmental and health risks. This paper examines the morbidity status, its determinants as well as the cost of illness for households living in the areas irrigated with wastewater in comparison with those using normal quality water. Primary data collected from six villages irrigated with wastewater along Musi River which is fed with wastewater and one control village where normal quality water is used for irrigation has been used for the analysis.

III. METHODOLOGY

Geospatial technology have been used to investigate the geomorphic setting using satellite imagery Landsat-8 (30m) collected from the USGS Earth Explorer and digital elevation model (DEM) SRTM (30m)after pre-processing techniques. Various image processing techniques such as image correction, rectification, enhancement including standard color composites, intensity-hue-saturation (IHS) transformation and decorrelation stretch (DS) were applied to map rock types.

In order to assess the groundwater pollution, 50 groundwater samples were collected using the random sampling techniques (Nelson and Ward, 1981).The samples were collected during the month of April-May for the pre-monsoon season and October-November for the post-monsoon season by using the one-liter narrow-mouthed pre-washed polyethylene bottles. Although, the groundwater locations were selected to cover the entire study area that have been extensively used for drinking and other domestic purposes and attention was given to the area where contamination is expected. Environment sensitive index such as pH (hydrogen ion concentration), electrical conductance (EC) and total dissolved solids (TDS) were measured in the field at the time of sample collection. For the field measurement of pH, a portable pH meter (waterproof pH Scan 2 Tester) was used. EC value of the samples were measured by the EC meter (water proof EC scan 3 Tester); whereas TDS was measured with TDS meter (water proof TDS Scan1Tester).The techniques and methods for collection and analysis of water samples followed in this study were those after the American Public Health Association (APHA, 1992) and Manual of Pollution Control Board, New Delhi (MPCB, 1997).

The identification of major ions concentrations were carried out at the Hydrochemical Laboratory, Department of Geology, University of Jammu, Jammu. The analytical accuracy of these methods ranges from 3% to 5%. The dissolved oxygen (DO) analysed in the laboratory by the Winkler titrimetric azide modification (iodometric) method and total alkalinity by the color indicator method. The total hardness (TH) and calcium were estimated by the ethylene diamine triacetic acid(EDTA) titrimetric method and magnesium was estimated by their difference. Sodium and potassium were analyzed using the instrument Flame Photometer.Bicarbonate was measured by titration with 0.1 NHCl using color turning method with methyl orange. The chloride concentration was analysed by titrimetric (argentometric) method. Fluoride ion concentration was estimated by fluoride ion selective electrode coupled to ion analyze atomic absorption photometer. The sulphate, nitrate and silica ion concentration were estimated by the gravimetric method using the instrument Flame Photometer. All the concentrations are expressed in mg/l except pH and EC in μs/cm.

Meanwhile, the location of each well was taken into the GIS environment using ARC GIS 10 software, and the results of each parameter analyzed were added to the concerned wells. The spatial analysis was carried out for drinking and irrigation water quality mapping in the study area.

IV. CONCLUSION

The study reveals that there is a close relationship between physiography and soils. The formation of the diverse group of soils can be attributed to the variation in topography, causing erosion, leaching, sedimentation and other pedogenic processes modified by water table.

The water quality is the precarious factor that influences the social, industrial and agricultural development of any region. Moreover, the assessment of groundwater water quality is an important aspect of evaluating groundwater pollution due to natural or anthropogenic inputs. Groundwater quality and its suitability for irrigation and domestic purposes were evaluated by various physicochemical and water quality parameters during pre-monsoon and post-monsoon seasons by comparing the results with different water standards. Groundwater in the Western Doon valley is acidic to alkaline in

nature and shows marginal seasonal changes. The results of ground water indicates that the alkaline earths(Ca2+ and Mg2+) exceeds the alkalies (Na+ and K+),weak acid (HCO3-) exceed the strong acids(Cl-,SO42-, NO3-) and secondary salinity exceeds 50% which is dominated by alkaline earth and weak acid. Hence, the groundwater of the study area shows dominance of calcium-magnesium-bicarbonate, indicating the recharging of water from carbonate present as cementing materials in the sandstone aquifer.

The Ca2+ and TH (Ca2++ Mg2+)more than the highest desirable limit indicating moderately hard to very hard water in some areas. The Gibbs ratio for the anions and cations of the water samples plotted against the relative values of the total dissolved solids, point towards rock dominance of the chemistry of groundwater in the region, which reflects the influence of the chemistry of aquifer lithology vis-à-vis groundwater. The groundwater is classified as fresh water, normal chloride, normal sulphate, normal carbonate water and moderately hard to hard. Based on the RSC value of groundwater samples of the study is within the safe limit. The classification of irrigation water in relationship to salinity and sodium hazard shows the low sodium hazard and low to medium salinity hazard, which indicate that, the groundwater is suitable for irrigation purposes. The permeability index shows that majority of groundwater samples fall in the class-I, and class-II and a few samples fall in class-III indicates that the groundwater quality is good for irrigation purpose. Hence, the overall quality of groundwater is suitable for the drinking as well as irrigation purposes. Although, it is also imperative for the sustainable groundwater quality and quantity that special attention should be paid to minimize the excessive withdrawal for water management, efficient water quality monitoring program incorporating measurements of physical, chemical and biological parameters over a long period.

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