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SOIL DATA NUTRIENTS PROFILE MANAGEMENT AND INTERPRETATION PRACTICE IN MUSTANG DISTRICT OF GANDAKI PROVINCE, NEPAL

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ABSTRACT

"Soil data characteristics" are the different things about the soil that are used to sort it into groups and see if it is proper for various purposes. When soil studies are done with the help of remote sensing and field samples, this kind of information is often gathered. Researchers and regular people can use survey data to help them make smart choices about farming, building, and how to use land. In the Mustang area, from April 4th week to March 1st week, a small-scale cross-sectional sample survey study was started. Prior testing in different parts of Mustang made sure that the questionnaire design form was well organized. Regional Soil Testing Laboratory tested some of the findings made in the field study. It was easy to use statistical software that was then run on these data that were recorded in Microsoft Excel and then analysis by SPSS. Based on the study, the highest level of boron was found to be 98.08%, and the highest level of alkaline PH was found to be 63.46%. There was a middling amount of organic matter and potassium, but only a low amount of copper and iron. Mineral zinc was found in very small amounts in the sample that was taken. Significantly, there was a significant positive correlation ($r = 0.897^{**}$, $p^{**}<0.01$) between the amount of organic matter and nitrogen in the soil. A negative association ($r=-0.273^{*}$, $p^{**}<0.01$) was found between pH and zinc because they work against each other. In order to solve the soil data crisis, the study was significant for making decisions and policy formulation that would improve agricultural output and productivity, support food security, and ensure long-term growth in agriculture.

Keywords: Data, Correlation, Management, Observation, Sample, Soil.

I. INTRODUCTION

The topography of Nepal varies strangely from Terai region to Himalayan region, which contributes the national economy of Nepal through enrichment of the natural resource. There are so many numerous factors such as vegetation types ,climate and geology cause the variation in soil quality. Soil-quality evaluations frequently concentrate on identifying a "Minimum Data Set" (MDS) of soil because it is impossible to determine soil quality completely with a single indicator(Garrigues et al., 2012).

Soil is the life basis of living things, composed of organic and inorganic materials that found in the surface of earth. Since, soil is the complex mixture of the it composed of various kind of layers which is simply understood as horizons, each layer is formed by combined actions of percolating waters and living organisms. Soil is the life basis of living things, composed of organic and inorganic materials that found in the surface of earth. Since, soil is the complex mixture of composed various kind of layers which is simply understood as horizons, each layers are formed by combined actions of percolating waters and living organisms. Weathering of rocks and decay of organic materials play a crucial role in formation of soil. Better understanding of the soil formation technique and soil composition is essential for all to protect the soil, to increase the fertility gradients of soil. Among the 17 sustainable development goals declared by United Nations Program, at least 3 goals were directly linked with soil health, production and productivity. There was a strong linkage between soil data with soil data and sustainable development goals, targets and indicators from initial stage of planning to organizing and their systematic monitoring and evaluation.

Mustang district is one of the magnificent districts of Gandaki province of Federal Republic of Nepal 280.00 N to 840 .00 E. Managing soil data is essential for sustainable land use and resource management, especially in Nepal's Gandaki province. Soil data analysis in the Gandaki province, for instance, allows specialists to pinpoint regions with severe nutrient deficits, allowing for more precise fertilization plans that ultimately lead to higher harvests. Soil data management also aids in locating erosion hotspots, which can lead to the installation of erosion controls like terracing or contour plowing, which keep agricultural land productive for the long haul .A small town in the Gandaki province that mainly relies on traditional farming methods provide a detailed counterexample to the need of soil data monitoring. The hamlet has been growing crops for decades using only traditional knowledge, even though they lack access to modern soil data management procedures. In order to address nutrient deficits and erosion, the villagers have come up with their own methods, like crop rotation and organic composting, without depending on thorough soil data analysis. The emphasis here is on Data regarding soil characteristics, qualities, and condition must be gathered, organized, examined, and used. Decisions in resource management, land use planning, environmental conservation, and agriculture all can benefit from this method. In order to improve agricultural output, reduce soil erosion, increase biodiversity, and ensure sustainable land management techniques, it is crucial to monitor soil data in Gandaki province. Soil data management in Gandaki province provides important information about soil structure, origin, and properties; this information is crucial for improving land use management and soil preservation. In order to make educated judgments about land use planning, crop selection, and sustainable agricultural practices, land managers and policymakers require access to vast amounts of soil data. More sustainable land management practices, less soil erosion, more biodiversity, and higher agricultural yields are all possible outcomes of this in the Gandaki region. The undulating and fragile agricultural terrains of Gandaki province are particularly vulnerable to soil erosion and degradation, making soil data management a crucial issue in the area. Farmers and land managers can benefit greatly from well-man-aged soil data when deciding what crops to plant, how much fertilizer to use, and how often to water .One rebuttal could be that small-scale farmers in the Gandaki region may lack the financial resources and technical know how necessary to undertake soil data management procedures .In order to reduce soil erosion and maintain soil fertility, it also guides the use of appropriate soil conservation techniques like agroforestry, terracing, and contour plowing .In order to advance agriculture in Nepal's Gandaki Province, proper monitoring of soil data is essential. Collecting soil samples from different areas and studying them in labs to find things like pH, organic matter content, nutrient levels, and texture is what field-based techniques are all about .Satellite imaging and aerial surveys are examples of remote sensing technologies that can gather soil data from a larger area. The correlations between soil properties and agricultural yields, soil fertility, and the effects of soil erosion can be better understood with the help of data mining tools. However, problems with soil data management exist in Nepal due to factors such a lack of infrastructure and resources for gathering and analyzing data. Government funding for the construction of laboratories and training facilities dedicated to the study of soil data would greatly enhance soil data management. Infrastructure and resource enhancement, use of suitable methods and technology, construction of a comprehensive soil data-base, active monitoring and documentation of soil data, and training programs to increase farmers' and land managers' knowledge of soil data management are all part of the plan. The agriculture-al development in Gandaki can be greatly impacted by the efficiency of soil data management. This is because accurate and timely soil data allows land managers and farmers to make well-informed decisions on irrigation management, crop selection, and fertilization methods. This leads to more efficient use of land, higher crop yields, and improved agricultural output. Stakeholders may establish precise strategies for soil fertility and environmental preservation with the help of an improved soil database and cutting-edge technology that integrates with it. The main objective of this paper is to explore the soil data characteristics, data management and interpretation practice on the basis of household survey and laboratory data finding in Gandaki province of Nepal. However, this tries to identify tools and techniques of soil data management with small scale study such that suitable analysis and interpretation practicable.

II. MATERIALS AND METHODS

From March to April, 2023, a small-scale cross-sectional sample survey was conducted in the Mustang area along this line. Out of the 23-population size of the study area 22 samples were taken by accounting 5% margin of error for the household survey. Out of the 59-target place of the location 52 places were chosen for soil sampling taking 5% margin of error for the sample size calculation in order to soil testing.

A set of semi structured questionnaire were constructed and pretested before conducting survey. The data collection was carried out with trained enumerators of soil and fertilizer testing office, Pokhara. Then collected data were entered in to Microsoft Excel in which data editing and validation task completed. Thus, edited data were imported to user-friendly statistical software for further statistical analysis. In addition to standardizing the soil testing technique, an array of questionnaires was created using the results of the preliminary tests. Many of the samples and results were tested at the Soil Testing Laboratory, Pokhara. R studio version 4.3.10 and SPSS version 20.00 were used for data analysis. The cartographic map of Global positioning System coordinate was sketched by Arcmap 10.03. About 5-7 soil sample points were randomly selected for one composite soil sample. Fertilized plots, bunds, channels, marshy area, near large trees, wells, compost piles, border areas etc. were discarded properly. The surface litter, grass, debris from the sampling point were removed. Inserted the auger to a depth of 30 cm and drew the soil sample and collected in a bucket. (Mixed the samples from 5-7 spots in same bucket). Again, inserted the auger in the same hole to a depth of 30-60 cm and drew the soil sample and collected in a different bucket. (Mixed the samples from 5-7 spots in same bucket) Collected soil samples from 5-7 spots are mixed thoroughly with hands, spread on a clean plastic sheet and made four quarter. The opposite two quarters and retain the other two. Same process was repeated till the soil was reduced approximately 500 grams. Then there were 2 composite soil samples of the same soil sampling area, one up to 30 cm depth and another 30-60 cm depth. Collected samples are placed in a plastic bag, leveled and sent to the soil testing laboratory. The data generated from laboratory work and field work were entered in Microsoft Excel 2013 and then subjected on other statistical software SPSS and Stata 16.00.

III. RESULTS AND DISCUSSION

Distribution of Land Area of Respondents

Table 1 shows the distribution of frame land ownership by cropping structure in the research area is shown in Table 1. Since the mean value is higher than the median, the irrigated lands were positively skewed. The table shows the land ownership among the surveyed households in the research region. Of the 22 respondents, 22 had an average irrigated area of 22 ropanis, while the median value was 15.5 ropanis.17 farmers produced cereal crops on their property, with an average area of 3.44 ropanis and a median value of 4 ropanis. This suggests that the land used for cereal crops is negatively skewed.

Table 1: Distribution of Land Area of Respondents

Statistics	Irrigated Land ropani (n=22)	Cereal Crops (n=17)	Fruit (n=21)	Vegetable Farming Area (n=20)	Legume (n=21)
Mean	22	3.44	16.2	5	1.5
95% CI Mean Lower Bound	14.7	2.59	9.75	2.38	1.13
95% CI Mean Upper Bound	29.3	4.29	22.6	7.62	1.87
Median	15.5	4	10	3	1
Mode	8	5	4	2	1
Standard Deviation	16.6	1.66	14.1	5.6	0.806
Variance	275	2.75	200	31.4	0.65
IQR (Interquartile Range)	21	3	19	3.25	1
Range	57	4	47	24	3
Maximum	60	5	50	25	4
Skewness	1.06	-0.467	1.23	2.7	1.9
Std. Error of Skewness	0.491	0.55	0.501	0.512	0.501
Kurtosis	0.119	-1.59	0.401	8.53	3.73
Std. Error of Kurtosis	0.953	1.06	0.972	0.992	0.972

The distribution of respondents by fertility management technique and perspective is shown in Table 2. Significantly more than 75% of farmers did not acquire soil. Minority respondents 22.73% of those surveyed said they have received instruction on managing soil fertility. According to the majority of respondents, they received no advice whatsoever on how to manage soil fertility. Merely 22.73% and 18.18% of the surveyed respondents, respectively, reported having a rather poor degree of awareness of the components of nutrients and micronutrients. Only 13.64% of respondents said "yes," and 45.5% said "uncertain," indicating incredibly low levels of expertise and knowledge in soil sampling.

Distribution of Nitrogen Level among the collected sample of soil

with regards to soil data and their nutrients profile management ,the distribution of land area of respondents, distribution of respondents according to perception and practice of fertility management, Distribution of Soil components in collected sample, : statistical assumption checking, Comparison of various level of organic matter and Nitrogen and Correlation coefficient of different soil parameters were as shown in following table. Both descriptive and inferential statistics were used to describe and interpret data.

Four categories—very low, low, medium, and high—depict the distribution of nitrogen levels in Figure 1 of the pie chart. Figure 1 of the pie chart displays the percentage of each group at 5.77%, indicating that nitrogen levels are present in only a small portion of the data. 17.31% nitrogen levels labeled as "low" account for a significantly higher proportion of the data. 42.31%. This group contains the majority of the data and represents the most prevalent nitrogen level.34.62%. This group contains the second-highest proportion of nitrogen levels in the data. This graphic indicates that the majority of nitrogen levels in the data are either medium or high.

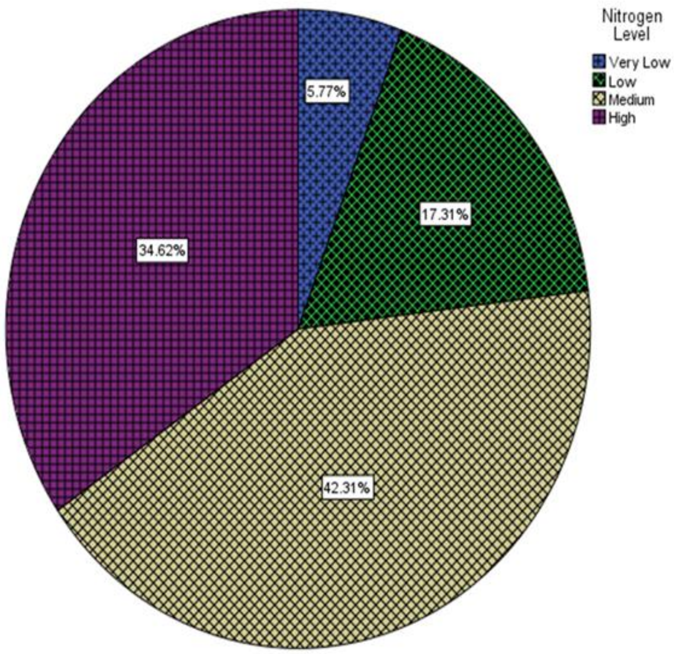

Figure 1: Distribution of Nitrogen Level among the collected sample of soil

Distribution of pH Level among the collected sample of soil

The simple bar diagram in figure 2 depicts the pH value dispersion among the soil samples collected.The alkaline group has the highest percentage (36.42%) and the highest average pH (7.86).The normal category has a modest percentage (33.91%) and a somewhat lower average pH (7.32).The strong alkaline category has the lowest percentage (29.67%).The alkaline category has the highest percentage (36.42%) and the highest average pH (7.86).

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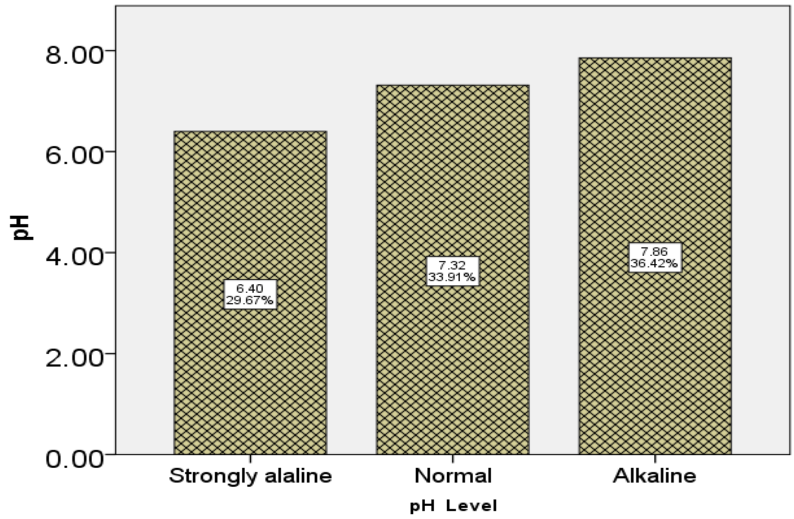

Figure 2: Distribution of Nitrogen Level among the collected sample of soil

Distribution of organic matter among the collected sample of soil

The bar diagram in Figure 3 depicts the distribution of organic materials in the collected sample. This category includes the majority of samples (45.56%), with an average organic matter concentration of 5.68. This category represents 31.09% of the samples, with an average organic matter concentration of 3.87. About 15.54% of the samples have low organic matter concentration, with an average of 1.94.

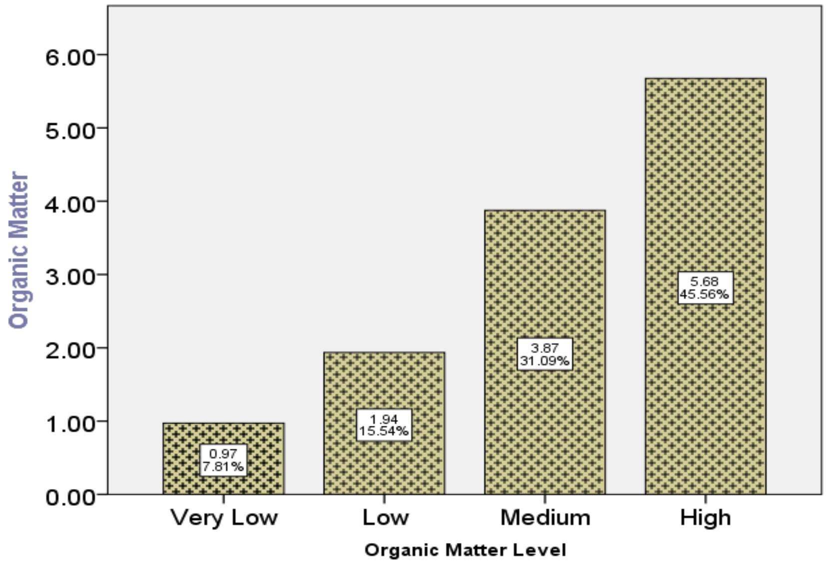

Figure 3: Distribution of organic matter among the collected sample of soil

Respondents perception and practice of Fertility Management

Table 2: Distribution of Respondents according to perception and practice of Fertility Management

Perception	Number	Percent
Training on Soil Fertility Management Yes	5	22.73
No	17	77.27
Nutrients Component		
Yes	5	22.73
No	16	72.73
Don't know	1	4.55

Micronutrients		
Yes	4	18.18
No	17	77.27
Don't know	1	4.55
Soil sampling		
Yes	3	13.64
No	9	40.91
Don't know	10	45.45
Types of Soil		
Yes	6	27.27
No	16	72.73
Quantity of Fertilizer		
Yes	11	50.00
No	8	36.36
Don't know	3	13.64

Table 3 reflects the preferences and possibly the market demand or suitability of specific crops and vegetables in the respondents' farming systems. Let me know if you'd like more detailed comparisons or visualizations! Table 3 shows that among the ceral crops, Buckwheat is the leading crop, with over two-third of respondents cultivating it. Other crops (maize, millet, wheat, and barley) show varying levels of adoption, with maize and millet being the least common. Among the vegetables: Potatoes is extensively cultivated followed by cauliflower, and cabbage by respondents, while carrots are far less common.

Table 3: Distribution of respondents based on their growing crops

Descriptions	Responses	Percent
Cereal crops		
Maize	4	25.00
Buckwheat	11	68.80
Wheat	5	31.30
Millet	4	25.00
Barely	9	56.30
vegetables		
Cauliflower	15	75.00
Cabbage	15	75.00
Carrot	4	20.00
Potato	16	80.00

The table 4 summarizes the distribution of soil components in 52 collected samples. It categorizes various soil parameters into levels and presents the number of samples and their respective percentages for each. The table depicts the most of the samples 33 (63.46%), are categorized as alkaline, portentous a pervasiveness of basic soils in the sample. 18 samples (34.62%) fall within the normal range, a remarkable proportion. Only 1 sample (1.92%) is strappingly alkaline, indicating sporadic extreme conditions. 22 samples (42.31%) fall into the medium category, indicating moderate levels. 18 samples (34.62%) are rich in nitrogen, a bulky proportion. 9 samples (17.31%) have lower than optimal nitrogen. 3 samples (5.77%) are undersupplied in nitrogen. The majority, 28 samples (53.85%), are low in phosphorus, indicating extensive deficiency. However, 8 samples

(15.38%) fall within the medium range. Melodramatically, only 1 sample (1.92%) has an excessive phosphorus level, rare in this set. The majority, 28 samples (53.85%), are low in phosphorus, indicating widespread deficiency 15 samples (28.85%) have critically low phosphorus levels. 8 samples (15.38%) fall within the medium range. Only 1 sample (1.92%) has an excessive phosphorus level, rare in this set 23 samples (44.23%) are in the medium range, forming the largest category. Followed by: 12 samples (23.08%) have high potassium levels. Next, 7 samples (13.46%) have excessive potassium and 2 samples (3.85%) are underprovided in potassium. However, 8 samples (15.38%) have low potassium.

A majority, 30 samples (57.69%), have critically low zinc levels 12 samples (23.08%) have low zinc 10 samples (19.23%) are within the medium range samples (26.92%) are severely deficient in copper samples (46.15%) show low copper levels' samples (7.69%) have medium copper levels' samples (15.38%) have high copper levels. 2 samples (3.85%) show excess copper 15 samples (28.85%) have critically low iron 21 samples (40.38%) are low in iron, the most common deficiency samples (15.38%) are in the medium range samples (9.62%) have high iron's samples (5.77%) which show very high iron. Only 1 sample (1.92%) has a medium boron level, suggesting limited variability in this parameter. Alkaline soils, low phosphorus, and critically low zinc levels are common. Nitrogen and organic matter are generally in moderate to high levels. Zinc, phosphorus, and iron exhibit significant deficiencies in a substantial number of samples. This statistical overview helps in identifying the areas requiring intervention for soil improvement and nutrient management.

Table 4: Distribution of Soil components in collected sample n = 52

Soil parameters	Level	Number	Percent
pH	Strongly alkaline line	1	1.92
	Normal	18	34.62
	Alkaline	33	63.46
Organic Matter	Very Low	7	13.46
	Low	11	21.15
	Medium	27	51.92
	High	7	13.46
Nitrogen	Very Low	3	5.77
	Low	9	17.31
	Medium	22	42.31
	High	18	34.62
Phosphorous	Very Low	15	28.85
	Low	28	53.85
	Medium	8	15.38
	Very High	1	1.92
Potassium	Very Low	2	3.85
	Low	8	15.38
	Medium	23	44.23
	High	12	23.08
	Very High	7	13.46
Zinc	Very Low	30	57.69
	Low	12	23.08
	Medium	10	19.23
Cupper	Very Low	14	26.92

	Low	24	46.15
	Medium	4	7.69
	High	8	15.38
	Very High	2	3.85
Iron	Very Low	15	28.85
	Low	21	40.38
	Medium	8	15.38
	High	5	9.62
	Very High	3	5.77
Boron	Medium	1	1.92

Table 5 shows the statistical presumptions for approving additional statistical testing for one way analysis of variance for nitrogen and organic matter .A one way ANOVA statistical model is accepted if the test statistical value has a Global test of significance with a p value higher than the level of significance of 0.05.A skewness result with a p-value greater than 0.05 indicates that the data is roughly regularly distributed, confirming that the normalcy assumptions were not broken. The kurtosis number shows that there was no deviation from the normal distribution of the data. The assumptions of homoscedasticity are supported by the estimated statistic and p value greater than 0.05, which indicate that there was a constant variance across the independent level.

Table 5: Statistical assumption checking

Variables	Criteria /Assumptions		p-value
Organic matter	Global Stat	2.879	0.5783
	Skewness	0.178	0.6731
	Kurtosis	0.2945	0.5874
	Link Function	6.56E-16	1
	Heteroscedasticity	2.406	0.1209
Nitrogen	Global Stat	2.795	0.5928
	Skewness	0.1679	0.682
	Kurtosis	1.791	0.1808

Table 6 compares different levels of nitrogen and organic matter using the global test of significance from one-way analysis of variance. The soil's nitrogen content and organic matter ranking varied among the soil samples gathered from the study location.

Table 6: Comparison of various level of organic matter and Nitrogen

Variables	Ranking Level	Mean± SEM
Organic Matter	Very Low	0.97303^{d}±0.052595
	Low	1.93679^{c}±0.107277
	Medium	3.87434^{b}±0.138036
	High	5.67643^{a}±0.11273
Nitrogen	Very Low	0.0427^{c}±0.00402
	Low	0.0688^{c}±0.00589
	Medium	0.152^{b}±0.0068
	High	0.2517a±0.00677

P<0.05 statistically significant

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The table revealed the spearman's rank correlation coefficient between various soil parameters in study area. The diagonal element of the rank correlation matrix from top left to bottom right is always unity in which correlation between each variable is perfectly correlated with itself. A positive value of the correlation coefficient shows the proportion of increase in one variable leads to increase in other variables in same direction.(Herzog & Aaron Clarke, n.d.). A negative value of the correlation coefficient shows the proportion of increase in one variable leads to decrease in other variables in opposite direction. The value ±1 indicates a stronger perfect positive or negative correlation among the parameters. The correlation matrix indicates there was a strong positive correlation between Nitrogen and Zinc (0.764**) which was highly significant at 1% level of significance. Likewise, there was a strong positive correlation between Nitrogen and Boron. There was a moderate positive correlation between Nitrogen and phosphorus pentoxide (P_2O_5) 0.464** and Iron (0.568**).which was significant at 0.01 level There was Significant positive correlation Phosphorus n with Boron (0.657**) and Zinc (0.518**) whereas phosphorus was inversely correlated with pH value ((-0.338*) which was found significant at 0.05 level of significance. On the other hand potash content in the sampled soil had weak correlations with most of the soil parameters. However, there was slightly positive correlation between potassium and phosphorus (0.342*) which is significant at 0.05 level. There was strongly positive correlations between Zinc and Nitrogen (0.764**), Boron (0.681**), and Iron (0.807**) are observed .There was a high correlation between Fe and Copper (0.669**) and Zinc (0.807**).pH was negatively correlated with P_2O_5 (-0.338*) and K_2O (-0.193), but correlations are weak. Correlation study can direct soil management techniques and aid in understanding how different soil qualities interact.

Table 7: Spearman Rank Correlation coefficient of different soil parameters

	pH	Nitrogen	P2O5 kg/ha	K2O kg/ha	Zn (ppm)	Cu (ppm)	Fe (ppm)	B (ppm)
pH	1							
Nitrogen	0.094	1						
P2O5 kg/ha	-0.338*	0.464**	1					
K2O kg/ha	-0.193	0.075	0.342*	1				
Zn (ppm)	-0.157	0.764**	.518**	0.024	1			
Cu (ppm)	-0.09	0.410**	-0.022	-0.222	0.588**	1		
Fe (ppm)	0.003	0.568**	0.236	-0.287*	0.807**	0.669**	1	
B (ppm)	-0.138	0.709**	0.657**	0.255	.681**	0.239	0.463**	1

*.=Correlation is significant at the 0.05 level (2-tailed).

**= Correlation is significant at the 0.01 level (2-tailed).

DISCUSSIONS

Soil data management plays a crucial role in the overall study of soil characteristics, leading to accurate results. Soil is a natural resource and the basis for agriculture and agricultural food production (Roesch et al., 2019). Soil data management is concerned with biotic and abiotic factors in the ecosystem.

https://www.nrcs.usda.gov/conservation-basics/natural-resource-concerns. Soil data management is essential for every aspect of planning and organizing the agricultural land of the country. It is a more advanced area of data science that involves taking samples of soil to a lab to test its different parts. This creates accurate data that can then be analyzed and interpreted using statistical methods. Beside experimental study socioeconomic survey are essential parts to connect farmer's soil to their livelihoods. Since the livelihood of farmers depends upon the production and productivity of the crops in limited land.

The data collection process is the fundamental step in obtaining an optimal amount of reliable and valid data. Soil is highly acidic if its pH is less than 4.5. When the soil's pH falls between 4.5 and 5.5, it is considered moderately acidic. Soil has a mildly acidic nature if its pH falls between 5.5 and 6.5. The soil is almost neutral if

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the value falls between 6.5 and 7.5. The soil is considered alkaline if the value is higher than 7.5. (Sauzet et al., 2024). Soil data were collected and generated using various methods: survey methods, experimental design, and geographical information systems with remote sensing techniques. Proprietary software as well as open-source statistical software were beneficial for statistical analysis and interpretation of soil research data. However, statistical methods and design**s were more popular than anything else.** The soil profile includes both nutrient components and morphological texture that comes from the nature of its parts, which are defined by their semi-arid climate and unique topographical features. This is in line with the principles shown in the sustainable development goals for soil. The study was conducted by Lal et al. in 2021.Another study called "Effect of Four Different Types of Vermicompost on Okra Production" showed that adding organic matter to soil can make it healthier and help plants grow better. It shows significant insightful knowledge about soil data management techniques. As reported in the study, managing soil data effectively is necessary to maximizing crop yields, preserving soil fertility, and incorporating long-lasting farming techniques. (Acharya et al., 2024)This study underscores the importance of monitoring soil characteristics such as pH, organic matter, and nutrient content to evaluate the effectiveness of vermicompost.

Joshi et al.'s 2023 study on how farmers feel about nitrogen inputs and how they manage their soil shows how important it is to control nitrogen levels and how farmers feel about the health of their soil for sustainable farming methods. Promoting soil fertility and attaining sustainable land use require an understanding of nutrient dynamics, especially nitrogen input and depletion, given Mustang's particular soil and climate. We need to combine the scientific management of soil health with the expertise of local farmers to establish specialized soil management, which in turn will create proper soil utility for areas such as Mustang. (Joshi et al., 2023).

It is claimed that combining research and extension plays a crucial role in improving soil fertility and thus encouraging sustainable farming methods and increasing food security. The technology-based solutions, institutional memory support, and participatory methods incorporate the soil productivity. It is argued that combining research and extension is essential to improving soil fertility, encouraging sustainable farming methods, and boosting food security (Integration of Agricultural Research and Extension, n.d.). To accomplish these objectives, the paper suggests using technology-driven solutions, institutional support, and participatory methods.

The pH value is an important characteristic of soil that indicates its acidic or alkaline nature. The pH scale is a logarithmic unit and inversely indicates the activity of hydrogen ions in the solution. The acidity or alkalinity of the soil depends on the pH scale. The pH scale is a determining factor for plant development, microbial activity, and nutrient availability in the soil. pH Value. The pH value less than 6 signifies acidic nature; greater than 7 indicates alkaline. A pH of 6.5 to 7 is generally considered ideal for most crops. Researchers can better evaluate soil health and crop suitability by using this information, which gives pH levels for diverse soil samples from Nepal (NSSRC, NARC)

Notably, significant impacts on soil fertility, structure, and water retention are dependent upon organic matter. The organic matter increases microbial activity, promotes nutrient cycling, and prevents erosion. The data set available on the website of the National Soil Science Research Centre shows that organic matter in the soil samples from around Nepal was found to have a rich amount of organic matter content, which is beneficial for sustainable agricultural production. High organic matter content is also advantageous for carbon sequestration, which is an essential aspect of climate change mitigation. The total nitrogen content of soil is critical for plant growth since it is a major nutrient for plants. It affects protein synthesis and overall plant development. This dataset examines nitrogen levels in soils across Nepal, which aids in assessing soil fertility and optimizing fertilizer use for increased crop yields. Adequate nitrogen levels also promote soil microbial health and biodiversity.

Boron is a micronutrient required for plant growth, namely the production of flowers, fruits, and seeds. Boron deficiency can lead to poor plant development and reduced crop output. This dataset includes measurements of boron content in soil from various regions of Nepal. Researchers utilize this information to identify locations with possible boron deficits and offer correction steps to increase agricultural yield.

Phosphate is a necessary ingredient for plant growth, aiding in energy transfer, root formation, and blooming. Phosphorus shortages can lower crop production and soil fertility. This dataset contains measurements of phosphorus pentoxide (P2O5) concentration in soils. It helps researchers and farmers assess soil fertility, determine nutrient requirements, and create sustainable fertilization strategies.

Zinc is a vital mineral for plants, significantly contributing to enzyme activity and metabolic processes. A zinc shortage can result in inhibited growth and diminished agricultural output. This dataset gives measurements of the amount of zinc in soils, which helps find places where zinc levels might be low and gives ideas for fixing the soil for sustainable farming.

Potassium is an essential macronutrient that facilitates water regulation, enzyme activation, and the overall vitality of plants. A potassium deficit can result in diminished agricultural output and suboptimal plant growth. This dataset quantifies potassium levels in soils, offering essential insights for academics and farmers to enhance fertilization strategies and promote soil health.

Currently, soil data management software, whether open-source or private, is an essential element of systematic research in soil sciences. Besides statistical software, ArcGIS and QGIS gained greater prominence in soil research. Statistical software is essential for soil data management and database development. Soil data collection and mapping in Indonesia commenced roughly 106 years ago (Shofiyati & Bachri, 2011). The National Soil Science Research Centre is crucial to soil research in Nepal. NARC. (2024).

https://soil.narc.gov.np/.The utilization of soil data management pertains to database construction, which is beneficial for food security models (Shofiyati & Bachri, 2011).To deal with the researchable issues that come up when decisions are being made about soil (Kosaki et al., 1981), you need a computer-based soil data management system (COSMAS) to gather, store, and get soil data. Researchers, planners, and stakeholders are increasingly favoring the digitalization of soil.The Sustainable Development Goals, proclaimed by the United Nations in 2017, also pertain to the appropriate use of land, which is associated with soil.

Researchers in soil science need to use statistical methods and computer-based soil science programs to look at and make sense of large amounts of data, understand how things change over time and space, and make smart decisions.

IV. CONCLUSION

Soil data were collected and generated from various methods survey methods, experimental design and geographical information system with remote sensing technique. Proprietary software as well as open source statistical software were beneficial for statistical analysis and interpretation of soil research data. However, Statistical methods and design were more popular than nothing else.

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Author's Contribution

Mr. Nabaraj Poudel is responsible in data analysis, interpretation, presentation as well as full article writing. Mr. Sunil Pandey is responsible for carrying and organizing the whole survey operation as well as managing the research work in field as well as Laboratory analysis of soil. Mr. Netra Panthi is responsible for soil sampling as well as editing of this paper.

Conflict of Interests

The authors declare that there is no conflict of interest with the present publication.

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