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Impact of Wide Use of Synthetic Fertilizers on Soil Health of Land Area in Nanded District, Maharashtra

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Abstract: A field study was conducted at Nanded District on soil and its various contents from January 2022 to December 2023. A thorough survey was conducted to examine the quality of soil samples collected from agricultural farmlands around Ardhapur City in Maharashtra state, India. The soil is mainly alluvial. Data presentation revealed different values of physical and chemical characteristics of soil. The study's objective was to assess and compare the soil physicochemical properties of this soil. The study was carried out on a few selected physical, chemical, and microbiological characterizations, as well as the quality of soil and its nature. Standard analytical methods were applied to the soil analysis.
Keywords: Soil quality, Chemical analysis, Microbiological, Ardhapur City

I. INTRODUCTION

Soil is one of the most significant ecological factors on which plants depend for their nutrients, water, and mineral supply. Is having living organisms and products of their decay intermingled? The major inorganic soil constituents are Al, Si, Ca, Mg, Fe, and K. However, it also contains minor quantities of B, Mn, Zn, Cu, Mo, Co, I, and F. The main organic constituent of soil is humus.

The essential plant nutrient elements, apart from carbon, hydrogen, and oxygen, are primarily supplied from the soil. These three, usually make up more than 90% of the mass of fresh plant tissue, differ in that they come from atmospheric carbon dioxide or water. The soil-derived essential elements and their important forms in soils are N, P, S, K, Ca, Mg, Fe, Mn, Cu, Zn, Mb, B, Cl, Co, and Se (Johns, 1982). It is presumed that certain native trees and differences in vegetation type are likely to impart soil properties. This is for the fact that soil supports flora and fauna (Wild, 1993). The accumulation of heavy metals in agricultural soils is a subject of increasing concern due to food safety issues, potential health risks, and detrimental effects on the soil ecosystem (McLaughlin et al., 1999). Plants grown on land polluted with municipal, domestic, or industrial wastes can absorb heavy metals in the form of mobile ions present in soil solution through their roots or through foliar absorption. These absorbed metals bioaccumulate in plants' roots, stems, fruits, grains, and leaves (Fatoki, 2000). Both industry and agriculture have contributed to an increase in the concentration of environmentally important trace elements through many ways, such as waste disposal, atmospheric deposition, fertilizer, pesticide use, and other media, in many areas around the world (Hesterberg, 1998; Kabata- Pendias and Pendias 2001; Cui et al., 2005). Salt accumulation in soils is a significant threat to agricultural production and ecosystem sustainability. Globally, 100 million ha (5%) of arable land is damaged by high salt concentrations (Lambers, 2003). In Australia, it is estimated that more than $130 million of agricultural production is lost annually from salinization. The National Land and Water Resources Audit (2000) reported that 5.7 million hectares have a high potential for the development of dry land salinity and predicts this to rise to 17 million ha by 2050. Copper, which is an active ingredient of fungicides, is reported as one of the most toxic metals to soil microorganisms and soil health (Dussault et al., 2008). Heavy metal concentrations in agricultural soils of industrialized countries have increased due to the expanded use of fertilizers and elevated atmospheric deposition (Banat et al., 2007; Zapusek & Lestan, 2009; Jalali & Moharami, 2010).

It is well known that soil organic matter is a reservoir for plant nutrients, enhances water-holding capacity, protects soil structure against compaction and erosion, and, thus, determines soil productivity. Agriculture, to some extent, depends on the content of soil organic matter as well as the soil nutrients. Maintenance of organic matter is critical for preventing land degradation (Martius et al., 2001). Salts in soil cause osmotic stress, which can reduce crop yields (Lambers, 2003),

Furthermore, the procedure used in the present study can be applied in many areas that bear characteristics like those of the study area of the present work.

II. STUDY AREA

Nanded district agriculture locations are selected for the current research. The Nanded [Ardhapur, Barad (Mudkhad), Lahan Loan and adjoining villages of district Hingoli (Girgaon), etc.

Nanded district has a geographical area of 10,528 square meters. Km, which accounts for 3.41% of the total geographical area of the state of Maharashtra. The district is located on the Deccan Plateau. The town of Nanded is located between latitude 19 ° 05 'N and longitude 77 ° 02' E. The urban area of Nanded is 51.67 km. Dhanegaon is one of the growing industrial zones. Yannawar Vyankatesh B. (2015)

The soil samples are randomly collected from Ardhapur, Barad (Mudkhad), Lahan Loan, and adjoining villages of district Hingoli (Girgaon), etc. Nanded district. The study area is located at latitude 19^{0} 9’54.05”N and longitude 77^{0} 20’15.84”E. Ten sampling sites were selected for the study.

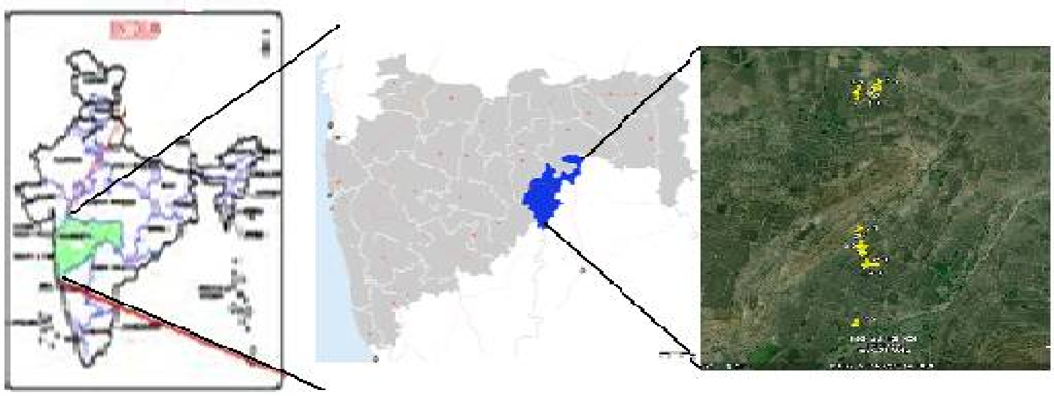

Figure 1: Location of the study area in Nanded, Maharashtra.

III. MATERIAL AND METHODS

A. Sample Collection

The soil samples were collected from agricultural farmlands using a corer and brought to the laboratory in a polythene bag, which was labeled correctly and analyzed. To determine the soil, samples were mixed thoroughly, air dried, and air dried through a mesh sieve. The samples were used for subsequent physicochemical and biological analysis using the following methods.

B. Determination of the physicochemical parameters of the soil samples

1) Soil moisture: The soil is dried in an oven at 150°C. The difference in the initial and final weight of the soil determines soil moisture.
2) Water Holding Capacity (WHC): WHC was determined as the amount of maximum water held in saturated solids.
3) Electrical conductivity (EC): The EC of the soil was determined in 1:5 (soil: water) suspension with the help of a Conductivity meter.
4) Soil pH: The pH of the soil was determined in 1:5 soils: water suspension with the help of a pH meter.
5) Organic carbon (OC): The organic carbon content of the samples was determined by the titrometric method as reported by Walkley and Black (1934) and represented as % of OC.
6) Organic matter (OM): The organic matter content of soil samples was calculated from organic carbon by multiplying it by the Von Bemmlen factor.
7) Alkalinity: Soil alkalinity is due to the presence of soil minerals producing sodium carbonate upon weathering. It was determined by titrating the soil suspension with a strong acid using methyl orange as an indicator.
8) Calcium Carbonate ($CaCO_3$): Calcium carbonate is determined by the rapid titration method.
9) Chloride: The chloride is an essential ion for plant growth. The chloride present in the sample was determined in 1:5 soils: water suspension by Argentometric method.

10) Calcium (Ca) and Magnesium (Mg): Exchangeable Calcium and Magnesium were determined in ammonium acetate leachate by titration method (Jackson, 1973).
11) Sodium (Na) and Potassium (K): The flame photometric method determined Exchangeable Sodium and Potassium.
12) Sulfate (SO_4): The sulfate present in the soil sample was determined in 1:5 soils: water suspension by turbidimetric method and measured by spectrophotometer.
13) Available Phosphorus: Available phosphorus is determined by extracting it with sulphuric acid using the stannous chloride method by spectrophotometer.
14) Fluoride: The fluoride present in the soil sample was determined in 1:5 soils: water suspension by SPANDS method on UV-Spectrophotometer.
15) Iron (Fe): Iron is estimated by acid digestion of soil using the standard Thiocynate method on a UV-Spectrophotometer.
16) Standard plate count (SPC): The soil samples were serially diluted and cultured on San PC medium, and the bacterial colonies were incubated after 24 and 48 hours at ambient conditions (Trivedy & Goel, 1998).

IV. RESULTS AND DISCUSSION

All physical, chemical, and biological parameters observed on the impact of fertilizers on the soil quality of the soil samples are shown in graphs below: The water holding capacity reported for the soil samples varied between 25 to 29 %, and soil moisture was 2.16 % to 37.32 %. The soil moisture commonly ranges from 5% to 35%. Generally, it depends on the void ratio, particle size, clay minerals, organic matter, and groundwater conditions. (Martin, 1994)

Site no.2 exhibits the highest electrical conductivity (109.5 uS/cm). The lowest electrical conductivity was exhibited by site no. 10 (69 uS/cm). The average electrical conductivity of the soil was 88.75 uS/cm. Electrical conductivity indicates the number of soluble ions (salt) in soil. Higher EC indicates an accumulation of salts in the soil. The pH range depends upon the available minerals/salts in the soil. The soils of the various farms are found to be slightly alkaline in nature. The pH ranged from 6.85-7.80. The acidic pH is due to more soil organic matter content associated with high microbial activity, producing high organic acid. The least acidity may be due to plant species' poor addition of soil organic matter. The chloride content was found to be from 1.065 to 2.13%, with an average of 1.735%. The alkalinity of soil samples was observed in the range between 1.5 to 2.5 meq/100 gm with an average of 1.85 meq/100 gm. The calcium carbonate ranged from 0.5 to 5%, with an average of 2.9%. The sulfate content was found to be 48 to 1843.2 mg/L. The mean value of sulfate content was 950.88 mg/L. The percentage of organic carbon was highest (0.30 %) in site no.1 and lowest (0.018 %) in site no. 10, and the percentage of organic matter was highest (0.517 %) and lowest (0.031 %) at the same sites. The mean value of organic carbon is 0.1862% from ten sampling sites. Magnesium ranged from 38.98 to 194.91 mg/g and Calcium from 533.04 to 901.8 mg/g. A high concentration of Ca and Mg increases the pH of the soil. Calcium and magnesium mean values were 723.116 and 90.631 mg/gm, respectively. The concentration of available phosphorus detected was in the range of 0.33 to 3.72 % with an average of 1 of .1305 %. As soil pH increases from very acid values (pH 3) to near neutrality (pH 7), phosphorous availability increases steadily (Cresser, 1993). The sodium was found to be 30.1 to 79.8 mg/L and potassium to be 00.0 to 72.2 mg/L. The average sodium and potassium content were 42.98 and 8.41 mg/L, respectively. The fluoride ranged from 9.44 mg/L to 21.77 mg/L, and Iron from 3.4 to 90 mg/L. In some samples, it is above the permissible limit, i.e.4.5, ppm (Agriculture dept.). The average fluoride and iron content were 18.587 and 23.62 mg/L. The standard plate count (SPC) from soil samples ranged between 3345.9 to 55046 cells/gm. The average standard plate count of soil samples was 34160.99 cells/gm.

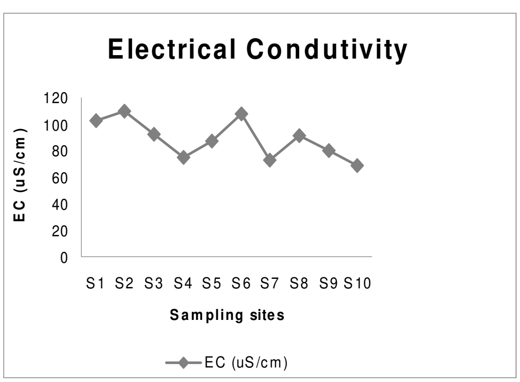

Fig.2: Observed Electrical conductivity . Of soil sample

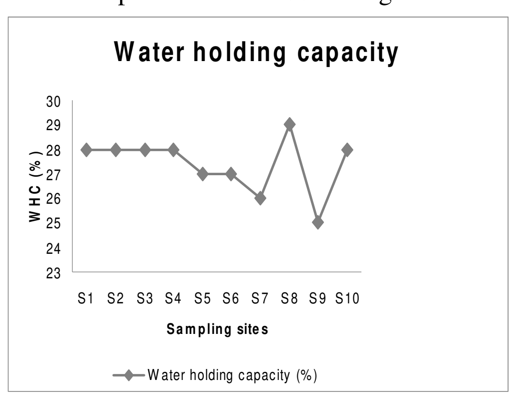

Fig.3: Observed water holding capacity from ten soil samples

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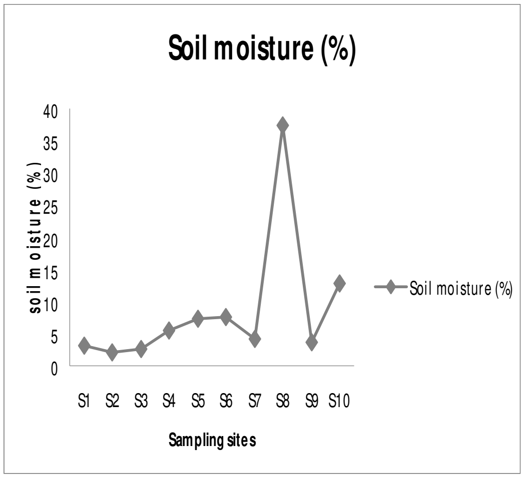


Fig.4: Observed soil moisture content. From ten soil samples.

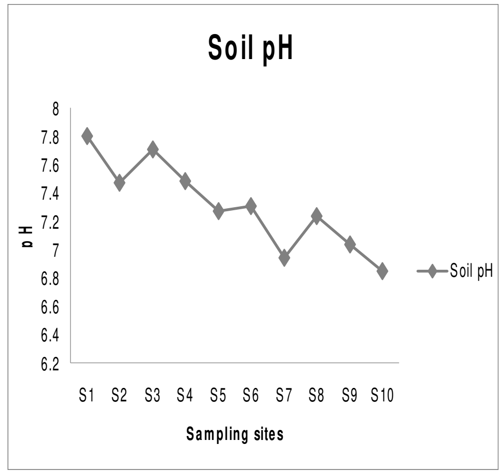


Fig.5: Observed pH of soil samples.

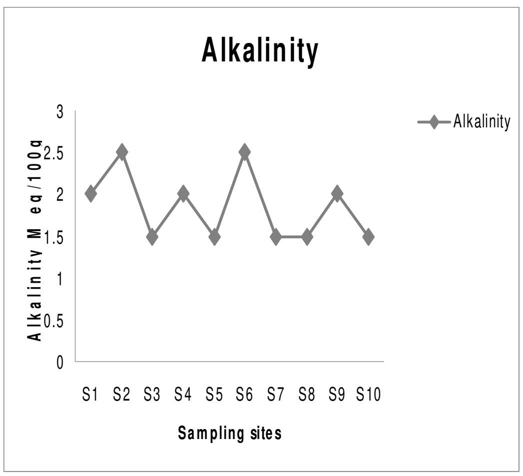


Fig.6: Variations in Alkalinity of selected ten soil samples.

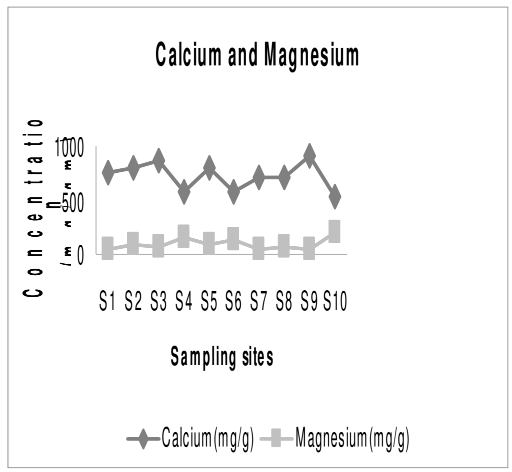


Fig.7: Concentrations of Calcium and Magnesium from different soil samples.

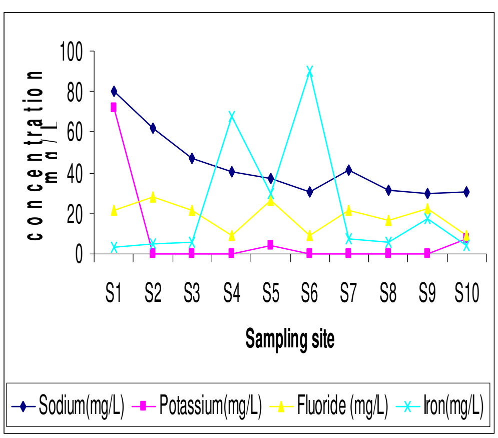


Fig.8: Concentrations of sodium, potassium, fluoride and Iron from ten soil samples.

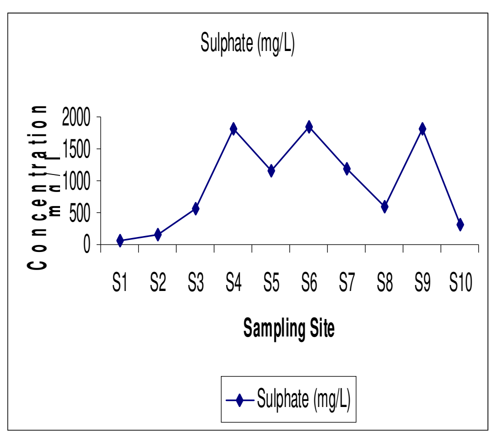
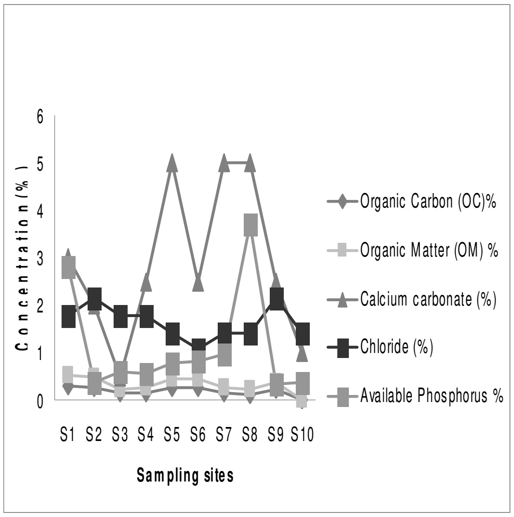


Fig.9: Variations in sulfate content in Different soil samples.



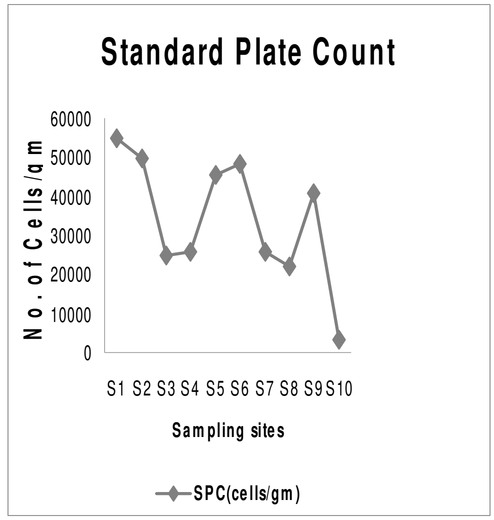


Fig.10: Concentrations of organic carbon, organic matter, calcium carbonate, chloride, & available phosphorous from soil samples.

Fig.11: Observed standard plate count in different soil samples.

V. CONCLUSION

From this study, it was concluded that the study area has black cotton soil, which is rich in Calcium and magnesium. The soil is mainly alluvial in nature.

From the results of the work, it can be concluded that the pH of all the soil samples was slightly neutral; microorganisms are also present in this soil. The organic carbon and calcium carbonate are low in all the soil samples. Most of the soil samples contain Iron above the permissible limit. Organic manures must be used for improvement in the fertility of soil instead of chemical fertilizers, which could improve the soil quality. Increase the use of natural pesticides to avoid the side effects of other pesticides and further avoid the loss of valuable black cotton soil in Ardhapur city.

Declaration: The authors of this manuscript do not oppose the interest.

VI. ACKNOWLEDGEMENT

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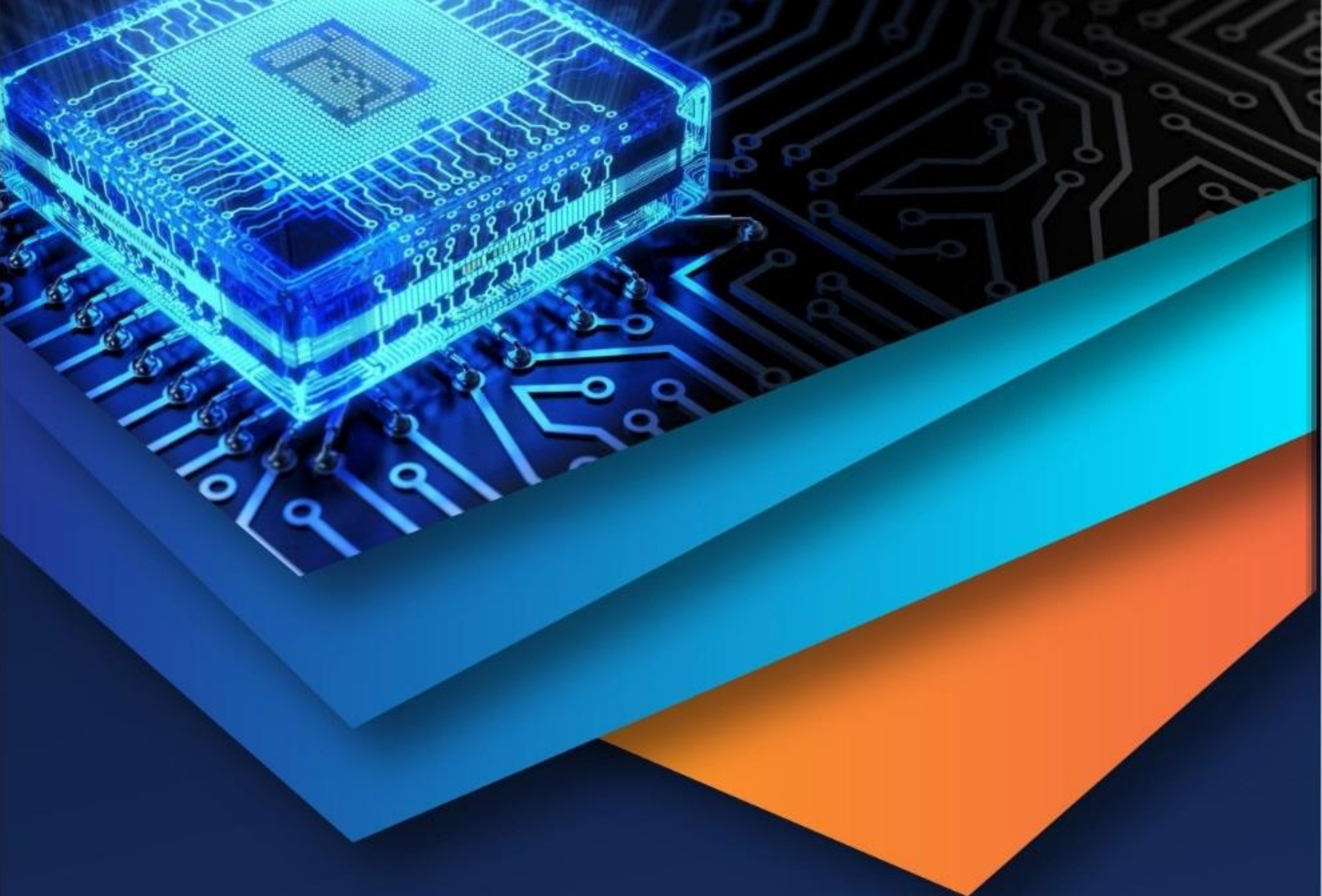

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