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Estimation of Carbon and Biomass Trees Outside Forest (Tof) Using Remote Sensing and GIS Case Study in Vikarabad District, Telangana State India

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Abstract: ***Geospatial technology, remote sensing (RS), geographic information system (GIS), and global positioning system (GPS), commonly called the three 'S' systems, and field inventory methods with hyper spectral sensors play a major role in developing effective forest information. Management to realize scientific management of system forest resources ,Non-forest trees play an important role in global carbon cycling, as they are large pools of carbon as well as potential carbon sinks and atmospheric sources. Given the importance of biomass estimates in the global carbon (C) cycle, the present study demonstrates the potential of stand wise trees outside of forest inventory data, and we specifically used Cartosat-1 panchromatic (2.5 m) and multispectral. LISS-IV (5.8 m) dataset to quantify vegetation and create a much-needed database for TOF. The total geographical study area of Vikarabad district is 104903 sq.km. Results will help address key ecosystem services in the TOF, including quantifying greenhouse gas emissions from agriculture, forests and other land use categories. What is different from the above TOF biomass is that the TOF biomass averaged 2150.12 t/ha in all three classes linear, polygonal and scattered. Total TOF biomass and carbon content above ground were calculated as 24.43 t/ha, 414.46 t/ha and 556.36 t/ha respectively in the study area. The results of the study conclude that classification of TOF and prediction of biomass and carbon content in TOF can be successful. Achieved through a combined approach of remote sensing and GIS based spatial techniques with supplement of field data. The current approach would help to find potential carbon sequestration area in Vikarabad District Telangana State India.***

Keywords: TOF, Biomass, Carbon, Remote sensing & GIS,

I. INTRODUCTION

Trees outside the forest (TOF), defined as 'trees growing outside the forest'. In India, trees growing outside recorded forest area (RFA) are called TOF. Trees outside forest (TOF) are found in various forms in rural and urban landscapes of the country such as small woodlots, block plantations, trees along linear features like roads, canals, embankments, etc. TOF plays an important role in the livelihood of rural and urban people of the country. They also act as important sources of wood and fuel wood, contribute to carbon sequestration and conservation of biodiversity, provide habitat for wildlife, stabilize microclimate, etc. They contribute significantly to sustainable agriculture, food security and rural household economy. They provide many of the same products and services as forests. They protect crops and soil from water and wind erosion, thus combating drought and desertification and protecting water resources. TOF in India has emerged as a major source of wood-based industries including plywood and wood panel industries. TOF resources are not only important from a national perspective but are part of strategies to deal with environmental problems at the global level. An accurate assessment of forest and tree resources is essential for formulating a sound policy for forest sector. Accurate data and up-to-date information on forest cover and extent of growing forest/tree stock and trends in its changes are fundamental elements for policy and planning purposes. Common tree resources exist outside the notified forest areas of our country, called 'trees outside forest' (TOF). These are small woodlots and block plantations, vegetation along drains and natural vegetation on community/private/government lands, trees and urban areas with linear features like roads, canal embankments etc. Traditionally, this has not been detected and little quantitative information exists about TOF. However, recently there has been a lot of interest in TOF worldwide. Besides supporting the rural economy, these trees are now a source of substantial forest produce.TOF has traditionally contributed to various wood and non-wood needs of households and Industries These trees increase soil fertility, provide food security, yield, prevent water and wind erosion, pulp, fuel wood, lumber etc.

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Performs various tasks depending on the assessment of TOF. Mainly roads, railway tracks, embankments, canals, riverbanks, parks, blocks and other empty spaces. The activities are agroforestry, agro-forestry and wasteland afforestation increased Tree resources in the state. The meaning of the word forest in Indian context should be understood according to its dictionary. This description includes all statutorily recognized forests, whether reserved, protected or otherwise designated for the purpose of Section 2(i) of the Forest Conservation Act. The word forest land appearing in section 2 does not include only 'forest' as understood in the dictionary, but any area recorded as forest in the Government records irrespective of ownership. The forest definition agreed by the UNFCCC in the context of the Kyoto Protocol has three main parts, of which only the first part has received much attention: • Forest is a country-specific selection of threshold canopy cover (10-30 percent) and tree height (2-5 m), Applied by 'expert judgments' based on this threshold. Reaching status, existing vegetation and temporarily unplanted areas (unless defined as 'temporary') remain forested until the State Forest Service believes they will, can or will return to a treed status.

II. MAIN OBJECTIVES OF STUDY

The main objectives of field records are to collect qualitative and quantitative information on trees outside forest reserves while preparing reports to meet the data needs of development planning.

1) The main objective of study is estimate and map of biomass and carbon total trees in TOF
2) Trees outside forest biomass can be estimated through field measurement and geospatial methods
3) To generate accurate carbon and carbon sequestration by using various methods.
4) To assess and identify the area of TOF in order to estimate the biomass and carbon in semi-arid region of vikarabad district, telangana state.

III. STUDY AREA

The district of Vikarabad was officially founded on October 11th, 2016. The area is quite sizable, measuring in at a whopping 1,386.00 square kilometers in total (1,307.34 sq. mi). Telangana's Sangareddy and Rangareddy districts, as well as Karnataka's Mahaboobnagar district, border these areas. According to the 2011 Indian Census, the district is home to 927,140 people. Ananthagiri Hills, a major tourist attraction in Telangana, are located in the Vikarabad district, which is justifiably proud of this fact. Nature lovers flock to the Anantagiri Hills, from which the River Musi flows on its way to the city of Hyderabad. The ancient Anantha Padmanabha Swamy Temple in the Ananthagiri hills is a popular destination for tourists. Sri Anantha Padmanabha Swamy, an incarnation of Vishnu, is the primary deity of Ananthagiri. Along with the Pambanda Ramlingeshwara Temple, other important religious sites in the area include the Bhavigi Bhadreshwara Temple, the Bugga Rameshwaram Temple, the Bhukailas Temple, the Ekambareshawar Temple, the Jhuntupally Rama Temple, and the Kodangal Venkateshwara Swamy Temple. In addition to their significance as irrigation projects, the Kotipally, Jhuntupally, Laknapur, and Sarpan Pally paddy fields are popular tourist destinations. Tandur, a significant town in the district, serves as its economic hub. Tandur is the primary source for both the blue and yellow limestone used around the globe. In the study area our research is focused on parigi, puddur, vikarabad ,nawabpet, mominpet mandals of vikarabad district, telangana state.

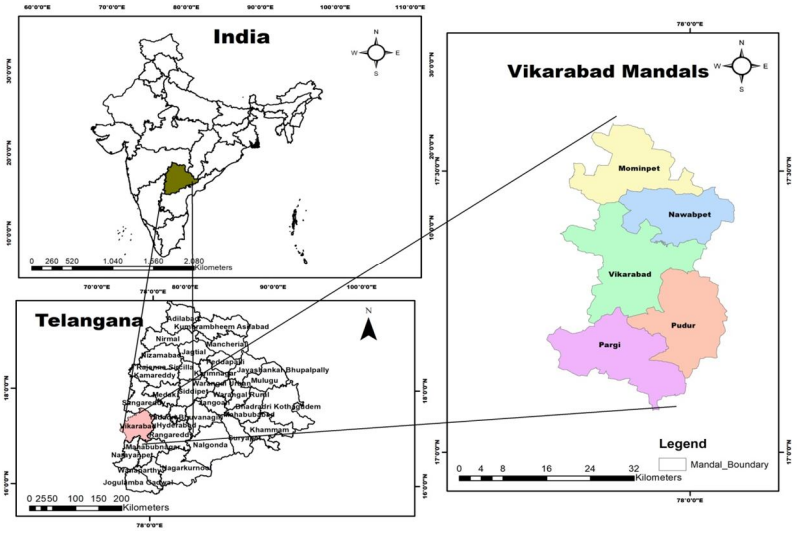
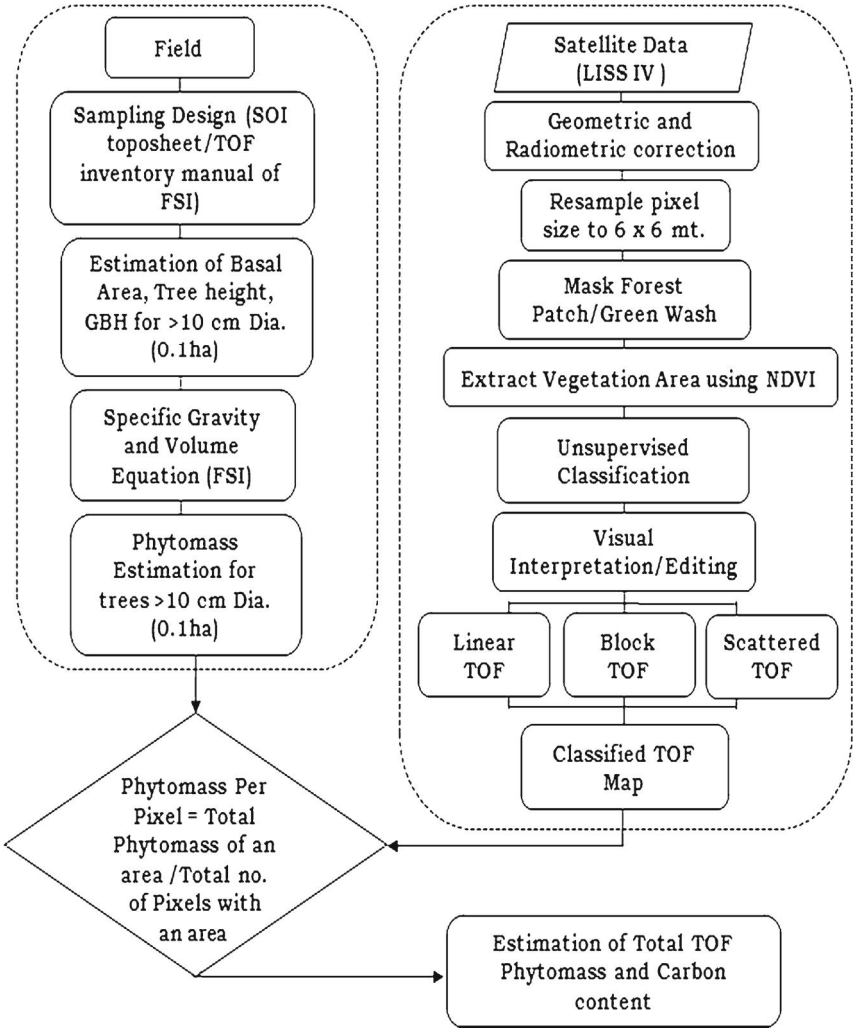


Figure 1: Map of the study area

IV. METHODOLOGY

A detailed step-by-step methodology has been followed for the present research work to accomplish the objectives. It includes development of spatial and attribute databases, thematic map generation using toposheet and high resolution satellite imagery, generation of spectral libraries using ASD Spectroradiometer, GPS field survey and development of plantation boundaries using final TOF. The overall methodology adopted for the present research work is broadlydivided into six phases, namely

1) Data collection and analysis
2) Field work and ground data collection
3) Data integration and generation of Protected ForestManagement Information System in GIS.
4) Species wise image classification TOF
5) Estimate of biomass in TOF
6) Evaluation of carbon in TOF
7) Forest cover mapping and change detection



V. RESULT AND CONCLUSIONS

A. Assessment Of TOF

A methodology based on remote sensing and GIS data from Cartosat-1 and IRS-P6 LISS-IV can work alternatively to assess and map TOF resources in semi-arid regions of India with visual interpretation and complementation of field data. Only large-scale TOF resources generated by field surveys are expected to provide good estimates. The current results show a positive outlook on the TOF total area detection capability, and the number of objects in the TOF area can mainly be attributed to the better spatial and geometric resolution of the satellite image.

The superficial nature of the various classified outputs shows that Cartosat-1 can effectively produce excellent image resolution Calculate the TOF. Very scattered and distinct TOF. Linear TOF patches as well as block/compact patches were more prominent in the classified dataset. While plantations on canals, roads or agricultural embankments were mapped separately in the dataset, some scattered TOF pixels fell on the periphery of the linear feature and in open areas, making it difficult to classify scattered TOFs due to sparse vegetation and low growth.

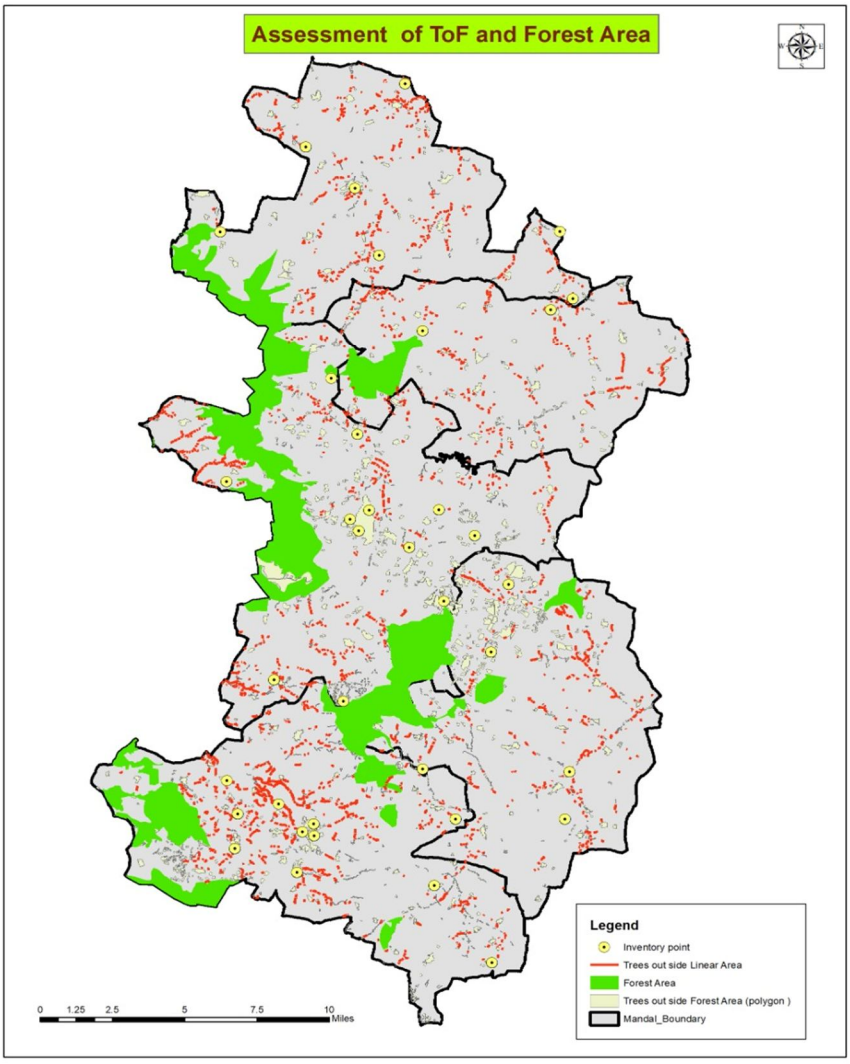


Figure 2, Shown Assessment of TOF

B. Estimation of biomass for TOF

Plot wise average biomass of different TOF classes from field data revealed that average calculated TOF biomass for all three TOF classes in the region was 1150.12 t/ha. Besides, the total calculated biomass content in each class of linear, block and scattered TOF was 50.6055 t/ha, 959.66 t/ha, 1194.49 t/ha. Biomass content per hectare with linear TOF is found to be highest due to the maximum tree density and continuity of old mature trees along the road. Biomass (t/ha) was also found to be maximum along the canal due to high moisture content of the soil along the canal which favors the growth rate of trees and block planting was mainly found in rural and urban areas. It is highly affected by many factors like grazing, fire and lopping etc. The area under the tree block pattern has also been used for several purposes such as solid waste (dung, agricultural waste) disposal. Scattered TOF, although covering the maximum area of the study area, has the least average TOF biomass (tons/ha) compared to other TOFs. This is mainly due to low tree density in urban, rural and agro-forestry systems, low growth of dispersed TOF and low biomass content of dispersed TOF species,

Table 1.Calculated total TOF biomass s and carbon content (as per the TOF Class wise).

TOF classes	Area (hectare)	Area % to total geographical area	biomass per pixel	Total biomass (tons/hectare)	Total carbon (tons/hectare)
Linear	337.37	0.3 21	0.15	50.605	24.43
Block	14764	14.07	0.065	959.66	414.46
Scattered	38532	36.74	0.031	1194.49	556.36

C. Estimation of Carbon conTent in TOF

The carbon content of biomass has been reported to be 45–50% of total biomass. Accordingly, an average of 47.5% biomass has been considered for carbon estimation. The total carbon content of the different TOF classes was estimated by multiplying the total biomass conversion factor by 0.475. The mean carbon content is linear, block and scatter plot wise for three individual TOFs as 24.43 t/ha, 414.46 t/ha and 556.36 t/ha respectively (Table 1). Given the growing importance of carbon sequestration studies worldwide, this type of study will provide a robust baseline database for assessing TOF biomass and carbon content and their changes over time, which can be used for various research and management purposes. This study can be of great help in tracking major carbon sequestration potential zones in sparsely forested semi-arid regions. The TOF classification allows for a more precise analysis of the biophysical and socioeconomic factors influencing each class of TOF. This study will be very helpful in preparing sampling plan for TOF area which is very different from sampling plan for forest area. To accurately quantify TOF biomass and carbon content for large-scale semi-arid regions under plantation conditions, Agro-forestry, deforestation and degradation, the use of remote sensing data is the need of the hour, as collecting field data for large areas will always be a problem at great cost and time. The latest remote sensing datasets from airborne laser altimetry, microwave and high spatial resolution sensors can be used for the TOF inventory. Future projections of biomass/carbon content and its temporal changes in tree characteristics and size in a semi-arid region

VI. CONCLUSIONS

The study concluded that clearly delineated built-up areas, agricultural production areas, waste lands, forest areas and watershed forest stands can be successfully assessed for large areas where the majority of people live and work. An integrated approach of GIS techniques, field data and high spatial resolution data of Cartosat-1. The approach adopted here has the following salient features: A method using digital image processing, GIS and high-resolution satellite imagery can effectively identify and map TOF resources in the semi-arid region of the study area. to estimate the above ground biomass and carbon content of TOF in Vikarabad district, India. The total geographical study area of Vikarabad district is 104903 to point production area. Results will help address key ecosystem services in the TOF, including quantifying greenhouse gas emissions from agriculture, forests and other land use categories. The ground TOF biomass is 2150.12 t/ha compared to the average calculated TOF biomass for all three TOF classes in that region. In addition, the total calculated biomass content in each class of linear, block and scattered TOF is 50.6055 t/ha, 959.66 t/ha, 1194.49 t/ha, in dense linear TOF along the canal. Total TOF biomass and carbon content above ground were calculated as 24.43 t/ha, 414.46 t/ha and 556.36 t/ha respectively in the study area. The results of the study conclude that classification of TOF and estimation of biomass and carbon content in TOF can be successfully achieved through a combined approach of remote sensing and GIS based spatial techniques with addition of field data. The present approach should be used by TOF mapping researchers as part of this study to conduct more comprehensive and timely studies on TOF for investigation of future new techniques that will help identify Potential carbon sequestration areas in Vikarabad district, Telangana state, India. .

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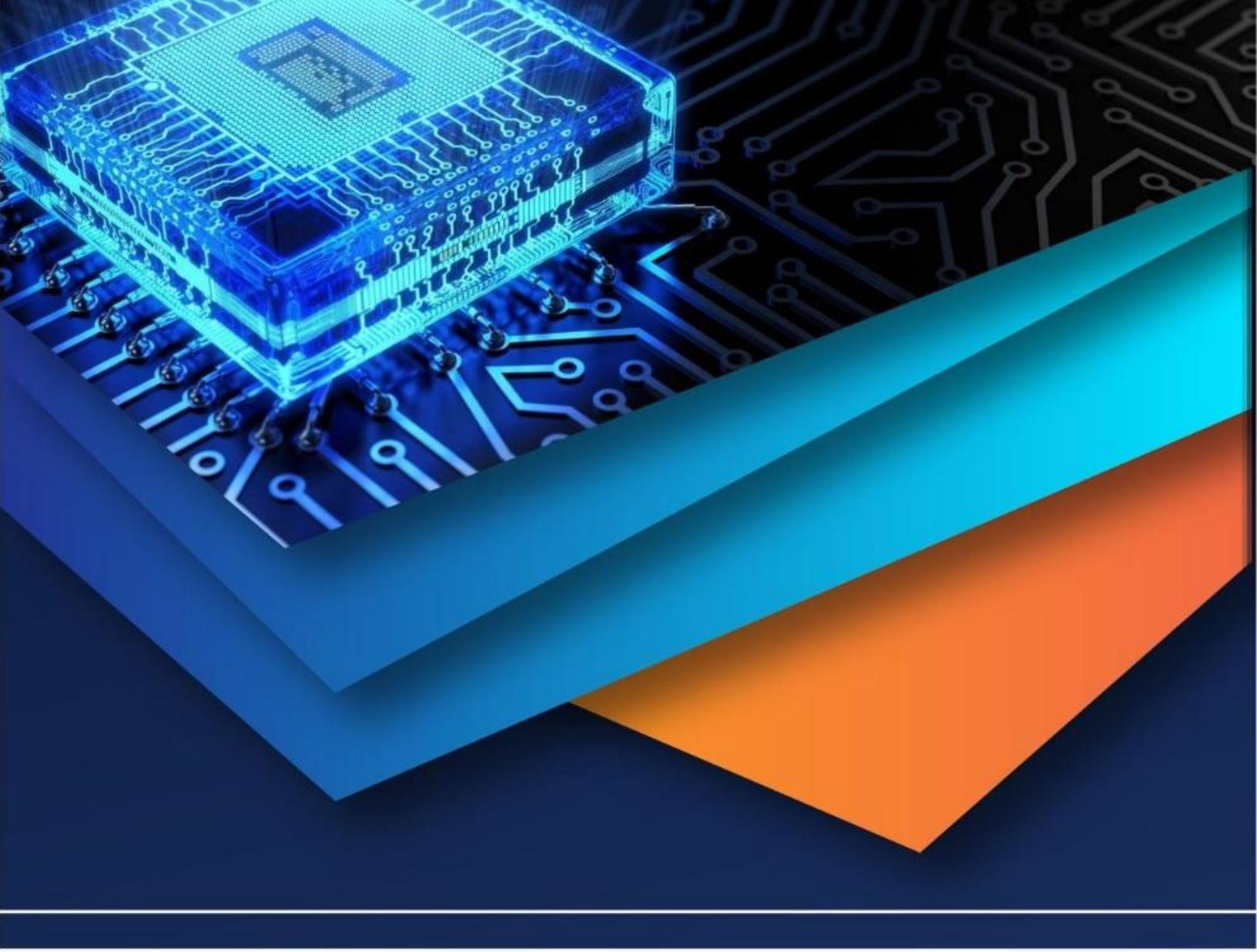

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