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Alpha Diversity Difference of Ichthyofauna of Ganga on North and South Portion of Farakka Barrage, West Bengal, India

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Abstract: ***River Ganga being the largest river of India supports the richest ichthyofaunal diversity of the country as well as productivity and harbours many rare and endemic species of fishes. One main threat to native fishes of Ganga is alteration of its hydrologic pattern by construction of dams and barrages over the river. Very well-known Farakka barrage Project (FBP) is one such construction over river Ganga at Murshidabad, which came into effect in 1975. The present study focuses on to find whether any notable difference can be found between the upstream and downstream stretch of Ganga divided by the barrage. A total of 81 species were found in the river Ganga at the upstream and downstream of Farakka barrage. There are 93% similarity in alpha diversity of ichthyofauna in between Ganga stretch of Malda (upstream of Farakka) and Murshidabad (downstream of Farakka) district. A number of exotic species are also found.***

Keywords: Ichthyofauna, Farakka, Ganga, Malda, Murshidabad

I. INTRODUCTION

Rivers play an important role on ecological, socio-economic, cultural and other valuable aspects for the nation, states and countries. Rivers are very important source of freshwater, natural habitat and migratory routes of many fishes. Anadromous, catadromous and diadromous fishes move between saline and freshwater system to complete their life cycle [1]. India revealed the presence of 79 native fish species belonging to seven orders and 25 families in thestretch of Ganga between Kanpur to Farakka [2]. Hydrologic projects such as dams, barrages on rivers are known to restrict upstream migration, cause domination of exotic species over native ones, habitat fragmentation leading to isolation of population, breaking natural integrity of aquatic ecosystem[1, 3]. All these ultimatelyexert negative impact on biodiversity. River Ganga being the largest river of India supports the richest ichthyofaunal diversity of the country as well as productivity, harbours many rare and endemic species of fishes [5, 6, 7]. One main threat to native fishes of Ganga is alteration of its hydrologic pattern by construction of dams and barrages over the river [6]. Sharp decline in *Tenualosa ilisha* (Hamilton, 1822) and *Ilisha megaloptera* (Swainson, 1839)catches was also reported after construction of dams and barrages on Hooghly and some other riversin the upstream of Barrage [3]. Some part of Lower range Ganga flows through Malda and Murshidabad districts of West Bengal [4]. Very well-known Farakka barrage Project (FBP) is one such construction over river Ganga at Murshidabad, which came into effect on 1975. The length of the barrage is about 2.6 km. It is located about 300 km north of Kolkata. The main objective of this project was to divert 40,000 cusec water from Ganga river into a feeder canal which connects Bhagirathi-Hooghly river, a tributary of Ganga to revive it and to preserve Kolkata Port. The 26-mile-long Feeder canal originates upstream of barrage at Farakka. The diverted water ensures supply of adequate freshwater throughout the year to the Bhagirathi-Hooghly river to revive it by reducing its salinity, maintaining its navigability [8]. Few studies regarding fish diversity and assemblage of different wetlands ofMalda and Murshidabad district arefound [9, 10]. Studies on the ichthyofaunal diversity on upstream and downstream of Farakka barrage is lacking. This year the barrage has completed 45 years. In this context, the present study focuseson to find whether any notable difference can be found between theupstream and downstream stretchof Ganga divided by the barrage and whether any significant effect of Farakka barrage is present or not on the Ichthyofaunal diversity of river Ganga.

II. METHODS OF STUDY

The river Ganga was surveyed from 24°52’15” N 87°58’17” E (Farakka) to 24°51’36” N 87°58’17” E(Rajmahal) in Malda district and 6 six different areas in Murshidabad district viz. Ramnagar Ghat (23°47’21” N88°13’57” E), Berhampore(24°6’3” N88°14’46” E), Farasdanga (24°6’53” N88°15’21” E), Radharghat (24°7’15” N88°13’22” E), Dhulian (24°41’19” N88°55’22” E), Farkka [Rasulpur] (24°48’21” N87°15’12” E) in the Pre-monsoon, Monsoon and Post Monsoon periods for 5 years (2014-2019). The local markets were also surveyed for the information of abundance about fish. The fishermen associated with the river were contacted, interviewed with specific questions and their catch of fish were analysed for analysis of abundance.

The collected fish were identified, photographed and preserved in 4% formalin. Taxonomic Identification was done primarily from the books of Day, F [5], Jayaram, K.C. [11], Talwar and Jhingran [12] and Barman, R. [13]. The fish fauna has been arranged taxonomically according to the classification of Jayaram, K.C. [11]. International Status of the species was also studied from the data of global (IUCN) abundance status from the conservation point of view.

III.RESULT

A total of 81 species were found in the river Ganga at the upstream and downstream of Farakka barrage. The results are shown below:

TABLE I

Comparison between Ichthyofauna of Ganga of Malda and Murshidabad district with their local status and IUCN status

Ichthyofauna	Malda Ganga	Murshidabad Ganga	Local Abundance (Malda)	Local Abundance (Murshidabad)	IUCN Status
Order: Clupeiformes Family: Clupeidae					
Corica soborna(Hamilton, 1822)	Absent	Present	NA	Abundant	Least Concern (LC) ; Date assessed: 06 October 2009
Tenualosa ilisha(Hamilton, 1822)	Absent	Present	NA	Rare /Seasonal	Least Concern (LC) ; Date assessed:23 January 2013
Gudusia chapra(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) (Decreasing) Date assessed: 06 October 2009
Gonialosa manmina(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) Date assessed: 06 October 2009
Ilisha megaloptera (Swainson, 1839)	Absent	Present	NA	Rare	Least Concern (LC) Date assessed: 28 February 2017
Family: Engraulidae					
Setipinna phasa(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) Date assessed: 04 December 2019
Order: Osteoglossiformes Family: Notopteridae					
Notopterus notopterus(Pallas, 1769)	Present	Present	Abundant	Abundant	Least Concern (LC) (Stable) Date assessed: 30 August 2019
Chitala chitala(Hamilton, 1822)	Present	Present	Abundant	Abundant	Near Threatened (NT) ; Date assessed: 28 May 2010
Order: Cypriniformes					
Family: Cyprinidae					
Chela cachius(Hamilton, 1822)	Absent	Present	NA	Very rare	Least Concern (LC) ; Date assessed: 21 March 2010
Salmostoma bacaila(Hamilton, 1822)	Present	Absent	Rare	NA	Least Concern (LC) ; Date assessed: 17 March 2011
Securicula gora (Hamilton, 1822)	Absent	Present	NA	Abundant	Least Concern (LC) ; Date assessed: 10 October 2009
Hypophthalmichthys molitrix (Valenciennes, 1844)	Present	Absent	Abundant	NA	Near Threatened (NT) ; Date assessed: 20 January 2011

Hypophthalmichthys nobilis (Richardson, 1845)	Absent	Present	NA	Less cultured	Data deficient (DD) ; Date assessed: 02 September 2010
Rasbora daniconius (Hamilton, 1822)	Absent	Present	NA	Rare	Least Concern (LC) ; Date assessed: 17 March 2011
Megarasbora elanga(Hamilton, 1822)	Absent	Present	NA	Rare	Least Concern (LC) ; Date assessed:23 January 2010
Cabdio morar(Hamilton, 1822	Present	Present	Abundant	Not available throughout the year	Least Concern (LC) ; Date assessed: 09 October 2009
Amblypharyngodon mola (Hamilton, 1822)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 09 October 2009
Barilius barila (Hamilton, 1822)	Present	Absent	Rare	NA	Least Concern (LC) ; Date assessed: 22 January 2010
Cyprinus carpio(Linnaeus, 1758)	Present	Absent	Abundant	NA	Vulnerable (VU); Date assessed: 1 January,2008 (Exotic)
Puntius chola (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 20 March 2010
Puntius conchonius(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 22 March 2010
Puntius puntio(Hamilton, 1822)	Present	Present	Abundant	Abundant	Not Evaluated
Puntius sophore(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 20 March 2010
Puntius terio(Hamilton 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 18 March 2010
Pethia ticto (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 22 March 2010
Osteobrama cotio cotio(Hamilton, 1822)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 09 October 2009
Labeo bata(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 17 March 2011
Labeo calbasu(Hamilton, 1822)	Present	Present	Rare	Abundant	Least Concern (LC) ; Date assessed: 21 March 2010
Labeo rohita (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 20 March 2010
Cirrhinus mrigala (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 21 March 2010
Cirrhinus reba(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC); Date assessed: 29 September 2010
Gibelion catla (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 08 October 2009
Ctenopharyngodon idella (Valenciennes, 1844)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 09

					October 2009
Garra annandalei(Hora, 1921)	Present	Present	Very Rare	Very Rare	Least Concern (LC) ; Date assessed: 01 March 2007
Family: Cobitidae					
Acanthocobitis botia(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed:21 January 2010
Botia dario(Hamilton, 1822)	Absent	Present	NA	Rare	Least Concern (LC) ; Date assessed: 27 May 2010
Botia lohachata (Chaudhuri, 1912)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 31 May 2010
Lepidocephalichthys guntea (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 06 March 2012
Order: Siluriformes					
Family: Bagridae					
Rita rita(Hamilton, 1822)	Present	Present	Less Abundant	Rare	Least Concern (LC) ; Date assessed: 26 March 2010
Mystus gulio(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 11 August 2019
*Mystus vittatus(*Bloch, 1794)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 05 October 2009
Mystus tengara(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 05 October 2009
Sperata aor(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 19 March 2011
Family: Siluridae					
Ompok bimaculatus(Bloch, 1794)	Present	Absent	Rare	NA	Near Threatened (NT) ; Date assessed: 13 October 2009
*Ompak pabda(*Hamilton, 1822)	Absent	Present	NA	Rare	Near Threatened (NT) ; Date assessed: 13 October 2009
Wallago attu(Bloch and Schneider, 1801)	Present	Present	Less Abundant	Rare	Vulnerable (VU); Date assessed: 12 August 2019
Family: Schilbeidae					
Ailia coila(Hamilton, 1822)	Present	Present	Rare	Rare	Near Threatened (NT) ; Date assessed: 21 September 2010
Pachypterus atherinoides(Bloch, 1794)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 13 October 2009
Clupisoma garua(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 13 October 2009
Eutropiichthys vacha(Hamilton, 1822)	Present	Present	Abundant	Rare	Least Concern (LC) ; Date assessed: 13 October 2009
Silonia silondia(Hamilton, 1822)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 01 March 2007
Family: Pangasiidae					
Pangasius pangasius(Hamilton, 1822)	Present	Absent	Rare	NA	Least Concern (LC) ;

					Date assessed: 13 October 2009
Pangasianodon hypophthalmus (Sauvage,1878)	Present	Present	Abundant	Abundant	Endangered (EN) ; Date assessed: 19 January 2011
Family: Amblycipitidae					
Amblyceps apangi(Nath and Dey, 1989)	Present	Absent	Very Rare	NA	Least Concern (LC) ; Date assessed: 16 December 2009
Family: Sisoridae					
Bagarius bagarius(Hamilton,1822)	Present	Present	Rare	Rare	Near Threatened (NT) ; Date assessed: 13 October 2009
Gogangra viridescens (Hamilton, 1822)	Absent	Present	NA	Rare	Least Concern (LC) ; Date assessed: 12 October 2009
Conta conta(Hamilton, 1822)	Present	Present	Rare	Rare	Data deficient (DD) ; Date assessed: 12 October 2009
Pseudolaguvia shawi (Hora, 1921)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed:12 October 2009
Glyptothorax telchitta(Hamilton, 1822)	Present	Present	Very Rare	Very Rare	Least Concern (LC) ; Date assessed: 13 October 2009
Family: Heteropneustidae					
Heteropneustes fossilis(Bloch, 1794)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 11 August 2019
Family: Loricariidae					
Pterygoplichthys multiradiatus (Hancock, 1828)	Absent	Present	NA	Rare (exotic)	Not Evaluated (NE) (Exotic)
Order: Atheriniformes					
Family: Belonidae					
Xenentodon cancila(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 12 August 2019
Order: Atheriniformes					
Family: Cyprinodontidae					
Aplocheilus panchax (Hamilton, 1822)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 21 June 2018
Order: Channiformes					
Family: Channidae					
Channa marulius(Hamilton ,1822)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 06 October 2009
Channa punctata (Bloch, 1793)	Present	Present	Abundant	Highly Abundant	Least Concern (LC) ; Date assessed:11 August 2019
Channa striata (Bloch, 1793)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed:11 August 2019
Order: Synbranchiformes					
Family: Synbranchidae					
Monopterus cuchia(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 20 March 2010
Order: Perciformes					
Family: Chandidae					

Chanda nama(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 16 March 2010
Parambassis ranga(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 16 March 2011
Parambassis baculis(Hamilton, 1822)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 20 March 2010
Family: Nandidae					
Badis badis (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 26 March 2010
Nandus nandus(Hamilton, 1822)	Present	Present	Rare	Rare	Least Concern (LC) ; Date assessed: 12 October 2009
Family: Cichlidae					
Oreochromis niloticus(Linnaeus, 1758)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 02 March 2018
Family: Mugilidae					
Rhinomugil corsula(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 20 March 2010
Family: Gobiidae					
Glossogobius giuris giuris(Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 11 August 2019
Family: Anabantidae					
Anabas testudineus(Bloch, 1792)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 10 August 2019
Family: Belontidae					
Trichogaster fasciata(Bloch and Schneider, 1801)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 21 January 2010
Trichogaster lalius(Hamilton,1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 21 January 2010
Trichogaster chuna(Hamilton,1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 12 October 2009
Trichogaster labiosa(Day, 1877)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 21 January 2010
Order: Tetraodontiformes					
Family: Tetraodontidae					
Leiodon cutcutia (Hamilton, 1822)	Present	Present	Abundant	Abundant	Least Concern (LC) ; Date assessed: 11 October 2009

Table III
Comparison between Orders and Families of Ichthyofauna of Ganga of Malda and Murshidabad district

Sl No.	Name of the Order	No of Family in Each Order (Malda)	Number of Families in each Order (Murshidabad)
1	Clupeiformes	2	2
2	Osteoglossiformes	1	1
3	Cypriniformes	2	2
4	Siluriformes	7	7
5	Atheriniformes	2	2
6	Channiformes	1	1
7	Synbranchiformes	1	1
8	Perciformes	7	7
9	Tetraodontiformes	1	1

Table IIIII
Comparison between Families and number of species in the families of Ichthyofauna of Ganga of Malda and Murshidabad district

Name of Family (Malda)	No. of Species in each Family (Malda)	Name of the Family (Murshidabad)	Species in each family
Clupeidae	2	Clupeidae	5
Engraulidae	1	Engraulidae	1
Notopteridae	2	Notopteridae	2
Cyprinidae	21	Cyprinidae	21
Cobitidae	3	Cobitidae	5
Bagridae	5	Bagridae	5
Siluridae	2	Siluridae	2
Schilbeidae	5	Schilbeidae	5
Pangasiidae	2	Pangasiidae	1
Amblycipitidae	1	AB	0
Sisoridae	4	Sisoridae	5
Heteropneustidae	1	Heteropneustidae	1
Belonidae	1	Belonidae	1
Cyprinodontidae	1	Cyprinodontidae	1
Channidae	3	Channidae	3
Synbranchidae	1	Synbranchidae	1
Chandidae	3	Chandidae	3
Nandidae	2	Nandidae	2
Cichlidae	1	Cichlidae	1
Mugilidae	1	Mugilidae	1
Gobiidae	1	Gobiidae	1
Anabantidae	1	Anabantidae	1
Belontidae	4	Belontidae	4
Tetraodontidae	1	Tetraodontidae	1
AB	0	Loricariidae	1
24 Families	69 species	24 Families	74 species

IV. DISCUSSION

The result showed that 69 freshwater fish species belonging to 9 Orders, 24 Families and 64 Genus found in Ganga stretch of Malda District (upstream of Farakka Barrage).74 species belonging to 9 orders and 24 families and 64 Genus are found in the river Ganges of Murshidabad district (downstream of Farakka Barrage).There are 84% similarity and 16% dissimilarity in alpha diversity of ichthyofauna in between Ganga stretch of Malda (upstream of Farakka) and Murshidabad (downstream of Farakka) district. FamilyLoricariidae is found in Murshidabad which is absent in Malda whereas Family Amblycipitidae is found in Malda but absent in Murshidabad. Altogether there are 81 species found in Ganga of both sides of Farakka barrage of which 30.23% species are very rare or rare category, in local population, as per the local fishermen observation and catch analysis from the local market.

Although in IUCN evaluation most of them are in NOT EVALUATED (NE) category. According to IUCN, among these 81 species 68 are LC (Least Concern), 06 are NT (Near Threatened), 02 are DD (Data Deficient), 02 VU (Vulnerable) and 02 NE (Not Evaluated).

The most important thing is absence of *Tenualosa ilisha* (Hamilton, 1822) and *Ilisha megaloptera* (Swainson, 1839), a very well-known migratory fish, in Malda district. *Corica soborna* (Hamilton, 1822) is the smallest fish in river Ganga, which is found inMurshidabad but absent in Malda. Another fish *Chela cachius* (Hamilton, 1822), which is very rare, is absent in Malda. *Securicula gora* (Hamilton, 1822) is so far reported only from river Ganges of Murshidabad, it is not found in Malda district.

The reason behind their absence is probably the "hydraulic pressure" generated by the flow of water in feeder canal and prevention of upward movement by barrage gates. Migratory fish viz. *Tenualosa ilisha* (Hamilton, 1822) and *Ilisha megaloptera* (Swainson, 1839) cannot migrate upward due to this reason.

Occurrence of exotic species are well known in river Ganga from survey of other regions. *Cyprinus carpio, Oreochromis niloticus, Aristichthys nobilis, Ctenopharyngodon idella, Hypophthalmichthys molitrix* and *Clarias gariepinus* has been high, mostly at confluences of the river stretches such as Ganga [14]. 4 exotic species, *Oreochromis niloticus* (Linnaeus, 1758), *Ctenopharyngodon idella* (Valenciennes, 1844), *Cyprinus carpio* (Linnaeus, 1758) and *Hypophthalmichthys molitrix* (Valenciennes, 1844) were found in the stretch of Ganga of Malda (upstream of Farakka). From downstream of Farakka, in Murshidabad district, 2 exotic species viz. *Pterygoplichthys multiradiatus* (Hancock, 1828) and *Hypophthalmichthys nobilis* (Richardson, 1845) were found in Ganga in only one sampling. The Brazilian Catfish or Armoured Cat fish *Pterygoplichthys multiradiatus* (Hancock, 1828) is aquarium in origin and probably accidentally released in Ganga. Many of these exotic specieswere originally introduced for aquaculture purposes, but have subsequently spread to many other watercourses, presumably due to natural dispersal and human activity. These species havethe ability to establish, invade and compete with nativefishes leading to high abundance in the new environments following their introduction [15,16]. In upstream stretch of Ganga (above Farakka), these exotic species are more in number than the downstream of Farakka.

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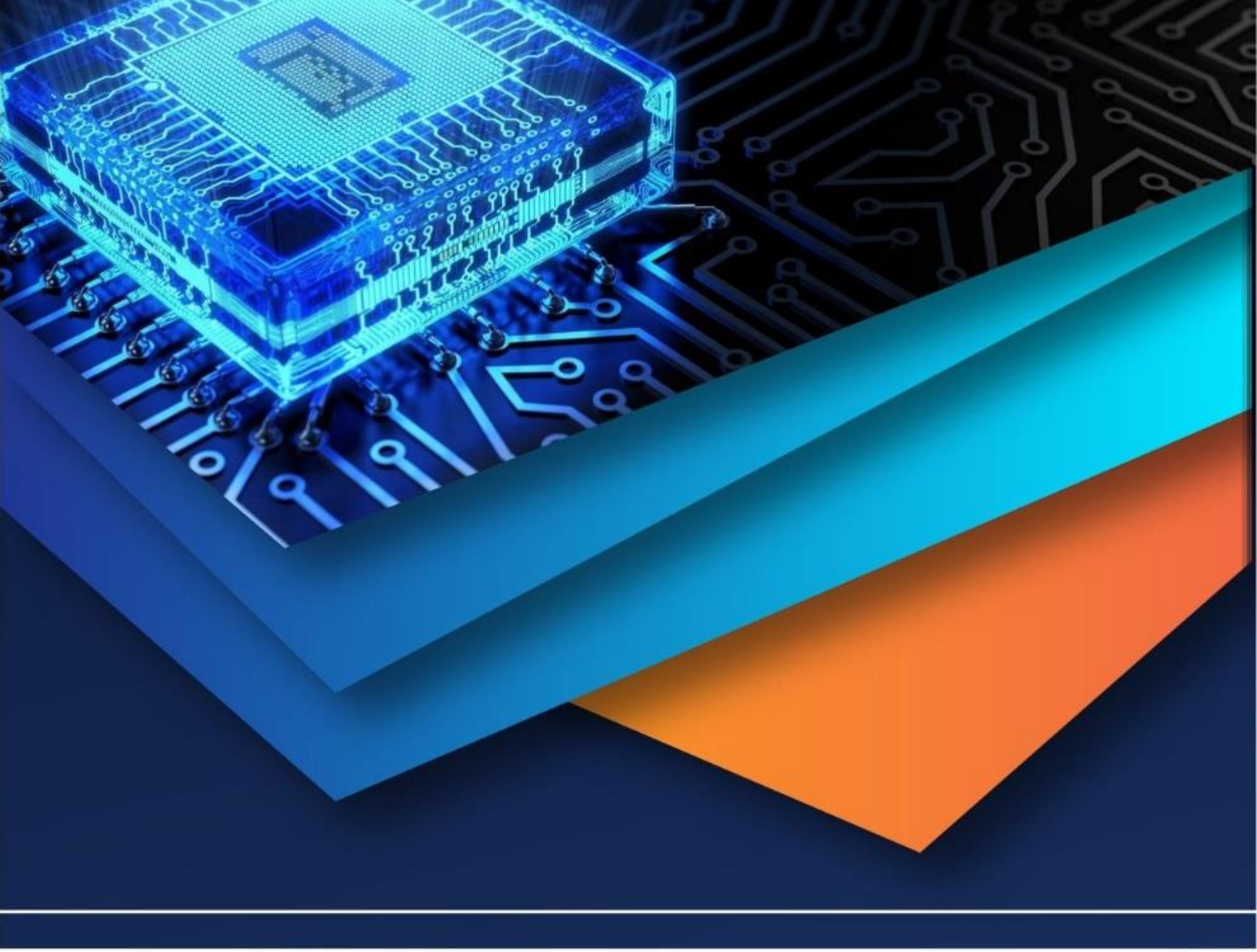

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