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Assessment of Soil Quality Parameters of Ujjain Region MP

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Abstract: Soil contamination due to excessive pesticide use poses a major threat to agricultural productivity, soil health and environmental sustainability. Traditional remediation methods often have limitations such as high costs, secondary contamination and poor degradation efficiency of pesticide residues. In recent years, green synthesized metal nanoparticles (NPs) have become a promising environmentally friendly solution for pesticide detoxification and soil remediation. These nanoparticles, synthesized from plant extracts, microorganisms, or other biological factors, have improved catalytic activity, biocompatibility, and stability compared to their chemically synthesized analogues. This study investigates the potential of green- synthesized metal nanoparticles such as silver (Ag), zinc oxide (ZnO), and iron oxide (FeO) nanoparticles in the degradation and neutralization of pesticide pollutants in soil. The degradation mechanisms, including photo catalytic oxidation, adsorption, and microbial stimulation, are critically analyzed. In addition, the influence of these nanoparticles on the microbial variety of the soil**.**The soil's overall fertility and nutrient balance are assessed .Results indicate that metals with green synthesis contribute not only to the effective degradation of pesticides, but also help to increase the quality of the soil, which makes it a viable alternative to the lasting practice of agriculture. This study highlights the potential of nanotechnology-based ecosystem remediation as a transformative approach to address soil contamination while minimizing ecosystem damage. Future research should focus on optimizing the synthesis of nanoparticles, understanding their long-term effects on soil ecosystems, and expanding their field applications to ensure practical and safe implementation**.**

IndexTerms **– Soil quality, Parameters, Organic Carbon, Sulphate, Nitrate.**

I. INTRODUCTION:

Ujjain, a well-known city in Madhya Pradesh**,** India is well known for its extensive agricultural history, and the local economy is based mostly on agriculture. The area's fertile black cotton floors encourage the cultivation of a variety of crops, including soybeans, corn and wheat.[1] To increase yields, Ujjain farmers have historically been based on chemical pesticides. However, the common use of these pesticide substances has led to fears about soil health, environmental stability**.** India is well known for its extensive agricultural history, and the local economy is based mostly on agriculture. The study reveals the results of pesticide use in the region.[2] Studies have shown that the use of certain pesticides can have a negative impact on natural microbial soil populations, which are essential to maintain soil fertility and ecosystem balance.[3] A promising approach implies the use of metal nanoparticles synthesized in green (MNP) for the decontamination of pesticides.[4] Green synthesis methods use organic entities, such as plant extracts, to produce MNPs, thereby minimizing environmental impact and avoiding the use of dangerous chemicals.[5] Among the various MNPs, silver nanoparticles (AGNPs) attracted attention due to their antibacterial properties and potential in pesticide recovery[6]. AGNPs can catalyze the degradation of organic pesticides such as chlorpyrifos and resolve them into fewer toxic compounds.[7] Using the green synthesized MNP in the restoration of the soil offers a stable solution to pesticides. These nanoparticles can absorb and aggravate the remains of pesticides, thus restaurants the health of the soil and fertility[8]. Furthermore, the use of natural materials in nanoparticle synthesis is consistent with the principles of green chemistry that promote environmental sustainability. This strategy helps achieve the long-term goal of sustainable agricultural practices in addition to addressing the current issue of soil contamination. [9] The production of metal nanoparticles from plant extracts and their use in cleaning up pesticide-contaminated soils in Ujjain are the main topics of this study[10]. By studying the effectiveness of these synthesized green nanoparticles, this study develops environmentally friendly strategies to rejuvenate soil health and ensures long-term stability of local agriculture. It is intended to do so.

II. STUDY AREA:

This research was conducted in two villages, Harsodhan and Undasa, located in the Ujjain region in Madhya-Pradesh, India. Ujjain, located on the banks of the Kshipra river and is situated at the coordinates of 23°10'45.4800"N latitude and 75°47'5.6832"E longitude Ujjain is located at a height of 494 meters above the mean sea level. The total land area of Ujjain is 60987.4 hectares. Ujjain is one of the oldest cities in India and an important agricultural center in the Malva region. The district's distinctive features

are extremely fertile and support the cultivation of crops such as soybeans, wheat, corn and legumes. However, the high level of pesticide use in these farmlands has led to growing worries about the deterioration of soil and environmental pollution

HARSODAN VILLAGE

Geographical coordinates: latitude 23.188172°N, 75.905675°E longitude

Distance from Ujjain city: Approx. 15 km northwest

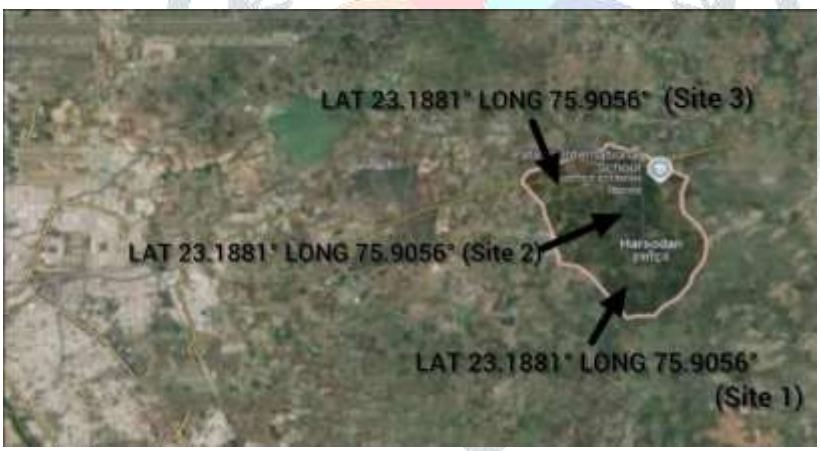
Harsodan is a predominantly agricultural village where agriculture is the main occupation. The village experiences a subtropical climate of distinct summer and winter seasons. Excessive dependence on chemical fertilizers and pesticides led to deterioration in the quality of the soil, the influence of agricultural crops and microbial variety on the productivity of agricultural crops. The presence of remains of pesticides in the soil requires the implementation of stable recovery methods, such as metal nanoparticles with green synthesization, to restore soil fertility**.**

UNDASA VILLAGE

Geographical coordinates: 23.225244°N latitude, 75.833059°E longitude

Distance from Ujjain City: Approx. 10 km south -East

Another important agricultural village in the Ujjain region, Undasa faces similar environmental problems due to the long-term use of pesticides. Although Undasa farmers mainly grow grain and oil seeds, fears about the long-term exposure of pesticide accumulation in the soil have been revealed. Recent studies in the region suggest that microbial soil activity and nutrient cycles are negatively affected, and it is essential explore ecological soil repair strategies.



III. MATERIALS AND METHOD:

A Study was carried out in 2023 at Ujjain, a district of Madhya Pradesh, India. The sample sites were selected over the agricultural land in the research region. Considering terrain and the diversity of soil types and maps of land use and soil association. The gathering of field data and soil sample was conducted by using GPS technology to navigate to certain spots. Ten soil samples from various locations (Harsodan and Undasa) in the Ujjain district, ranging in size from 0 to 15 cm, were collected in 2023 in order to estimate the various types of soil. Samples of collected soil were ground with a wooden hammer and allowed to air dry in the shade. A 2 mm sieve was used to filter these ground samples. A 1.0 kg composite soil sample that accurately reflects the area was

taken at each primary sampling location and recorded in a sample bag with the appropriate label for additional soil analysis to ascertain different soil parameters.

S. No.	Analysis	Techniques
1	Soil pH	pH meter
2	Electrical Conductivity (dsm^{-1})	Electrical conductivity meter [soil water suspension (1:2)]
3	Organic Carbon (%)	Walkley and black's titration method
4	Available nitrogen ($kg\ ha^{-1}$)	Alkaline permanganate method
5	Available phosphorus ($kg\ ha^{-1}$)	Olsen's method
6	Available potassium($kg\ ha^{-1}$)	Spectrographically method
7	Micronutrients (Fe,Cu,Mn,Zn)	Atomic Absorption Spectrophotometer (AAS) method

The analysis of the soil samples includes the evaluation of pH, electrical conductivity (EC), organic matter (OM), Organic Carbon (OC), available phosphate (P), potash (K), sodium (Na) ,andmicronutrients (Fe, Mn, Zn, Cu).The electrical conductivity is assessed using a digital conductivity meter, utilizing a 1:10 soil water suspension. Organic Carbon is calculated through the Walkley and Black's titration method. The available Phosphorus is determined through the stannous chloride colorimetric galvanometer method. The determination of potassium in soil K can be carried out in soil testing laboratories via various techniques, such as volumetric, spectrographic, gravimetric, potentiometric, or calorimetric. In the present study, it is quantified with the flame photometer. Sulphur in soil is estimated by a colorimeter or spectrophotometer. The measurement of micronutrients in soil, Fe, Cu, Mn, and Zn, is conducted by the Atomic Absorption Spectrophotometer (AAS) method.

IV. RESULTS AND DISCUSSION

Samples	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Agriculture soil**	**Permissible limit (ISOSS)**
Parameters	I	I	II	II	III	III	IV	IV	V	V	
Temperature (^{0}C)	28^0	28^0	28^0	29^0	29^0	27^0	27^0	27^0	29^0	29	NA
Colour	Black	Black	Black	Black	Brown	Brown	Black	Black	Black	Black	NA
pH	7.1	7.6	8.1	8.1	8.15	7.7	7.9	7.5	7.9	8.5	7-8.5
Electrical conductivity (ds/ms)	0.20	0.46	0.78	0.60	0.50	0.70	0.40	0.10	0.30	0.79	0-1
Organic carbon (%)	0.30	0.30	0.40	0.60	0.20	0.30	0.40	0.70	0.40	0.50	0.5-0.75
K (mg/l)	300	334	350	347	354	320	400	420	430	460	142-337
P(mg/l)	9.00	10	8.05	13.06	25.60	18.00	11.07	23.00	25.09	25.00	23-56
Fe(mg/l)	4.10	3.70	4.09	5.10	6.00	4.06	6.06	6.00	3.10	6.08	4.5

Cu(mg/l)	2.05	2.41	5.01	5.15	4.06	6.03	6.22	5.01	6.06	6.22	0.20
Mn(mg/l)	2.41	5.09	3.15	6.09	7.08	9.05	10.00	11.09	14.00	14.64	2.0
Zn(mg/l)	0.15	0.60	0.30	0.50	1.00	1.20	1.00	1.60	1.05	1.66	0.6

Each case's soil sample's physiochemical parameter values are listed in table no. 1 was noted during the month of December. Every result was compared to the Indian Society of Soil Science's (ISOSS) acceptable guidelines.

pH: The Ujjain district's soil pH ranges from 7.01 to 8.15, with a mean of 7.61, 6 2 and a standard deviation of 0.23. ISOSS 1 establishes the standard allowable limit for agricultural soil at 7-8.5. The study found that site III had the highest pH, which suggested that the pesticides were releasing alkaline wastewater.[Figure :1].

Electrical conductivity (EC): The range of EC for soil is 0point 10-0.79 dsm^{-1}, with a mean of 0.28 dsm^{-1} and a standard deviation of 0.15. The majority of the soil samples had normal levels of total soluble salt 2 concentrations, with Site V recording the highest value. The salt content of the soil samples at the surface as comparatively low. This could be the result of irrigation-induced salts leaching from the soil's surface to lower depths and accumulating there. [Figure :1].

Organic Carbon (%): The average organic carbon content of the soils in the Ujjain district area was between 0 and 48 percent, with a range of 5 to 60%.Taking into account the assessment of organic carbonic soil (. <0.25 as very low, 0.25-0.50 as low; 0.50-0.75 as medium; and > The Ujjain district area is classified as having a low and medium level of organic carbon, with a score of 0 to 75 being considered high in the five-point scale. The highest amount of organic carbon in this investigation was found at Site IV. The high temperatures in this region cause organic matter to burn quickly, which lowers the carbon content of the soils and results in low-living organisms.[Figure :1].

Potassium (kg/ha^{-1}): The concentration of potassium contamination in the soil sample ranged from -1300 to 460 mg/l, which was higher than the allowable limit [142-337 mg/l] for agricultural soil. For Site V, the highest values were greater than 400 mg/l.[Figure :2].

Phosphorus (kg/ha^{-1}): The average value is 15.08 kg ha^{-1}, with a standard deviation of 3.96 kg ha-1 3.96 .s. The highest value was recorded at Site V and Site III. The general statistics computed on the analyzed soil samples -1 9Show that affordable content ranges from 8.0-25.60. Variations in soil characteristics, such as pH, organic matter content, textures, and different agricultural and soil management techniques. It is embraced by nearby farmers. In terms of available phosphorus, the Ujjain district has a 10 percent high, 76 percent medium, and 14 percent low. Water-soluble P reacts with soil constituents to quickly transform into the insoluble solid phase when added to the soil.[Figure 2].

Iron (mg/l): The study areas' iron concentrations ranged from 4.9 to 6. 08 mg/l. 4–5 mg/l is the permissible limit. Sites V and IV recorded the highest value. [Figure 3]

Copper (mg/l): The study area's copper concentration ranged from 2.05 to 6.22 mg/l. ISOSS has established a standard allowable limit of 0–20 mg/l for soil.[Figure 3].

Manganese (mg/l): The ISOSS-established standard allowable limit for soil is 2 point 0 mg/l. The range of Mn in the current study sample was 2.41-14.64 mg/l. Site V was where the highest value was noted. [Figure :3].

Zinc (mg/l): The standard allowable limits for zinc ions in soil are ISOSS 0–6 mg/l. The sample in this study varied between 0 and 15 and 1 and 66 mg/l. At site V, the highest value was noted. [Figure 3].

Figure 1: Comparison of pH, EC, and OC of the selected study area

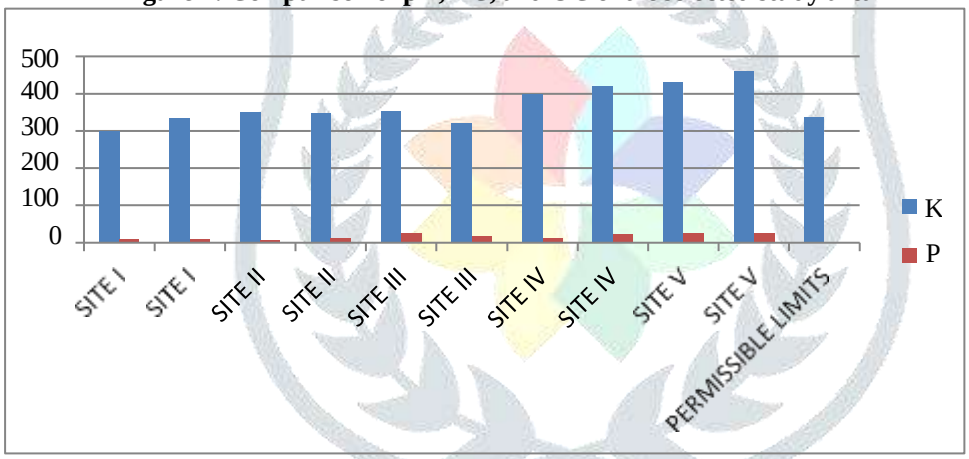


Figure 2: K and P experiments in a study area

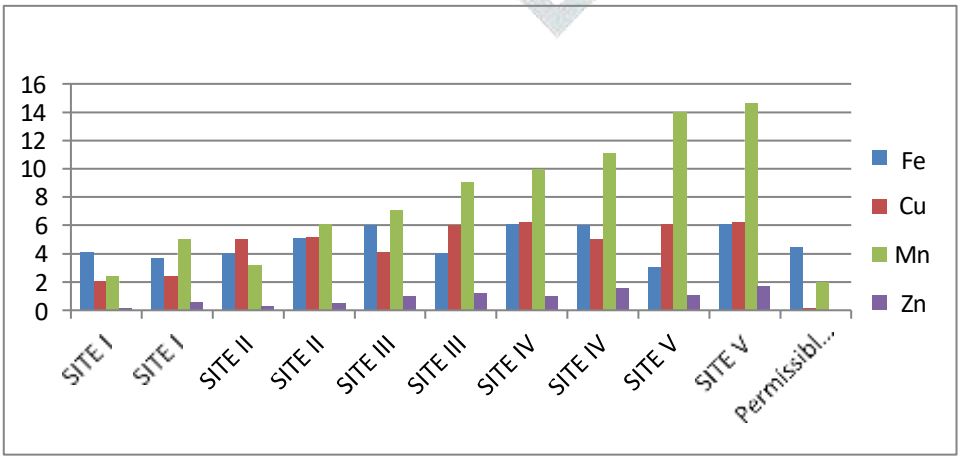


Figure 3: Micronutrients Fe, Cu, Mn, Zn experiments in a selected study area

V CONCLUSION:

The thorough examination of soil samples from Madhya Pradesh Ujjain district provides important new information about the fertility and health of the area's soil. According to the findings, the soils have medium levels of accessible phosphorus, medium to high levels of potassium, and sufficient levels of important micronutrients including zinc (Zn), iron (Fe), copper (Cu), and manganese (Mn). The electrical conductivity (EC) values stay below 1 dS/m, while the pH of the soil varies from neutral to alkaline, indicating that the soluble salt level is within the acceptable range for agricultural use. Farmers can benefit from the provided soil fertility database. It can direct the prudent application of organic amendments and fertilizers, encouraging balanced fertilization techniques. This is essential for reducing the negative effects of excessive chemical inputs on the environment while attaining sustainable agricultural productivity. Furthermore, periodic soil testing and monitoring programs should be institutionalized due to the moderate phosphorus levels and variability in micronutrients. These programs can assist in the monitoring of soil health changes over time and the subsequent adaptation of management practices. The integration of green

synthesis techniques, such as the application of green-synthesized metal nanoparticles, exhibits promising potential for the remediation of soil pollutants and the enhancement of nutrient availability, particularly in regions that are impacted by high levels of pesticide use.

VI REFERENCES:

II. REFRENCES:

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