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Formulation of India State Hunger Index and Assessment of Associated Factors

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Abstract: ***There are many faces of hunger such as loss of energy, lack of interest, increased vulnerability to disease, shortfalls in nutritional status and premature death. Hunger is usually linked with lack of food. India State Hunger Index was formulated by assigning weights to the components of the index using principal component analysis. Association between hunger index and factors affecting it was assessed. Kerala has the minimum index score indicating less hunger, whereas, Jharkhand has the maximum index score depicting serious hunger situation. Literacy (men-women), households with improved drinking water facility and households with sanitation facility are highly associated with the India State Hunger Index. The factors like literacy (men-women), household with improved drinking water and sanitation facility and child's adequate diet are required to be considered while framing the policies to mitigate the problem of hunger.***
Keywords: India State Hunger Index, literacy, water, sanitation.

I. INTRODUCTION

There are many faces of hunger such as loss of energy, lack of interest, increased vulnerability to disease, shortfalls in nutritional status and premature death. Hunger is usually linked with lack of food. The food and agriculture organization of United Nations (FAO) defines food deprivation and under nutrition, as the consumption of less than 1800 kcal – the minimum requirement that people need to live a fit and fruitful life.

One of the forms of hunger called hidden hunger that goes beyond calories which defines as the lack of energy, proteins or essential vitamins and minerals. It is also called undernourishment and is a result of insufficient intake of food (either quality or quantity), poor utilization of nutrients etc. These are caused by a variety of factors including insecure domestic atmosphere, inadequate maternal health or childcare practices or inadequate access to health services, clean water and sanitation. For the sake of assessment of hunger, it is necessary to point out the range of causes and factors which directly or indirectly affect hunger. Out of several factors affecting hunger worldwide, factors like, literacy (men-women), households with improved drinking water facility, households with improved sanitation facility, and child adequate diet, poverty and GDP are taken into consideration for present study.

India is dealing with one of the extreme situations of hunger and malnutrition which needs an urgent attention and effective action plans. Besides having a large population, India is having a great manpower and it can lead the nation towards advancements and growth. Since a healthy body can concentrate easily and can take initiatives for physical and mental activities, ultimately gives enormous results, it implies that healthy population has direct relationship with growth of its nation. So it is very necessary to showcase the hunger situation at sub national level. Present study explains the calculation of hunger index at state level viz; India State Hunger Index (ISHI) and factor affecting hunger. Such type of micro level index can serve as a powerful tool to measure the extent of hunger, formulate effective action plans and providing solutions to fight hunger.

II. METHODS

A. India State Hunger Index (ISHI)

It is a tool to calculate hunger and malnutrition at the sub-national level in India. It is engineered in the same way as the Global Hunger Index (GHI). The ISHI was developed by the International Food Policy Research Institute (IFPRI) and launched for the first time in 2008, in conjunction with the Non-Governmental Organization Welthungerhilfe and the Department of Economics, University of California. With regards to the planning and execution of the developmental programmes, state governments play a pivotal role in Indian political system. Thus calculating Hunger Index at state level will definitely become a tool to build awareness of the disparities among state hunger indices [1].

(Source: https://en.wikipedia.org/wiki/India_State_Hunger_Index)

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B. Components of India State Hunger Index (ISHI)

The India state hunger index is comprised of four components; 1) Percentage of population undernourished (PUN), 2) Percentage of Stunted children under 5years of age (CST), 3) Percentage of Wasted children under 5years of age (CWA) and 4) Mortality rate of children under 5years of age (CM).

C. Data

The data pertaining to the components of India State Hunger Index viz; stunting, wasting and child mortality under five years of age of children was taken from reports of 4th round of National Family Health Survey (NFHS) 2015-16. Whereas, the data for prevalence of undernourishment was calculated using method suggested by Food and Agriculture Organization (FAO) based on the available data of 2011-12 (Table 1) [2].

Table 1. State Wise Values OF Components of ISHI

Sr. No.	States / UTs	Percentage of Undernourished population (PUN)	Percentage of Stunted children under 5 years of age (CST)	Percentage of Wasted children under 5 years of age (CWA)	Percentage of Child Mortality under 5 years of age (CM)
1	A & N Islands	17.90	23.3	18.9	1.30
2	Andhra Pradesh	28.13	31.4	17.2	4.08
3	Arunachal pradesh	17.90	29.4	17.3	3.28
4	Assam	40.78	36.4	17.0	5.66
5	Bihar	31.09	48.3	20.8	5.81
6	Chhattisgarh	38.21	37.6	23.1	6.42
7	Daman & Diu	17.90	23.4	24.1	3.40
8	D & N Haveli	17.90	41.7	27.6	4.20
9	Delhi NCT	17.90	32.3	17.1	4.20
10	Goa	17.90	20.1	21.9	1.29
11	Gujarat	44.22	38.5	26.4	4.35
12	Haryana	28.09	34.0	21.2	4.11
13	Himachal Pradesh	16.31	26.3	13.7	3.76
14	Jammu &Kashmir	22.84	27.4	12.1	3.76
15	Jharkhand	39.19	45.3	29.0	5.45
16	Karnataka	43.69	36.2	26.1	3.22
17	Kerala	17.90	19.7	15.7	0.71
18	Lakshadweep	17.90	27.0	13.8	3.00
19	Madhya Pradesh	38.15	42.0	25.8	6.49
20	Maharashtra	36.97	34.4	25.6	2.91
21	Manipur	17.90	28.9	6.8	2.59
22	Meghalaya	17.90	43.8	15.3	3.97
23	Mizoram	17.90	28.0	6.1	4.59
24	Nagaland	17.90	28.6	11.2	3.73
25	Odisha	34.96	34.1	20.4	4.86
26	Punjab	28.41	25.7	15.6	3.32
27	Puducherry	17.90	23.7	23.6	3.22
28	Rajasthan	29.53	39.1	23.0	5.07
29	Sikkim	17.90	29.6	14.2	3.22
30	Tamil Nadu	48.74	27.1	19.7	2.69
31	Telangana	17.90	28.1	18	3.36
32	Tripura	17.90	24.3	16.8	3.26
33	Uttarakhand	18.34	33.5	19.5	7.81
34	Uttar Pradesh	34.45	46.3	17.9	4.67
35	West Bengal	38.38	32.5	20.3	3.18
36	India	36.38	38.4	21.0	5.00

(Source: NFHS, 2015-16)

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The data for the factors affecting hunger (Table 2) viz; literacy men, literacy women, percentage of population having access to safe drinking water, percentage of population having sanitation facility, percentage of children of age 6 to 23 months receiving an adequate diet were taken from National Family Health Survey [3].

Table 2:
Data Related to Factors Affecting Hunger Index.

Sr. No.	State	Literacy		Drinking water	Sanitation	Child adequate diet	GDP	poverty
		Men	Women					
1	A & N Islands-UT	88.5	84.1	94.3	74.3	14.2	--	--
2	Andhra Pradesh	79.4	62.9	72.7	53.6	7.6	604229	4.69
3	Arunachal Pra.	84.5	65.6	72.7	61.3	14	18509	36.94
4	Assam	82.8	71.8	83.8	47.7	8.9	227959	30.70
5	Bihar	77.8	49.6	98.2	25.2	7.5	371602	25.63
6	Chhattisgarh	85.7	66.3	91.1	32.7	10.9	225163	35.32
7	Daman & Diu-UT	89.7	83.1	89.4	60.4	6.5	--	--
8	D & N Haveli-UT	82.6	62.5	77.5	35.4	0	--	--
9	Delhi NCT-UT	89.3	80.9	80	73.3	5.2	--	8.44
10	Goa	94.7	89	96.3	78.3	10.4	55054	2.06
11	Gujarat	89.6	72.9	90.9	64.3	5.2	1029010	11.45
12	Haryana	90.6	75.4	91.7	79.2	7.5	495504	7.23
13	Himachal Pra.	96.2	88.2	94.9	70.7	10.9	114239	4.47
14	Jammu & Kashm.	87	69	89.2	52.5	23.5	117168	9.08
15	Jharkhand	79.7	59	77.8	24.4	7.2	206613	32.96
16	Karnataka	85.1	71.7	89.3	57.8	8.2	1045168	15.99
17	Kerala	98.7	97.9	94.3	98.1	28.4	561994	3.96
18	Lakshadweep-UT	98.8	95.6	91.5	99.2	15.9	--	--
19	Madhya Pradesh	81.8	59.4	84.7	33.7	6.6	541068	24.83
20	Maharashtra	92.8	80.3	91.5	51.9	6.5	1966225	11.12
21	Manipur	96	85	41.6	49.9	18.8	19531	36.29
22	Meghalaya	84	82.8	67.9	60.3	23.5	25117	10.01
23	Mizoram	98.1	93.4	91.4	83.3	14.5	15139	24.04
24	Nagaland	85.6	80.9	80.6	75.1	18.8	19524	28.88
25	Odisha	84.3	67.4	88.8	29.4	8.5	328550	23.64
26	Punjab	87.5	81.4	99.1	81.5	5.9	390087	4.90
27	Puducherry-UT	92	85.1	95.8	66.5	30.8	26617	7.83
28	Rajasthan	85.4	56.5	85.6	45	3.4	681482	9.04
29	Sikkim	91.5	56.6	97.6	88.2	23.1	18034	3.83
30	Tamil Nadu	89.1	79.4	90.6	52.2	30.7	1176500	6.61
31	Telangana	83.4	65.5	77.9	50.5	10.1	577902	--
32	Tripura	89.5	80.4	87.3	61.3	5.9	35938	7.70
33	Uttarakhand	90.7	76.5	92.9	64.5	8.5	177163	6.16
34	Uttar Pradesh	82.4	61	96.4	35	5.3	1137808	24.35
35	West Bengal	81.1	70.9	94.6	50.9	19.6	797300	14.69
36	India	85.7	68.4	89.9	48.4	9.6	--	16.18

(Source: NFHS, 2015-16)

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The data for poverty was not available for the year 2015-16. Therefore, it was calculated on the basis of previous year data available for 30 states (2004-05 and 2011-12) by using annual percentage change (Table 2).

The method of Principal Components provides a convenient way of assigning proper weights to the components to form India state hunger Index. It provides optimal weights that capture the largest fractions of the variance of the original variable based on the data available [4]. Principal component analysis was performed using the SPSS software trail version 20

India state hunger Index was framed by assigning the weights derived from PCA to the components of the index.

ISHI = (PCA weight)*PUN+(PCA weight)*CWA+(PCA weight)*CST+(PCA weight)*CM

The index reflects scoring by states on a 100-point scale where 0 is the best score (no hunger) and 100 the worst. A score greater than or equals 50 is defined as 'extremely alarming'; 35 to 50 as 'alarming'; 20 to 35 as 'serious'; 10 to 20 as 'moderate' and less than or equals 10 as 'low'.

The association between factors and index was analysed by calculating the Karl Pearson's correlation coefficient.

III.RESULTS

The weights for the components of the ISHI were calculated using principal component analysis. The percentage of children who are stunted in India have higher weight of 0.29 and that of wasted is 0.22. The weights for child mortality under 5 years of age and the percentage of population undernourished 0.24 and 0.25, respectively.

On the basis of weights the composite index was formed using the following formula

ISHI = 0.25*PUN + 0.22*CWA + 0.29*CST + 0.24*CM

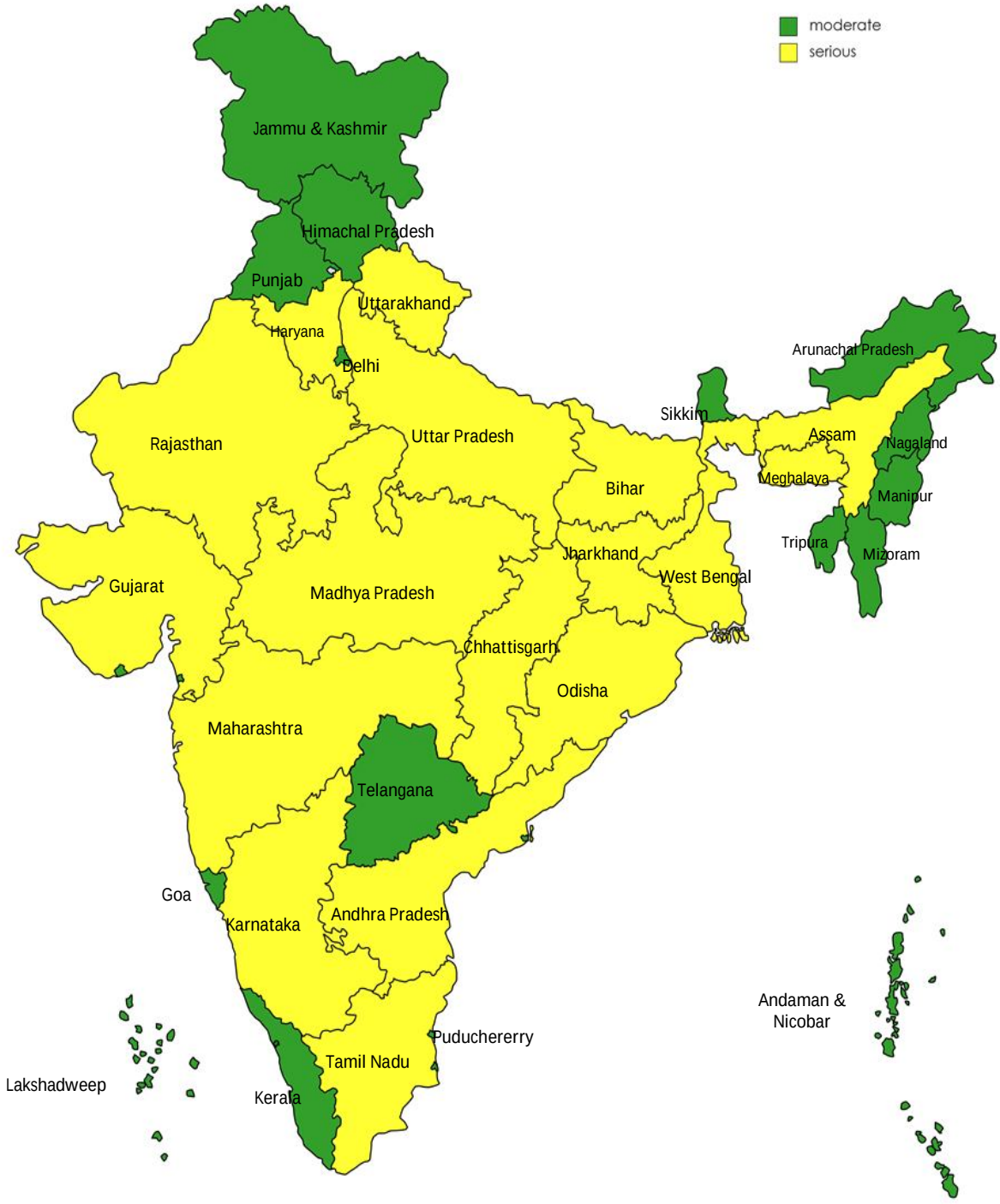
Table 3
Calculation of ISHI and Ranking of States

Rank	States / UTs	0.25 * PUN	0.22 * CWA	0.29 * CST	0.24 * CM	ISHI
1	Kerala	4.48	3.45	5.71	0.17	13.81
2	Manipur	4.48	1.50	8.38	0.62	14.97
3	Mizoram	4.48	1.34	8.12	1.10	15.04
4	Goa	4.48	4.82	5.83	0.31	15.43
5	Himachal Pradesh	4.08	3.01	7.63	0.90	15.62
6	A & N Islands	4.48	4.16	6.76	0.31	15.70
7	Tripura	4.48	3.70	7.05	0.78	16.00
8	Lakshadweep	4.48	3.04	7.83	0.72	16.06
9	Nagaland	4.48	2.46	8.29	0.90	16.13
10	Sikkim	4.48	3.12	8.58	0.77	16.96
11	Jammu & Kashmir	5.71	2.66	7.95	0.90	17.22
12	Puducherry	4.48	5.19	6.87	0.77	17.31
13	Daman & Diu	4.48	5.30	6.79	0.82	17.38
14	Telangana	4.48	3.96	8.15	0.81	17.39
15	Arunachal Pradesh	4.48	3.81	8.53	0.79	17.59
16	Delhi NCT	4.48	3.76	9.37	1.01	18.61
17	Punjab	7.10	3.43	7.45	0.80	18.78
18	Uttarakhand	4.59	4.29	9.72	1.87	20.47
19	Andhra Pradesh	7.03	3.78	9.11	0.98	20.90
20	Meghalaya	4.48	3.37	12.70	0.95	21.50
21	Haryana	7.02	4.66	9.86	0.99	22.53
22	D & N Haveli	4.48	6.07	12.09	1.01	23.65
23	West Bengal	9.59	4.47	9.43	0.76	24.25
24	Odisha	8.74	4.49	9.89	1.17	24.28
25	Rajasthan	7.38	5.06	11.34	1.22	25.00
26	Tamil Nadu	12.19	4.33	7.86	0.65	25.02
27	Maharashtra	9.24	5.63	9.98	0.70	25.55
28	Assam	10.19	3.74	10.56	1.36	25.85
29	Chhattisgarh	9.55	5.08	10.90	1.54	27.08
30	Uttar Pradesh	8.61	3.94	13.43	1.12	27.10
31	Bihar	7.77	4.58	14.01	1.39	27.75
32	Karnataka	10.92	5.74	10.50	0.77	27.94
33	Madhya Pradesh	9.54	5.68	12.18	1.56	28.95
34	Gujarat	11.05	5.81	11.17	1.04	29.07
35	Jharkhand	9.80	6.38	13.14	1.31	30.62
	India	9.10	4.62	11.14	1.20	26.05

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The index coins the value of 13.81 for Kerala, which is least, followed by 16 other states in Moderate category (Table 3). Apart from this remaining 18 states falls in serious category. The largest value of index is 30.62 for Jharkhand. Gujarat, Madhya Pradesh, Karnataka and Bihar are the predecessor of Jharkhand with index values 29.07, 28.95, 27.94 and 27.75, respectively (Fig. 1)(Table 4). The value of index for India is 26.05, which indicate that India comes in serious category.
According to the index score and ranking of states, no state falls in low, alarming and extremely alarming category.

Figure 1: Severity of Hunger in India



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Table 4
Categorization of States/UTS.

SN	<10 Low	>=10 to 20 Moderate	>=20 to 35 Serious	>=35 to 50 Alarming	>=50 Extremely alarming
1	None	Kerala	Uttarakhand	None	None
2		Manipur	Andhra Pradesh		
3		Mizoram	Meghalaya		
4		Goa	Haryana		
5		Himachal Pradesh	D & N Haveli		
6		A & N Islands	West Bengal		
7		Tripura	Odisha		
8		Lakshadweep	Rajasthan		
9		Nagaland	Tamil Nadu		
10		Sikkim	Maharashtra		
11		Jammu & Kashmir	Assam		
12		Puducherry	Chhattisgarh		
13		Daman & Diu	Uttar Pradesh		
14		Telangana	Bihar		
15		Arunachal Pradesh	Karnataka		
16		Delhi NCT	Madhya Pradesh		
17		Punjab	Gujarat		
18			Jharkhand		

TABLE 5
CORRELATIONS BETWEEN INDEX AND FACTORS.

	ISHI1	literacy-men	literacy-women	drinking water	sanitation	child adequate diet	GDP	poverty
ISHI	1	-0.648**	-0.656**	0.591	-0.726**	-0.412*	0.264	0.253
literacy-men	-0.648**	1	0.815**	0.128	0.750**	0.345*	-0.085	-0.220
literacy-women	-0.656**	0.815**	1	0.041	0.726**	0.387*	-0.111	-0.284
drinking water	0.591	0.128	0.041	1	0.237	-0.009	0.081	-0.228
Sanitation	-0.726**	0.750**	0.726**	0.237	1	0.371*	-0.137	-0.212
child adequate diet	-0.412*	0.345*	0.387*	-0.009	0.371*	1	-0.121	-0.124
GDP	0.264	-0.085	-0.111	0.081	-0.137	-0.121	1	0.038
poverty	0.253	-0.220	-0.284	-0.228	-0.212	-0.124	0.038	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

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A. Correlations Between Index and Factors

Karl Pearson's correlation coefficient was calculated between index and factors and displayed in table 5.

1) Literacy: Literacy (men & women) is significantly associated with India State Hunger Index. It indicates that small increments in the literacy rate can have positive effect on index.
2) Household with improved drinking water: Drinking water is positively correlated with all four version of the index. It showed that improving drinking facility may cut down the consequences of hunger.
3) Household with sanitation facility: The percentage of household with sanitation facility is highly correlated with index and other factors viz; literacy (men & women) and child's adequate diet. It does not have any significant association with access to safe drinking water, GDP, and poverty.
4) Child's adequate diet: Child's adequate diet is significantly correlated with the index, literacy and sanitation facility. Also it shows negative correlation with GDP and poverty.

GDP and poverty does not show any significant correlation with the index and factors.

B. Discussion

The book "Towards Hunger Free India" [5] examines the possibilities for achieving freedom from hunger in India by 2007. Emphasis is also placed on prioritized community-based investments such as the provision of clean drinking water, nutritious food, health care and education.

The main reason why child malnutrition is still rampant in South Asia and at a higher rate than the drought-stricken, sub-Saharan Africa disputes that women's nutrition, eating habits and childcare practices are inadequate, related to shortages in terms of women's education and social status [6].

The role of female literacy in reducing the risk of child malnourishment was studied and concluded that when a mother learns, the real benefits flow to children in terms of reduced risk; the same benefits, however, do not go away when the father, but not the mother, learns. Educated mothers make more effective use of health-care institutions and hospitals [7].

Child and infant mortality; child malnutrition; schooling enrolment and completion; gender disparities in schooling; and hunger-poverty: the 5 millennium development goals were focused and emphasized that the data and analysis will be essential for policy-makers, scholars and researchers in the fields of development studies, health, economics and politics, and also for activists in organizations [8].

Intensive nutrition education for mothers improves child nutritional status significantly and sustainably even when no nutritional supplements are provided, and this effect is accountable to proper maternal child feeding and caring practices [9].

India's rising GDP has had very less influence on food security and the nutrition situations of the country. Per capita availability and consumption of food grains has also reduced; the cereal consumption of the bottommost 30% of the population remains to be much less than that of the top two deciles of the population. The percentage of under-nourished stunted children was as high as 39% in 2014; and more than half of India's women and three-quarters of its children are anaemic, with little decline in these estimates in the past eight years, resulted in maternal mortality and underweight babies [10].

Global Hunger Index (GHI) with the predictors encompassing a variety of factors including basic, political, economic, and infrastructural needs was discussed and concluded that the GHI in India and Nigeria was significantly affected by gross domestic product per capita (GDPC) and water access, while only water was significant in determining Brazil's GHI [11].

Poor sanitation remains a chief public health concern linked to several important health issues; it is quite evident that poor sanitation is linked with childhood stunting. The author also found that more than half of the population defecates openly in India; therefore, prevalence of stunting remains higher [12].

IV. CONCLUSIONS

No state falls in low, alarming and extremely alarming category. Kerala has the minimum index score indicating less hunger, whereas, Jharkhand has the maximum index score depicting serious hunger situation. 17 states of India fall in moderate category and 18 states in serious category. India is categorized in serious category.

Literacy (mem-women), households with improved drinking water facility and households with sanitation facility are highly associated with the India State Hunger Index.

The states which are categorized in serious category of hunger index the factors like literacy (men-women), household with improved drinking water and sanitation facility and child's adequate diet are required to be considered while framing the policies to mitigate the problem of hunger.

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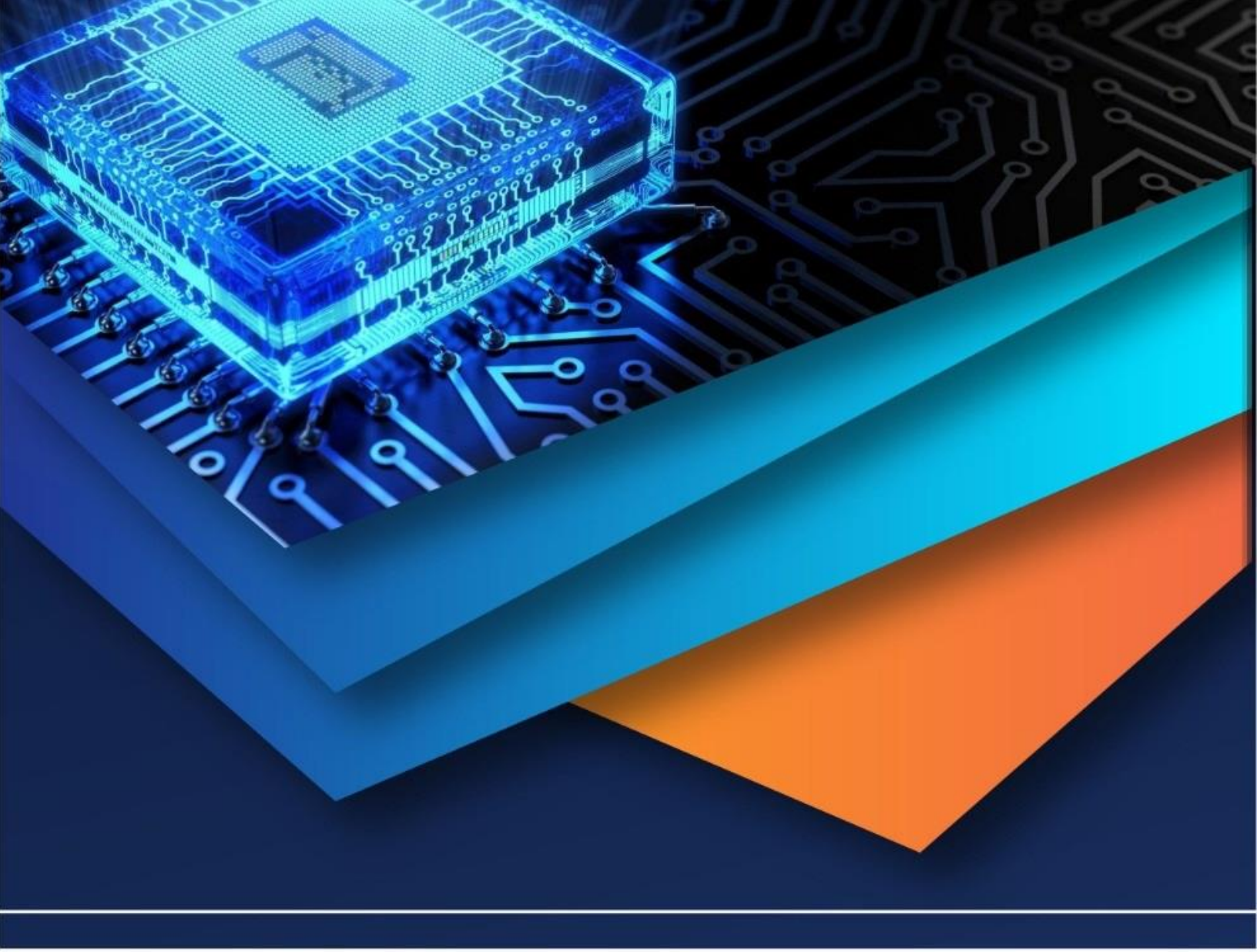
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