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Identification of Physicochemical Properties of Agriculture Land Soil Near Highway in Udham Singh Nagar District of Uttarakhand

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Abstract
Soil plays a major role in providing facilities to our society, most importantly, food production. The word soil came from the Latin word 'solum', which means earthly material in which a plant grows. The weathering process of rocks forms soil. Soil quality and health are defined as the soil volume that functions as an energetic living system within land-use limits. Roadways crisscross many forest areas, and they might have destructive effects on forest soils, including the modified stability of soil organic matter (SOM). Soil health has become a serious concern worldwide, specifically in India, due to increasing traffic and anthropogenic actions. Highways navigate many agricultural areas and often have destructive effects on agricultural soils, including the modified stability of SOM. This study aimed to test the hypotheses that a highway will adapt the composition of the CE capacity of adjacent agricultural soil and significantly decrease the stability of SOM. Systematic information regarding the impact of highways on soil properties in the selected region will be used to achieve the expected data. Various parameters like soil moisture, OC, available N, P, K, clay, and CE are the basis of the physicochemical study of soil. Here, we analyze the physicochemical properties of the soil of Udham Singh Nagar district of Uttarakhand, India. All representative samples were obtained from the selected region of Udham Singh Nagar district along the road route based on distance from the highway and analyzed for their physicochemical properties. The current study will help farmers understand soil quality and determine which fertilizers or manures need to be added to their soil for optimal productivity.
Keywords: *Agricultural Land; Highway Construction; Organic Carbon; Physicochemical; Soil Testing.*

1. Introduction
Soil creation is a productive as well as damaging process. Particles of broken rock that have been altered by chemical and mechanical processes (weathering and erosion) compose soil [R. Kamal et al., 2023]. According to the Soil Science Society of America (SSSA), soil is an alive arrangement that signifies a fixed resource vital to life on earth. On the Earth's surface, it forms the thin skin of organic matter and unconsolidated minerals. It matures gradually from numerous parent materials and is improved by climate, time, micro- and macroorganisms, topography, and vegetation [9]. Pollution in Soil by the progress of urbanization and industrialization has become an evolving problem in urban-industrialized countries as well. Adulteration of soil is the key problem in emerging nations like India due to the insufficiency of land [R. Geetha et al., 2013]. Soil contamination has a high-risk impact on human health and might be irreparable. It may cause premature mortality, pretentiousness serious difficulties to the human race. Highways discharge various harmful metals due to running countless regular vehicles on them. Presence of heavy metals in these discharges easily enters to nutrition chain from polluted soil used for the production of harvests, which has direct consequences on man and the ecosystem (S. Mobar et al., 2015). Budding consciousness of the potential to moderate global climate change through the appropriation of soil organic carbon makes it important to systematically explore the mechanisms of Soil Organic Carbon destabilization. Human actions can lead to the development of emission sources from substances that change the chemistry of soils. The expanding network of highways is one of these actions, which are a vital territorial source of soil contamination (D.

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Kupka et al., 2021). Important soil elements that control its fertility are Macronutrients (Nitrogen, Phosphorus, Potassium) and micronutrients (Zn, Fe, Cu, Mn). Soil fertility is one of the important factors governing yields and quality of the crops. Soil characterization for the evaluation of the fertility status of the soils of an area or region is an important aspect in the context of sustainable agricultural production (H.B. Meena et al., 2006). Soil can be tested on two parameters –Physical parameters and Chemical parameters. Both parameters are very important to distinguish the soil based on fertile and non-fertile soil [10]. We can understand these parameters from the given table 1, as both parameters are differentiated in it.

Table 1 Soil Testing Parameters

Physical	Chemical	
	Macro-nutrients	Micro-nutrients
pH	Chloride	Copper
CE	Phosphorus	Zinc
Soil moisture	Nitrogen	Manganese
Alkalinity	Magnesium	Iron
	Calcium	

For any soil analysis, soil sampling is possibly the most dynamic step because a minor fraction of the massive soil mass is used for analysis, and it becomes very imperative to get an actual representative soil sample of the selected region. Many states, including Karnataka, Andhra Pradesh, Gujarat, Uttar Pradesh, and Haryana, have made admirable improvements in the soil testing programme in numerous ways (S.A. Jain et al., 2014). Some studies recognized the harmful effects of vehicle transportation on the environment and human health. An extensive range of contaminants, among which heavy metals (HM), polycyclic aromatic hydrocarbons (PAH), de-icing salts (DS), and total petroleum hydrocarbons (TPH) are included, are generated by Motor vehicles. The adverse effects of HM on human health include the ability to promote blood, neurological, and respiratory diseases, as well as cancer (O. Nikolaeva et al., 2021). The present study is an attempt to find out the nutrient's quantity in soil near the highway of Udham Singh Nagar district of Uttarakhand, India. This data will help growers to decide the amount of fertilizer to be added to the soil to make the production profitable. The objective of this paper was to analyze the trend in Nitrogen, Organic carbon, Clay, Potassium, Phosphorus, and cation exchange status of soils near the highway of Udham Singh Nagar district of Uttarakhand, India.

2. Methodology

We analyzed five soil samples collected at a depth of 15-25 cm from different plots near the highway in Udham Singh Nagar (Uttarakhand) to determine the effect of highways on the above six parameters of soil.

2.1. Soil Sampling

Soil samples were collected with the help of a hand-skew auger. For soil samples, firstly, we collect 10-15 sub-samples. Sub-samples were not taken in the form of a straight line. It was taken in a zig-zag pattern. Mix every sub-sample taken for a specific site with each other in a plastic container. After mingling subsamples, we will take the soil profile in the form of the above given figure 1.

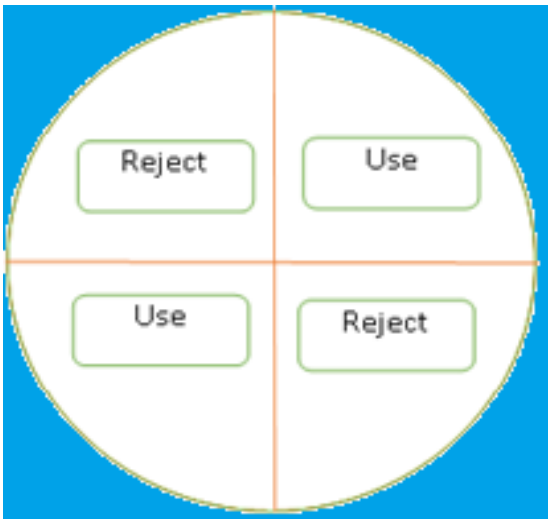

Figure 1 Soil Mixing Sample Format [2]

We obtained soil samples by using quartering and compartmentalization methods for monitoring. After obtaining the samples in a sufficient amount, we kept them in the shade to dry completely for further testing. After the entire aeration of the sample, we fill them discretely in sample bags and label them according to the sample-taking area. Later, we bring these sample bags to the lab for testing. For soil

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analysis, we used Agronxt Bhu Parikshak, A soil testing device by Agronxt (technology developed by IIT Kanpur).

2.2. Soil Samples and Their Code

Six different soil samples, filled in the sample bags with their latitude and longitude, their distance from the Highway, and the codes are as follows, table 2:

Table 2 Sample Code

Place	Code	Latitude	Longitude	Distance from highway
Jafarpur	S1H	28.98852	79.34107	300m
Kichcha	S2H	29.02245	79.27770	100m
Ramjiw-anpur	S3H	29.05373	79.26120	10m
Bajpur, talli	S4H	29.13153	79.12998	900m
Kashipur	S5H	29.23296	78.90975	800m

2.3. Soil Analysis

Figure 2 S1H [2]

By using Agronxt Bhu Parikshak, a soil testing device (technology developed by IIT Kanpur) in UCB (Uttarakhand Council for Biotechnology, Haldi, Udham Singh Nagar), we test soil samples which gives us direct results on a connected mobile. All five screenshots of results are as follows, shown in Figure 2 to Figure 6.

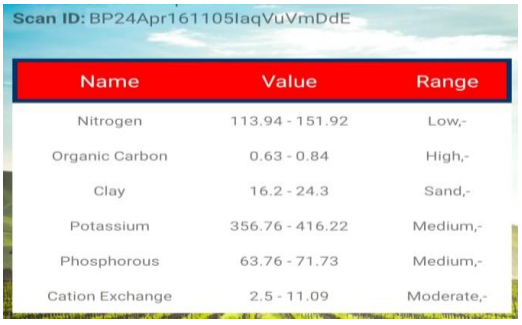

Figure 3 S2H [2]

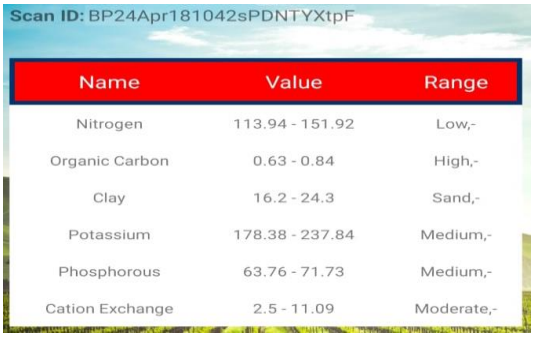

Figure 4 S3H [2]

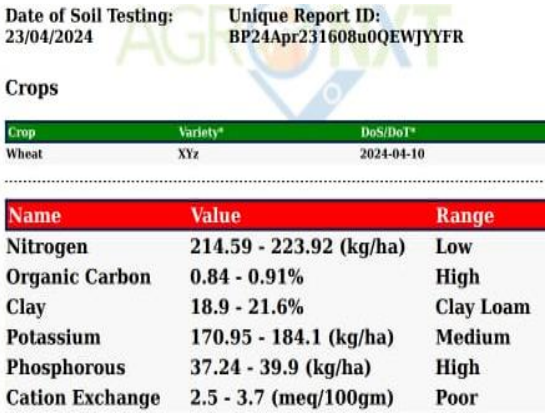

Figure 5 S4H [2]

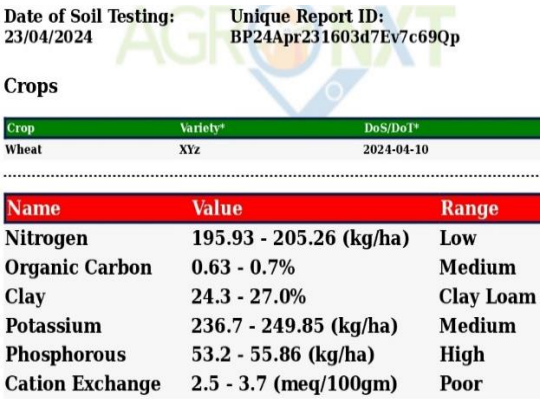

Figure 6 S5H [2]

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3. Results and Discussions

3.1. Results

After completion of the test of all samples, we obtained the results of soil testing in UCB (Uttarakhand Council of Biotechnology) with the Agronxt Bhu Parikshak soil testing device, which are mentioned below in the table with their sample codes and range:

Table 3 Physicochemical Properties of Soil

Sample Code	Nitrogen	OC	Clay	Potassium	Phosphorus	CE
S1H	149.28-158.61 (low)	0.7-0.77 (high)	18.9-21.6 (sand)	341.9-355.05 (medium)	58.52- 61.18 (medium)	2.5- 3.7 (moderate)
S2H	113.94-151.92 (low)	0.63-0.84 (high)	16.2-24.3 (sand)	356.76-416.22 (medium)	63.76-71.73 (medium)	2.5-11.09 (moderate)
S3H	113.94-151.92 (low)	0.63-0.84 (high)	16.2-24.3 (sand)	178.38-237.84 (medium)	63.76-71.73 (medium)	2.5-11.09 (moderate)
S4H	214.59-223.92 (low)	0.84-0.91 (high)	18.9-21.6(clay loam)	170.95-184.1 (medium)	37.24-39.9 (high)	2.5-3.7 (poor)
S5H	195.93-205.26 (low)	0.63-0.7 (medium)	24.3-27.0 (clay loam)	236.7-249.85 (medium)	53.2-55.86 (high)	2.5-3.7 (poor)

3.2. Discussion

From the above table 3, we can say that-

- Nitrogen is low in every sample.
- Organic carbon is high in all samples except S5H.
- The soil texture is sandy for all three samples, which are nearer to the highway, while clay loam for S4H and S5H, which are at a sustainable distance from the highway.
- Potassium is medium in all five samples.
- Phosphorus is medium in the first three samples, while high in the last two samples, which are at a sustainable distance from the highway.
- Cation exchange is moderate in the first three samples, while poor in the last two samples.

Conclusions

The physiochemical study of five different samples of agriculture land soil in Udham Singh Nagar district of Uttarakhand, India on various parameters like soil clay particles, OC, CE, and available N, P, and K we can say that the soil that has the highest distance from the highway have better soil particles and high amount of phosphorus. Conclusively, the study of soil samples of selected areas provides information about the nitrogen, potassium, phosphorus, OC, clay, and CE in that particular soil. This information may work as an effective tool to help farmers in better crop yields by adding the needed amount of water and fertilizers to their soil.

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