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"STUDY OF TOXICITY OF DYES CONTAMINATION IN DIFFERENT VEGETABLES GROWN IN AND AROUND URBAN AREAS OF JAIPUR DISTRICT (RAJASTHAN)"

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ABSTRACT
The detection and resolution of specific environmental issues related to the disruption of the ecological balance in nature depend on the analysis of dyes and their accumulation in the food chain. Diverse biological species are affected directly by the accumulation of heavy metals, including their health, ability to reproduce, and biomass reserves. The assessment of the ecosystem as a medium for the growth of living organisms, including people, has resulted in a substantial increase in the discussion of environmental changes in recent years. Heavy metal concentrations are thought to be the most significant type of pollution out of all the others. The environment must be safeguarded against the many negative effects of heavy metals and their propensity to accumulate in ecosystem components that are both living and non-living. The origins of heavy metals, their consequences, and the mechanisms through which they accumulate in the soil, water, and ultimately in plant systems, appear to be of particular significance. Additionally, the issue of environmental pollution brought on by toxic metals now affects both land and water.As a result of industrialization and urbanization, the production of urban wastewater has rapidly increased, making it a current research topic. The world's freshwater resources are under stress. Reusing wastewater, especially when combined with other water conservation techniques, can help lessen anthropogenic stress caused by excessive extraction and contamination of receiving water.

INTRODUCTION

Composition of dyes in vegetables

As essential parts of the human diet, fruits and vegetables must be taken into account for their level of heavy metal contamination (Di Salvatore et al., 2009; Nirmal Kumar et al., 2007; Parveen et al., 2003). In urban settings, the plants are frequently utilised as passive biomonitoring equipment. Unquestionably, due to airborne metal particles from vehicle exhaust, green vegetables grown close to busy highways may have a large amount of Pb and Cd (Ayodele and Oluyomi, 2011; Hashmi et al., 2005). Vegetable metal content needs to be understood from the perspectives of agricultural production technology, nutrition, and health implications.High concentrations of Fe^{2+} in plants can cause the production of free radicals, which damage DNA, proteins, and membranes. In variable degrees, other metal ions are toxic to plants, halting enzyme and metabolic pathways and harming the morphology and physiology of plants (Arif et al., 2016).

Due to the numerous negative impacts of heavy metals and their propensity to accumulate in both the biota and non-living ecosystem components, research on these compounds is essential. In order to identify and address specific environmental issues associated to the disruption of the natural ecological equilibrium, it is crucial to look at heavy metals and how they accumulate in the food chain. Analyzing the buildup of heavy metals in different biological species might help us understand how anthropogenic pollution is affecting their habitat and how well-being of the species is maintained.

Description of the Study Area

Jaipur has a semiarid climate and receives about 650 millimetres (26 inches) of rainfall year, with the majority of that falling between June and September during the monsoon season, according to the Koppen climate classification. The average daily temperature throughout the summer, which lasts for the majority of the year, is around 30 °C (86 °F) from early April to early July. Despite the frequent, heavy rains and thunderstorms that take place during the monsoon, flooding is not typical. The winter months of November to February are mild and pleasant, with typical temperatures ranging from 15 to 18 °C (59 to 64 °F) and little to no humidity, despite the occasional cold waves that bring temperatures to drop below freezing.

The Sanganer Tehsil is connected to the major city of Jaipur.For its handcrafted paper and textile printing industries, it is well recognised. Sanganer is well known throughout the world for its handcrafted paper industry and vibrant apparel with block prints. Because they are consistently produced with vividly coloured motifs on white backgrounds, Sanganeri prints are distinctive. Industrial waste from textile printing and dyeing businesses is improperly treated before being deposited into Jaipur's municipal Sanganer and Sewer water systems. Vegetables that have been irrigated with water that has been contaminated by both human and business waste are hazardous, which is the main problem.

A significant source of dyes and water contamination

There is an increasing demand on local and regional water supplies for irrigation, energy production, industrial uses, domestic uses, and environmental reasons as a result of a combination of growing populations, rising resource demands brought on by rising standards of living, and various other external forces of change. These variables are rapidly and often unpredictably shifting, creating new challenges for water management as well as opportunities and risks for all water users (UNESCO, 2012).

After being utilized in the household, in agriculture, and in industry, water becomes contaminated. Used water may contain contaminants like trash and even harmful substances. Pollutants are substances created by humans that have an impact on the environment. However, population increase, rapid industrialization, and pollution have harmed the majority of water supplies, whether they are surface water or groundwater (Yousei et al., 2019). Approximately 90% of wastewater in underdeveloped countries is reportedly deposited directly into surface water sources without being cleaned (Yousei et al., 2017). This may be due to low expertise, a lack of resources, and financial constraints. The severity of the issue is highlighted by the claim that over 70% of India's water supplies are contaminated (Murty and Kumar, 2011). The majority of groundwater supplies are contaminated with harmful metals/metalloids like arsenic, cadmium, and manganese, making the water unsafe for human use, claim Sharma et al. (2012) and Selvakumar et al. (2017).

Anthropogenic environmental changes may have a profound impact on the ecology and physiology of animals. The physical, chemical, biological, and social components of the natural environment have gotten worse as a result of human activities and advancements, which has a negative impact on people's quality of life (ATSDR, 1999). As industrialization, population growth, and consumer trends all rise, this problem is getting more urgent. Rapid technological improvements, such as an increase in mining and industrial activities, have led to a progressive redistribution of certain hazardous metals from the earth's crust, increasing the likelihood of exposure through ingestion, inhalation, or skin contact.

MATERIALS AND METHODS

In order to gather the factual data needed to identify issues and maintain continual suspension, which maintains the existing treatment plants operating profitably and efficiently, numerous analytical techniques have been created. Chemical, biochemical, biological, bacteriological, bioassay, and instrumental techniques are frequently used in the analytical processes required to produce qualitative data, and the outcomes are typically interpreted in connection to the impact on people or microorganisms. Additionally, many of the results come within the micro analysis category because the sample only includes trace amounts of contaminants. The distance between industrial sites and different priority zones was calculated based on the level of pollution by comparing these indicators.

Study Sites

The municipality and town of Bagru are situated in the Jaipur district of the Indian state of Rajasthan. It is located 32 km from Jaipur on the Jaipur-Ajmer Road. Bagru is known for its hand block printing and natural colours. Bagru is renowned for using indigo dyes, natural dyes, and wooden hand block printing on textiles. The Amanishah Nala, a river that passes through Jaipur, is quickly contaminated by the discharge of business and household trash. The primary sewage system in Jaipur, Amanishah Nala, is typically filthy.

Field Experiment Included Following Steps:

Ground Water Collection

Samples of ground water or potable water were taken at the research site from the nearby water resources during the pre-monsoon (June), monsoon (August), and post-monsoon (January) seasons. Various places were used to collect and analyze the samples. By collecting two water samples from the Sanganer and Bagru locations near the Dravyavati River, the quality of ground water was assessed. These samples were taken using hand pumps and tube-wells placed in clean, sterile, 4L plastic containers at various depths and distances.

Industrial WasteWater Sample Collection

For this investigation, samples of industrial waste water were taken at several locations along the Dravyavati and Bagaru Rivers in Sanganer (Amanishah nalla). The effluent samples were taken from the sampling site and put in a 2 litre polythene container for examination. The current investigation used a spot sampling strategy. Surface water should always be sampled by a crew that has taken the essential safety measures. A sample of groundwater was taken at least one or two hours after the well or bore hole started pumping. There was no room for dissolved gases to escape during the transit period because the water sample was taken all the way to the top of the container.

Sample Preservation

The polythene bottles (with volumes of 100/500 ml) that were used to preserve the samples were meticulously cleaned by rinsing with 8M HN03 solution, followed by many washings with distilled water, and finally with double distilled (DD) water. Before collection, the bottles underwent three more cleanings with a wastewater sample. Temperature, pH, and electrical conductivity were measured as water quality parameters (WQPs) in the field (within 30 minutes of sampling). With the exception of BOD, all other WQPs were calculated within 72 hours of the sample's collection. The wastewater samples were always kept in a suitable polythene/glass container in a refrigerator (between 10 and 15°C) after the addition of the necessary preservatives. The wastewater samples weren't taken out of the refrigerator until it was time for the inspection. In general, starting the study within 4 hours for some parameters and 24 hours for others is preferred. Additionally, the analysis must be completed within a week following the data gathering.

Physico-Chemical Analysis of Water Sample:

The most crucial step in determining the water quality is evaluating effluent and waste waters. Physical-chemical techniques were used to analyze the metal ion concentration, pH, EC, TDS, chloride, total hardness, calcium hardness, and magnesium hardness. The physico-chemical and bacteriological characteristics of sewage, urban area waste waters, and effluents from different industrial units were examined. Monitoring water analysis involves using conventional, automatic recording, and remote sensing approaches. Chemical analysis is an important test for assessing parameter quality and is employed to assess water quality. The parts that follow go into great detail on each method used during the study..

Determination of pH

At the time of sampling under field circumstances, the pH values of the effluent samples were also determined. Using a pen-style digital pH metre (Hanna Instruments, Portugal) with 0.1 precision, the pH values of the samples were calculated. The equipment was warmed up for 30 minutes before the electrode system was calibrated against standard buffer solutions with known pH values of 4, 7, and 9.2. Distilled water with a conductivity of less than 2 mhos/cm was used to clean the electrode. The pH was then checked right away after this was introduced to the water sample that was collected in a 100 ml beaker. It is important to test and record the sample's pH and temperature.

Colour of Water

To determine hue, a visual comparison of the sample with platinum cobalt is made. One milligramme of the platinum-like chloroplatinate ion per mL produces one standard unit of colour.Dissolve 1.246 g potassium chloroplatinate (equivalent to 500 mg of metallic platinum) and 1.0 gm crystalline cobaltous chloride (equivalent to 250 mg of metallic cobalt) in 100 ml of concentrate HCL-containing distilled water.1000 ml of distilled water should be diluted. This typical answer corresponds to 500 colour units. Standards with different colour units can be produced by combining 50 ml of standard chloroplatinate solution with distilled water. These standards were shielded from the ammonia's ability to enhance colour. Remove turbidity from the sample by centrifuging or filtering it until the liquid in the supernatant is clear. If the sample was clear, level the object on this white surface and look vertically downward through the cylinder to compare it to the standards. If the color is too strong, add distilled water to the sample until the level is within acceptable bounds.

Determination of Total Hardness

The EDTA titrimetric technique was employed to determine the overall hardness. The outcome of this process depends on the capacity of ethylene diamine tetraacetic acid (C10H16O8N2) or its disodium analogue to form stable complexes with calcium and magnesium ions.

100 ml of the water sample was titrated against a standard EDTA (0.01M) solution at a pH of 10 (ammonia buffer was used and prepared by mixing NH4Cl and NH4OH). Eriochrome Black T was used as the indicator. When all traces of the red colour faded and the solution turned a clear blue hue, indicating that all Ca2+ and Mg ions had complexed with EDTA, it was time to stop adding regular EDTA solution and stop stirring. Calcium carbonate concentrations in ppm or mg/l are used to display the results.

Determination of Specific Conductance

When the solution is very diluted, the conductivity is proportional to the concentration of these compounds dissolved in the water. The electrolytes dissolved in any sample determine its electrical conductivity. After being cleaned with distilled water, the conductivity cell was inserted into a potassium chloride solution (0.01N). After adjusting, the value was 1409 (mhos/cm). In this way, the EC meter has been standardized. After the cell had been cleaned with distilled water and rinsed with the sample, the sample was placed in a 100 ml beaker, and specific conductivity was then computed. The electrical conductivity is precisely measured by the EC meter. The measurement is in micromhos/cm at 250C.

Determination of Alkalinity

TA was used to identify water ions in a water sample, including hydroxide, bicarbonate, and carbonate. Waters that are very alkaline are frequently useless. Due to the increased alkalinity in the water, irrigation poses a risk since it degrades the soil and reduces agricultural output. Alkalinity is necessary for several operations, including the treatment of natural and wastewaters. The water samples were titrated against a standard acid using the markers phenolphthalein and methyl orange in order to determine the TA. By using phenolphthalein indicator, the hydroxide ions in water and the carbonate ions in bicarbonate ions (HCO3-) were neutralized. The application of methyl red indicator in water and carbon dioxide (CO2) then served to further neutralize these ions.

Alkalinity is the term used to describe a liquid's capacity to accept protons. It is defined as an aqueous medium's quantitative capacity to react with hydrogen ions to pH 8.7 (phenolphthalein alkalinity), followed by pH 3.7 (total alkalinity or methyl orange alkalinity). distilled water with a pH of at least 6.0 was used. If the pH is greater than 6.0 and the conductivity is less than 2 s/cm, deionized water may be used.

Requirements

(A) Hydrochloric Acid – 0.1 N

By dissolving 8.34 ml of 12N concentrated HCl that had been diluted to 1000 ml, 0.1N HCl was created. 0.1N sodium carbonate solution was used to standardize this solution. (To make 1 liter, 5.3 g of previously dried Na2CO3 was dissolved in distilled water for 4 hours at 250 C).

(B) Methyl Orange Indicator 0.05%:-

0.5 gm. of methyl orange was dissolved in 100ml. of distilled water.

(C) Phenolphthalein Indicator:-

50 ml of 95% ethanol and 50 ml of distilled water were added after dissolving 0.5 g of phenolphthalein in them. Additionally, 0.05N CO2 free NaOH solution was added until the solution took on a pale pink color.

Procedure:

(i) 100 ml of the sample were added, causing the solution to become pink.

(ii) After adding 0.1N HCl to the pink solution, the color was titrated until it vanished. The quantity of HCl utilized was recorded (V1).

(iii) The same sample was then given 3 drops of methyl orange, and the titration was maintained until the color returned to pink. The quantity of HCl utilized was recorded (V2).

Calculation:-

Total alkalinity, carbonate and bicarbonate alkalinity were calculated with the help of the following formula.

$$\text{Total alkalinity mg/lit} = \frac{V_2 \text{ X N of HCl X1000}}{\text{ml of sample}}$$

$$\text{Carbonate \% alkalinity mg/lit} = \frac{V_1 \text{ X N of HCl X1000X60}}{\text{ml of sample}}$$

$$\text{Bicarbonate \% alkalinity mg/lit} = \frac{(V_2 - V_1) \text{ X N of HCl X1000X61}}{\text{ml of sample}}$$

Where:

V1 = Amount of HCl used for phenolphthalein titration.

V2= Volume of HCl used from phenolphthalein end point to methyl orange end point.

Sodium Adsorption Ratio (SAR)

The metric used is the Sodium Adsorption Ratio (SAR), which gauges the relative activity of sodium ions in soil exchange processes. High sodium ions in water have an effect on soil permeability, which also affects infiltration. This is brought on by the soil's exchangeable sodium, which disperses soil particles and replaces calcium and magnesium adsorbed on soil clays.This ratio evaluates the sodium content in relation to the calcium and magnesium levels. Piper (1966) defined this ratio using the following equation:

SAR = Na **/** √ Ca + Mg **/** 2

Hence, Na^{+}, Ca^{+2}, Mg^{+2} represent the concentration in milliequivalent per litre of respective ions.

Groundwater standards are based on SAR. According to Richards (1954), "Excellent" groundwater for irrigation is defined as having a SAR value of less than 10 meq/L, "Good" groundwater has a SAR value between 10 and 18 meq/L, and "Doubtful" groundwater has a SAR value between 18 and 26 meq/L.

Water quality index

A simple "ranking of water quality" (e.g., good, excellent, moderate, low) is what the drinking water quality index (WQI) aims to give. For determining if water is suitable for drinking, the water quality index was calculated. Three stages are used to calculate WQI.

Step 1: Each of the fundamental criteria has been given a weight in the first step, ranging from 1 to 5, depending on how important it is in relation to the aim of drinking.

From the following equation, we calculate the relative weight of each parameter.

$Wi = Wi / \sum^{n}_{i=1} Wi$ ....(1)

Wi is calculated according to its relative importance in the overall quality of drinking water.

Step 2- In the second step, a quality rating scale (qi) is determined for each parameter by dividing the concentration in each water sample (Ci) by the corresponding standard (Si) 50, as per the Indian Standard and WHO drinking water standards. The necessary WQI is then calculated by multiplying the findings by 100.

qi= (Ci / Si)× 100 ………(2)

Where Ci = Concentration of each parameter Si= Respective Indian standard value qi = Quality rating

Step 3- The Sub Index (SIi) of a water sample is obtained for each parameter, and WQI is calculated using the equation below. SIi = Wi × qi ……....(3)

WQI = ∑SIi …..…..(4)

Overall WQI = ∑qiWi **/** ∑ Wi ……… (5)

Where qi = Quality rating Wi = Relative weight

Based on the computed WQI the water was classified into five types: WQI 0–25 excellent, 26–50 good, 51–75 poor, 76–100 very poor, and>100 unsuitable.

Plants use during Investigation

The seeds of the test plant species, Capsicum annuum L., Solanum lycopersicum L., and Solanum melongena L., were purchased from the Agriculture Research Centre of the Rajasthan Agriculture University of Bikaner in Durgapura, Jaipur, Rajasthan. Throughout the pre-monsoon, monsoon, and post-monsoon seasons, crop plant samples were sporadically collected from the agricultural fields in the research region at two different locations.

***Solanum lycopersicum* L.**

The tomato, a member of the Solanaceae family, is a well-known fruit or vegetable. To grow, tomatoes need both warm and temperate climates because they are a warm-season crop. Frost and a lot of rainfall are both problematic for the plant. Additionally, fruit set, colour, and pigmentation are impacted by light intensity. Unfavorable climatic conditions have a substantial impact on the plant. A variety of environmental factors are required for seed germination, seedling growth, flower and fruit set, and fruit quality. Both extremely low temperatures (below 10°C) and extremely high temperatures (over 30°C) can injure plant tissue. Tomatoes grow best when the temperature is between 21 and 24 degrees Celsius. There are almost 7,000 distinct tomato types grown globally. The majority of tomato varieties are red, however they can also be green, yellow, orange, pink, black, brown, white, or purple (Diez & Nuez, 2008).

The tomato plant has a slender stem that periodically sprawls over the ground and tramples other plants. It normally grows to a height of one to three metres. Tomatoes are widely grown for both the fresh market and for processing. In addition to water (93.1%), protein (1.9%), fat (0.3g), fibre (0.7%), carbohydrates (3.6%), calories (23), and vitamin C, tomato fruit (0.8 mg) also contains calcium (20 mg), phosphorus (36 mg), iron (0.8 mg), and vitamins A (320 I.U.), B1 (0.07 mg), B2 (0.01 mg), nicotinic acid (0.4 mg), and C (31 mg).

***Capsicum annuum* L.**

Red pepper, also referred to as chili and a plant in the nightshade family known as the Solanaceae, is a prominent vegetable crop farmed in India. India is one of the world's top producers of chiles. The Jaipur district dominates Rajasthan in terms of area and green chili (Capsicum annum) output. It is a crop that may be planted up to an altitude of 2000 meters and can be grown in both tropical and subtropical regions. For it to flourish in India, the country needs a warm, humid climate. Green peppers can be grown in a number of soil types, but they thrive in loamy, well-drained soils with a pH range of 6-7, a high organic matter content, and good drainage. Although it was initially created as a crop for spices, it quickly became popular for usage in pharmaceutical industrial medicine, food preparation, and food preservation (Raju and Lukose, 1991).

***Solanum melongena* L.**

It is one of the commercially significant crops in Asia, Africa, India, and Central America in addition to various warm temperate regions of the Mediterranean and South America (Sihachkr et al., 1993). Eggplant fruits are excellent for human health since they are low in calories and high in potassium, magnesium, calcium, and iron. (Zenia and Halina) 2008. An appropriate and balanced food has a considerable impact on the plant's yield.

Plant Based Examination

After being initially selected for uniformity criteria (seed size and colour), the seeds were surface sterilised with 0.1% HgCl2 for two minutes (Misra, 1968), followed by three washing with distilled water. The germination process took place over the course of ten days in the given climatic conditions. The experiment's tenth day saw the counting of germinations as well as measurements of seedling fresh weight, root length, and shoot length.

Fresh Weight and Dry Weight (g/seedling):

An electric balance was used to weigh seedlings in order to ascertain their fresh weight before measuring the roots' and shoots' lengths. The average result for each duplicate was calculated and expressed in grammes per seedling. For the purpose of calculating dry weight, individual plants were carefully removed while the root and shoot system was preserved. Plant roots were meticulously cleaned under running water to remove any dirt. After being separated, roots and shoots were dried for 48 hours at 800 C before their dry weights were calculated (the biomass of the shoot was measured without the ear). These weights per plant were provided in grammes. The number of plants or duplicates served as the basis for calculating the average.

Biochemical analysis

The amounts of chlorophyll "a," "b," and total chlorophyll in plant sample samples were calculated using the following techniques.

Estimation of chlorophyll:

Chlorophylls: The concentration of chlorophyll was evaluated using the Arnon (1949) method. A leaf sample that weighed about 1 g was broken up into tiny bits and homogenised with 80% (V/V) acetone in a pre-cooled mortar and pestle. A small amount of calcium carbonate was added while the food was being ground. The extract was centrifuged at 3000 rpm for 15 minutes before being diluted to 25 ml with 80% (V/V) acetone. The optical density of the clear solution was measured at 645 and 663 nm in a shimadzu twin beam spectrophotometer (UV 240) in comparison to a blank of 80% acetone.

The following equation was used to calculate the amounts of chlorophylls 'a' and 'b':

Chlorophyll ‘a’ (µ/g/ml) = (12.7 x O.D. at 663 nm) – (2.69 x O.D. at 645 nm)

Chlorophyll ‘b’ (µ/g/ml) = (22.9 x O.D. at 645 nm) - (4.08 x O.D. at 663 nm)

Total chlorophyll (µ/g/ml) = (20.2 x O.D. at 645 nm) + (8.02 x O.D. at 663 nm)

The amount of chlorophyll was given as mg of chlorophyll per gm of fresh leaf weight.

RESULTS AND DISCUSSIONS

In the past, it seemed as though we had a limitless amount of natural resources at our disposal. Water is one of the most precious natural resources needed for human life. But the tremendous growth in the human population, the ensuing industrialization, and consumer-oriented lifestyles in the 20th century led to a vast and fluctuating demand for commodities. This resulted in an excessive pressure on our resources and accelerated worldwide environmental deterioration.

Drinking water is the main factor affecting human health, and it can be contaminated by municipal sewage, storm water runoff, drainage from cattle feed lots, and factory discharges from the slaughter and processing of poultry and meat. Public water is not always toxin-free, regardless of how it has been treated. Over half of all outbreaks of waterborne diseases occurred between 1940 and 1970, and the majority were caused by contaminated ground water sources. Understanding the chemical makeup of water is necessary for practical uses such as domestic usage, irrigation, and water supply. Understanding the chemical makeup of water is essential for reducing wastewater contamination of water basins.

52 metrics have been suggested by India's Central Board for the Prevention and Control of Water contamination to track contamination in a water body. Since using so many factors is a difficult task, only a few features that are relevant to that particular type of aquatic system are frequently incorporated into the water quality index. An extensive study of water yields data on its physical and chemical composition, which is expressed as a number. The suitability of the water for drinking has been evaluated at several locations throughout the study area, and the results are presented in numerous parts.

Physico-chemical analysis of sample water

According to Sivakumar and Dheenadayalan (2012), "physicochemical attributes" refers to the properties of water, such as colour and flavour, that may also influence its appeal due to aesthetic considerations. These properties can also cause toxicological reactions, abrupt physiological responses with a laxative effect, and unpleasant side effects when used frequently.

In this chapter, values for all samples are displayed as observation tables along with an explanation of the findings. The results and their comparison to the drinking water guidelines for health set by the WHO revealed that the contaminants present in the water samples differed significantly. The findings show that there are significant seasonal variations in water quality. Some of the physical markers are turbidity, colour, scent, total dissolved solids, total fixed solids, total suspended solids, and total solids.

pH:

The physico-chemical characteristics of water are altered by pH, which has detrimental effects on people, plants, and marine life. The logarithm of the reciprocal of the hydrogen ion activity or hydrogen ion concentration in moles per liter is used to calculate pH using the glass electrode method. The concentration of heavy and trace metals, as well as both micronutrients and metals, is known to be influenced by the pH of the water. Water's pH determines whether or not it is appropriate for a given function.The bulk of the values are within the 5.98–7.87 range allowed by the Bureau of Indian Standards (BIS), formerly known as ISI. Since it affects a number of physical, chemical, and biological processes in the water system, the pH has a considerable impact on determining the quality of the water.Other physicochemical properties of water are known to be influenced by it and are linked to changing the biotic composition of the system, even though the pH of water can fluctuate within a range that has no direct impact on human consumption (Sharma et al., 2014).

The current study also demonstrates that the basic pH and value of the contaminated water in the Bagru study region was 8.739, while the average pH values of the groundwater samples across the Pre-Manson, Manson, and post-Monsoon periods were 7.537, 8.022, and 8.419, respectively. In the Pre-Manson, Manson, and post-Monsoon periods, the average pH of ground water samples was 7.1425, 7.245, and 7.5385, respectively. The Aaminshah region's contaminated water, on the other hand, had a fairly basic pH value of 7.905. The pH range of the several samples being examined is within the HDL, or highest recommended level, which is suggested by the WHO to be between 6.5 and 8.0.

Colour

The hue of the water is influenced by metallic ions, humus and peat materials, plankton, weeds, and industrial waste. The darkness in the water may be brought on by inorganic ions. The colour of water is the actual hue that remains after turbidity has been removed. The term "obvious colour" now includes colours brought on by suspended chemicals as well as colours brought on by compounds in solution. The apparent colour of the original material is identified without the use of centrifugation or filtering.

The current study further demonstrates that, whereas ground water samples' typical colour values during the Pre-Manson, Manson, and Post-Manson eras were less than 5 HZN, the contaminated water in the Bagru region had a hue and value that reached 6.812 HZN. During the Pre-Manson, Manson, and Post-Manson eras, the average colour value of ground water samples was less than 5 HZN, in contrast to the tainted water of the Aaminshah study region, which had a colour and value derived of 7.892 HZN.

Total hardness (TH)

Hardness is an essential characteristic to lessen the harmful effects of dangerous chemicals. According to the current investigation, the hardness value of the contaminated water in the Bagru research area was 546.8365 mg/ ml, while the average hardness values for the groundwater samples taken during the Pre-Manson, Manson, and post-Monsoon periods were 462.745, 513.8705, and 520.7455 mg/ ml. During the Pre-Manson, Manson, and post-Monsoon periods, the average hardness values of ground water samples were 464.889, 512.9845, and 528.8045 mg/ ml, respectively. However, the contaminated water of the Aaminshah region had a hardness and value obtained of 554.8295 mg/ ml.

The value, found by Nair and Rajendran (2002); Hulyal and Kaliwal (2011), was higher in the summer and lower in the winter. According to Kiran (2010), water may be classed as mild (0–75 mg/L), moderately hard (75–150 mg/L), hard (150–300 mg/L), or extremely hard (beyond 300 mg/L).

Total Dissolved Solids:

The inorganic salts and trace amounts of organic matter contained in water are referred to as "total dissolved solids" (TDS). The study's TDS concentrations rose with time, indicating increased conductivity that could be caused by contaminants including fertilizers, salt runoff from roadways, leaky septic systems, building activities, or leaking septic tanks (Das et al., 2014). The amount of organic contamination in the water is shown by the TDS in drinking water, which also discloses the salinity of the water. Substances in water that can pass through a filter with a nominal average pore size of 2.0 m or less are referred to as total dissolved solids. The majority of the total dissolved solids are inorganic salts, with a little amount of organic stuff. The increased TDS levels could be due to several contaminants leaking into groundwater from the underlying solid waste.Additionally, the current study demonstrates that the contaminated water in the Bagru region had high TDS concentrations, with a value of 3374.905 mg/ ml, in contrast to the average TDS values of ground water samples, which were 2588.81, 2795.545, and 3194.615 mg/ ml during the Pre-Manson, Manson, and post-Monsoon periods, respectively. During the Pre-Manson, Manson, and post-Monsoon periods, the average TDS value of ground water samples was 3024.83, 3185.33, and 3495.86 mg/ ml; however, the polluted water of the Aaminshah study region had high concentrations of TDS with a value of 3679.325 mg/ ml.

Alkalinity

Total alkalinity is measured in CaCO3 equivalents to quantify the effectiveness of H+ neutralization by water (De, 2008). Alkalinity is crucial for aquatic creatures because it acts as a pH buffer. The total alkalinity is determined by the quantity of acid necessary to react with the basic elements hydroxide, carbonate, bicarbonate, borate, phosphate, silica, and others. For practical purposes, alkalinity brought on by other compounds, such as borates, silicates, phosphates, etc., may be neglected.

Total alkalinity (TA), according to Egleston et al. (2010), has a significant effect on a water body's capacity to function as a buffer. Because it can act as a buffer against sudden pH changes brought on by plants' photosynthetic activity, alkalinity is crucial for fish and other aquatic life (Capkin et al., 2006). Low alkalinity (24 ml L1 as CaCO3) waters have a limited ability to withstand pH changes because of their low buffering capacity.

According to the current study, the contaminated water in the Bagru region had an alkalinity of 168.0985 mg/ ml, whereas the average total alkalinity readings for the groundwater samples taken during the Pre-Manson, Manson, and post-Monsoon periods were 130.454, 138.0565, and 156.3915 mg/ ml. In comparison to the contaminated water's value of 159.524 mg/l, the average total alkalinity value of ground water samples was 136.9185, 143.0335, and 149.2595 mg/ml during Pre-Manson, Manson, and post-Manson, respectively.

According to the location and season, natural water sources in the tropics frequently exhibit a wide range of variations in their alkalinity value (Hulyal and Kaliwal, 2011). The change in TA is proportional to the change in pollutant load, claim Parashar et al. (2006). More often than not, the combined alkalinity of the treated water and GW is less than 200 mg/l, which is the maximum permitted by the WHO.

Electric Conductance

The current study also demonstrates that the polluted water in the Bagru region had high electric conductance values, measuring at 2.788824 mmhos/cm, while the average electric conductance values of ground water samples during the Pre-Manson, Manson, and post-Monsoon periods were 1.3995, 2.328, and 2.599 mmhos/cm, respectively. While pre-Manson, manson, and post-Manson ground water samples showed average electric conductance values of 1.694, 2.457, and 2.555 mmhos/cm, respectively, the polluted water of the Aaminshah region had a high electric conductance and value obtained of 2.849 mmhos/cm.

For Parmeshwari et al. (2012), Kurakalva et al. (2016), Maiti et al. (2016), and Gworek et al. (2016), the results were the same. The EC values in the current study were significantly lower than those found by El-Salam and Abu-Zuid (2015). A high EC value, according to Chakraborty and Kumar (2016), indicates that dissolved inorganic ions are migrating from the surface into the groundwater and collecting there. According to Badmus et al. (2014), EC is significantly influenced by the sample's dissolved salt quality. As Parmeshwari et al. (2011) also pointed out, the values decreased in both years' wet seasons.

Sodium Adsorption Ratio (SAR)

In general, there is no threat to vegetation when SAR is less than 3.0; but, when SAR is greater than 12.0, there is a real risk to the life of the plant. SAR-based groundwater standard According to Richards (1954), "Doubtful" groundwater is defined as having a SAR value between 18 and 26 meq/L, "Good" groundwater is defined as having a SAR value between 10 and 18 meq/L, and "Excellent" groundwater for irrigation is defined as having a SAR value less than 10 meq/L (SAR 10 meq/L).

The current analysis also reveals that the water in the Bagru region was contaminated and had a high SAR value of 13.41 meq/L, while the average SAR values for ground water samples throughout the Pre-Manson, Manson, and post-Manson eras were 4.19, 6.625, and 5.69 meq/L, respectively. Although ground water samples' average SAR values for the Pre-Manson, Manson, and Post-Monsoon periods were 6.245 meq/L, 4.365 meq/L, and 4.05 meq/L, respectively, the contaminated water of the Aaminshah region had a much higher SAR and value detected of 13.442 meq/L.

Water quality index

In essence, a WQI seeks to provide a technique for supplying a numerical expression that specifies a specific level of water quality and is calculated cumulatively. Based on the computed WQI, the water was categorised into five categories: WQI 0–25 excellent, WQI 26–50 decent, WQI 51–75 awful, WQI 76–100 extremely poor, and WQI >100 inappropriate. The WQI values are greatly influenced by the dissolved oxygen content of the water. There are many limitations with the WQI. For instance, WQI was unable to offer sufficient information regarding the actual quality of the water.

Additionally, the current study demonstrates that the contaminated water in the Bagru region had a high WQI and a value of 126.5, whereas the average WQI values for the groundwater samples during the Pre-Manson, Manson, and post-Monsoon periods were 45.9, 70.5, and 59.2, respectively. The water quality index (WQI) for the tainted water in the Aaminshah region was significantly higher, coming up at 104.65, whereas the WQI for groundwater samples was, on average, 37.4, 45.85, and 54.35 during the Pre-Manson, Manson, and Post-Monsoon periods.

Morphological and Biochemical Analysis of Plants

Due to the enormous amount of solid waste created globally, numerous methods are being developed to manage and utilise the trash in different ways. Landfill mining, according to Zhou et al. (2014), is a technique for handling municipal solid waste in the material cycling process and for cleaning up existing landfills or dumpsites.Composts that contain plant diseases, weeds, or toxic substances can harm crops if the composting process is not managed properly. Contrarily, a properly maintained compost has the power to encourage plant growth and protect crops from disease (Fuchs et al., 2008). According to the habitat and the type of plant, there are wide variations in the concentrations of heavy metals in plants (terrestrial and aquatic) (Wong, 1996). If the other factors remain the same, it is possible to compare how a metal is absorbed by various plant species.

Similar results were found for tomato, aubergine, cucumber, melon, and MSW compost-grown seedlings by Chrysargyris et al. (2015), Mami and Peyvast (2010), and Asgharipour and Armin (2010), respectively. It is important to understand that expanding plants have more nodes, which causes the plants to produce more fruit (Shabani et al., 2011). Shabani et al. (2011) and Tzortzakis et al. (2012) discovered that as the amount of composted MSW rose, plant height and leaf count also increased.

The availability of nutrients to plants is impacted by organic and inorganic amendments that frequently enhance the amount of various nutrients, particularly nitrogen (Simeon and Ambah, 2013). At the top of the dumpsite soil, all three plants displayed a height reduction. This backs with the research of Soheil et al. (2012) who discovered that applying excessive amounts of compost had a negative impact on the physical characteristics of the plants.

Seeds are the most important factor influencing prospective agricultural output and a key element in the success of modern agriculture. These are used as food for humans, animals, and birds. The availability of high-quality seeds with good germination, emergence, and great vegetative growth potential is crucial to the success of agricultural development projects. It is possible to determine how metals affect plant growth and development by observing how seeds germinate and seedlings grow. In any given habitat, these two processes are essential for the establishment of plants. Several environmental factors can affect seed germination. Seed germination is an appropriate topic for scientific investigation due to how simple it is to observe and how many obvious and less evident environmental variables may impact germination. Comparing the source of the tainted water, however, revealed the most decrease in germination. They asserted that this is brought on by a decrease in water intake at greater salinity levels because of the high osmotic pressure of the seedling medium, which is poisonous. Hayward and Wadleigh hypothesised that the harmful effects of excessive chloride ion concentrations might possibly be to blame for the lower germination.

According to the current study, dirty water in the Bagru region had a substantial impact on seed germination and resulted in a percentage value of 76.58%, while polluted water in the Aaminshah region had an impact on the plant Solanum lycopersicum and produced a percentage value of 86.48%.

The current study also demonstrates that while polluted water in the Aaminshah region had a significant impact on seed germination, the Capsicum annuum plant, polluted water in the Bagru region had a significant impact on seed germination, with a percentage value of 86.34% discovered.

The current study also demonstrates that polluted water had a substantial impact on seed germination in the Bagru region, where it resulted in a percentage value of 86.42%, and in the Aaminshah region, where it resulted in a percentage value of 91.45% in the plant Solanum melongena

The current study also reveals that contaminated water in the Bagru region had a significant impact on root length, with a value of 20.58 cm obtained, but polluted water in the Aaminshah region had a significant impact on root length, with a value of 19.88 cm discovered in the plant *Solanum lycopersicum*.

The current study also shows that contaminated water from the Bagru region had a significant impact on root length, which was measured at 18.35 cm, but polluted water from the Aaminshah region had a significant impact on root length, measured at 21.34 cm in the *Capsicum annuum* plant.

The current study also demonstrates that the root length of the plant Solanum melongena was significantly affected by dirty water in the Bagru region, where a value of 18.65 cm was acquired, as opposed to the Aaminshah district, where a value of 17.85 cm was found.

The current study also demonstrates that whereas filthy water in the Aaminshah region had a major impact on shoot length and the value achieved at 38.17 cm in the plant Solanum lycopersicum, contaminated water in the Bagru region had a substantial impact on shoot length and the value achieved at 42.86 cm.

According to the current analysis, polluted water in the Bagru region had a significant impact on shoot length, with a value of 44.82 cm found, but had no such impact on shoot length in the Aaminshah region, with a value of 48.26 cm discovered in the Capsicum annuum plant.The current study also shows that dirty water from the Bagru region significantly affected the shoot length of the plant Solanum melongena, reaching a value of 31.82 cm, while polluted water from the Aaminshah region similarly affected the shoot length, reaching a value of 35.68 cm.

The current study also reveals that the Bagru region's dirty water had a significant impact on the fresh weight and value acquired at 7.82 gm, whereas the Aaminshah region's polluted water had a significant impact on the fresh weight and value discovered at 6.24 gm in the *Solanum lycopersicum* plant.

The current analysis also shows that whereas fresh weight and value obtained from the Capsicum annuum plant in the Aaminshah region were significantly impacted by dirty water, fresh weight and value obtained from the Capsicum annuum plant in the Bagru region were significantly impacted by contaminated water.

The current study also shows that the polluted water in the Aaminshah region significantly affected the fresh weight and value discovered to be 6.12 gm in the plant Solanum melongena, while the polluted water in the Bagru region significantly affected the fresh weight and value discovered to be 5.14 gm.

The current study also shows that the polluted water in the Aaminshah region significantly affected the dry weight and value obtained 188.36 mg in the Solanum lycopersicum plant, whereas the polluted water in the Bagru region significantly affected the dry weight and value obtained 196.5 mg.

The current study also shows that while the polluted water of the Aaminshah region affected the dry weight and value obtained 352.88 mg in the plant Capsicum annuum, the polluted water of the Bagru region significantly affected the dry weight and value obtained 334.45 mg.

The current study also shows that the polluted water in the Aaminshah study area significantly affected the dry weight and value acquired at 203 mg in the Solanum melongena plant, whereas the polluted water in the Bagru region significantly affected the dry weight and value acquired at 196 mg.

Chlorophyll

Studies of biochemical properties are essential in plant analysis. These pigments are greenish and have a porphyrin ring. It is a stable ring-shaped molecule that permits unrestricted movement of electrons all around it. Chlorophyll comes in a number of different forms. being chlorophyll "a" the most important. In order for photosynthesis to make sugars, this molecule transfers its charged electrons to other molecules.

The pigments utilised in photosynthetic activities are immediately harmed by pollution. When not under stress, chlorophyll pigments have a complex structure; nevertheless, when under stress, they can undergo a range of photochemical reactions, such as oxidation, reduction, pheophytinization, and reversible bleaching (Puckett et al., 2003).

Pathak et al. (2012) discovered similar results for brinjal. Topcuoglu et al. published similar findings in brinjal in 2007. The reduced chlorophyll content in 100% site soil compared to other treatments may be due to the high concentration of heavy metals in the soil, which may have a negative impact on the pigments. Furthermore, the effects of increasing Zn concentration on decreasing chlorophyll levels were demonstrated by Manivasagaperumal et al. (2011), Vijayarengan (2013) in brinjal, and Jain and Bhansali (2008) in Cyamopsis tetragonoloba. According to testimony from Chrysargyris et al. (2015), the amount of chlorophyll b in aubergine seedlings treated with various concentrations of municipal solid waste compost decreased but increased at 45% of MSWC substrate. Since chlorophyll-a is the major photosynthetic pigment and chlorophyll-b is the accessory pigment that collects energy to transfer to chlorophyll a, there is an increase in the photosynthetic activity at this particular level.

According to the current study, polluted water had a significant impact on total chlorophyll in the Bagru study area, which was measured at 0.734 mg/g, but not on total chlorophyll in the Aaminshah region, which was measured at 0.738 mg/g in the plant Solanum lycopersicum.

The current study also shows that while polluted water in the Aaminshah region had an impact on total chlorophyll and caused a value of 0.654 mg/g in the plant Capsicum annuum, it had a significant impact and produced a value of 0.662 mg/g in the Bagru study area.

The present study also demonstrates that total chlorophyll in the plant Solanum melongena was significantly impacted by dirty water from the Bagru region, with a value of 0.688 mg/g, but not by polluted water from the Aaminshah district, with a value of 0.727 mg/g.

Table 1: Ground water analysis of Bagru region during pre Manson, Manson and post Manson

Parameters	**Unit of Measurements**	Pre-Manson	Manson	Post-Manson
pH	**-**	7.537±0.055940828	8.022±0.101964	8.419±0.010737618
Colour	**HZN**	<5	<5	<5
Total Hardness (as $CaCO_3$)	**mg/l**	462.745±1.790129832	513.8705±0.698838	520.7455±1.134309059
Total Dissolved Solids	**mg/l**	2588.81±1.723494423	2795.545±0.377823	3194.615±0.425580558
Alkalinity	**mg/l**	130.454±3.451506932	138.0565±3.734986	156.3915±0.983134145
Specific Conductance	**mmhos/cm**	1.3995±0.053355253	2.328±0.047517	2.599±0.053704921
SAR	**meq/L**	4.19±0.420341395	5.69±0.384961043	6.625±0.500201
WQI		45.9±5.161541042	59.2±5.498964106	70.5±5.066748

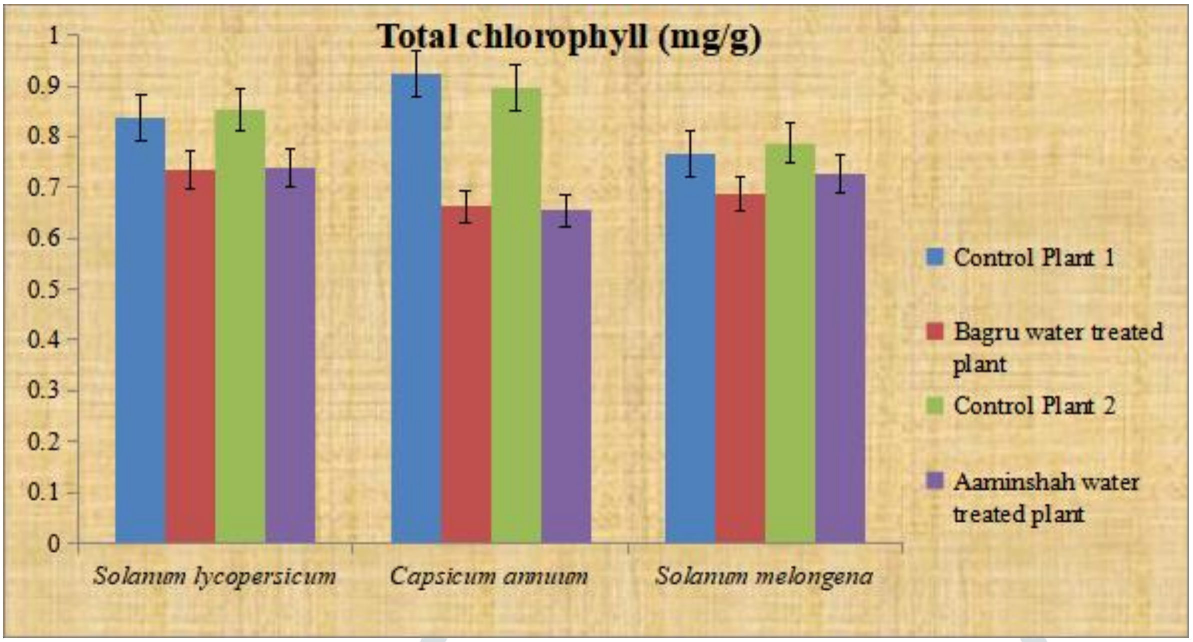
Table4.2 Ground water analysis of Aameinshah region during pre Manson, Manson and post Manson.

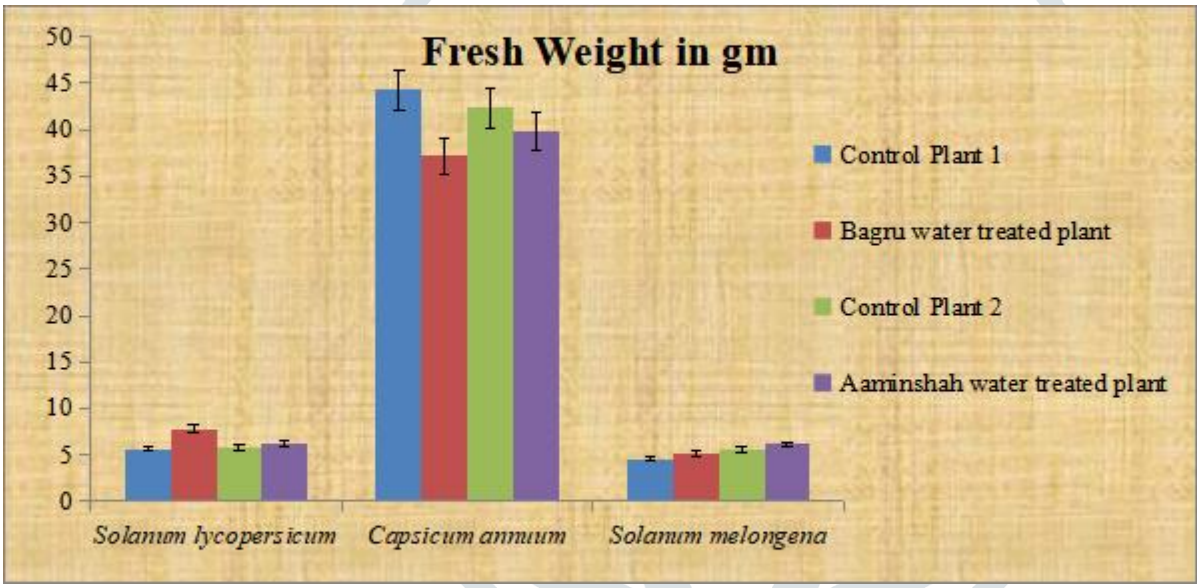
Parameters	**Unit of Measurements**	Pre-Manson	Manson	Post-Manson
pH	**-**	7.1425±0.054549	7.245±0.035707	7.5385±0.030125199
Colour	**HZN**	<5	<5	<5
Total Hardness (as $CaCO_3$)	**mg/l**	464.889±3.310882	512.9845±2.127923	528.8045±0.364974228
Total Dissolved Solids	**mg/l**	3024.83±2.436945	3185.33±0.448319	3495.86±0.277474096
Alkalinity	**mg/l**	136.9185±1.647681	143.0335±0.479511	149.2595±1.950443586
Specific Conductance	**mmhos/cm**	1.694±0.013172	2.457±0.069164	2.555±0.046533107

SAR	**meq/L**	6.245±0.522835	4.365±0.277845	4.05±0.285695301
WQI		37.4±3.02583467	45.85±3.373762	54.35±4.6306

Table 4.3 : Site wise water physiochemical properties with respect to acceptable Limit

Parameters	**IS 10500 : 2012 Requirement Acceptable Limit**	**Bagru region**	**Aaminshah region**	**Protocol**
pH	6.5-8.5	8.7395±0.007747	7.9055±0.023199	IS: 3025 (pt-11)-1983, Reaff.2017
Colour		6.812±1.516	7.892±1.642	
Total Hardness (as CaCO3)	200	546.8365±0.46268	554.8295±2.954919	IS: 3025 (pt-21) Reaff.2019 (EDTA Titrimetric Method)
Total Dissolved Solids	500	3374.905±0.193411	3679.325±0.769724	IS: 3025 (pt-16)-1984, Reaff.2017
Alkalinity	200	168.0985±0.684973	159.524±1.840801	IS: 3025 (pt-23)-1986, Reaff.2019
Specific Conductance	-	2.788824±0.011099	2.849±0.028085	
SAR (meq/L)	-	13.41±0.431213	13.442±0.906324	
WQI	-	126.5±5.40454	104.65±9.809181	
CFU/ml (X 10^5)	-	5.385±0.161367	5.225±0.136152	





CONCLUSION

Wastewater reuse comes with concomitant environmental risks, such as groundwater and surface water pollution, Stalinization, degradation of soil quality and effects on plant growth, disease transmission through consumption of vegetables irrigated with wastewater, and even increased greenhouse gas emissions linked to pumping sizable volumes of wastewater to an irrigation district. The significance of these risks will, of course, depend on the reuse strategy being used. Reusing wastewater eventually has to deal with the challenge of minimizing these risks while maximizing net environmental advantage. The population is expanding, so more food needs to be produced.

The study's goal was to measure the concentrations of heavy metals in vegetables that were being irrigated with secondary processed waste water. It was found that all veggies contain some level of heavy metals by analyzing vegetable samples with an atomic absorption spectrophotometer. Even though some vegetables have heavy metal levels below WHO/FAO permissible limits, consuming these vegetables over an extended period of time could increase the negative effects of these heavy metals on health. More heavy metals are present in leafy plants like mustard than in other types of plants. This is due to the strong propensity of leaves to collect heavy metals. Numerous companies flush their waste down the drain untreated, which is the main cause of the buildup of these heavy metals in the veggies.

This work has provided fundamental knowledge on the sustainable use of wastewater for agricultural productivity. We advise against using wastewater for agriculture in its present state in light of the aforementioned conclusions. The wastewater is processed to make it suitable for irrigation of agricultural land.

The findings of this study will aid in guiding government policy towards developing a treatment for wastewater from the textile industry as well as improved water recycling for agriculture. The government should support regulations that promote wastewater treatment and reuse by establishing a legal framework. The suggested integrated approach would assist textile industries in adhering to Pollution Control Board regulations, maintaining the nation's industrial infrastructure, and reducing or eliminating the deposition of solid/chemical waste in the form of sludge after chemical treatment. It would do this by directing biologically treated wastewater water into fields for irrigation.

The findings also make it possible to advise rural residents, including farmers and households, to keep using treated wastewater for short-term irrigation. It's also suggested to make it legal to use treated sewage water for irrigation of farms. Among the tactics we might utilize on a small scale is training farmers about the creation of healthy feed using treated wastewater. For those who are knowledgeable about making feed from treated wastewater, create educational opportunities. Make rules and strong limitations for the use of untreated wastewater in agriculture and animal breeding. Create ongoing educational initiatives regarding the dangers of allowing animals to graze on land that is near untreated sewage or to drink from canals, streams, and other water sources.To treat the water well and to a high grade suitable for its usage in agricultural irrigation in line with regional criteria, the relevant authorities' main priority is to enlarge the treatment station (Ameen Rageh 2014). The growing focus on this topic will be advantageous for a community that is growing sustainably in terms of its agriculture, economy, and health.

The main source of heavy metals in wastewater is industrial sewage. As a result, laws for the pre-treatment of industrial wastewater have been put in place in a number of countries, with a focus on removing heavy metals and trace elements before introducing them to urban water's wastewater treatment facilities.

Wastewater must be used to create water by recycling, reusing, recharging, and storing. It is urgently necessary to create planning approaches and advance policies that give developing wastewater treatment facilities and enhancing water supply similar weight. Municipal wastewater collection, treatment, and disposal are still not given priority by the municipality or state government in comparison to water service. There are no sewer hookups, which means untreated sewage is spilling into storm water drains and endangering the health of local residents. The operation and maintenance of most facilities are subpar due to poor power supply, insufficient backup power, a lack of skilled labour, and the fact that most facilities are underloaded as a result of bad sewage pipes. The main prerequisite for wastewater treatment is a sufficient supply of power, which is now a barrier in nearly all of the states in the nation.

With the primary objectives of preventing and managing water pollution and restoring water quality, the government passed the Water (Prevention and Control of Pollution) Act in 1974. The Central and State Pollution Control Boards were established for its execution (310 India Infrastructure Report 2011). Under the Water Act, the pollution control boards have the power to create and uphold water standards.

The actual sanctions, including fines and prison terms, are mainly limited to source-specific restrictions for certain pollutants. All businesses that may pollute water or produce solid or hazardous waste are required to undergo environmental audits. The Ministry of Environment and Forests has adopted a "Pollution Abatement Policy" that calls for the use of clean technology, resource conservation, the change from mass-based standards to concentration-based standards, incentives for reducing pollution, public involvement, environmental auditing, and the Ecomark labeling of environmentally friendly products. The legislative and institutional rules are contained in the Water (Prevention and Control of Pollution) Act of 1974.Standards are established and upheld by pollution control boards for the treatment of municipal wastewater. There are provisions for state pollution control boards to tighten criteria for site-specific demands, in light of low flow or no flow in portions of rivers or streams, and for seriously contaminated regions in light of notable concentrations of pollution loads in a given location.

Need-based norms for zero discharge are mandated for industrial units that emit a lot of pollution, however municipal authorities are immune from these enforcements. Sewage separation from rivers is gaining popularity in river conservation methods and may improve the water quality of recipient water bodies significantly. Institutional measures are still needed to maintain perennial rivers and streams by introducing minimum/environmental/ecological flows in order to conserve biodiversity and a sustainable ecosystem of aquatic resources.

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