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Use of Space Based Information in the Planning Activity at Grass- Root Level –Case Study in Jambu Gram Panchayat, Kendrapara District, Odisha, India

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Abstract*: *Annual planning processes followed in India in earlier years attached lesser importance to local bodies such as Panchayat, Municipalities, Blocks and Districts. These processes were not participatory in nature and lack scientific approach which resulted in inadequate achievement of objectives. As a result the concept of Decentralized Planning emerged. The decentralized planning at local level was introduced in the Eleventh Schedule of the 73rd Constitutional Amendment. The 73rd and 74th Amendment led to the establishment of Panchayat at village and local self government at block and district levels. The people are now opening up and started taking part in planning process at grass root level. In order to involve the people and make planning exercise more effective, National Remote Sensing Centre (ISRO), Dept. of Space (DOS) have begun activities using GIS and Communication Technology (Geo-Ict). In the present study Jambu, a disaster prone Gram Panchayat of Mahakalpada block of Kendrapara district of coastal Odisha is selected as case study. Thematic information on Land use, Settlements, Infrastructure and drainage have been generated. The findings of the study will be useful for the decision makers at downstream level in planning process. Jambu GP is having an area of 2445.51hectares. The area is mostly dominated by Crop land (765.23) hectares and other land cover features include Mangroves (541.5ha), Settlement (294.12ha), Aquaculture Pond (237.61ha), River/Stream (174.97ha), Tank/Pond (0.86ha), Mudflat (139.77ha), Plantation (258.06), Scrub forest (7.65) and Sea (8.14ha).The findings of the study will be useful for the decision makers at grass-root level like Block and Gram panchayat. The findings of the study can be useful for the Coastal managers and decision making authority for proper implementation of Coastal Sustainable goals.

Keywords*: *Remote Sensing, GIS, Ortho-rectified Image, Decentralized Planning, LULC

I. INTRODUCTION

The Coastal land use and land cover features are dynamically regulated due to marine and terrestrial processes and controlling by natural and anthropogenic activities. The detail knowledge of extent and impact of past changes and their implications for future management is needed to understand the challenges in coastal tract. Worldwide the coastal zone occupy about 8% of earth's terrestrial surface But contribute 37% and 44% of world's population (as of 1994) within 100k.m and 150k.m of a coast line respectively(Cohen et.al, 1997). Thus, coastal zone ecosystem (Estuaries, Wetlands, Coral reefs etc), which are rich in natural resources are in extreme pressure. There has been a tremendous pressure on the resources and habitats of Odisha coast in the last few decades.

The coastal zone refers to a broad geographic area in which terrestrial and marine features are mixed to produce unique landforms and ecological systems. They are known for their rich socio-cultural heritage, ecological diversity, living resources and environmental contamination. Thus, coastal zones are important biologically, ecologically and economically point of view. Coastal regions are the most fragile, dynamic and productive ecosystem and quite often under tremendous pressure due to man-made activities and natural processes. It is covered with very wide range of habitats such as coral reefs, mangroves, sea-grasses, sand dunes, vegetated stungle, mudflats, salt-marshes, estuaries; lagoons etc.The coastal landforms have an important role in protecting the coast line from erosion and flooding. Although coastal zone constitute just about 10% of the land yet it sustains about 60% of world population. India is having 7517 k.m long coastal line where about 35% of population lives within 100 k.m from the coast. They are continuously changing due to the dynamic interaction between the ocean and land. Erosion and accretion, inundation due to sea level rise and storm surge, shifting of shore line due to natural or anthropogenic forces like construction of artificial structure, port and harbor leads to alter in the coastal environment.

Remote Sensing and geo-spatial technology have been widely used in monitoring and management of the natural resources in the coastal areas. Due to its repetitive, multi-spectral and synoptic nature, Satellite Remote Sensing (RS) has been proved to be extremely useful in acquiring information on various aspects of coastal environment such as: Coastal wetlands, Coastal landforms, Shore line changes, High tide and Low tide boundary, Coastal inundation, brackish water areas, Coastal hazard, Sea level rise, Coastal saltpans, Suspended sediment dynamic various coastal habitats etc. Remote Sensing is proved to be an important tool towards generating a sustainable development plan of the coastal areas. Remote sensing technology is considered as a fundamental and cost effective tool to establish coastal environmental baselines and monitoring purpose. (Shetty et al., 2015). The study area has been degraded from 1972 to 2017 continuously (Thakur,R.R. et.al, 2018).For a sustainable development of a coastal region, the conservation of Mangroves forest is essential to achieve the sustainable development(Kumar,P, 2004).The study of land use through Remote sensing technology is always accurate and cost effective(Palria, S, 2001).

II. STUDY AREA

The district experiences wide variability of rain fall from monsoon.Kendrapara is having geographical area of 2644 km2.The average rainy days per annum is 78 days. The total population is 14, 39,891 which comprises 7, 17,695(Male) and 7, 22,196(Female).The sex ratio is 1006.The population per Sq. km is 545.The population growth is 10.59(source-Census-2011). The district comprises of 9 blocks, 249 Gram Panchayats, 1592 revenue villages and 2 Municipality. The district is situated in the catchment of rivers like Mahanadi, Brahmani and Baitarani. Some other rivers and nalas those flow inside the district of Kendrapara are Luna, Hansua, Chitrapola, Mahipura etc. Flood and Cyclone are the recurring and most insidious phenomenon in this district.

The study area enjoys a tropical wet-dry type of climate which is generally hot with high humidity. The maximum temperature recorded is 45°C and the minimum is 10°C during May and January respectively. The average annual rainfall is about 1300 mm, bulk of which is received during June to mid October. Mean relative humidity ranges from 70 to 85% throughout the year. It comprises villages such as Bhateni, Bhuipada, Jambu, Sankachit and Kandarapatia. The Gram Panchayat is surrounded by other GP such as Suniti, Baulakani, Badihi and Kharinasi.It lies in the administrative Mahakalpada block of Kendrapara district of Odisha.

The GP is predominantly occupied by the tertiary and recent alluvium brought by the distributaries of the rivers. The soil of the district is arable land and consists of alluvium. The Study area geographically lies between 20’39” and 20’49” North latitudes and 86’69” and 86’72” East longitude (Fig-1). The Gram Panchayat has a geographical area of 2445.41 hectares and its population as per 2011 census is 5759 consisting 2802 Male and 2957 Female with literacy rate of 68.27%. There is an increase of 23.29% in the population compared to 2001. Forestry is the secondary occupation of people. The Gram has a low agricultural productivity of which more than 2/3rd population depend for their livelihood. There are many landless labourers. Jambu nadi is the main river of Jambu Gram panchayat. Over the years, indiscriminate tree falling and local climate change has causing serious negative impact on the normal rainfall of the region.

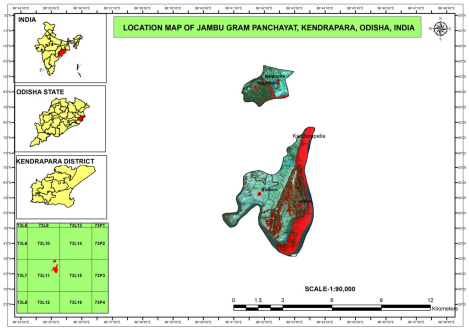

Fig.1 Location Map of Study area

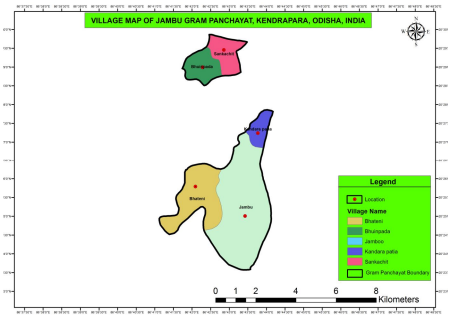

Fig.2 Village Map of Study area

III.DATABASE PREPARATION

The satellite data (LISS-IV) 2015 was used for land use/cover classification. These datasets were imported in ERDAS Imagine version 14 (Leica Geosystems, Atlanta, U.S.A.), satellite image processing software to create a false colour composite (FCC). The layer stack option in image interpreter tool box was used to generate FCCs for the study areas. The sub-setting of satellite images were performed for extracting study area from both images by taking geo-referenced out line boundary of the study area. All satellite images have been registered and geo-corrected from the source. Re-sampling of satellite images carried out using ERDAS-Imagine 2014 and the resolution is kept at 40meter after the resampling process. The visual image interpretation technique was adopted to classify the land use/land cover.

The study was undertaken utilizing High Resolution Ortho-Rectified Satellite data of Cartosat-1(PAN) and Resourcesat-1(LISS-IV MX) on 10,000 scale. The PAN sensor has spatial resolution of 2.5m and the LISS-IV MX has a resolution of 5.8m. Ortho photo was prepared by the following methods. Cartosat-1 stereo –image of the period 2014-15 was used for Block preparation using Leica Photogrammetric Suite. Then Resolution Merged data was prepared using the Cartosat Ortho-Rectified images and Resource sat LISS-IV data. The Ortho-rectified satellite data was interpreted by onscreen visual interpretation using ARC-GIS software on 10,000 scale. The following layers were generated viz.,(i)Land use/Land cover (Polygon),(ii)Drainage (Line),(iii)Infrastructure (Roads & Rails), (Line),(iv)Settlement (Polygon).These layers were overlaid on Gram Panchayat boundary and linked with GP wise socio-economic data resulting in GP wise GIS database. All administrative boundaries such as village, GP, Block and Assembly constituency have been super imposed with the space input maps.

A. Decentralized planning

The role of local administrative bodies such as Gram Panchayat, Block, municipality and Districts were being ignored by the annual planning process followed in India. These processes were not participatory in nature and lack scientific approach which resulted in total failure. As a result the concept of Decentralized Planning came into being. The decentralized planning at local level was introduced in the Eleventh Schedule of the 73rd Constitutional Amendment. The 73rd and 74th a Amendment led to the establishment of Panchayat at village and local self government at block and district levels. It envisaged planning units to operate their budgets exercise their skills and take holistic initiative in the development of that local area. The first pre-requisite of a successful local area planning is up-to date and near real -time information on natural resources, infrastructure, population etc. in integrated spatial format. The information should be organized in such a way that these can be scientific, low cost, integrated and up-to date. Such database can be scientifically analyzed and various development scenarios can be displayed.

B. Geo-ICT Solutions to Decentralized Planning

Innovations in Satellite Remote Sensing, Global Positioning System, Information Technology and Geographical Information System have the capabilities of generating, capturing, integrating and analyzing spatial and non-spatial information of a local area. These base line data can be stored, manipulated and displayed on computer screen so that decision makers at all level can plan and manage their localities in integrated and inclusive ways. Remote Sensing and GIS technologies enable the local area planners to create various natural resources information in shortest possible time and repeatedly allow further analysis in systematic, compatible and quantitative manner.

IV. RESULTS & DISCUSSION

The land use/land cover, infrastructure, settlement and drainage were generated for the Jambu Gram panchayat. This enabled the local people and planning officials for grass root planning. Jambu Gram panchayat is very close to the Bay of Bengal and thus it is prone to the natural disaster from time to time. There is a luxuriant growth of Mangroves in the Seaward side of the Gram panchayat. The Mangroves present in the G.P act as a barrier during the natural calamities. But there is degradation in the Mangroves vegetation which needs to be checked to achieve the sustainable development.Dependance on Mangroves forest for wood and fuel activities, conversion of Mangroves in to Aquaculture land and other purposes etc. are the causes of deterioration in Mangroves. Due to population growth, there is a Settlement sprawl (294.12ha) in the study area. The spatial distribution of Aquaculture land (237.61ha) which is a result of conversion of Forest and Agricultural land in to Aquaculture activities is a major concerned in the study area. The coastal manager at Grass-root level must develop some result oriented initiatives to protect the natural resources present in the study region. The GIS database of the GP now holds all information as points, line & polygons in an integrated manner and can be analyzed in various ways. The maps can be further used in locating different infrastructural facilities and land use for local level planning.

The details interpreted thematic layers such as land use/land cover, drainage and road networks are described below:

(i)The land use/ land cover Map of Jambu Gram panchayat is given in Fig-3. The GP wise wastelands, which were identified earmarked for agriculture and plantation purposes. Water bodies were identified for programmes in aquaculture/pisciculture. The local people and line department officials could now plan the development of the GP in an inclusive way.

(ii)The Transportation Network identified District roads, Village roads-Pucca, Village roads-Kutchha, and Foot paths (Fig-4). This helped the local people and planners to make connectivity studies and propose new roads or up gradation of existing roads. The missing links on the road networks could be identified and construction of bridges could be planned.

(iii)Drainage map of GPs helped in identification of river, stream and main canal, (Fig-5). By use of the drainage map the local people and the planners could plan water harvesting structures and check dams. Proposed canals could be taken up. The spatial information helped Integrated Watershed Management Programmes in constructing Water Harvesting Structures (WHS), conservation plans and linked poverty alleviation programmes.

(iv)The Transportation map helped in transport planning exercises. The foot paths have been identified which can be a asset for the planner in at grass-root level.

As a sample study, different thematic layers i.e. Land use/land Cover, Drainage Network and Transportation network of Jambu Gram Panchayat were generated at 1:10 000 scale .Spatial coverage of different land use units are as follows:

Table-1 Land use/land cover area breaks up of Jambu G.P

LULC CLASS	AREA (ha)
Aquaculture Pond	237.61
Crop Land	765.23
Mangroves-Dense	412.80
Mangroves-Open	128.70
Mudflat	139.77
Plantation	258.06
River/Stream	174.97
Scrub forest	7.35
Sea	8.14
Settlement	294.12
Tank/Pond	0.86
Waterlogged Area	17.79
	2445.41

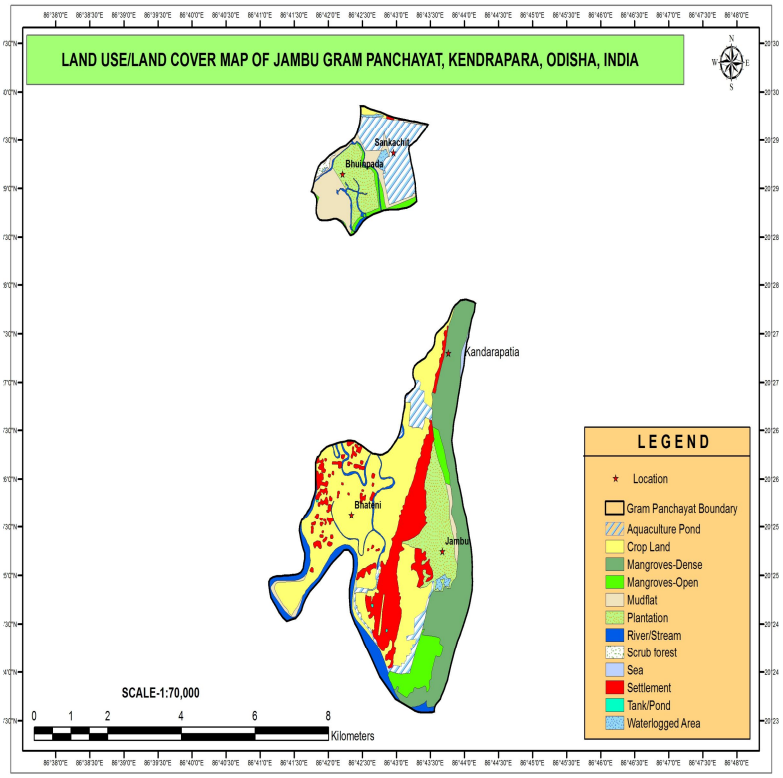

Fig.3 Land use/land cover Map Jambu GP, Kendrapara, Odisha, India

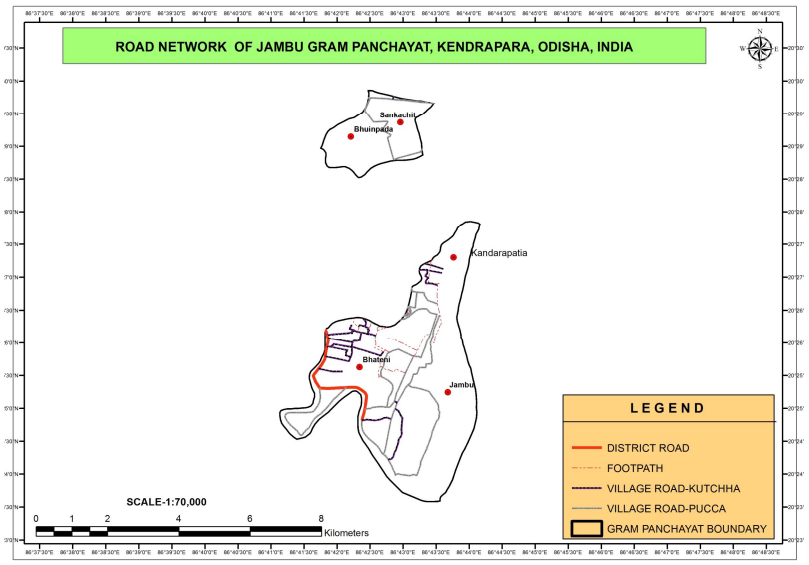

Fig.3 Road Network of Jambu GP, Kendrapara, Odisha, India

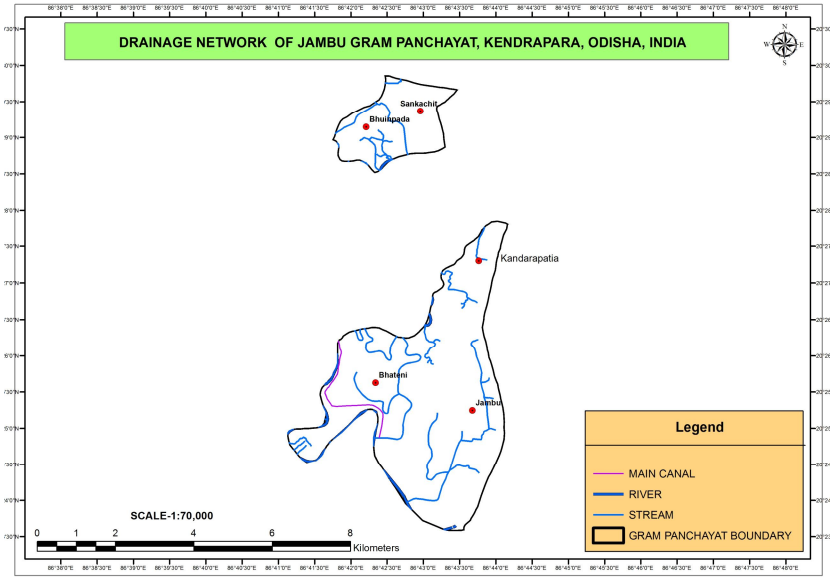

Fig.4 Drainage Network of Jambu GP, Kendrapara, Odisha, India

V. CONCLUSION

The above studies demonstrate the use of Remote Sensing and GIS technology in preparing resource maps in an adequate scale for regional as well as local planning .The cost of preparation of such map is also low and the data can be integrated to various stake holders data for decentralized planning exercises, monitoring and management of a micro administrative unit. The above studies demonstrated how Remote Sensing & GIS technology could generate low cost, up-to date, integrated information required for decentralized planning exercises where the planning officials and local people could work together in planning, monitoring, management of all aspects of locality in quantitative, time bound and transparent manner.

The study conducted in the Jambu Gram Panchayat of Kendrapara district in Odisha state (India) advocates that high resolution satellite imagery plays a vital role in quantifying spatial and temporal phenomena which is otherwise not possible to attempt through conventional mapping. Thus, the present study illustrates that remote sensing and GIS are important technologies for temporal analysis and quantification of spatial phenomena which is otherwise not possible to attempt through conventional mapping techniques.

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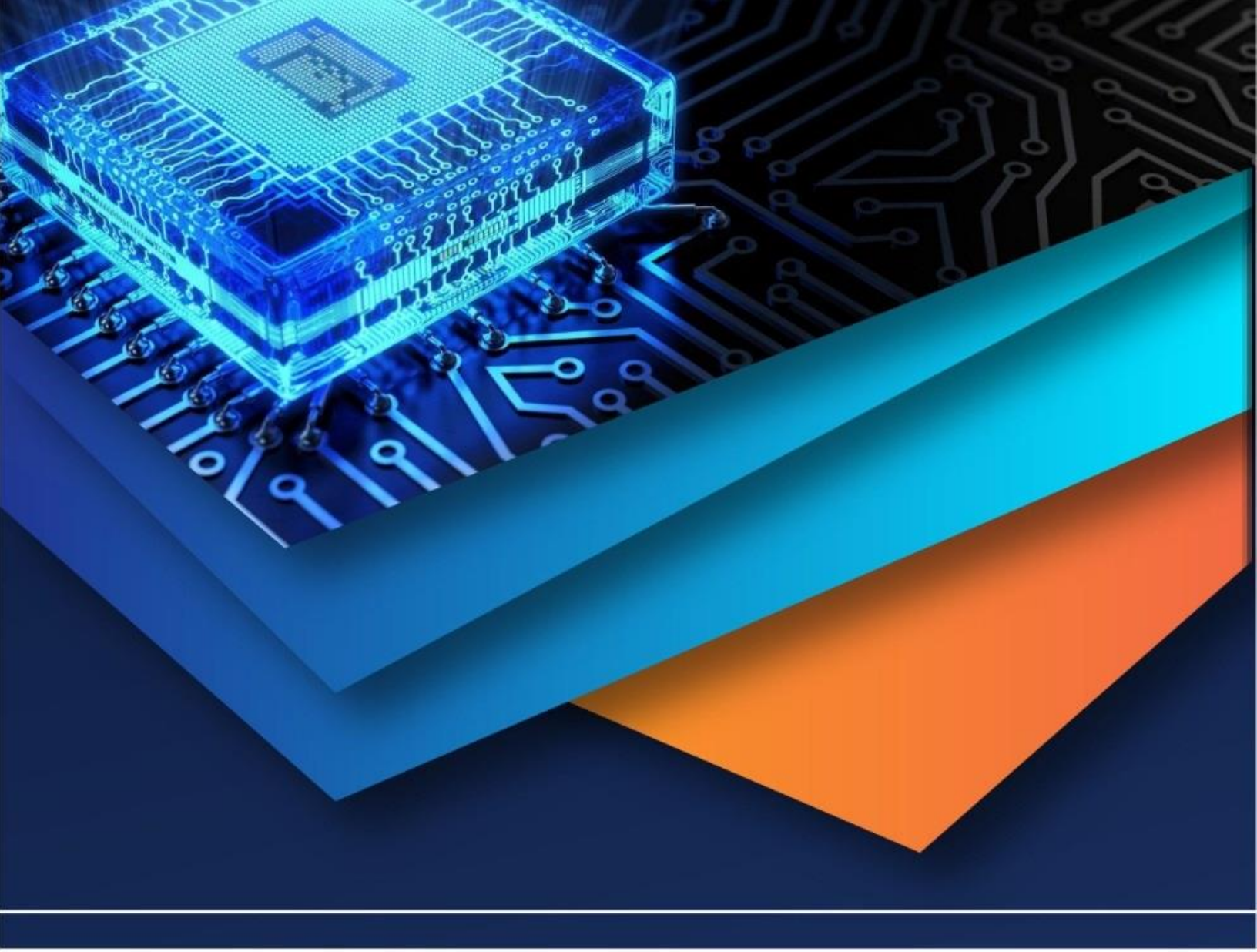

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