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# INDIA, AND NEARBY REGIONS ENVIRONMENTAL MONITORING

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***ABSTRACT***

*Traditional drought evaluation techniques rely on weather and climatic data such as precipitation and temperature. The main aim of the study is to India, and Nearby Regions Environmental Monitoring. Mean and standard deviation were used to describe the data collected in a descriptive analysis.The ecosystems that makeup wetlands are very dynamic, including elements of both land and water. They aid in water recharging and purification, provide shelter for a wide range of plant and animal life, moderate the local temperature, and enhance the natural landscape in a variety of ways.*

***Keywords:*** *Drought, Evaluation, Environmental, Monitoring, weather, climatic*

## 1. INTRODUCTION

Traditional drought evaluation techniques rely on weather and climatic data such as precipitation and temperature. New developments in Remote Sensing and GIS have altered conventional methods and improved the precision of drought assessment. Indicators of drought derived from Remote Sensing data are a useful tool for improving the efficiency with which resources are managed and monitored. The absence of atmospheric moisture that characterises meteorological droughtsincluding dry winds, high temperatures, and a decline in rainfallis the result of a combination of factors. Drought might have negative effects on wildlife and plants. Drought is caused mostly by climate change brought on by global warming, such as the transition from very wet to dry conditions that have been seen in many regions of India and the migration of soil storms from one continent, such as Africa, to another, Asia.

The warming of the planet is a contributing element in the shifting weather patterns. Yet, climate change is to blame for the decimation of vast swaths of forest and other forms of flora and fauna, the emission of smoke from fossil fuels, and the removal of non-combustible minerals. Some rivers drying up, snow and ice melting early, extreme temperatures in winter, intense downpours in summer, and hundreds of other phenomena are all signs of climate change. When we talk about climate change, we're referring to any measurable shift in the long-term average weather patterns that have been recorded for a certain area or the whole planet.

## 2. LITERATURE REVIEW

**Kamboj, Kuldeep & Mathur, Anil (2021)** Air pollution from particulate matter in the city has gone from being a local problem to a global one because of the harm it does to people and the planet over time. The researchers in this study want to determine the ecological environment risk category of Kota city in Rajasthan (India) throughout the course of the next four years (2018 - 2021). The World Health Organization's (WHO) AirQ+ software has been used to evaluate the risks to human health, and the risk quotient has been used to categorise the dangers to the environment (RQ). The current situation of PM concentration is compared with norms set by several governing bodies (WHO, USEPA, and Indian NAAQS) to verify PM contamination. Jaipur, Udaipur, Ajmer, Pali, Alwar, and Jodhpur are some of the other major cities in Rajasthan (India) that have been compared to Kota in terms of current particulate matter concentration levels.

**Gulia, Sunil &Shukla, Nidhi&Padhi(2021)**Air pollution's negative effects are still being seen, pointing to questions and inadequacies in current management policies and control techniques. Hence, a more strict and perfect set of judgements that might manage the problem, together with technology improvements, is necessary to lessen the negative effects of air pollution. Knowing where further research is needed is the first step towards more efficient and effective air quality management. Data from previous studies are stored in a database called Indian Air Quality Studies Interactive Repository, and this page aims to provide light on the development of air quality control policy in India (IndAIR). The study also uses GIS to identify research gaps from prior studies and to visualise dispersion throughout the nation (GIS). According to the investigation, the problem of air pollution is best understood in the metropolitan areas and the Indo-Gangetic Plains (IGPs). The Eastern, Southern, and Central States, on the other hand, have received very little attention from scholars. Also, the geographical distribution of PM2.5 and NOx concentrations are evaluated, and it is determined that highly contaminated cities are researched more than less polluted ones. The socioeconomic implications of air pollution are one of the least-studied topics of several air quality domains. As a result, additional research has to be done in these areas and fields to better understand the challenges of combating air pollution in these particular areas.

**Fang, Shifeng&Xu, Li & Zhu (2014)**The value of an IIS in the context of climate change and environmental monitoring and management has been widely recognised in recent years. Using a case study on regional climate change and its ecological effects, this paper presents a novel IIS that combines IoT, Cloud Computing, Geoinformatics [remote sensing (RS), geographical information system (GIS), and global positioning system (GPS),] and e-Science for environmental monitoring and management. Data and other information for the perception layer was gathered using multi-sensors and web services, while at the network layer, large amounts of data and other information were accessed from and transported over both public and private networks.

## 3. METHODOLOGY

### 3.1 Sample preparation

The collected soil samples were processed by being washed, air-dried, homogenised, and sieved through a <2-millimeter filter after collection. For the preparation of soil extracts (1:5 w/v), 20 g of sample was added to 100 mL of distilled water (DW) and agitated overnight using a mechanical shaker at room temperature (Trivedi et al., 1987). Samples of grains or seeds were washed with DW, dried in an oven (at 60oC), and ground into a powder. Before being digested using the tri-acid combination procedure, the powdered samples were kept in sterile, airtight containers at 4oC.

### 3.2 Statistical analysis

In order to analyse the data, we utilised statistical programmes such SPSS 16.0 (SPSS Inc., Chicago, USA) and Microsoft Office Excel 12.0 (Microsoft Corporation, Washington, USA). The soil, crop, groundwater, and surface water samples were analysed in triplicate for physicochemical, metal, metalloid, and heavy metal composition. Information gathered was subjected to a descriptive analysis, with findings presented as a mean and standard deviation. Soil, groundwater, and surface water data were all analysed using a two-way ANOVA.

## 4. RESULTS

### 4.1 SOIL ANALYSIS

In March (Sampling 1) and September (Sampling 2) of 2013, soil samples were gathered from nine communities in the Ropar wetland and its environs for agricultural purposes (Sampling 2). Both rounds of sampling included collecting samples from the same fields that had previously been used to grow various types of edible crops. Sample 1 was conducted while fields had wheat and mustard; sample 2 found rice and maize growing. Several physicochemical characteristics, as well as the levels of heavy metals and metalloids, were measured in all of the soil samples. We used a DNA nicking experiment using plasmid pBR322 and an Allium cepa root chromosomal aberration assay to evaluate the genotoxic potential of soils. Soil samples were taken from various locations and times throughout the study period, and a two-way analysis of variance (ANOVA) was performed to determine the significance of variation in the various parameters measured; a Pearson correlation analysis was performed to estimate the relationship between the various physico-chemical properties, contents of metalloid and heavy metals, and genotoxic potential of soil samples. In addition, throughout both sample periods, an effort was made to compare the outcomes of various parameters analysed for soils that were cultivated with various crops.

### 4.1.1. Physico-chemical analysis soil samples

Several physico-chemical parameters, including pH, electrical conductivity (EC), soil texture, moisture content (MC), bulk density (BD), water holding capacity (WHC), soil organic matter (SOM), contents of carbonates (CO3 2-), available phosphorous (Avl P), total nitrogen (TN), calcium (Ca), magnesium (Mg), sodium (Na), potassium (K), and chloridation state (Cs) were measured in soil samples collected from agricultural fields in Ropar wet (Cl- ). The acquired data are shown in Tables 4.1-4.3.

**Table 4.1 Physicochemical parameters (Mean ± SE) samples of agricultural soil taken from Ropar wetland and the region around it were analysed**

| Samplecode# | pH | Electricalconductivity (µS/cm) | Sand(%) | Silt(%) | Clay(%) | Moisturecontent(%) | Bulk density(g/cm$^3$) | Water holdingcapacity (%) | Soil organicmatter(%) |
|---|---|---|---|---|---|---|---|---|---|
| Sampling1# | | | | | | | | | |
| DBAST1 | 8.23±0.01 | 360.67 ±0.33 | 90.55±0.34 | 8.36±0.38 | 1.09±0.07 | 1.13±0.26 | 0.99±0.008 | 48.68±0.41 | 1.80±0.18 |
| DBBSB1 | 8.19±0.004 | 408.00±0 | 82.95±0.34 | 15.87±0.30 | 1.18±0.14 | 2.10±0.40 | 0.85±0.01 | 49.10±1.50 | 2.92±0.80 |
| MIAST1 | 8.09±0.001 | 416.00 ±0.58 | 89.83±0.70 | 9.08±0.68 | 1.09±0.001 | 4.51±0.82 | 0.93±0.01 | 49.54±2.39 | 1.88±0.09 |
| MIBSB1 | 8.50±0.002 | 346.67 ±0.33 | 88.25±0.67 | 10.66±0.72 | 1.08±0.07 | 0.61±0.06 | 1.12±0.02 | 47.09±1.90 | 1.38±0.13 |
| BDAST1 | 8.12±0.003 | 471.00±0 | 77.10±0.34 | 19.52±0.34 | 3.37±0.34 | 0.96±0.23 | 1.12±0.01 | 37.84±0.81 | 1.25±0.03 |
| BDBSB1 | 8.32±0.002 | 680.67 ±1.20 | 77.17±0.68 | 19.74±0.34 | 3.08±0.59 | 2.07±0.41 | 0.82±0.01 | 60.40±0.45 | 2.25±0.19 |
| ALAST1 | 7.96±0 | 314.67 ±1.20 | 85.44±0.34 | 13.46±0.38 | 1.10±0.07 | 1.45±0.14 | 0.97±0.02 | 41.40±0.18 | 1.42±0.03 |
| ALBSB1 | 8.53±0.003 | 428.33 ±1.76 | 85.34±0.68 | 13.62±0.68 | 1.04±0.001 | 2.10±0.51 | 0.92±0.01 | 32.06±1.52 | 3.12±0.07 |
| KTAST1 | 8.36±0.002 | 420.33 ±0.33 | 90.92±0.58 | 8.07±0.59 | 1.01±0.002 | 0.80±0.06 | 1.11±0.01 | 38.61±1.49 | 1.47±0.06 |
| KTBSB1 | 8.13±0.0003 | 238.00±0 | 92.19±0.34 | 6.79±0.34 | 1.02±0.002 | 1.57±0.27 | 0.99±0.008 | 40.63±0.35 | 2.08±0.04 |
| BNAST1 | 8.32±0 | 261.00 ±1.00 | 83.94±0.34 | 14.87±0.27 | 1.18±0.07 | 2.30±0.20 | 0.91±0.01 | 49.52±9.14 | 2.57±0.08 |
| BNBSB1 | 7.77±0.001 | 428.33 ±1.76 | 73.13±1.36 | 25.70±1.22 | 1.17±0.14 | 1.93±0.18 | 0.79±0.005 | 54.52±1.95 | 2.58±0.04 |
| GDAST1 | 8.12±0.0003 | 370.67 ±0.88 | 80.00±0.68 | 19.97±0.68 | 1.03±0.0007 | 1.57±0.23 | 0.94±0.01 | 50.66±0.61 | 2.34±0.07 |
| GDBSB1 | 8.39±0.0003 | 497.67 ±0.33 | 84.50±0.34 | 14.48±0.34 | 1.01±0.0007 | 0.99±0.14 | 1.10±0.01 | 46.47±1.32 | 1.59±0.02 |
| GHAST1 | 8.11±0.004 | 580.33 ±1.20 | 82.04±0.34 | 15.93±0.34 | 1.03±0.001 | 1.60±0.54 | 1.02±0.008 | 46.73±3.25 | 2.47±0.14 |
| GHBSB1 | 8.27±0.001 | 431.00±0 | 80.13±0.67 | 19.85±0.68 | 1.01±0.001 | 0.95±0.04 | 1.06±0.009 | 41.22±2.37 | 1.34±0.12 |
| GUAST1 | 8.33±0.002 | 196.67 ±0.33 | 88.95±0.34 | 9.99±0.34 | 1.06±0.002 | 3.19±1.33 | 1.15±0.01 | 35.20±0.72 | 1.80±0.12 |
| GUBSB1 | 8.12 ±0 | 167.00±0.58 | 88.46±0.34 | 10.51±0.34 | 1.03±0.0007 | 1.64±0.52 | 1.29±0.02 | 41.70±0.71 | 2.72±0.09 |
| Sampling2# | | | | | | | | | |
| DBASO2 | 7.82±0.001 | 528.33 ±0.67 | 91.56±0.67 | 7.42±0.68 | 1.02±0.0003 | 1.08±0.07 | 1.19±0.004 | 42.14±0.87 | 2.41±0.11 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| DBBSO2 | 8.15±0.001 | 440.67 ±0.33 | 82.42±0.34 | 16.55±0.34 | 1.02±0.0007 | 1.31±0.13 | 1.16±0.02 | 54.36±0.81 | 3.01±0.11 |
| MIASO2 | 7.80±0.001 | 491.67 ±0.89 | 89.58±1.34 | 9.40±1.36 | 1.01±0.0007 | 0.75±0.08 | 1.38±0.008 | 46.83±1.40 | 1.62±0.13 |
| MIBSO2 | 7.97±0.001 | 519.00 ±0.58 | 87.20±0.34 | 11.71±0.41 | 1.08±0.07 | 0.99±0.19 | 1.19±0.008 | 41.44±0.91 | 1.91±0.20 |
| BDASZ2 | 7.47±0.001 | 419.67 ±0.88 | 77.80±0.58 | 18.83±0.34 | 3.37±0.68 | 0.86±0.19 | 1.21±0.01 | 39.80±0.74 | 1.78±0.06 |
| BDBSZ2 | 8.20±0.0003 | 467.67 ±0.88 | 85.13±0.34 | 13.78±0.32 | 1.09±0.07 | 1.29±0.31 | 1.24±0.008 | 40.56±0.10 | 1.33±0.04 |
| ALASO2 | 7.23±0.0003 | 472.00 ±0.58 | 84.43±0.34 | 14.54±0.34 | 1.02±0.001 | 1.42±0.33 | 1.20±0.008 | 40.41±0.81 | 1.58±0.02 |
| ALBSZ2 | 7.67±0.002 | 334.33 ±0.33 | 82.35±0.34 | 16.55±0.38 | 1.10±0.07 | 1.71±0.13 | 1.18±0.01 | 50.20±0.50 | 3.29±0.06 |
| KTASO2 | 7.99±0.001 | 355.67 ±0.33 | 92.52±0.34 | 6.45±0.34 | 1.03±0.001 | 1.75±0.47 | 1.14±0.007 | 46.93±0.44 | 1.67±0.02 |
| KTBSO2 | 7.94±0.0003 | 443.67 ±1.20 | 87.49±0.67 | 11.49±0.68 | 1.03±0.0009 | 1.30±0.26 | 1.24±0.01 | 37.85±0.89 | 1.18±0.02 |
| BNASO2 | 8.35±0.001 | 425.33 ±0.67 | 85.18±0.34 | 11.44±0.68 | 3.38±0.34 | 0.97±0.45 | 1.00±0.003 | 57.30±0.22 | 2.64±0.21 |
| BNBSO2 | 8.30±0.001 | 439.00 ±0.58 | 73.68±0.68 | 23.22±0.68 | 3.10±0.00 | 2.40±0.12 | 1.03±0.01 | 55.53±0.33 | 2.78±0.24 |
| GDASO2 | 7.91±0.00 | 498.00 ±0.58 | 77.92±0.68 | 20.37±1.18 | 1.71±0.68 | 1.80±0.24 | 1.25±0.004 | 50.59±0.33 | 2.34±0.04 |
| GDBSO2 | 7.63±0.001 | 458.67 ±1.20 | 84.47±0.34 | 14.51±0.34 | 1.02±0.0007 | 1.18±0.14 | 0.97±0.005 | 53.84±1.56 | 3.26±0.05 |
| GHASO2 | 8.00±0.003 | 414.67 ±0.88 | 81.12±0.67 | 17.85±0.68 | 1.02±0.0009 | 1.10±0.15 | 1.04±0.004 | 47.03±0.13 | 1.26±0.27 |
| GHBSO2 | 8.03±0.001 | 544.33 ±0.88 | 85.98±0.90 | 13.63±0.90 | 1.39±0.34 | 2.20±0.19 | 1.26±0.006 | 44.77±0.58 | 1.65±0.16 |
| GUASZ2 | 7.24±0.001 | 295.33 ±1.20 | 91.27±0.67 | 7.72±0.68 | 1.01±0.001 | 0.62±0.08 | 1.27±0.02 | 31.18±0.46 | 1.75±0.11 |
| GUBSZ2 | 7.79±0.001 | 198.00 ±0.58 | 89.83±0.59 | 9.14±0.59 | 1.02±0.0007 | 1.49±0.55 | 1.25±0.008 | 32.11±0.30 | 1.54±0.19 |
| DBAST1 | 5.43±0.19 | 8.99±0.07 | 762.09±130.59 | 374.08±35.35 | | 341.11±28.13 | 976.00±8.38 | 400.00±128.84 | 828.33±31.31 |
| DBBSB1 | 9.49±0.03 | 11.05±0.16 | 1213.13±169.67 | 320.64±23.14 | | 527.90±29.28 | 768.14±2.84 | 401.25±59.66 | 662.67±85.33 |
| MIAST1 | 5.23±0.03 | 14.52±0.09 | 863.12±13.91 | 440.88±23.14 | | 259.89±16.24 | 977.31±5.28 | 2202.94±112.25 | 899.33±47.33 |
| MIBSB1 | 5.80±0.07 | 6.66±0.52 | 602.74±57.27 | 280.56±23.14 | | 414.20±28.13 | 877.94±1.06 | 702.88±34.716 | 757.33±62.62 |
| BDAST1 | 4.14±0.09 | 18.30±0.91 | 810.48±46.59 | 320.64±46.28 | | 316.74±42.20 | 1501.52±2.69 | 452.51±101.89 | 568.00±40.99 |
| BDBSB1 | 4.32±0.06 | 9.10±0.34 | 1477.05±11.90 | 347.36±13.36 | | 300.50±8.12 | 1549.25±1.76 | 762.15±140.14 | 899.33±47.33 |
| ALAST1 | 4.09±0.06 | 5.14±0.11 | 1015.15±46.71 | 400.80±40.08 | | 251.77±40.61 | 1092.79±17.91 | 1130.41±28.215 | 733.67±23.67 |
| ALBSB1 | 5.89±0.03 | 14.29±0.43 | 2131.54±88.85 | 334.00±35.35 | | 665.97±29.28 | 1419.98±5.41 | 1051.71±117.76 | 733.67±62.62 |
| KTAST1 | 6.38±0.06 | 5.99±0.32 | 848.11±81.06 | 293.92±48.17 | | 316.74±24.36 | 1473.27±1.02 | 1867.00±109.99 | 473.33±85.33 |
| KTBSB1 | 4.74±0.09 | 6.65±0.07 | 1286.34±81.23 | 360.72±23.14 | | 316.74±14.07 | 1293.53±2.73 | 1975.58±116.29 | 591.67±23.67 |
| BNAST1 | 6.34±0.03 | 11.62±0.32 | 2421.16±11.60 | 414.16±13.36 | | 324.86±8.12 | 1264.40±1.79 | 1739.09±152.39 | 875.67±23.67 |
| BNBSB1 | 7.17±0.06 | 5.64±0.02 | 2287.76±467.65 | 360.72±46.28 | | 357.35±21.49 | 2214.20±4.25 | 2187.19±96.90 | 686.33±47.33 |
| GDAST1 | 10.56±2.81 | 8.47±0.35 | 1008.30±98.66 | 213.76±26.72 | | 341.11±28.13 | 1042.80±2.78 | 3025.31±292.22 | 757.33±23.67 |
| GDBSB1 | 7.27±0.19 | 10.31±0.37 | 1140.66±178.96 | 400.8±46.28 | | 373.59±21.49 | 1266.47±1.03 | 1770.51±44.64 | 781.00±40.99 |
| GHAST1 | 5.66±0.09 | 9.60±0.48 | 959.78±105.65 | 253.84±13.36 | | 511.66±61.32 | 875.81±3.84 | 994.11±157.48 | 733.67±47.33 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| GHBSB1 | 5.22±0.09 | 6.32±0.88 | 762.77±41.98 | 307.28±13.36 | 454.81±8.12 | 821.00±3.60 | 1036.25±167.86 | 639.00±0 |
| GUAST1 | 2.61±0.06 | 8.83±0.57 | 2629.09±1.16 | 240.48±23.14 | 365.47±37.22 | 885.75±4.87 | 2292.83±127.37 | 497.00±40.99 |
| GUBSB1 | 6.03±0.06 | 7.84±0.28 | 1651.85±4.27 | 334.00±13.36 | 251.77±16.24 | 988.68±3.17 | 1332.33±66.43 | 686.33±85.33 |
| Sampling2# | | | | | | | | |
| DBASO2 | 5.19±0.06 | 4.96±0.44 | 701.92±0.58 | 414.16±13.36 | 48.73±0 | 1759.25±5.20 | 944.50±145.60 | 260.33±47.33 |
| DBBSO2 | 9.89±0.03 | 5.85±0.65 | 2725.08±696.37 | 400.80±0 | 219.28±14.07 | 2239.47±7.60 | 2852.25±58.08 | 236.67±23.67 |
| MIASO2 | 4.13±0.07 | 12.63±1.03 | 916.68±6.33 | 293.92±13.36 | 332.98±8.12 | 1151.00±3.13 | 3413.75±341.94 | 236.67±23.67 |
| MIBSO2 | 5.45±0.03 | 5.18±0.60 | 982.84±147.65 | 387.44±13.36 | 357.35±21.49 | 2470.75±5.99 | 1121.50±47.59 | 284.00±40.99 |
| BDASZ2 | 11.43±0.06 | 10.67±0.60 | 1148.33±180.35 | 334.00±13.36 | 81.22±8.12 | 933.25±4.85 | 2441.00±111.69 | 355.00±40.99 |
| BDBSZ2 | 3.95±0.09 | 5.21±0.20 | 728.18±53.14 | 267.20±13.36 | 259.89±8.12 | 1306.25±1.79 | 1870.00±194.79 | 260.33±23.67 |
| ALASO2 | 5.44±0.09 | 10.13±0.26 | 1142.66±62.83 | 427.52±13.36 | 316.74±14.07 | 112.94±6.12 | 892.30±25.66 | 165.67±23.67 |
| ALBSZ2 | 6.58±0.44 | 7.26±0.86 | 1467.99±160.60 | 307.28±26.72 | 227.40±16.24 | 162.00±3.37 | 881.50±33.93 | 213.00±0 |
| KTASO2 | 4.92±0.06 | 8.47±0.21 | 852.38±19.97 | 320.64±23.14 | 284.25±21.49 | 326.33±2.35 | 867.75±68.25 | 307.67±23.67 |
| KTBSO2 | 4.05±0.07 | 8.57±0.30 | 999.68±79.73 | 320.64±0 | 178.67±8.12 | 1080.80±6.88 | 3037.56±119.45 | 284.00±0 |
| BNASO2 | 8.72±0.06 | 3.61±0.27 | 1558.20±222.23 | 227.12±13.36 | 219.28±14.07 | 198.37±1.91 | 953.75±89.41 | 307.67±23.67 |
| BNBSO2 | 8.91±0.03 | 9.04±0.12 | 1475.21±156.34 | 374.08±35.35 | 203.04±16.24 | 235.12±5.70 | 2402.49±89.65 | 236.67±23.67 |
| GDASO2 | 8.14±1.31 | 10.34±0.28 | 1736.21±5.78 | 427.52±26.72 | 24.36±0 | 234.17±8.19 | 455.38±34.93 | 236.67±23.67 |
| GDBSO2 | 6.10±1.37 | 5.75±0.59 | 1591.15±5.89 | 334.00±13.36 | 276.13±21.49 | 171.00±0.96 | 1174.74±123.66 | 260.33±23.67 |
| GHASO2 | 6.91±0.15 | 4.50±0.24 | 1080.31±0.01 | 253.84±13.36 | 292.38±14.07 | 472.67±46.23 | 1442.36±56.79 | 165.67±23.67 |
| GHBSO2 | 5.45±0.10 | 4.83±0.43 | 547.89±0.59 | 347.36±13.36 | 276.13±8.12 | 436.25±1.91 | 1224.14±138.38 | 142.00±0 |
| GUASZ2 | 6.84±0.37 | 5.71±0.53 | 2491.83±6.06 | 334.00±74.38 | 235.53±32.49 | 35.75±2.60 | 1927.56±112.78 | 142.00±0 |
| GUBSZ2 | 4.19±0.06 | 4.80±0.37 | 1080.04±5.77 | 307.28±35.35 | 211.16±21.49 | 45.32±0.57 | 740.25±423.49 | 307.67±23.67 |

**Table 4.2The Ropar wetland and the lands around it were sampled to compile this report on the physicochemical characteristics of the soil used to grow wheat and mustard.**

| Parameter | Limit | Sampling1[#] | | | | | | Sampling2[#] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Soilsamplesunderwheatcultivation | | | Soilsamplesundermustardcultivation | | | Soilsamplesunderricecultivation | | | Soilsamplesundermaizecultivation | | |
| | | Range | Mean ±SE | % Samplesabove thelimit | Range | Mean ±SE | % Samplesabove thelimit | Range | Mean ±SE | % Samplesabovethelimit | Range | Mean ±SE | % Samplesabovethelimit |
| pH | 6.50 – 8.50[a] | 7.96-8.36 | 8.18±0.04 | - | 7.77–8.53 | 8.25±0.08 | 11.11 | 7.23–8.35 | 7.93±0.08 | - | 7.24–8.20 | 7.67±0.16 | - |
| Electrical conductivity(μS/cm) | 4500.00[b] | 196.67–580.33 | 376.81±37.96 | - | 167.00-680.67 | 402.85±49.19 | - | 355.67–544.33 | 463.92±14.52 | - | 198.00–467.67 | 343.00±47.32 | - |
| Sand(%) | NA | 77.10 – 90.92 | 85.53±1.64 | - | 73.13 – 92.19 | 83.57±1.99 | - | 73.68 – 92.52 | 84.89±1.44 | - | 77.80 – 91.27 | 85.28±2.46 | - |
| Silt(%) | NA | 8.07–19.97 | 13.14±1.49 | - | 6.79–25.70 | 15.14±1.90 | - | 6.45–23.22 | 13.66±1.34 | - | 7.72–18.83 | 13.20±2.12 | - |
| Clay(%) | NA | 1.01–3.37 | 1.33±0.26 | - | 1.01–3.08 | 1.29±0.22 | - | 1.01–3.38 | 1.45±0.23 | - | 1.01–3.37 | 1.52±0.46 | - |
| Moisturecontent(%) | NA | 0.80–4.51 | 1.95±0.40 | - | 0.61–2.10 | 1.55±0.19 | - | 0.75–2.40 | 1.40±0.14 | - | 0.62–1.71 | 1.19±0.20 | - |
| Bulkdensity($g/cm^3$) | NA | 0.91–1.15 | 1.01±0.03 | - | 0.79–1.29 | 0.99±0.05 | - | 0.97–1.38 | 1.16±0.03 | - | 1.18–1.27 | 1.23±0.02 | - |
| Water holdingcapacity(%) | NA | 35.20 – 50.66 | 44.24±1.99 | - | 32.06 – 60.40 | 45.91±2.78 | - | 37.85 – 57.30 | 47.62±1.74 | - | 31.18 – 50.20 | 38.77±3.44 | - |
| Soilorganicmatter(%) | 3.40[c] | 1.25–2.57 | 1.89±0.16 | - | 1.34–3.12 | 2.22±00.22 | - | 1.18–3.26 | 2.10±0.19 | - | 1.33–3.29 | 1.94±0.35 | - |
| Carbonates (% $CaCO_3$equivalent) | NA | 2.61–10.56 | 5.60±0.74 | - | 4.32–9.49 | 6.21±0.52 | - | 4.05–9.89 | 6.41±0.53 | - | 3.95-11.43 | 6.60±1.34 | - |
| AvailablePhosphorous(mg/kg) | NA | 5.14–18.30 | 10.61±1.38 | - | 5.64–14.29 | 8.65±0.94 | - | 3.61–12.63 | 7.22±0.77 | - | 4.80–10.67 | 6.73±1.07 | - |
| Totalnitrogen(mg/kg) | NA | 762.09–2629.09 | 1257.47±241.90 | - | 602.74–2287.76 | 1394.87±188.16 | - | 547.89–2725.08 | 1254.63±158.33 | - | 728.18–2491.83 | 1383.27±301.03 | - |
| Calcium(mg/kg) | 0-3500.00[d] | 213.76–440.88 | 328.06±27.64 | - | 280.56–400.80 | 338.45±11.57 | - | 227.12–427.52 | 348.39±17.93 | - | 267.20–334.00 | 309.95±12.24 | - |
| Magnesium(mg/kg) | 0-500.00[d] | 251.77–511.66 | 336.59±25.15 | 11.11 | 251.77–665.97 | 406.98±42.68 | 22.22 | 24.36 – 357.35 | 233.03±28.20 | - | 81.22 – 259.89 | 203.04±31.45 | - |
| Sodium(mg/kg) | 0-300.00[d] | 875.81–1501.52 | 1121.07±79.36 | 100.00 | 768.14–2214.20 | 1244.35±152.40 | 100.00 | 112.94–2470.75 | 837.55±230.66 | 61.54 | 35.75 – 1306.25 | 496.51±262.12 | 40.00 |
| Potassium(mg/kg) | 0-450.00[d] | 400.00–3025.31 | 1567.13±295.81 | 88.89 | 401.25–2187.19 | 1246.65±204.98 | 88.89 | 455.38–3413.75 | 1598.65±269.60 | 100.00 | 740.25–2441.00 | 1572.06±327.03 | 100.00 |
| Chloridesmg/kg) | 100.00[e] | 473.33–899.33 | 707.37±52.99 | 100.00 | 591.67–899.33 | 715.26±30.24 | 100.00 | 142.00–307.67 | 240.31±14.88 | 100.00 | 142.00–355.00 | 255.60±36.97 | 100.00 |

**Table 4.3This table summarises the wide variety of physicochemical characteristics measured in agricultural soil samples taken from the Ropar wetland and its environs.**

| Parameter | Limit | Sampling1# | | | Sampling2# | | |
|---|---|---|---|---|---|---|---|
| | | Range | Mean± SE | %Samplesabove thelimit | Range | Mean± SE | %Samplesabovethelimit |
| pH | 6.50 – 8.50[a] | 7.77 – 8.53 | 8.21 ±0.04 | 5.56 | 7.23 – 8.35 | 7.86±0.008 | - |
| Electricalconductivity(µS/cm) | 4500.00[b] | 167.00-680.67 | 389.83±30.31 | - | 198.00–544.33 | 430.30±20.65 | - |
| Sand(%) | NA | 73.13–92.19 | 84.55±1.28 | - | 73.68-92.52 | 85.00±1.21 | - |
| Silt(%) | NA | 6.79 – 25.70 | 14.14±1.20 | - | 6.45 – 23.22 | 13.53±1.10 | - |
| Clay(%) | NA | 1.01 – 3.37 | 1.31±0.16 | - | 1.01 - 3.38 | 1.47±0.20 | - |
| Moisturecontent(%) | NA | 0.61 – 4.51 | 1.75±0.22 | - | 0.62 – 2.40 | 1.35±0.11 | - |
| Bulkdensity(g/cm$^3$) | NA | 0.79 – 1.29 | 1.00±0.03 | - | 0.97 – 1.38 | 1.18±0.02 | - |
| Waterholdingcapacity(%) | NA | 32.06-60.40 | 45.08±1.67 | - | 31.18–57.30 | 45.16±1.80 | - |
| Soilorganicmatter(%) | 3.40[c] | 1.25 – 3.12 | 2.05±0.14 | - | 1.18 – 3.29 | 2.06±0.16 | - |
| Carbonates(%CaC$O_3$equivalent) | NA | 2.61 – 10.5 | 5.91±0.45 | - | 3.95 – 11.4 | 6.46±0.51 | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6 | | | 3 | | |
| AvailablePhosphorous(mg/kg) | NA | 5.14 – 18.30 | 9.41±0.83 | - | 3.61 – 12.63 | 7.08±0.62 | - |
| Totalnitrogen(mg/kg) | NA | 602.74 – 2629.09 | 1326.17±143.59 | - | 547.89 – 2725.08 | 1290.37 ± 137.47 | - |
| Calcium(mg/kg) | 0-3500.00[d] | 213.76–440.88 | 333.26±14.59 | - | 227.12–427.52 | 337.71±13.82 | - |
| Magnesium(mg/kg) | 0-500.00[d] | 251.77–665.97 | 371.79±25.50 | 16.67 | 24.36–357.35 | 224.70±21.92 | - |
| Sodium(mg/kg) | 0-300.00[d] | 768.14 – 2214.20 | 1183.00±84.69 | 100.00 | 35.75–2470.75 | 742.82±181.62 | 55.56 |
| Potassium(mg/kg) | 0-450.00[d] | 400.00 – 3025.31 | 1406.89 ±178.85 | 88.89 | 455.38 – 3413.75 | 1591.26 ±209.89 | 100.00 |
| Chloridesmg/kg) | 100.00[e] | 473.33–899.33 | 711.30±29.61 | 100.00 | 142.00–355.00 | 244.60 ±14.32 | 100.00 |

Soil samples taken from wheat fields showed a wide variation in electrical conductivity during the first round of measurement, from 196.67 to 580.33 µS/cm (mean = 376.81 µS/cm). Soil samples taken from mustard fields showed an EC ranging from 167.0 to 680.6 µS/cm, with a mean of 402.8 µS/cm. During the first round of sampling, the EC varied from 167.00 to 680.67 µS/cm, with a mean of 389.83 µS/cm. Soil EC under rice and maize cultivation varied from 355.67 to 544.33 µS/cm (mean = 463.92 µS/cm) and from 198.00 to 467.67 µS/cm (mean = 343.00 µS/cm), respectively, in the second round of sampling. The total range was from 198.00 to 544.35 µS/cm (mean = 430.30 µS/cm). The percentages of sand, silt, and clay in wheat field soils ranged from 77.10 to 90.92% (mean = 85.53%), 8.07 to 19.97% (mean = 13.14%), and 1.01

to 3.37% (mean = 1.37%), respectively, during sampling 1 of the current research. Soil samples taken from mustard fields included compositions of sand (73.13–92.19%), silt (6.79–25.70%), and clay (1.01–3.08%), respectively (mean = 83.57%), 15.14% (median = 83.57), and 1.29 (median = 1.29)%. The percentages of sand, silt, and clay found during sample 1 ranged from 73.13 to 92.19% (mean = 84.55%), 6.79 to 25.70% (mean = 14.14%), and 1.01 to 3.37% (mean = 1.31%), respectively. However, the percentages of sand, silt, and clay found in the soil samples taken from rice fields during sampling 2 ranged from 73.68 to 92.52% (mean = 84.89%), 6.45 to 23.22% (mean = 13.66%), and 1.01 to 3.37% (mean = 1.49%), respectively. In soil samples used for growing maize, the percentages of sand, silt, and clay ranged from 77.2 percent to 18.83 percent (mean = 13.20 percent), 1.01 percent to 3.3 percent (mean = 1.52 percent), respectively. Soil samples taken during the second round of sampling included sand contents ranging from 73.68 to 92.52% (mean = 85%), silt contents from 6.45 to 23.22% (mean = 13.53%), and clay contents from 1.01 to 3.38% (mean = 1.47%).

## 5. CONCLUSION

The ecosystems that make up wetlands are very dynamic, including elements of both land and water. They aid in water recharging and purification, provide shelter for a wide range of plant and animal life, moderate the local temperature, and enhance the natural landscape in a variety of ways. In comparison to the about 6% of land covered by wetlands worldwide, India's wetlands account for just 1.23 percent of the country's land area. Half of India's wetlands have vanished because of pollution and people's indifference to the delicate ecosystems they support. Punjab has lost most of its wetland habitat during the last century; now just 1% of India's original wetland acreage remains there. The Ropar wetland in Punjab, India is an artificial wetland along the banks of the Sutlej River and is recognised as a Ramsar site. It's home to a wide variety of flora and fauna. Industrial facilities (a thermal power plant and a cement factory), farmland, and nearby homes have all contributed to increased levels of organic and inorganic pollution in the wetland's soil, water, and air.

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