American-Eurasian J. Agric. & Environ. Sci., 14 (7): 681-684, 2014
ISSN 1818-6769

DOI: 10.5829/idosi.aejaes.2014.14.07.12374

Effects of Deforestation and Nutrients Loss on Watershed Degradation in Hana Urak and Karkhasa Regions

[1]Abdul Kabir Khan Achakzai, [2]Huma Batool, [1]Zahoor Ahmed Bazai, [3]Pashtana Sahib Jan, [4]Mohammad Afzal and [5]Uzma Hanif

[1]Department of Botany, University of Balochistan, Quetta, Pakistan
[2]Department of Environmental Sciences, SBK Women University, Quetta, Pakistan
[3]Department of Botany, SBK Women University, Quetta, Pakistan
[4]Department of Soil and Environmental Sciences, Agriculture University, Peshawar, Pakistan
[5]Department of Botany, Government College University, Lahore, Pakistan

Abstract: This study was carried out to assess the water quality of Hana Urak and Hazar Ganji (Karkhasa) of Quetta city. A total of 12 water samples were collected from two locations. The physico-chemical parameters for water quality included pH (7.56±0.2-7.43±0.19), total solids (0.03±0.007-0.04±0.01) and total coliform bacteria (412.33±52.08-381±98.38). Some heavy metals (Cu, Mn, Fe, Pb) were also determined. All parameters were compared with standard permissible limits to assess the best-designated use of water for drinking purposes. The concentration of all the trace metals was with in the permissible limits for its use as drinking water and other purposes according to World Health Organization (WHO). Since the water of both areas contain high number of coliform bacteria, hence cannot be used for drinking purposes without prior treatment. The present study recommends that top priority should be given to monitor the depletion of water level of both areas.

Key words: Deforestation · Nutrient loss · Water quality · Heavy metals · Coliform bacteria

INTRODUCTION

Deforestation leads to vegetation loss and also decrease nutrient uptake in the soil, which results in an increased rate of nutrient leaching from the soil. The leached nutrients are deposited in water bodies. Which alter physical stream characteristics as well as rates of productivity and ecological components of water bodies [1]. Mismanagement of land degrades water quality and reduces water productivity [2, 3]. Urbanization is a threat to lakes and streams; it alters the landscape and ecological characteristics, resulting in degraded streams [4]. Elements of watershed degradation are deforestation, soil erosion, adverse changes to river flow and sediment content. Watershed degradation is a serious threat to the environmental conditions and also to the survival of millions of people living in upland as well as downstream areas [5]. Impervious surfaces (e.g., rooftops, parking lots and roads) collect pollutants, such as nutrients, heavy metals, sediment, oil and grease, pesticides and fecal coliform bacteria. These pollutants are washed off and delivered to aquatic systems by storms [6, 7].

Groundwater depletion is the main component of the land degradation process in Balochistan Province, Pakistan. This is because the majority of the population of the province depends on groundwater, for which no economic alternative is available. The water table level is dropping in some places by as much as 3 meters per year. If this situation continues the research study concludes that in the next 10-20 years loss of the groundwater will lead to a decline of the province's largest economic sector, irrigated agriculture [8]. Around Quetta in Pakistan, where the abstraction rate is 2.5 cubic meters per second (cumecs), while the recharge rate is 2.0 cumecs, the groundwater level is decreasing at around one meter per year [9].

Corresponding Author: Abdul Kabir Khan Achakzai, Department of Botany, University of Balochistan, Quetta, Pakistan.

The pollution loads from the watershed and habitat degradation and change of lands surrounding the water body are causing increased risk to public health and gastrointestinal disease to those who want to use the water body for swimming and other contact recreation [10]. The main objectives of this study were therefore to assess the causes of watershed degradation and to compare the water quality of the selected areas by estimating different physical, chemical and biological parameters. And also to recommend the ways which can be useful in combating against the potential risk of nutrient loss due to watershed degradation.

MATERIALS AND METHODS

Study Area: Balochistan is the largest province in Pakistan with an area about 343,000 square km. It has a population of about only one million, mainly due to its arid geography. The name Quetta originates from the Pashto word Kwatta which means a fort. Quetta is situated about 1676–1900 meters above sea level in north-western Pakistan.

The study area of the research project was Hana Urak in Quetta city and Hazargangi (Karkhasa). Hazarganji literally means "*Of a thousand treasures*". In the folds of these mountains, there are over a thousand treasures buried. In the Hazarganji Chiltan National Park, 20 km south-west of Quetta, Markhors have been given protection. The park is spread over 38,429 acres, altitude ranging from 2021 to 3264 meters. The Park is a storehouse of some 225 plant species including pistachio, junipers, wild olives, wild ash and wild almonds.

Karkhasa is a recreation Park situated at a distance of 10 km to the west of Quetta. It is 16 km long narrow valleys which have variety of flora like Ephedra, Artimisia and Sophora. Urak valley is located at the foothills of the Zarghun Mountain, located at about 25 kilometers to the north-east of Quetta city. Peaches, plums, apricot and apples of many varieties are grown in this valley. In summer this place remain quite busy as this is the only nearest picnic place for the people of Quetta city. Due to global climate change and less rain and snow in the region, the streams in the Urak valley are often dry.

Laboratory Analysis

Water Samples: Two randomly selected drinking water samples were collected in order to analyze for the physical and chemical characteristics from two different locations (Hana Urak and Hazar Ganji karkhasa) of Quetta city during the first week of June. The sample was collected in wide mouthed sterilized bottles (1000ml), the water temperature and the atmospheric temperature was noted at the site. The samples were taken to the Laboratory for further investigation.

Color of Water: The color of each water sample was determined visually.

Odor of Water: The odor of each water sample was determined by smelling the water samples.

Temperature: The water temperature was recorded with the help of Centigrade Thermometer.

Hydrogen Ion Concentration (pH): The pH value of each water sample was determined by pH meter Model- 3505.

Total Solid (TS): The total solids of the water were calculated by the Formula

Formula = final weight – initial weight

Number of Bacteria (Coliform): The bacteria were grown on EMB (Eosin Methyl Blue) agar plates under aseptic conditions. After 24 hours colonies of coliform bacteria appeared on agar plates which were then counted with the help of colony counter Model- 230.

Heavy Metals Analysis: 100 ml of water samples were analyzed for heavy metals (Cu, Mn, Fe, Pb, Zn, Ni and Cd) by using an atomic absorption spectrophotometer (Model ca- 2380).

RESULTS AND DISCUSSION

The average level of concentration of various parameters including physical and chemical analyzed on water samples from Hana Urak and Karkhasa are presented in Table 1 & 2. The appropriate limits of drinking water standards by WHO, PCRWR and PSI for the parameters analyzed are quoted in the Table 3 for comparison.

Temperature: Mean temperature values both for air and water varied between the two locations as indicated by Table 1. The total mean temperature at Hana Urak was 19.67±0.00 with atmospheric temperature 32.67±1.27 and Karkhasa was 22.50±1.05 with atmospheric temperature 27.00±2.66. The highest water temperature was recorded at Karkhasa and lowest temperature was found at Hana

Table 1: Values of physical, chemical and biological characteristics of water samples from Hana Urak and Karkhasa.

	Hana Urak			Karkhasa		
Parameters	Sample 1	Sample 2	Mean Values	Sample 1	Sample 2	Mean Values
Air Temp.°C	30.33±1.53	35±1.01	32.67±1,27	26.67±3.78	27.33±1.53	27.00±2.66
Water Temp. °C	19.67±0.58	19.67±0.58	19.67±0.00	22.33±1.53	22.67±0.57	22.50±1.05
pH	7.43±0.19	7.24±0.14	7.34±0.17	7.56±0.2	7.50±0.05	7.53±0.13
Total Solid Gm	0.02±0.007	0.03±0.007	0.025±0.007	0.04±0.01	0.04±0.007	0.04±0.008
No. of Coliform	344.33±24.98	412.33±52.08	378.33±8.53	381±98.38	452±62.94	416.5±80.64
Color	clear	Turbid greenish with mud		Muddy	clear	
Odor	odorless	Foul smell		Odorless	Odorless	Odorless

Data is the mean of three replicates ± standard error (S.E.).

Table 2: Mean concentrations of trace metal ions in parts per millions (ppm) in drinking water samples from Hana Urak

S. No.	Location	Mn	Fe	Cu	Pb
1	Hana Urak	0.06	0.61	0.09	0.02
2	Karkhasa	0.09	0.54	0.08	0.03

Table 3: Water quality standards drinking as recommended by WHO, PCRWR and PSI

Parameter	WHO standards	PCRWR standards	PSI standards
Taste and Odor	-	-	Unobjectionable
TDS	1000	500 - 1500	1000 - 1500
Iron	0.1	0.1 -1.0	0.3 -1.0
Manganese	0.500	0.05 – 0.5	0.1 -0.5
Copper	2.000	0.05-1.5	1.0 – 1.5
Zinc	3	5.0-15.0	5.0-15.0
Lead	0.10	0.05	0.05
Nickle	0.020	-	-
Cadmium	0.003	-	0.01
pH	-	7.0-8.5	7.0-8.5
Coliform organisms	0/100ml	10/100ml	No more than 100

All units are in mg L^{-1}, except pH.

Urak. The temperature of water is important for biological activity and varied with atmospheric temperature. Temperature is important because of its influence on water chemistry. The rate of chemical reactions generally increases at higher temperature, which in turn affects biological activity [11]. Higher temperatures also decrease the maximum amount of oxygen that can be dissolved in the water, leading to oxygen stress if the water is receiving high loads of organic matter.

pH: Among the physico-chemical factors, hydrogen ion concentration is an important factor which influences the availability of heavy metals in the aquatic system [12]. The pH of investigated sample varied from both locations. The pH value was 7.53±0.13 at Karkhasa and 7.43±0.17 at Hana Urak. Basically the pH is determined by the amount of dissolved CO_2 form carbonic acid in water [13]. The pH values at both locations were within the WHO permissible limits.

Total Solids: The total solids in the water samples collected from Hana Urak and Karkhasa varied from 0.025±0.007 to 0.04±0.008.

Coliform Bacteria: Variation was found in the number of bacteria (Coliform) of both the areas. The number of Coliform bacteria was 378.33±38.53 at Hana Urak and 416.5±80.64 at Karkhasa. The relatively high values of coliform bacteria at both locations exceed from the permissible limits of world health organization table.

Manganese (Mn): The mean concentration of Mn in Hana Urak and Hazar Ganji was 0.06 and 0.09 respectively according to the Table 2 and 3. The values are within the permissible limits of WHO standards.

Iron (Fe): The level of iron ranged between 0.61 and 0.54 at Hana Urak and Karkhasa respectively. Both the values are with in the permissible limits of WHO standards.

Copper (Cu): The concentration of Cu in Hana Urak and Karkhasa was 0.09 and 0.08 respectively.

Lead (Pb): The concentration of Pb was 0.02 and 0.03 at Hana Urak and Karkhasa. The level of Lead in this study was with in the permissible limits of WHO standard (Table 3).

Therefore, it can be stated that the water of Hana Urak and Karkhasa are safe for drinking purposes. The results agreed with the work of [14] that the concentration of all the estimated trace metals was within the permissible limits for its use as drinking water and other purposes according to WHO.

The concentration of different elements present in water sample of two locations (Hanna and Karkhasa) was considered as parameter to evaluate the level of degradation of watershed. The increase in concentration of nutrients in water sample of respective area indicates more loss of nutrients ultimately is watershed degradation.

CONCLUSIONS AND RECOMMENDATIONS

In conclusion, deforestation has a significant impact on stream ecology. Significant differences in phosphate and silica are strong indicators of erosion inputs to streams in deforested watersheds. Increases in nitrate and nitrite concentrations are indicators of leaching inputs to streams in deforested watersheds. Changes in concentration of all of these nutrients change stream ecology in that they are often limiting and can cause severe ecological consequences, such as eutrophication.

Deforestation also significantly increases conductivity, temperature and decreases dissolved oxygen. Many aquatic organisms are sensitive to these parameters, either directly or indirectly. Therefore, changes result in alterations of the biotic community.

The analytical results revealed that some physicochemical characteristic of water samples of Hana Urak and Karkhasa meet WHO guidelines while some characteristics did not match WHO guidelines for drinking and other purposes. All the trace metals were within the permissible limits of drinking and other purposes. Since the water of both areas contain high number of coliform bacteria, hence cannot be recommended its use for drinking and recreational purposes. So it is concluded that top priority should be given to the prevention of water from degradation. It is believed that the preventive measures must be taken at all levels to prevent water contamination for achieving best quality water. Top priority should be given to conservation of water resources.

REFERENCES

1. Caruso, B., 2002. A survey comparing streams from forested and deforested watersheds to assess impact of land use change on the northeastern shore of Lake Tanganyika. Nyanza 2002 Annual Report.
2. Molden, D.J., H. Murray-Rust, R. Sakthivadivel and I. Makin, 2003. A water productivity framework for understanding and action. In 'Water productivity in agriculture: limits and opportunities for improvement". Wallingford UK (CABI), pp: 1-18.
3. Zwart, S.J. and G.M. Bastiaanssen, 2004. Review of measured crop water productivity values for irrigated wheat, rice, cotton and maize. Agricultural Water Management.
4. Morse, C.C., 2001. The response of first and second order streams to urban Land-use in Maine. Ecol. & Environ. Sci. Program, pp: 98.
5. Kapta, S.K., 2004. Experiences of integrated watershed development (Hills-II), Kandi project in 'Shivaliks' of Himachal Pradesh. Wastelands News, 19(3): 27-35.
6. Schueler, T., 1995. Site Planning for Urban Streams Protection. Environmental Land Planning Series: Washington, DC.
7. Gove, N.E., R.T. Edwards and L.L. Conquest, 2001. Effects of scale on land use and water quality relationships. J. Amr. Water Resource Assoc., 37(6): 1721-1734.
8. Gils, H.V. and M.S. Baig, 1992. Environmental Profile of Balochistan Pakistan. LARUS-ITC Enschede the Netherlands/EU-SSP Lahore Pakistan.
9. Acreman, M.C., 1993. Hydrology and the environment. The Lower Indus and Balochistan. Report to IUCN Pakistan. Gland, Switzerland: IUCN.
10. Novotny, V., 2003. Incorporating Diffuse Pollution Abatement into Water Shed Management. Water Quality: Diffuse Pollution and Watershed Management, New York.
11. Michaud, J.P., 1991. A citizen's guide to understanding and monitoring lakes and streams. Publ. # 94-149". Washington State Dept. of Ecology, Olympia, WA, USA.
12. Polprasert, C., 1982. Heavy metals pollution in the Chao Phraya river estuary, Thailand. Water Res., 16: 775-784.
13. Hem, J.D., 1985. Study and Interpretation of the Chemical Characteristics of Natural Water. 3rd Edn, United States Geological Survey, Washington.
14. Al-Naeem. A.A., 2008. Hydrochemical Processes and Metal Composition of Ain Umm-Sabah Natural Spring in Al-Hassa Oasis Eastern Province, Saudi Arabia. Pak. J. Biol. Sci., 11(2): 244-249.