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Climate Change: Causes, Consequences, and Strategies for Prevention

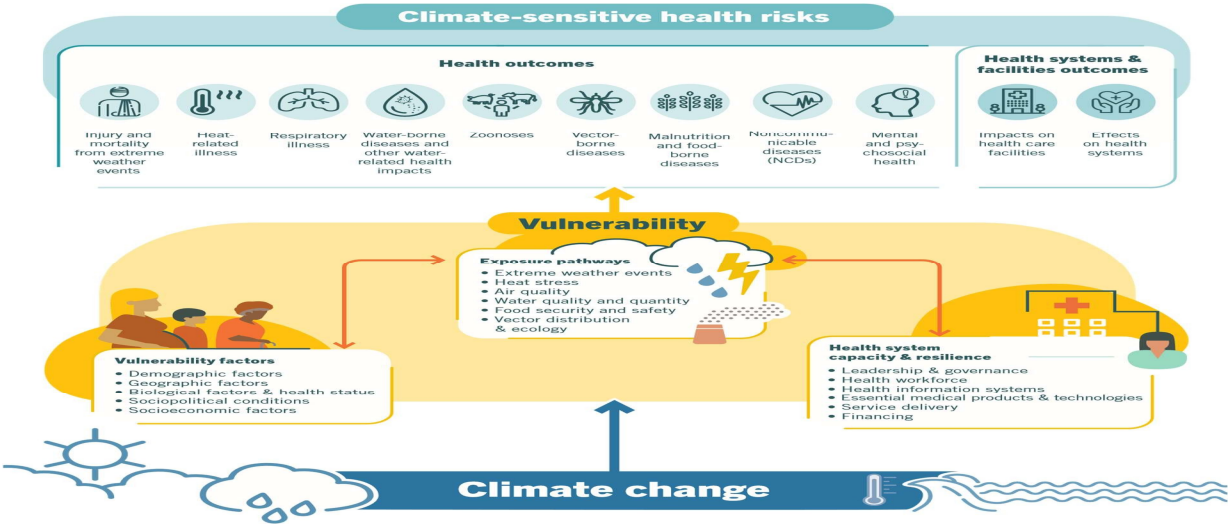
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Abstract: ***Climate change is a pressing global issue, primarily driven by human-induced activities such as fossil fuel combustion, deforestation, and industrialization. The rise in greenhouse gas emissions has led to severe environmental consequences, including global warming, extreme weather patterns, and biodiversity loss. Addressing this crisis requires immediate intervention through sustainable strategies and policy implementation. This research aims to analyse the key causes and consequences of climate change while exploring effective prevention and mitigation strategies. The study emphasizes the role of renewable energy, afforestation, and global policies in combating climate change.A qualitative research approach is adopted, primarily relying on a literature review of authoritative sources such as NASA Climate Change, IPCC reports, World Bank Climate Data, and UNEP publications. Case studies of successful mitigation efforts and policy frameworks are analysed to assess their effectiveness.Findings suggest that transitioning to renewable energy, enforcing stricter environmental policies, and promoting public awareness are critical in reducing global carbon emissions. Case studies indicate that countries with proactive climate policies experience slower environmental degradation. Furthermore, technological innovations such as carbon capture and smart grid systems show promising potential in mitigating climate change effects.Climate change mitigation requires a collective effort from governments, industries, and individuals. Strengthening international policies, fostering technological advancements, and encouraging sustainable practices are essential steps toward preserving the planet for future generations. This research highlights the urgency of immediate action and provides a framework for effective climate resilience strategies.***
Keywords: ***Climate Change, Global Warming, Mitigation Strategies, Renewable Energy, Environmental Policies.***

I. INTRODUCTION

Climate change stands as one of the most pressing threats to global health in the 21st century. The world is witnessing a rise in the intensity and frequency of extreme weather events such as heatwaves, wildfires, floods, and droughts. These environmental changes are having serious impacts on the health of millions globally and have resulted in economic damages exceeding USD 170 billion by the year 2020. Governments, UN agencies, healthcare workers, civil society, and other key stakeholders are now faced with both the responsibility and the opportunity to combat this crisis. By implementing strategies focused on mitigation and adaptation, they aim to safeguard and enhance the health and well-being of populations across the globe.

Figure.1 An overview of climate-sensitive health risks, exposure pathways and vulnerability factors



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For many years, UN agencies have consistently emphasized the need for immediate action to tackle climate change. They have urged both national and local leaders to integrate climate priorities into their development strategies and, more recently, into their COVID-19 recovery plans. The concept of a sustainable, green recovery was strongly emphasized by UN Secretary-General Antonio Guterres in his address on December 2, 2020. In his speech, he called on governments and businesses to aim for carbon neutrality and to boost international funding for climate resilience and adaptation. He also stressed the crucial role of preserving biodiversity and adopting nature-based approaches to combat climate change while also promoting environmentally friendly employment opportunities.

WHO Manifesto for a healthy and green recovery from COVID-19 (3)

Released by the WHO in May 2020, the Manifesto calls for creating a healthier, fairer and greener world while maintaining and resuscitating the economy hit by the effects of the COVID-19 pandemic. The six prescriptions of the Manifesto lay out concrete instructions that policy makers, national and local decision-makers, and other stakeholders should follow to contribute to healthy recovery and shape the way people live, work and consume.

1 Protect and preserve the source of human health: Nature.
2 Invest in essential services, from water and sanitation to clean energy in health care facilities.
3 Ensure a quick healthy energy transition.
4 Promote healthy, sustainable food systems.
5 Build healthy, liveable cities.
6 Stop using taxpayers' money to fund pollution.

The six prescriptions are accompanied by over 70 related actionables, or practical steps for implementation at the national and local levels.

Studying the links between climate change and health is crucial for identifying, anticipating, and responding to climate-related risks. Such research plays a vital role in shaping strategies that both reduce emissions and help communities adapt, ensuring these efforts are practical, impactful, fair, and inclusive. It also supports the goal of safeguarding public health globally, ensuring that no one is left behind. International cooperation in research is essential to strengthen the scientific foundation in this area and to ensure that health remains a central focus in climate policy discussions and advocacy efforts.

II. OBJECTIVES AND BRIEF METHODOLOGY

To recognize existing trends and pinpoint gaps in current scientific research, as well as to evaluate how well recent studies align with the five focus areas stated in the World Health Assembly (WHA) resolution, the research subgroup of the WHO–Civil Society Working Group on Climate Change and Health conducted a scoping review. This review focused on original research related to climate change and human health from the last ten years. The findings, summarized here, are intended to guide future research efforts in this field and contribute to the Health Programme of COP26.

A team of researchers carried out a comprehensive scoping review, analyzing both quantitative and qualitative original studies published between 2008 and 2019. They used three major databases—PubMed, Embase, and ScienceDirect—employing keywords related to climate change and human health. After removing duplicates, reviews, editorials, reports, articles unrelated to human health, and non-English publications, the team narrowed the pool of over 10,000 articles down to 2,181 studies. These selected papers were then reviewed and organized based on several criteria, including research priority themes, specific health sectors, income classifications of countries (using 2019 World Bank standards), and geographic locations according to WHO and UNFCCC regions, along with cross-cutting thematic areas.

The number of studies within each priority category was quantified to evaluate the focus of current research by topic and region, as well as to uncover existing trends and research gaps in the intersection of climate change and health. For an in-depth explanation of the methodology used, please consult Annex 1.

It should be acknowledged that there were certain limitations in conducting this review. Notably, the research only included articles indexed in the three selected databases. These platforms were chosen due to their leading status in health-related academic publishing, but this selection may have excluded relevant studies found elsewhere.

This review may have overlooked studies available on platforms outside the selected databases. Additionally, the analysis was limited to English-language publications, excluding potentially valuable research published in other languages. Another limitation stems from the review's primary goal: rather than conducting a detailed evaluation or performing a systematic review and meta-analysis of each study, the focus was on identifying patterns and research areas within climate and health literature over the past ten years. The intention was to highlight where research is being conducted and to provide a broad overview of thematic trends across regions.

It's also important to acknowledge the possibility of subjective bias in how studies were classified. Variations in interpretation among the research team could have influenced categorization. However, to minimize discrepancies, the team maintained regular discussions and conducted collaborative assessments of articles. Lastly, it's worth noting that published academic literature does not always reflect the full spectrum of knowledge—particularly insights, practices, and technologies developed by communities outside formal academic institutions. This includes rural, remote, and Indigenous populations, who often live in climatesensitive regions and may have developed effective, experience-based strategies for coping with climate change that are not captured in peer-reviewed studies.

III. OVERALL SUMMARY OF IMPLEMENTED RESEARCH

Over the last decade, research exploring the connection between climate change and health has seen substantial growth—expanding over six times from just 58 publications in 2008 to 373 studies in 2019. This upward trend continued consistently in recent years, with the most notable increase occurring between 2018 and 2019, when the number of studies rose by 25%.

The scoping review revealed that, although there has been increased research activity since the adoption of the WHA recommendations, the five outlined research priorities have not been addressed uniformly. Out of the 2,181 articles examined, the majority (50.6%) focused on Priority 1, which involves evaluating health risks linked to climate-related hazards. Priority 4, concerning tools and support systems for decision-making, followed with 42.7% of the studies. In contrast, significantly fewer studies concentrated on Priority 3, which looks at the health effects of mitigation and adaptation strategies (7%), Priority 2 on protective health measures (4.3%), and Priority 5 addressing the economic costs (3.2%).

Figure.2 Number of articles on climate change and health published by year

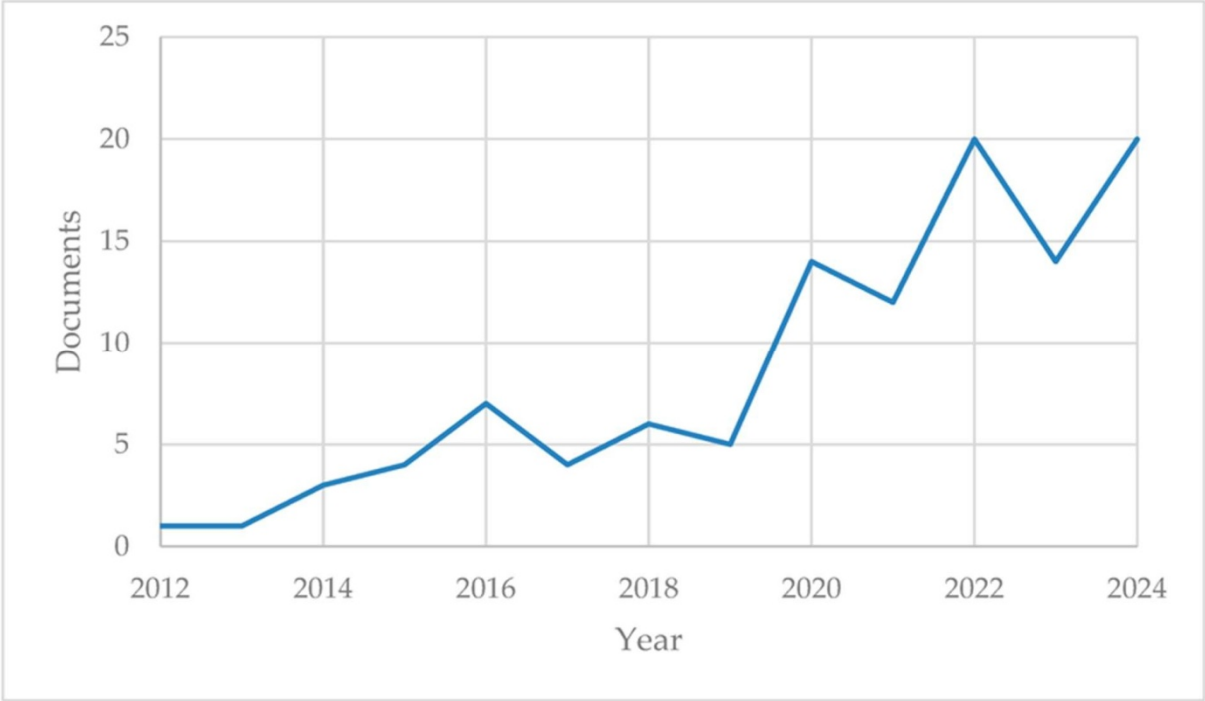


Figure 3 Distribution of articles between research priorities

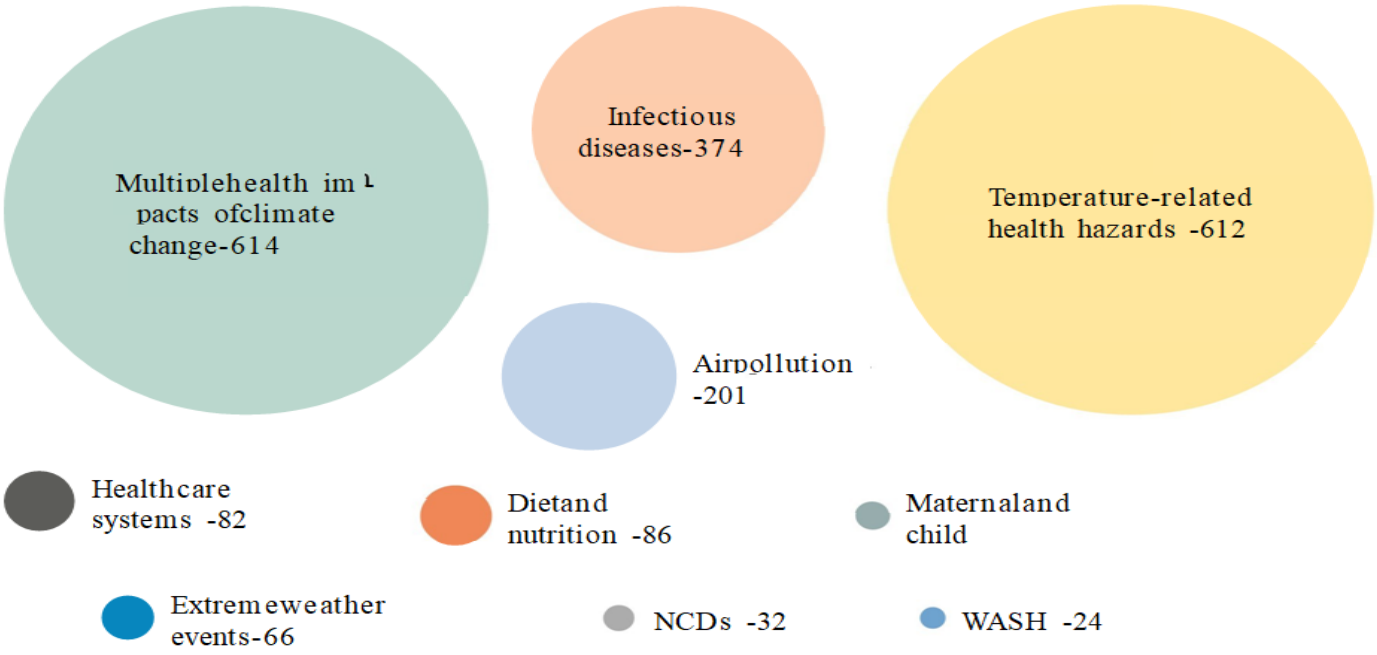


Significant variation was observed in how different health-related subjects were represented in the research. Among the health issues triggered by climate change, those linked to temperature were the most frequently studied, accounting for 28% of the total. This was followed by research on infectious diseases (17.1%) and air pollution (9.2%). Other areas of focus included the relationship between climate change and nutrition-related health effects (3.9%), the influence on healthcare systems (3.7%), extreme weather conditions (3%), mental health (2.2%), maternal and child health (1.6%), noncommunicable diseases (1.5%), and water, sanitation, and hygiene (1.1%). A smaller proportion of studies investigated topics such as toxicity-related illnesses, occupational health issues not related to heat, negative health outcomes from radiation exposure, and skin-related diseases. Additionally, over 28% of the reviewed articles examined multiple health issues connected to climate change.

IV. DISTRIBUTION OF ALL ARTICLES BY HEALTH FIELD

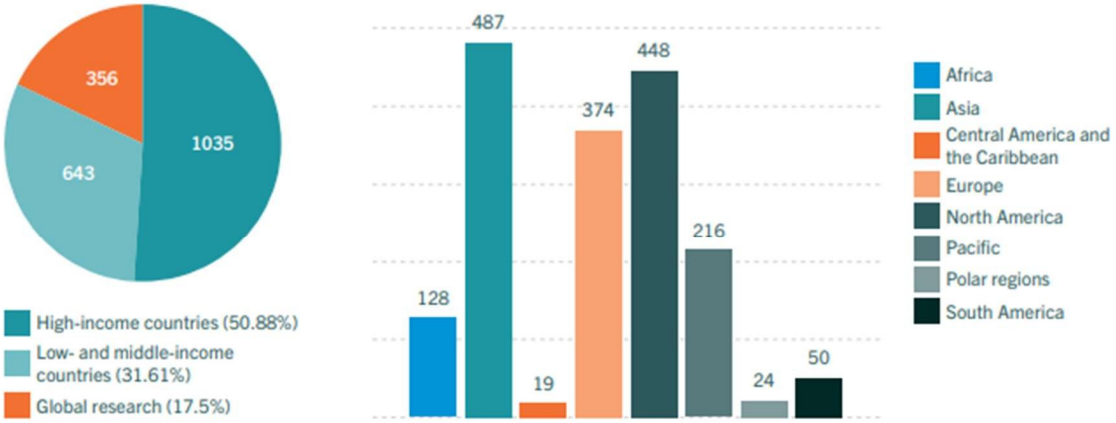
The reviewed articles that targeted specific countries were classified according to national income levels based on the World Bank's 2019 classification. This analysis showed a clear imbalance in research distribution, with a majority of studies centered on high-income nations. In contrast, less than one-third of the studies focused on low- and middle-income countries, despite the fact that these nations are home to approximately 84% of the global population. A smaller portion of theresearch was either conducted on a global scale or included case studies from both high- and lowerincome countries.

Figure.4 Distribution of all articles by health field



When evaluating the geographical distribution of country-specific studies, it was found that Asia was the most studied region, accounting for 21.5% of the research on climate change and health. North America followed with 19.3%, and Europe with 16.1%. By comparison, significantly fewer studies were conducted in the Pacific region (9.8%), where most research was concentrated in Australia and New Zealand. Africa was represented in only 5.6% of the reviewed literature. Even fewer studies focused on South America (2.2%), the Polar regions (1.1%), and Central America and the Caribbean (0.8%).

Figure.5 Geographical distribution of all articles by income groups and regions



V. ADVANCING THE RESEARCH ON CLIMATE AND HEALTH



Efforts to address the wide-ranging effects of climate change are supported by diverse types of research—including fundamental, clinical, public health, and implementation studies. These often require interdisciplinary collaboration to fully understand the health, societal, and economic consequences. Over the past ten years, there has been a noticeable rise in studies examining the relationship between climate change and human health. A substantial portion of this research has focused on the effects of extreme weather events—such as heatwaves, droughts, water shortages, storms, and declining air quality and food production—on global health and nutrition.

There has also been growing attention to how these changes impact particularly vulnerable groups, including the elderly, infants, pregnant women, and people with existing health or socioeconomic disadvantages. Nonetheless, this report highlights ongoing disparities in how research is distributed both within and between countries—especially between wealthier nations and those with lower and middle incomes.

This gap may be partially due to limited local research capacity, but it also reflects uneven distribution of funding and support for building that capacity.

To effectively respond to emerging climate threats, it is essential to adopt a research approach that is guided by real-world needs and demands. Achieving this will require stronger cooperation among researchers, advocates, and institutions, along with sufficient investment to support their shared mission.

VI. FUNDING GAPS AND POTENTIAL FINANCIAL OPPORTUNITIES FOR RESEARCH ON CLIMATE AND HEALTH

In recent years, several wealthier nations have started investing government funds into research that connects climate change and public health. Notable examples include Canada's initiatives through Natural Resources Canada's Climate Change Impacts and Adaptation Program, as well as Health Canada's Climate Change and Health Office. Similarly, the European Union has been supporting this field through Horizon Europe, which stands as the largest international research and innovation framework. However, the persistent "10-90 gap"—where only 10% of global research funds are dedicated to conditions affecting 90% of the global population—also appears to apply to climate and health research, indicating an imbalanced allocation of resources.

Under the UNFCCC framework, financial mechanisms aimed at climate action have also been developed. For instance, the Green Climate Fund (GCF), launched at COP16 in 2010, was designed to channel resources toward both mitigation and resilience-building. The Adaptation Fund, created for developing countries participating in the Kyoto Protocol, serves a similar role. The Global Environment Facility (GEF), a collaborative body involving 183 nations, international agencies, businesses, and civil society organizations, has disbursed nearly $18 billion in grants for environmental initiatives worldwide. Nonetheless, funding from the GEF and GCF tends to focus on implementing projects rather than supporting academic or applied research.

Access to these financial resources and the breadth of related research has been inconsistent and often insufficient. Although considerable research has addressed environmental, technical, and sociological aspects of climate-related health threats, studies that evaluate the health effects of climate mitigation and adaptation strategies have been comparatively rare. This suggests the need for stronger collaborative partnerships aimed at both securing funding and generating meaningful, action-oriented research.

Learning from past successful collaborations may prove beneficial. For example, the Wellcome Trust has significantly contributed to global health research, particularly in areas such as HIV/AIDS and noncommunicable diseases, supporting a variety of studies across public health, applied science, and social sciences, especially in Asia and Africa. In 2020, it identified climate and health as one of its three core areas, with an aim to work directly with affected communities to investigate the impacts of global warming and develop solutions to protect public health.

Other philanthropic organizations—including the MacArthur, Rockefeller, Ford, Robert Wood Johnson, and IKEA Foundations—have also begun emphasizing support for climate changerelated research and capacity building. Their engagement is both timely and essential. In line with the UNFCCC's principle of "common but differentiated responsibilities and respective capabilities," developed nations have an ethical duty to provide financial support to developing countries to help meet climate goals.

Special attention should be directed toward highly vulnerable areas like Small Island Developing States (SIDS), through partnerships that can unlock funding for research tailored to their specific needs. This research is crucial in shaping effective local climate policies and actions. Coordinated efforts among the WHO, UN agencies, global funders, and the research community are vital to expanding the scientific foundation of climate change and health.

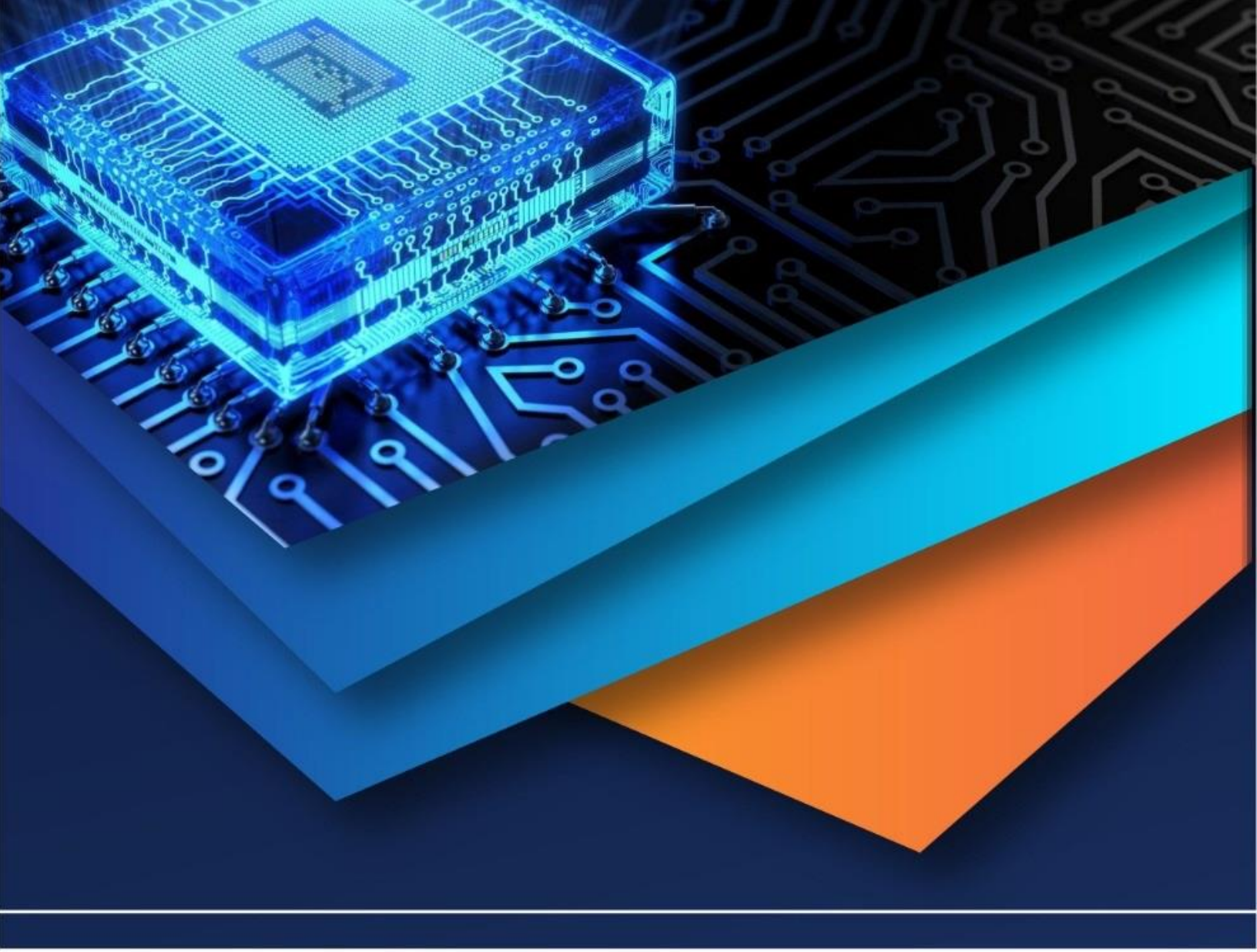


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