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An Economic Analysis of Area, Production and Productivity of Sericulture in India and Karnataka

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Abstract: ***Sericulture is the origin of sustainable livelihood for sericulture farmers and it is an important subsidiary activity which provides year around employment to family labour and help in augmenting household income to large and weaker sections of the peoples in the rural areas. The study was undertaken to examine the growth in area under mulberry, production and yield of mulberry silk in India as well as Karnataka. Secondary data were collected over the period of 32 years (1985-86 to 2016-17) from Central Silk board, Bangalore. The growth rates were worked out for different decades by using exponential function. The magnitude of variability was calculated using Cuddy and Dalle Vale instability index which is treated as superior measure to variability in time series analysis. The contribution of area and productivity to increase in production was worked out by using decomposition analysis. The paper focuses on overall performance of sericulture in India as well as Karnataka from 1985-86 to 2016-17. From study it is observed that the growth rates of sericulture area, production and yield of silk in Karnataka as well as for all India were positive and significant during period I (1985-86 to 1994-95) followed by negative (statistically significant) growth in the following decade ending with 2004-05. The overall analysis of growth of sericulture area and production and productivity over 1985-86 to 2016-17 period indicated declining trend in area but positive growth in production and productivity of raw mulberry silk. Overall instability in area under mulberry, production and productivity of raw silk was higher at the all India level when compared with instability of all the three in Karnataka. The yield effect was the most important factor for an increase in production of mulberry silk in Karnataka as well as in the country as a whole. Since the supply of resources especially land is limited in nature, productivity in sericulture should be boosted up by adoption of improved mulberry varieties, better methods of cultivation and advanced /improved technique of production to meet the future increased demand of silk***.

I. INTRODUCTION

Sericulture is a part of agriculture; silk farming is an agro based industry that involves soil ploughing, seed rearing, harvesting, silk worm rearing and marketing. Sericulture is an agro based cottage industry combining activities of both agriculture and industry. The continent Asia is the main producer of silk in the world and it producers over 98.5% of silk share in global output. Sericulture is an important agro industry in Indian economy. India is the only country in the world which produces all varieties of silk namely tasar, muga and mulberry. India occupies a predominant position in the world and it is the second largest producer of silk after China. Sericulture labour intensive sector next to agriculture and provide sizeable employment to rural households. It is one of the important subsidiary activities taken up to augment household income in the country as well as in Karnataka.

A. Growth Trends of Sericulture: Global Scenario

There are more than three dozen regions engaged in sericulture (silk production) in the world. However, China, India followed by Japan, Brazil and Korea are the bulk producers of silk. China is the leading supplier of silk to the world with an annual production of 104000 MT (2008), out of which the Mulberry raw silk production is 70980 MT. India is the second largest producer of silk in the world with 21273 MT (2016-17) and also the largest consumer of silk in the world and contributes around 15% of the total world raw silk production.

B. Growth Trends of Production and Productivity in India and Karnataka

It has a strong tradition and culture bound domestic market of silk. In India, mulberry silk is produced mainly in the states of Karnataka, Andhra Pradesh, Tamil Nadu, Jammu & Kashmir and West Bengal, while the non-mulberry silks are produced in Jharkhand, Chhattisgarh, Orissa and north-eastern states.

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Karnataka is the homeland of Mysore Silk. Karnataka sericulture has a history of more than 215 years. In 1785, the Tiger of Mysore Tippu Sultan established sericulture in Mysore kingdom. He wanted Mysore to be the foremost among silk producing nations. The dream of this great ruler became true during later period. During these years Karnataka sericulture has seen many ups and downs in its long journey. It has transformed into a model in mulberry sericulture in the country. Sericulture is an important cottage industry in Karnataka. Sericulture which was considered as a subsidiary occupation in the past is being considered as major activity. Sericulture sector provides employment opportunities about 10.67 lakh rural, semi- urban people and 1 hectare of mulberry cultivation provides year long continuous employment in the state. Thus, sericulture has importance role in rural economy of Karnataka. Karnataka is the major mulberry growing state and shared more than 60 per cent of the area under mulberry as well as raw silk production in the country.

Area under mulberry cultivation was increasing before the introduction of economic liberalization and this was facilitated by technological innovations provided by silk research institutions as well as incentives from the government for expansion of sericulture. However, pursuance of economic liberalization and signing of WTO exposed sericulture industry in the country to international competition and opened the flood gates for import of cheap raw silk from china. These impinge upon the demand for mulberry silk produced in the country and led to downward trend in cocoon and silk prices for domestic production and sericulture turned non-remunerative. This resulted in decline in the area under mulberry cultivation despite improvement in productivity. Khan (2009) reported there was a declining trend the area under mulberry cultivation, which could be attributed to rapid urbanization in traditional mulberry growing regions like Devanahalli, Anekal, Vijaypura, Kolar and other areas, and in and around Mysore district. Also, the rising input and labour costs, besides competition with imported Chinese silk had forced thousands of farmers to uproot mulberry cultivation and abandon sericulture all together.

An analysis of the growth trends of area under mulberry as well as production and productivity of mulberry silk in the state as well in the country has been attempted which can provide a basis for future projection of future output (Sharma, 1977). This paper therefore endeavours to analyze (i) the growth trends in area under mulberry, production and productivity of mulberry silk, (ii) to analyse the magnitude of instability in area under mulberry, production and productivity of silk and finally (ii) Source of increase in mulberry silk production by decomposition analysis.

II. MATERIALS AND METHODS

The present study was Time series data (secondary data) on Mulberry area, production, and productivity of mulberry raw silk in India as well as Karnataka for the period from 1985-86 to 2016-17 were collected from Central Silk Board, Bangalore. In order to analyze the growth in of mulberry area, production and yield of mulberry silk, compound growth rate analysis was carried. The compound growth function was specified as follows:

A. Estimation of Growth in Area, Production and Yield

The compound annual growth rates (CAGR) of area under mulberry, production of mulberry raw silk and productivity of silk are computed using the exponential growth function. The form of function used is

$Y = a\, b^t e$

Where,

Y= Dependent variable for which growth rate is estimated

a = Intercept

b = Regression coefficient

t = Time variable

e = Error term

Since the model being the multiplicative the function was transformed into additive model by simple logarithmic transformation as below:

$\ln Y = \ln a + t \ln b$

The per cent compound growth rate (CAGR) was derived using following formulae

CAGR= (Anti ln of b-1) x100

Growth rate is indicated by the value and sign of the ‘b’ coefficient. If coefficient is statistically significant and positive then growth of the estimated parameters over the years is positive or accelerating. If the value of ‘b’ coefficient is negative, it indicates that growth is negative or decelerating during the reference period.

B. Instability Index

Cuddy-Della index is most commonly used measures of instability of time series data and is universally acceptable. The indices were originally developed by John Cuddy and Della Valle for measuring the instability in time series data (Cuddy and Della Valle, 1978). This index is a better measure compared to coefficient of variation, as it is inherently adjusted for trend, often observed in time series data. This measure included as a component of instability all cyclical fluctuations present in the time series data, whether regular or irregular, as well as any component which could be defined as "white noise". The original formulation of the index is given as follows:

$$Ix = \frac{SEE}{\bar{Y}} \times 100$$

Where, Ix = Instability index

SEE = Standard error of the trend line estimates

$\bar{Y}$ = Average value of the time series data

It was shown that instability could also be measured as:

$Ix = CV \sqrt{(1- \bar{R}^2)}$

Where,

CV = Coefficient of variation

$\bar{R}$ = Adjusted coefficient of multiple determination

C. Decomposition of Output (Silk Production) Growth

To measure the relative contribution of area and yield to the total output change for individual crop, Minhas (1964) component analysis model as given below was used. Sharma (1977) redeveloped the model and several research workers used this model and studied growth performance of crops on state level (*see* Narula and Vidysagar, 1973; Bastine and Palanisami, 1994; 1994; Mundinamami et. al, 1995; and Siju and Kombairaju, 2001), etc.

Thus, the total change in production can be decomposed into three effects viz. Yield effect, area effect and the interaction effect due to change in yield and area.

$\Delta P = A_B*\Delta Y + Y_B*\Delta A + \Delta A*\Delta Y$

Change in Production = Yield effect + Area effect + Interaction effect.

Where,

$\Delta P = P_C - P_B$

$\Delta Y = Y_C - Y_B$

$\Delta A = A_C - A_B$

A_B, P_B and Y_B are the area, production and yield of mulberry and silk for the base year.

A_C, P_C and Y_C are the area, production and yield of mulberry and silk for the current year.

The analysis is done for 4 periods i.e. 1985-86 to 1994-95, 1995-96 to 2004-05, 2005-06 to 2016-17 and 1985-86 to 2016-17.

III. RESULTS AND DISCUSSION

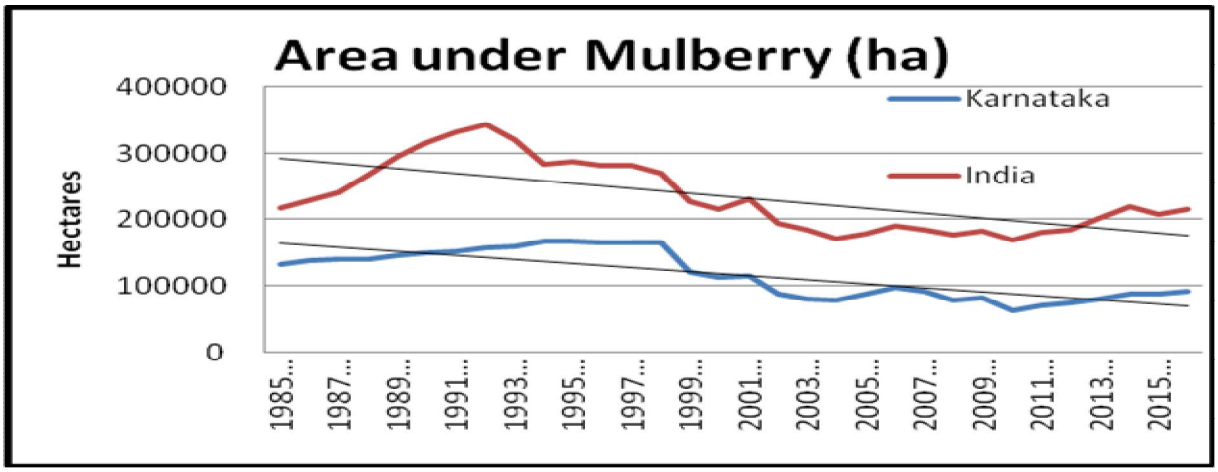
Trends in mulberry area, production of raw silk and productivity per hectare

A. AREA

The area under mulberry in Karnataka which was 132420 ha in 1985-86 increased to 166000 ha in 1996-97 and started declining thereafter and reached to 62697 ha in 2010-11.

However, the area under mulberry cultivation increased gradually from 2011-12 and it reached to 91492 ha in 2016-17 (Fig. 1). At the all India level, the area under mulberry which stood at 2, 17,839 ha in 1985-86 reached the peak of 3, 42,728 ha in 1992-93 and it gradually declined to 216810 ha by 2016-17.The decline in area under mulberry impinge upon the total all India area under mulberry and it was lowest 1,70, 314 ha in 2010-11.

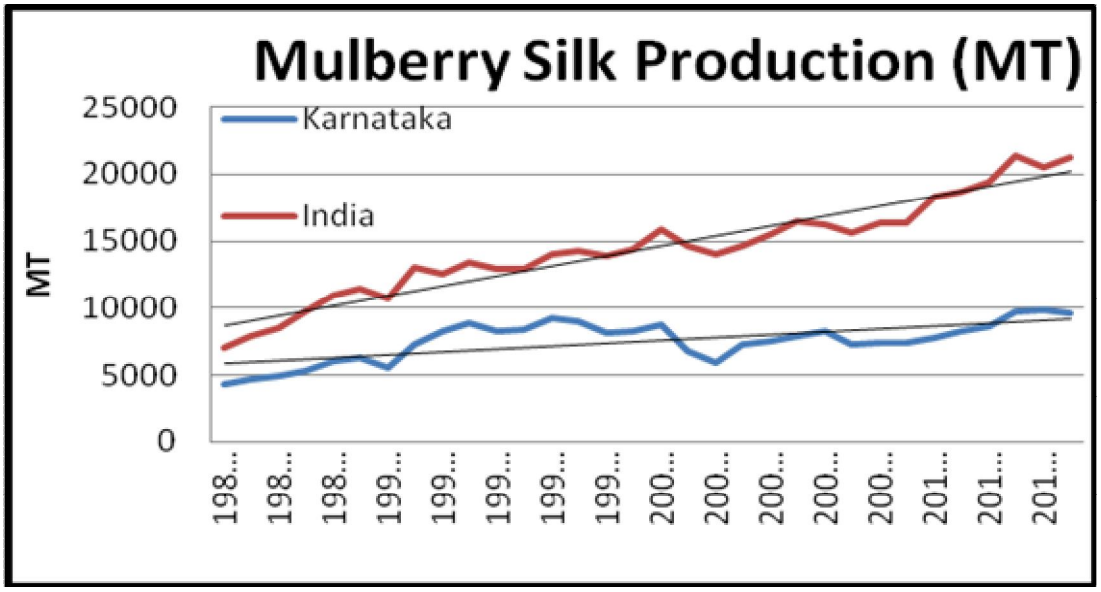
Fig. 1: Trend in the Area under Mulberry in Karnataka and India



B. Production

The production of raw silk in Karnataka which was 4300 MT in 1985-86 increased to 9236 MT during 1997-98 and it decelerated thereafter and reached 5949 MT during the year 2003-04. The production of raw silk increased in the following years and reached to 9823 MT in 2015-16. The trends in the production of mulberry silk along with linear trends of the same in Karnataka as well as all India are depicted in Fig 2. The Production of mulberry silk in the country was 7029 MT during 1985-86 and it increased to 14260 MT in 1998-99 and further to 21390 MT during the year 2014-15. The all production indicated sharper linear trend when compared to the linear trend of mulberry silk production in Karnataka**.**

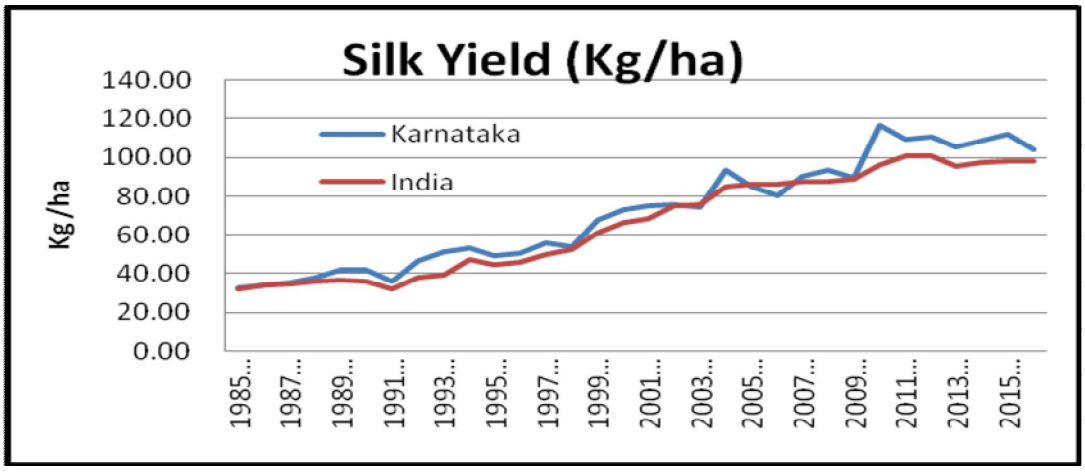
Fig. 2: Trends in Production of Mulberry Raw Silk in Karnataka and India



C. Productivity

The productivity of mulberry raw silk increased steadily over the years with a few aberrations in yield levels both in Karnataka as well as at the all India level. The average yield of mulberry raw silk in Karnataka was 32.47 kg/ha in 1985-86, crossed the 50 kg/ha mark in 1993-94 and reached 117.04 kg/ha during 2010-11 (Fig. 3). The per hectare yield of mulberry raw silk at the all India level was always lower than in Karnataka. The mulberry raw silk yield was 71.43/ha at the all India level during 1985-86 and steadily increased to 100.90 kg/ha during 2011-12. The yield levels experienced a slight decline thereafter.

Fig. 3: Trends in Productivity of Mulberry Raw Silk in Karnataka and India



D. Compound Growth In Mulberry Area, Production Of Raw Silk And Productivity Per Hectare

The compound growth rates of area, production and yield of pulses were computed and presented in Table 1. The growth rate of area and production were positive and significant during the pre-liberalization period (period I) both in Karnataka and for all India. However, area under Mulberry declined significantly during period II (1995-96 to 2004-05) resulting in significant reduction in silk production in Karnataka but not at the all India level. Srinivasan, S. M (2006), also reported that in the pre-WTO period, area under mulberry crop increased almost linearly at the rate of 2.45 per cent per annum. The production of reeling cocoons experienced a growth of 6.42 per cent per annum resulting in 7.88 per cent compound growth in raw silk production. However, in the post-WTO (1995-96 to 2004-05) period, growth in mulberry area, production of reeling cocoons as well as silk production decelerated. The area under mulberry in Karnataka declined by 10.32 per cent per annum whereas, production of cocoons and silk production decelerated by 5.09 per cent and 3.36 per cent per annum, respectively.

In period III, production and productivity increased significantly. Overall, production of mulberry silk production increased significantly during 1985-86 through 2016-17 due to significant growth in productivity notwithstanding the statistically significant decline in the mulberry area.

Table 1: CAGR of Mulberry Area, Production and Productivity of Raw Silk

Description	Period I		Period II		Period III		Over all	
	1985-86 to 1994-95		1995-96 to 2004-05		2005-06 to 2016-17		1985-86 to 2016-17	
	CAGR	R^2	CAGR	R^2	CAGR	R^2	CAGR	R^2
KARNATAKA								
Area	2.45***	0.98	-9.39***	0.91	-0.25	0.09	-2.73***	0.66
Production	7.89***	0.89	-3.04***	0.40	2.49***	0.60	1.57***	0.44
Productivity	5.30***	0.80	7.00***	0.90	2.75***	0.58	4.42***	0.95
INDIA								
Area	4.41***	0.63	-5.81***	0.92	1.71***	0.49	-1.57***	0.46
Production	7.26***	0.91	1.35**	0.39	3.20***	0.86	2.77***	0.88
Productivity	2.74***	0.47	7.60***	0.98	1.47***	0.68	4.41***	0.94

Note: *** Statistically significant at 1 per cent level.
** Statistically significant at 1 per cent level.

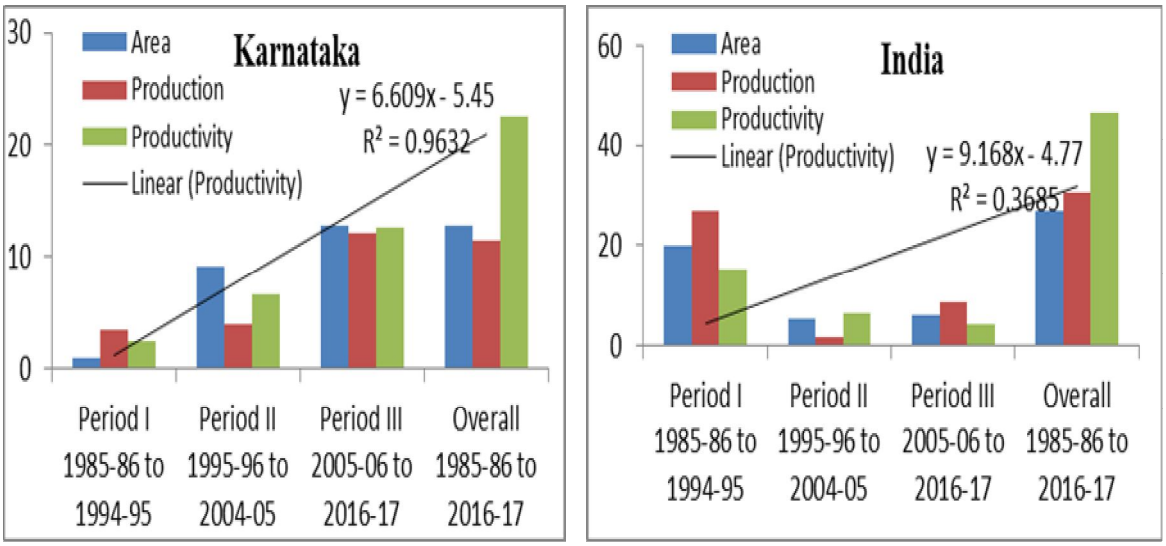
E. Instability in Area under Mulberry, Production of Silk and Productivity

Cuddy and Delle Vale (1978) index was used as the measure of instability in the mulberry area, production and productivity of raw silk both for Karnataka and India. The Table 2 shows that the area, production as well as yield instability was the highest during period I (1985-85 through 1994-95 at the all India level. On the contrary it was least the least in Karnataka during period I.

Table 2: Instability Index for Mulberry Area, Production and Productivity of Silk

Particulars	Period I 1985-86 to 1994-95	Period II 1995-96 to 2004-05	Period III 2005-06 to 2016-17	Over all 1985-86 to 2016-17
KARNATAKA				
Area	1.05	9.07	12.72	12.81
Production	3.52	3.91	12.03	11.45
Productivity	2.49	6.63	12.66	22,51
ALL INDIA				
Area	19.82	5.33	6.01	26.85
Production	26.91	1.74	8.75	30.52
Productivity	15.29	6.40	4.39	46.52

Fig. 4: Instability Index for Mulberry Area, Production and Productivity of Silk



The above table-2 and figure-4 depicts the instability index for mulberry area, production and productivity of sericulture in India as well as Karnataka. The instability in mulberry area as well as production and yield was the maximum during period III (2005-06 to 2016-17) in Karnataka. Overall, instability was higher for area, production and productivity at the all India level when compared to Karnataka state for the entire study period 1985-86 to 2016-17.

F. Productivity Analysis

To estimate the percentage contribution of area, yield and the interaction of area and yield in increasing production of mulberry silk, a decomposition analysis was carried out and presented in Table 3 for the four periods i.e., 1985-886 to 1994-95, 1995-96 to 2004-05, 2005-06 to 2016-17 and overall 1985-86 to 2016-17. It can be seen from the Table 3 that during period I (1985-94), all the three effects are positive. The yield effect is very high in Karnataka contributing almost two third of the increased production whereas area expansion is most important contributor to increased silk production at the all India level. However, in the next period (1995-96-2004-05), production of silk in Karnataka declined due to reduction in area and only improved yield contributed to the output. At the all India, incremental production was due to productivity alone.

Table 3: Productivity Analysis

Effect/Period	Period I 1985-86 to 1994-95	Period II 1995-96 to 2004-05	Period III 2005-06 to 2016-17	Over all 1985-86 to 2016-17
KARNATAKA				
Area Effect	24.15	227.39	-14.51	-32.28
Productivity Effect	64.23	-257.91	118.46	2.6703
Interaction Effect	11.62	130.52	-3.95	-71.39
ALL INDIA				
Area Effect	54.37	-408.02	52.11	-3.72
Productivity Effect	33.38	782.37	41.23	110.724
Interaction Effect	12.15	-274.35	6.65	-7.01

The above table-3 depicts that the decomposition of sericulture. This table observed that the during period III, increased production in Karnataka is contributed solely by yield improvement whereas area, yield and interaction accounted for 52 per cent, 41 per cent and 7 per cent share in the increases production of mulberry silk in India. Over all, Productivity was found to contribute for increased production of silk both at the state as well as all India level.

IV. SUMMARY AND CONCLUSION

From the study, an increasing trend in production and productivity of mulberry silk was observed despite declining trend in the area under mulberry both in Karnataka and India. . However, the compound growth rate of yield over three decades was positive and significant. Area under mulberry declined significantly during economic liberalization (1995-96 to 2004-05) both in Karnataka and the all India level. This was accompanied by significant decline in production in Karnataka as against positive growth at the all India level. Instability in mulberry area, production and productivity of silk was the least in Karnataka in pre-liberalization period and on the contrary, it was the maximum at the all India level. Productivity was found to contribute for increased production of silk both at the state as well as all India level.

The supply of silk was unable to meet the growing domestic demand in spite of the growing trend in area, production. Since the supply of resources especially land is limited in nature, productivity in sericulture should be boosted up by adoption of improved mulberry varieties, better methods of cultivation and advanced /improved technique of production to meet the future demand of silk.

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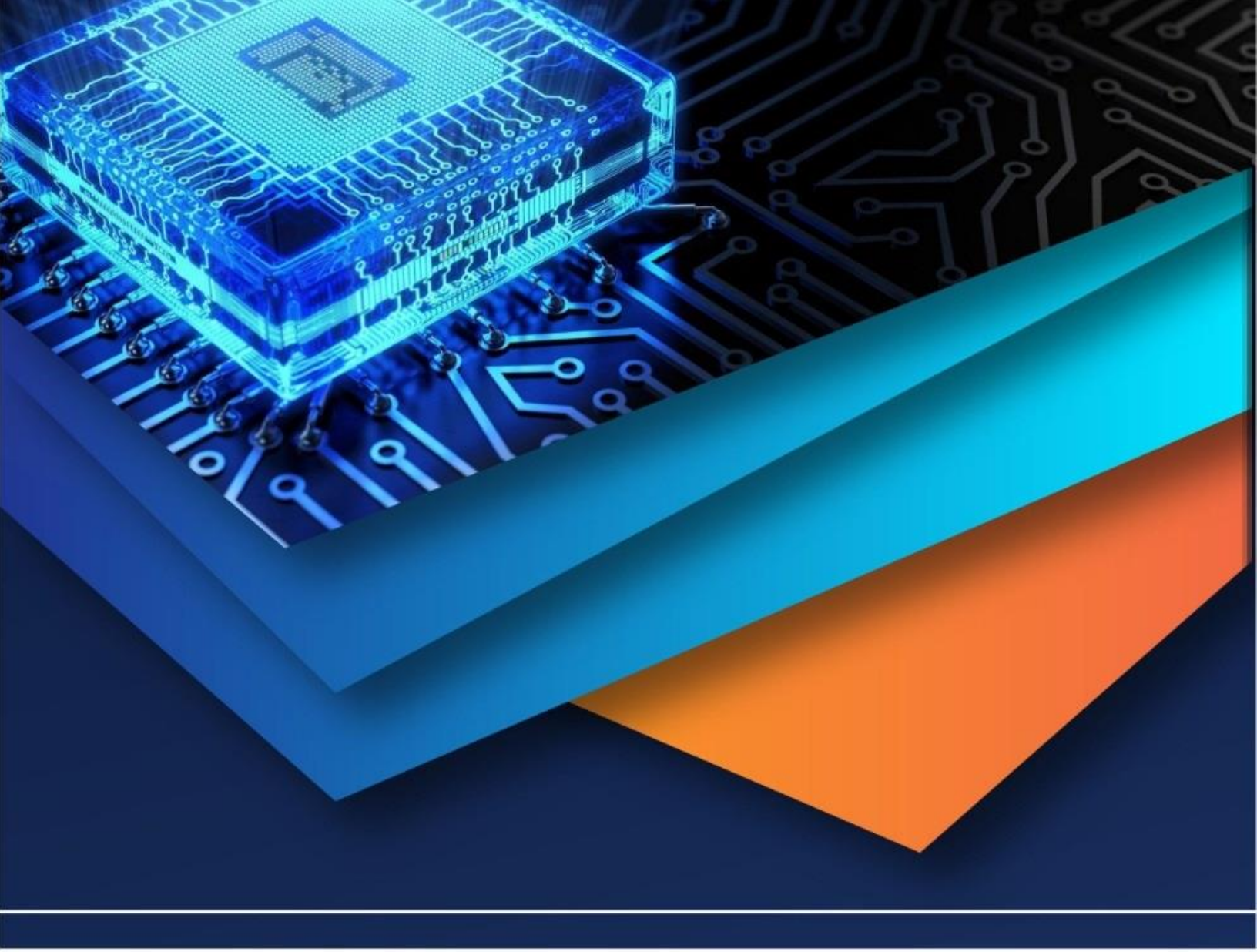

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