A Comparative Study of Indian States: With Special Reference to Achievement of Sustainable Development Goal of Zero Hunger

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ABSTRACT

This study advocates for the creation of a comprehensive hunger measurement index and proposes a framework for its development. The India State Hunger Index (ISHI) is introduced utilizing secondary data from NFHS-5 to compare hunger levels across Indian states and union territories. The construction of this index involves the application of weights derived from principal component analysis to various components. The findings indicate that India's State Hunger Index is 23.99, highlighting ongoing challenges in eliminating hunger. ISHI scores among Indian states vary significantly, from 12.79 in Puducherry to 28.05 in Gujarat, showing notable regional disparities. Prominently, none of the states are classified as having low, alarming, or extremely alarming hunger levels; most are categorized as moderate. The study suggests that Indian states should focus on inclusive economic growth and specific measures to improve food security, and enhance child nutrition. These efforts are crucial for addressing hunger issues and promoting development.

Keywords: *Hunger; Sustainable Development; Food Security; India State Hunger Index (ISHI).*

1.0 Introduction

The Sustainable Development Goals, particularly Goals 1 (No Poverty) and 2 (Zero Hunger), underscore the fundamental significance of adequate nourishment and a healthful dietary regimen as elemental human requisites.

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To uphold the prominence of addressing hunger within the realm of international deliberations and policy formulation, the establishment of dependable mechanisms for systematically assessing the trajectory towards its elimination assumes paramount importance. The Global Hunger Index (GHI) operates as an exemplar of such a mechanism, effectively gauging and continuously monitoring advancements in the global endeavor to combat hunger. This endeavor further facilitates the generation of public discourse concerning the underpinnings and repercussions of hunger. India's GHI rating for 2022, according to a report by Oxfam, tragically reflects the terrible realities faced by the nation, where hunger has been worse since the COVID-19 pandemic broke out.

The world as a whole and a few particular nations are expected to be unable to achieve even significant levels of hunger reduction by 2030, according to the GHI forecasts. The GHI incorporates significant indicators used to monitor progress at the national, regional, and global levels towards achieving Zero Hunger by 2030. Undernourishment, child wasting (a sign of acute malnutrition), child stunting (a sign of chronic malnutrition), and child mortality (under five years old) are among these indicators. These indicators include undernourishment, child wasting (reflecting acute under nutrition), child stunting (indicating chronic under nutrition), and child mortality (under the age of five). The GHI uses a 100-point scale to measure hunger, with 0 being the greatest possible result (no hunger) and 100 denoting the worst (Menon *et al.*, 2008).

**Figure 1: GHI Score Trend for India**

	2017	2018	2019	2020	2021	2022
Value	31.4	31.1	30.3	27.2	27.5	29.1
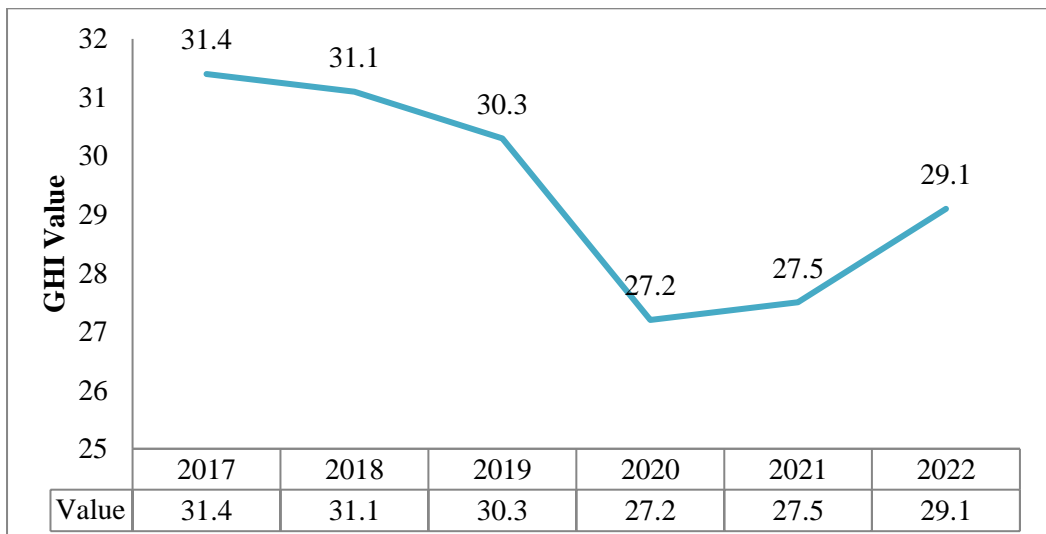
Source: Global Hunger Index Report (GHI, 2022)

The severity of hunger is reflected in each country's GHI score, which ranges from low to extremely worrying. Based on GHI scores, there has been a downward trend in global hunger since 2000, however the rate of improvement is decreasing. Comparably, between 2012 and 2022, India's GHI score dropped from 38.8 in 2000 to a range of 28.8–29.1 (Chandra, 2021). Figure 1 shows the GHI score Trend for India.

The fact that India ranks 107th out of 121 countries in the recently released Global Hunger Index for 2022 is concerning because India is one of the world's leading producers of food grains (Von Grebmer *et al.*, 2022). Table 1 presents the India vs. World Data Related to Hunger Component. India continues to fall short of satisfying its people's basic necessities. India accounts for 25% of the world's hungry population. India has long been recognized as having attained food self-sufficiency.

As a result, India may be delighted with its capacity to offer current demand with domestic production. However, millions of people living in poverty are unable to eat two meals every day, and over 320 million people in India go to bed hungry, according to current figures (Chandra, 2021). These statistics are dreadful, and the situation is just getting worse. Figure 2 shows the facts and figures related to Hunger in India (2022) while figure 3 displays trend for GHI Indicator's Value – India.

**Figure 2: Hunger in India (2022): Facts and Figures**
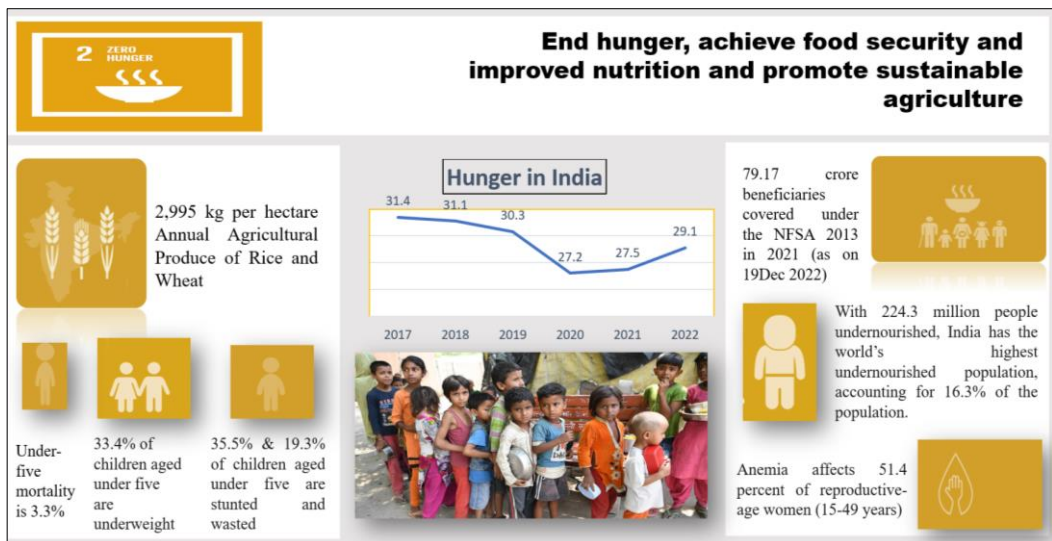
Source: SDG India 2019 & 2020

Table 1: India vs. World Data Related to Hunger Component

Particulars	World		India	
	Value (in %)	Year	Value (in %)	Year
Children under 5 years affected by stunting (low height-for-age)	-	2017	34.7	2017
Children under 5 years affected by wasting (low weight-for-height)	6.69	2020	17.3	2017
Proportion of undernourished in the population	8.9	2019	15.3	2019
Under 1 mortality rate	2.74	2020	2.7	2020
Share of children who are overweight (aged above 5 years)	5.6	2017	1.6	2017
Prevalence of anaemia in women of reproductive age (aged 15-49 years)	29.9	2019	53.0	2019

Source: Our World in Data

Figure 3: Trend for GHI Indicator's Value – India
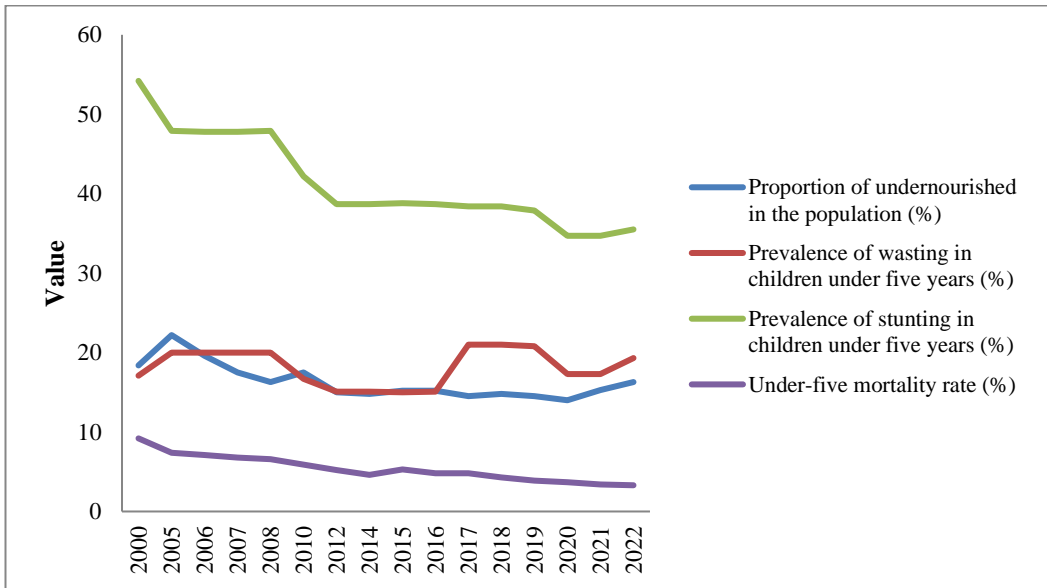
Source: Global hunger Index Report

In this particular situation, the present study outlines the methodology behind the calculation of the India State Hunger Index (ISHI), which serves as an indicator of hunger at the state level. The primary objective of the ISHI is to increase awareness of the problem of hunger and malnutrition in India at both the state and national levels by developing an index that enables comparison throughout the country.

2.0 India State Hunger Index (ISHI)

The ISHI serves as a measurement tool to assess the levels of hunger and malnutrition in specific regions of India. It was computed for 17 states in India, which collectively represent over 95% of the country's population, and its structure is comparable to that of the GHI 2008. The ISHI was developed by IFPRI in collaboration with Wealth hunger life, a non-governmental organization, and the Department of Economics at the University of California, and it was first introduced in 2008. From 2000 to 2022, India displayed signs of improvement according to the GHI. Nevertheless, India still faces a significant level of hunger, as indicated by a score of 29.1 GHI (2022). Figure 4 displays the components of India state hunger index (ISHI). Table 2 provides key health and nutrition indicators, including the prevalence of undernourishment (PUN) from NSS 68 (2011-12) and child health metrics like stunting (CST), wasting (CWA), and under-five mortality rate (CM) from NFHS-5. These indicators reflect the nutritional and health status of children under five in India. Table 3 presents the components of ISHI: State Wise Values.

Figure 4: Components of India State Hunger Index (ISHI)
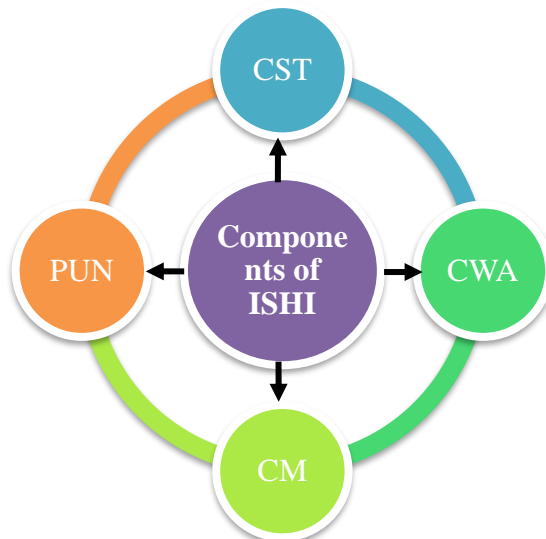
Note: *CST-Children under five years who are stunted (height-for-age)(%)*
CWA-Children under five years who are wasted (weight-for-height) (%)
CM-Under-five mortality rate (U5MR) (per 100 live births))
Source: Authors

Table 2: Data Sources and Description

Variable	Source
PUN- Prevalence of Undernourishment	NSS 68 Consumption Expenditure Round 2011-12
CST-Children under 5 years who are stunted (height-for-age) (%)	NFHS-5
CWA-Children under 5 years who are wasted (weight-for-height) (%)	NFHS-5
CM-Under-five mortality rate (U5MR) (per 100 live births)	NFHS-5

Source: Authors Compilation from given sources

Table 3: Components of ISHI: State Wise Values

Sr. No.	States and UTs	PUN	CST	CWA	CM
1	Andaman & Nicobar Island	17.90	22.50	16.00	2.45
2	Andhra Pradesh	28.13	31.20	16.10	3.52
3	Arunachal Pradesh	17.90	28.00	13.10	1.88
4	Assam	40.78	35.30	21.70	3.91
5	Bihar	31.09	42.90	22.90	5.64
6	Chhattisgarh	38.21	34.60	18.90	5.04
7	Dadra &Nagar and Diu& Daman	17.90	39.40	21.60	3.70
8	Delhi, NCT	17.90	30.90	11.20	3.06
9	Goa	17.90	25.80	19.10	1.06
10	Gujarat	44.22	39.00	25.10	3.76
11	Haryana	28.09	27.50	11.50	3.87
12	Himachal Pradesh	16.31	30.80	17.40	2.89
13	Jammu & Kashmir	22.84	26.90	19.00	1.85
14	Jharkhand	39.19	39.60	22.40	4.54
15	Karnataka	43.69	35.40	19.50	2.95
16	Kerala	17.90	23.40	15.80	0.52
17	Ladakh	17.90	30.50	17.50	2.95
18	Madhya Pradesh	38.15	35.70	19.00	4.92
19	Maharashtra	36.97	35.20	25.60	2.80
20	Manipur	17.90	23.40	9.90	3.00
21	Meghalaya	17.90	46.50	12.10	4.00
22	Mizoram	17.90	28.90	9.80	2.40
23	Nagaland	17.90	32.70	19.10	3.30

24	Odisha	34.96	31.00	18.10	4.11
25	Puducherry	17.90	20.00	12.40	0.39
26	Punjab	28.41	24.50	10.60	3.27
27	Rajasthan	29.53	31.80	16.80	3.76
28	Sikkim	17.90	22.30	13.70	1.12
29	Tamil Nadu	48.74	25.00	14.60	2.23
30	Telangana	17.90	33.10	21.70	2.94
31	Tripura	17.90	32.30	18.20	4.33
32	Uttarakhand	18.34	27.00	13.20	4.56
33	Uttar Pradesh	34.45	39.70	17.30	5.98
34	West Bengal	38.38	33.80	20.30	2.54
35	India	36.38	35.50	19.30	4.19

*Note: *Lakshadweep and Chandigarh are not considered for calculating ISHI due to the non-availability of data.*
Source: NFHS-5 and NSS 68 Consumption Expenditure Round 2011-12

Among the total of 34 states and Union Territories (UTs), there are nine states that demonstrate better performance compared to the overall Indian level in the PUN component. Conversely, twenty-five states fall below the Indian level in terms of the PUN component. In terms of the CST and CM components, seven states and UTs perform at a level higher than the Indian average, while twenty-seven states and UTs perform below it. Regarding the CWA component, nine states and UTs surpass the Indian level, while twenty-five states and UTs fall below it.

3.0 Methodology

In the context of this research, the assignment of suitable weights to the components constituting the State Hunger Index (SHI) in India was carried out using Principal Components Analysis (PCA). PCA, a technique employed to capture significant variations in original variables through available data, was used to determine the optimal weights for these components.

The calculated PCA weights were then applied to the respective components of the SHI using the trial version of the Statistical Package for the Social Sciences (SPSS) software. The calculation of PCA took into account the values within the component matrix. Initially, the values of Physical Undernutrition (PUN), Child Stunting (CST), Child Wasting (CWA), and Child Mortality (CM) were summed, and each value was

subsequently divided by the sum of all values to establish the PCA weights. These computed weights were utilized in the computation of the India State Hunger Index (ISHI).

The ISHI assigns a score to each state on a 100-point scale, where a score of 0 signifies the absence of hunger (most favorable outcome) and a score of 100 represents severe hunger (most adverse situation). The severity of hunger is categorized as follows: extremely alarming (score of 50 or above), alarming (score between 35 and 50), serious (score between 20 and 35), moderate (score between 10 and 20), and low (score below 10). Furthermore, the study explored the hypothesis concerning the presence of a significant difference in hunger levels between large and small states. This scientific framework was tested using a significance test involving the "t" statistic. The aim of this analysis was to provide empirical evidence for assessing the disparity in hunger across different sizes of states.

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

4.0 Result of Collected Data

Weights for the constituent elements of the ISHI were derived through the application of Principal Component Analysis. In India, the proportion of stunted children (0.28) exceeds that of wasted children (0.24). The weights assigned to under-5-year-old child mortality and the percentage of the population affected by undernourishment are 0.25 and 0.23, respectively. The composite index was constructed using the given weights according to the following formula.

ISHI = 0.23*PUN + 0.28*CST + 0.24*CWA + 0.25*CM

Note: Values have been taken from Table 4

Table 4: Component Matrix

	Component	PCA Weight
PUN	.705	0.23
CST	.876	0.28
CWA	.739	0.24
CM	.785	0.25
Total	3.105	

Note: Extraction Method: Principal Component Analysis a.1 Component extracted
*Source: Generated through SPSS*

Table 5: Calculation of ISHI

Sr. No.	States / UTs	PUN*. 23	CST*. 28	CWA*. 24	CM*. 25	ISHI
1	Andaman & Nicobar Island	4.12	6.30	3.84	0.61	14.87
2	Andhra Pradesh	6.47	8.74	3.86	0.88	19.95
3	Arunachal Pradesh	4.12	7.84	3.14	0.47	15.57
4	Assam	9.38	9.88	5.21	0.98	25.45
5	Bihar	7.15	12.01	5.50	1.41	26.07
6	Chhattisgarh	8.79	9.69	4.54	1.26	24.27
7	Dadra &Nagar and Diu & Daman	4.12	11.03	5.18	0.93	21.26
8	Delhi NCT	4.12	8.65	2.69	0.77	16.22
9	Goa	4.12	7.22	4.58	0.27	16.19
10	Gujarat	10.17	10.92	6.02	0.94	28.05
11	Haryana	6.46	7.70	2.76	0.97	17.89
12	Himachal Pradesh	3.75	8.62	4.18	0.72	17.27
13	Jammu & Kashmir	5.25	7.53	4.56	0.46	17.81
14	Jharkhand	9.01	11.09	5.38	1.14	26.61
15	Karnataka	10.05	9.91	4.68	0.74	25.38
16	Kerala	4.12	6.55	3.79	0.13	14.59
17	Ladakh	4.12	8.54	4.20	0.74	17.59
18	Madhya Pradesh	8.77	10.00	4.56	1.23	24.56
19	Maharashtra	8.50	9.86	6.14	0.70	25.20
20	Manipur	4.12	6.55	2.38	0.75	13.80
21	Meghalaya	4.12	13.02	2.90	1.00	21.04
22	Mizoram	4.12	8.09	2.35	0.60	15.16
23	Nagaland	4.12	9.16	4.58	0.83	18.68
24	Odisha	8.04	8.68	4.34	1.03	22.09
25	Puducherry	4.12	5.60	2.98	0.10	12.79
26	Punjab	6.53	6.86	2.54	0.82	16.76
27	Rajasthan	6.79	8.90	4.03	0.94	20.67
28	Sikkim	4.12	6.24	3.29	0.28	13.93
29	Tamil Nadu	11.21	7.00	3.50	0.56	22.27
30	Telangana	4.12	9.27	5.21	0.74	19.33
31	Tripura	4.12	9.04	4.37	1.08	18.61
32	Uttarakhand	4.22	7.56	3.17	1.14	16.09
33	Uttar Pradesh	7.92	11.12	4.15	1.50	24.69
34	West Bengal	8.83	9.46	4.87	0.64	23.80
35	**India**	**8.37**	**9.94**	**4.63**	**1.05**	**23.99**

Source: Author's Calculation

For analytical purposes, all states in India and only six Union Territories (UTs) were taken into account. With a score of 23.99, India falls into the severe category according to the index. When comparing the hunger value at the national level with all Indian states and UTs, nine states have exhibited particularly poor performance. The ISHI scores of Indian states exhibit a considerable range, ranging from 12.79 in Puducherry to 28.05 in Gujarat, indicating a notable level of diversity among them.

The ISHI values range from 14.87 to 23.99, indicating significant diversity within the nation. The researcher has concluded that hunger persists in all states, regardless of population size. As a result, the null hypothesis has been accepted by the researcher (Refer to Annexure 2). Table 5 displays the ISHI (degree of hunger in Indian States & UT) and its basic components for each of the states and union territories in the United States. Figure 5 shows the states and union territories rankings based on the India State Hunger Index.

**Figure 5: Ranking of Indian states and UTs (ISHI Basis)**
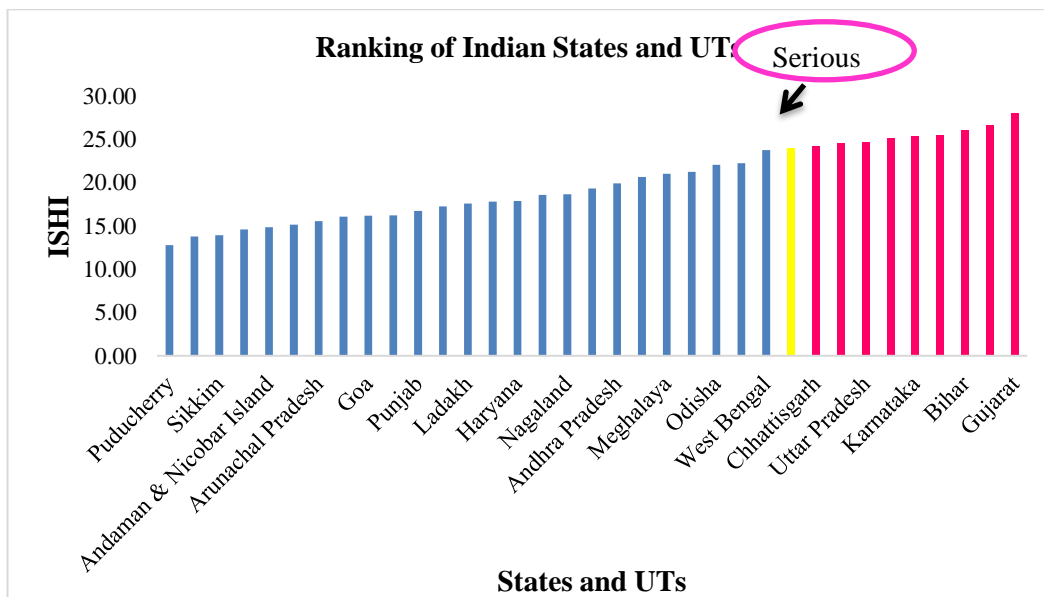
Source: Based on Table 5

The index utilizes a 100-point scale to assess the scoring at the state level, where a score of 0 indicates the most favourable outcome (no hunger), and a score of 100 represents the most dire situation. The severity levels are categorized as follows: a score of 50 or higher is considered extremely alarming, a score ranging from 35 to 50 is classified as alarming, a score falling between 20 and 35 is deemed serious, a score within

the range of 10 to 20 is categorized as moderate, and a score below 10 is labelled as low. Table 6 provides the categorization of Indian states as low, moderate, serious, alarming and extremely alarming.

Figure 6: India State Hunger Index (By Severity)
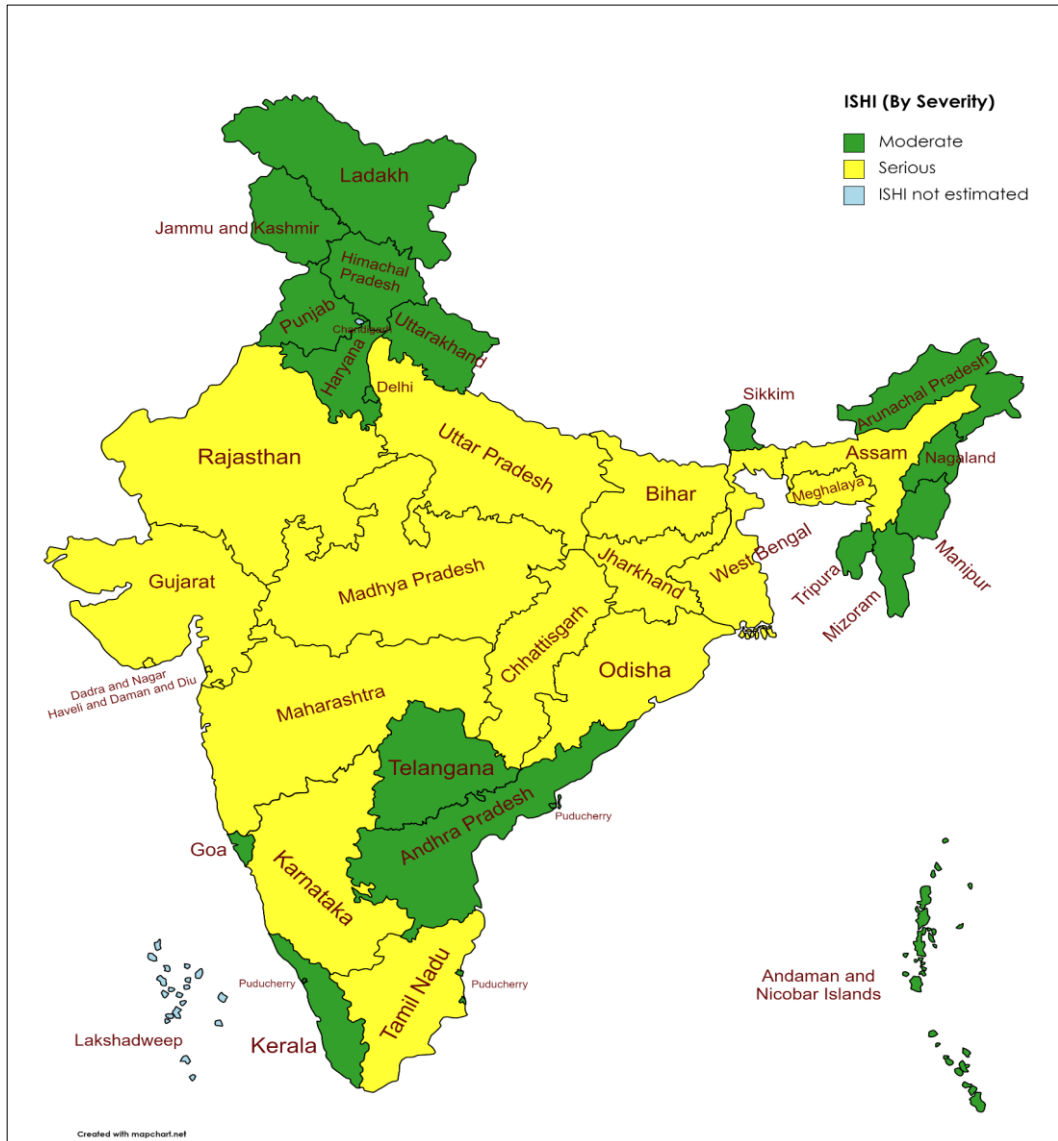
Source: Author Preparation[1]

Table 6: Categorization of States/UTS

<10 low	>=10 to 20 Moderate	>=20 to 35 Serious	>=35 to 50 Alarming	>=50 Extremely Alarming
None	Puducherry	Rajasthan	None	None
	Manipur	Meghalaya		
	Sikkim	Dadra & Nagar and Diu & Daman		
	Kerala	Odisha		
	Andaman & Nicobar Island	Tamil Nadu		
	Mizoram	West Bengal		
	Arunachal Pradesh	Chhattisgarh		
	Uttarakhand	Madhya Pradesh		
	Goa	Uttar Pradesh		
	Delhi NCT	Maharashtra		
	Punjab	Karnataka		
	Himachal Pradesh	Assam		
	Ladakh	Bihar		
	Jammu & Kashmir	Jharkhand		
	Haryana	Gujarat		
	Tripura			
	Nagaland			
	Telangana			
	Andhra Pradesh			

Source: Authors' calculation

5.0 Conclusion

India's undernutrition rate dropped to 224.3 million in 2019–2021 from 15 million in the previous 15 years, according to a U.N. study (The Hindu, 2022). The second-most populous country in the world has seen a rise in the number of obese adults and anaemic

women, according to the research. The Zero Hunger Challenge is built upon a set of core values derived from the 2030 Agenda for Sustainable Development and the United Nations Charter. UN Secretary-General Ban Ki-moon presented this challenge at the Rio+20 UN Conference on Sustainable Development, held in Brazil in June 2012.

The aforementioned study indicates that most Indian states are classified as moderate. Puducherry has the lowest index score, indicating less hunger, whereas Gujarat has the highest index score, indicating a significant hunger issue. There are eighteen states and union territories in the Moderate category, with Puducherry having the lowest index value (12.79). The remaining fifteen states and the Union Territory are included in the serious category. Gujarat possesses the highest index value of 28.05. Jharkhand, Bihar, Assam, Karnataka, and Maharashtra are the states that preceded Gujarat, with corresponding index values of 26.61, 26.07, 25.45, 25.38, and 25.20. Based on the determined index score and ranking of states, no state is classified as low, alarming or extremely alarming.

6.0 Suggestions

- It is becoming more and more crucial to plan and develop more efficient integrated systems for food production, processing, distribution, and preservation that can adapt to the changing needs of the country.
- To enable the delivery of food from food excess to food deficit areas, resilient transportation infrastructure should be created.

The comprehensive action plan clearly outlines the necessary steps required to implement the specific strategy. Based on the findings of the current study, the researcher presents a detailed action plan that highlights crucial tasks for achieving SDG 2. The first stage of developing the action plan involves identifying the challenges associated with the underlying goals and objectives of SDG 2 (Wiesmann, D. et.al. 2007). This is followed by the creation of the action plan, which necessitates collaboration with coordinating partners. While the SDGs have a global focus, the researcher proposes a localized approach, suggesting that the concept of globalization should be adapted to the household level, ensuring that no one is left behind. The action plan is developed using this localized approach.

7.0 Action Plan

Figure 7 present the action plan to achieve zero hunger in India.

Figure 7: Action Plan
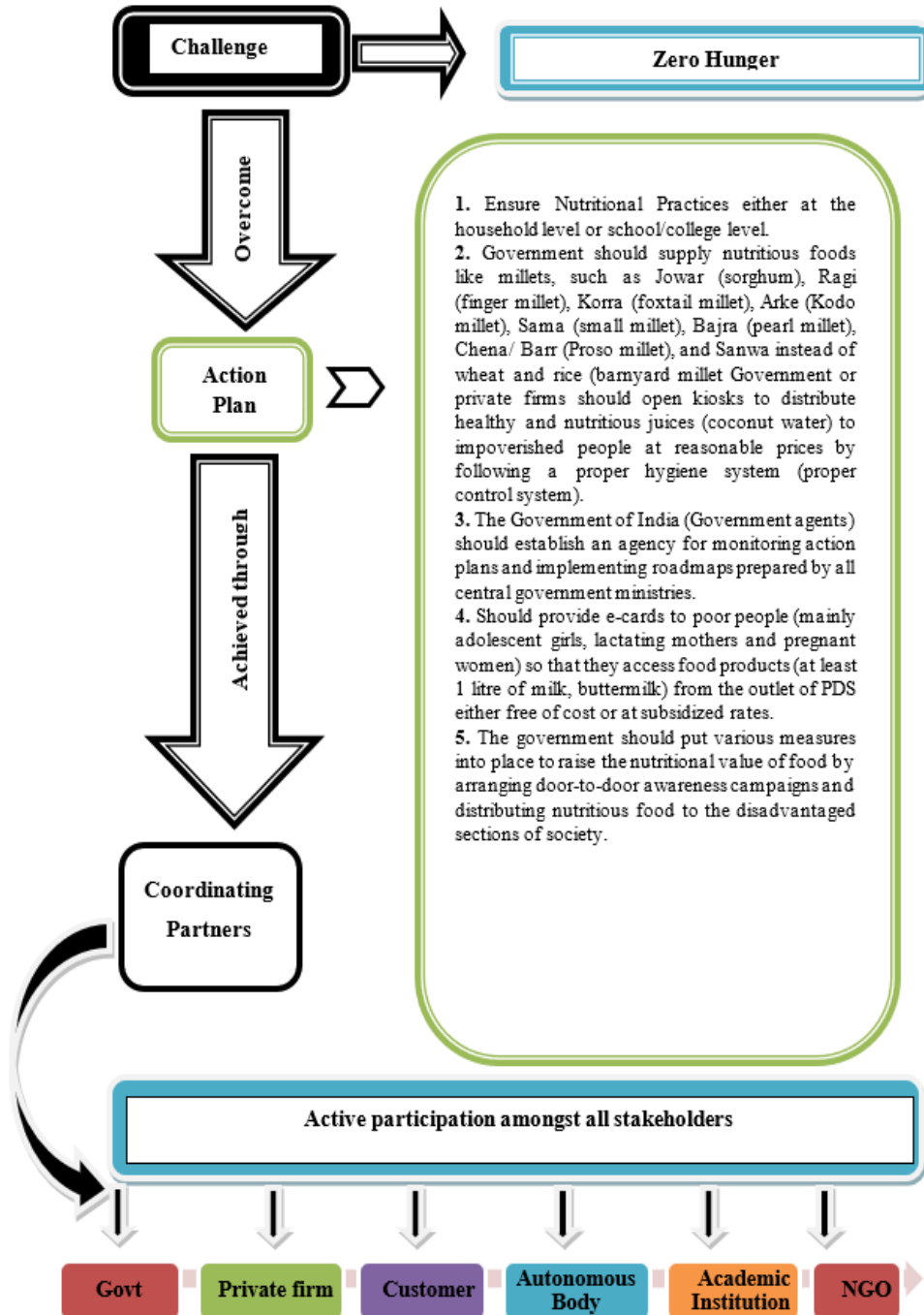
8.0 Managerial Implication

The research paper's managerial implications call for policy formulation to address hunger and food security, optimizing resource allocation based on regional hunger variations, and fostering collaborative efforts between nations. Practical implications include targeted interventions to combat hunger in specific regions, ongoing monitoring using the India State Hunger Index (ISHI), public awareness and advocacy for hunger alleviation, and a focus on long-term sustainable approaches such as investments in agriculture, education, and economic development. By incorporating these implications, managers can make data-driven decisions, enhance efficiency in resource allocation, and contribute to global efforts towards food security and sustainable development.

Endnotes

1. https://www.mapchart.net/india.html

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Appendix

Annexure 1: PCA Result

Commonalities		
Initial		**Extraction**
PUN	1.000	.497
CST	1.000	.767
CWA	1.000	.546
CM	1.000	.616
Extraction Method: Principal Component Analysis		
Component Matrix[a]		
Component 1		
PUN	.705	
CST	.876	
CWA	.739	
CM	.785	
Extraction Method: Principal Component Analysis a.1 Components extracted		

Annexure 2: Hunger Hypothesis

t-Test: Paired Two Sample for Means		
	Small States	**Larger States**
Mean	16.70	23.15
Variance	5.96	13.17
Observations	16.00	16.00
Pearson Correlation	0.37	
Hypothesized Mean Difference	0.00	
Df	15.00	
t Stat	-7.30	
P(T<=t) one-tail	0.00	
t Critical one-tail	1.75	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.13	