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Research Article

A Categorization Based Comparative Study of Food Security and Population in the World's Five Most Populous Countries

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Abstract: This research examines Global Food Security Index (GFSI) along with its components and population changes through comparative analysis for world's top five most populous countries (India, China, USA, Indonesia and Pakistan). This study utilizes innovative Theory of Categorization (ToC) to classify GFSI scores into groups, i.e., poor, weak, normal, good and best. India's GFSI rank slightly dropped from 67th to 68th and categories weak; however, its GFSI scores remains with in normal category. Availability, quality and safety (QS) moved from normal to good, while sustainability and adaptation (SA) improved from weak to normal. India needs to focus on all components with particular attention to affordability and SA. China improved GFSI ranks from 49th to 25th and categories good with significant gains in GFSI scores and its component. USA ranked at 13th in GFSI and categories best. Indonesia ranks 63rd, falls in the weak category. Affordability moved from good to best but sustained efforts are required in other components. Pakistan is ranked at 84th, classified as poor with challenges in SA and QS. China and the USA are managing their populations, whereas unproductive population growth may threaten future food security, particularly for Pakistan, India and Indonesia. This research can assist countries in prioritizing their sectors to achieve food security and in conducting comparable assessments in other countries. Weak countries (Pakistan, Indonesia and India) should enhance food affordability, quality, sustainability, and manage population growth. Strong countries (China and USA) should sustain high standards and invest in sustainable practices and innovations.

Keywords: Global Food Security Index, Comparative Analysis, Theory of Categorization, Top Five Populous Countries.

1. INTRODUCTION

The 1996 World Food Summit defines food security as a fundamental pillar of human well-being [1, 2]. It encompasses the availability, access, utilization and stability of food resources [3-5]. A heightened interest in analyzing and evaluating global food security emerged in the early 21st century. This interest was driven by factors such as environmental changes, growing population, political instability and socio-economic disparities worldwide [6-8]. The Global Food Security Index (GFSI) developed by the research and analysis division of the Economist Group known as Economist Intelligence Unit (EIU) in collaboration with the Barilla Center for Food & Nutrition (BCFN) in 2012 and it is a crucial tool for assessing and comparing the food security situation in various countries [9, 10]. GFSI scores ranging from 0 to 100 and measures the performance, where higher scores reflect superior performance [11-14]. GFSI aims to evaluate a country's food security by assessing affordability, availability, quality and safety (QS), sustainability and adaptation (SA) [15-17]. GFSI serves as an important framework for assessing and comparing food security. It assists policymakers, researchers and other stakeholders in identifying vulnerable areas and supporting the design of focused

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interventions and informed development strategies [18-20]. This index contributes to a broader global understanding of food security by encouraging international collaboration, enabling comprehensive assessment, informing policy decisions and guiding strategic to improve food security worldwide [21]. Islam *et al.* [22] and Hakeem *et al.* [23] indicated that global population was anticipated to reach from 8.9 billion to 10.6 billion by 2050, as opposed to the 7.75 billion recorded in 2020 and these anticipated expansion in population are poised to significantly impact the future food demand. In 1798, economist T.R Malthus (1766-1834) introduced the idea that the ongoing expansion of the population would consistently outpace the availability of food and leading to a global challenge of food scarcity [24, 25]. Malthus was a pioneer in addressing the concern of food scarcity, contending that the expanding global population would ultimately surpass the Earth's ability to sustain it. Organizations such as the World Health Organization (WHO), Food and Agriculture Organization (FAO) and numerous other international bodies are actively engaged in addressing the problem of food insecurity. Islam *et al.* [25] and Kagan [26] indicated that addressing the issue of food insecurity requires a 70% increase in food production within developed countries and a twofold rise in the developing world by the year 2050.

The distinctive characteristics of population as outlined in the United Nations World Population Prospects and the Global Food Security Index, which ranks the top five most populous countries are elaborated as:

India: In the GFSI of 2022, India secures the 68th position. Further examination by specific categories discloses India's standings at 80th, 42nd, 67th and 71st positions for affordability, availability, QS and SA, respectively. India boasts the title of the world's most populous country, with an estimated population of around 1,463.86 million in 2025, contributing a substantial 17.78% to the global population. The 37.61% of India's population resides in urban areas.

China: In the Global Food Security Index 2022 rankings, China secures the 25th position and standings in affordability at 33rd, in availability at 2nd, in QS at 46th and in SA at 55th. Being the second most populous nation, China boasts a population of 1,416.09 million in 2025. The country's population is experiencing steady growth, moderated by the implementation of the "one-child policy" by the government. China's demographic magnitude accounts for a substantial 17.20% of the world's total population. A significant majority about 67.55% resides in urban areas.

United States of America: In the Global Food Security Index of 2022, the USA held the 13th position, scoring 29th, 31st, 3rd and 12th for affordability, availability, QS and SA. in 2025, the USA have a population of 347.27 million, constituting 4.22% of the worldwide population and securing its position as the third most populous country. A significant 82.76% of the USA' population resides in urban areas.

Indonesia: Indonesia is ranked 63rd in the Global Food Security Index for 2022 with specific standings of 44th, 84th, 78th and 83rd for affordability, availability, QS and SA. Indonesia stands as the most densely populated country in Southeast Asia and holds the fourth position globally in terms of population. Indonesia's population in 2025 is 285.72 million, contributing approximately 3.47% to the total world population. The 59.63% of Indonesia's population resides in urban areas.

Pakistan: In the Global Food Security Index 2022, Pakistan holds the 84th position with rankings of 75th, 61st, 97th, and 106th for affordability, availability, QS and SA. Pakistan stands out among Asian nations with population growth. As of 2025, Pakistan's population is at 255.21 million, contributing to 3.10% of the global population. The country holds the 5th position among the world's most populous nations. The 34.39% of Pakistan's population resides in urban areas.

The global population is rapidly increasing, presenting a significant challenge to the world's ability to provide sustenance for nations and ensure food security for everyone. The growing global population has the potential to impact various components of the GFSI, including the affordability of food products, availability of agricultural production, quality and safety of food production practices and sustainable adoption of food production. This study aims to employ a comparative performance analysis (CPA) to examine the complex relationship between population changes and the components of GFSI. The objective is to provide evidence-based insights that may assist policymakers and researchers in developing sustainable and flexible strategies to address the challenges arising from continued global population growth. Such type of CPA has not

been applied previously using the statistical tools, especially for the top five populous countries in the world (India, China, USA, Indonesia, and Pakistan). This study seeks to explore both the favorable and adverse impacts of population growth on the GFSI and its components with a particular emphasis on the world's top five populous countries. The objective is to enhance better understanding of the challenges and opportunities associated with the population changes and food security of these countries.

2. MATERIALS AND METHODS

2.1. Data Collection

The Economist Intelligence Unit (EIU) in collaboration with the Barilla Center for Food & Nutrition (BCFN) developed the Global Food Security Index (GFSI). This tool evaluates and ranks global food security based on factors like affordability, availability, QS, and SA. Data for this study is obtained from the GFSI database, covering the period from 2012 to 2022 and available at https://impact.economist.com/sustainability/project/food-security-index/. GFSI scores are ranging from 0 to 100 and 100 representing the highest score. Data regarding the Annual Population Changes (APC) for the years 2012 to 2025 is gathered from the United Nations World Population Prospects, focusing on the five most populous countries available at https://www.worldometers.info/population/.

2.2. Analysis of Variance

Analysis of Variance (ANOVA) is a statistical method used to assess whether there are any statistically significant differences exist between the means of two or more groups [27-29]. In the current study, ANOVA is applied for six different factors (GFSI, affordability, availability, QS and SA. F- Statistic formula used in ANOVA is defined as:

$$F = \frac{\text{MSE between groups}}{\text{MSE within groups.}} \qquad (1)$$

$$F = \frac{\sum_{i=1}^{m} n_i(\bar{Z}_{i.} - \bar{Z})^2 /(m-1)}{\sum_{i=1}^{m}\sum_{j=1}^{ni}\left(Z_{ij} - \bar{Z}_{i.}\right)^2 /(n-m)} \qquad (2)$$

where *"$Z_{i.}$"* represents the means in the *"i^{th}"* groups, *"n_i"* signifies the number of observations in the *"i^{th}"* group, *"Z"* denotes the overall mean, *"m"* denotes the number of groups, *"Z_{ij}"* is the *"j^{th}"* observations in the *"i^{th}"* out of *"k"* group and *"n"* is sample size. The statistical hypothesis defines as:

Null Hypothesis (H_0): There are no statistically significant differences between the means of the top five populous countries for each factor.

Alternative Hypothesis (H_1): There are statistically significant differences between the means of the top five populous countries for at least one factor.

2.3. Theory of Categorization (ToC)

The GFSI scores and rankings have not yet been classified into distinct groups. GFSI scores range from 1 to 100, where higher scores are deemed better performance and lower scores are considered worse. Similarly, GFSI ranks also span from 1 to 100, where higher ranks are considered worse and lower ranks are considered better. There is a need to categorize GFSI scores and ranks into distinct categories to identify the levels of factors within distinct groups. This study introduced the approach of ToC to identify the GFSI scores and ranks within distinct groups (Table 1) and categorized as poor, weak, normal, good and best as:

2.3.1. GFSI scores categories

- GFSI scores ranging from 0 to 20 indicate a poor level of food security, necessitating rapid and significant improvements.
- GFSI scores ranging from 20.1 to 40 represent weak scores, signaling a subpar performance in terms of food security and substantial enhancements are required.
- GFSI scores ranging from 40.1 to 60 fall into the normal category, suggesting room for improvement, but overall, the performance is deemed satisfactory.
- GFSI scores ranging from 60.1 to 80 are classified as good, indicating effective systems in place, yet there is still potential for refinement.
- GFSI scores ranging from 80.1 to 100 signify the best, indicating high standards of food security.

2.3.2. GFSI ranks categories

- GFSI ranks ranging from 0 to 20 indicate the best category, signify high standards of food security
- GFSI ranks ranging from 21 to 40 represent

Table 1. Theory of categorization of GFSI scores and ranks.

GFSI scores categories range				
Poor	**Weak**	**Normal**	**Good**	**Best**
0-20	20.1- 40	40.1- 60	60.1-80	80.1-100
GFSI ranks categories range				
Poor	**Weak**	**Normal**	**Good**	**Best**
81-100	61-80	41- 60	21- 40	0-20

Source: Author's categorization based on GFSI scores and ranks ranges.

good ranks indicating effective systems in place, yet there is still potential for refinement

- GFSI ranks ranging from 41 to 60 fall into the normal category, suggesting room for improvement, but overall, the performance is deemed satisfactory
- GFSI ranks ranging from 61 to 80 are classified as weak, and substantial enhancements are required.
- Finally, GFSI ranks ranging from 81 to 100 signify the poor level of food security, necessitating rapid and significant improvements.

3. RESULTS AND ANALYSIS

3.1. Analysis of Variance

Table 2 shows ANOVA results assessing significant mean differences in GFSI factors and population growth among the top five populous countries. All the p-value founds less than 0.001 (Sig. = 0.00), leading to accept the "H_1", indicating a statistically significant difference between the groups for six different factors of top five populous countries. It reveals that there exists a statistically significant difference between the means of GFSI score and population growth of top five populous countries in the world. The low P-values consistently suggest a rejection of the null hypothesis emphasizing the impactful nature of these factors on global food security (Table 2).

3.2. Theory of Categorization (ToC)

ToC method outlines GFSI scores and rankings for the top five populous countries. Table 3 shows the Comparative Performance Analysis (CPA) of GFSI ranks and scores along with population changes for India. In 2012, India had a GFSI rank of 67 classified as weak which slightly decreased to 68 in 2022. The change in rank indicates a slight decline (-1) in the overall global food security index. The GFSI score improved from 53.8 in 2012 to 58.9 in 2022, reflecting a positive trend in GFSI scores and classified as normal (Table 3). Components such as availability, QS and SA also show improvements from 56.5, 53.4, 39.9 in 2012 to 62.3, 62.1 and 51.2 in 2022. Availability and QS improved to good from normal, while SA improved to normal from weak. Affordability score decreases to 59.3 in 2022 from 62.5 in 2012. This shows a fall from good to normal for affordability. The population of India increased by 11.47% in 2022 compared to 2012. Despite a marginal drop in GFSI rank, India demonstrated slight improvement in GFSI scores and its components, but it still falls in weak ranks. It gains good category from normal for availability and QS, while attains normal for SA from weak. The decline in affordability may warrant attention to ensure food remains economically accessible to the population.

Table 4 presents a comprehensive overview of China's performance in the GFSI over the span

Table 2. ANOVA for the GFSI score and Population growth for top five populous countries.

	GFSI	**Affordability**	**Availability**	**Quality and safety**	**Sustainability & adaptation**	**Annual population growth**
F-Statistic	155.9	59.4	46.1	292.2	148.9	40.6
P-values	0.00	0.00	0.00	0.00	0.00	0.00

Source: Author's analysis based on GFSI scores and ranks ranges.

Table 3. CPA of GFSI ranks, scores and population changes for India.

Years	GFSI rank of India	GFSI and its components score of India					Yearly % increase in population in 2022 as compared to 2012
		GFSI score	Affordability	Availability	Quality & safety	Sustainability & adaptation	
2012	67 (Weak)	53.8 (Normal)	62.5 (Good)	56.5 (Normal)	53.4 (Normal)	39.6 (Weak)	11.47%
2022	68 (Weak)	58.9 (Normal)	59.3 (Normal)	62.3 (Good)	62.1 (Good)	51.2 (Normal)	

Source: Author's categorization based on GFSI scores and ranks ranges.

of a decade (2012 to 2022) with annual population changes. In 2012, China secured the 49th position in the GFSI rankings with an overall score of 60.5, indicating a classification of normal. The component scores were distributed across the spectrum, with affordability, availability, QS and SA garnering scores of 65 (good), 64.5 (good), 64.8 (good) and 45.8 (normal). China has effectively managed its population growth and reported 4.06% increase in population in 2022 compared to 2012. China recorded significant improvement in its food security, stands at 25th position with an improved GFSI score of 74.2 and categorized as good. A detailed breakdown of GFSI component scores reported advancements in each GFSI components. Affordability score is 86.4 and categories as best, availability found as 79.2 and ranks as good, QS found as 72 and reported as good, while SA found as 54.5 and categories as normal. This shows China's commendable efforts and advancements in enhancing its food security profile over the period spinning from 2012 to 2022. The progress observed in the GFSI and its individual components indicates a favorable trend toward strengthening of accessibility, quality, safety and sustainability of food resources in the country. A steady population growth rate may suggest that food security policies are more effectively aligned with demographic changes.

Table 5 presents the GFSI rankings and scores for the USA, along with the associated components and annual population changes. In 2012, the USA secured the 5th position with an overall GFSI score of 76.7 and it indicating a good level of food security. The components contributing to this score are affordability (87), availability (65.8), QS (88.2) and SA (63.8). Affordability and QS are categories best and all others categories are good. The USA's GFSI rank dropped to 13th place, although it still maintained a good with overall score of 78. The components contributing to the score included affordability (87.1), availability (65.1), QS (88.8) and SA (69.4). Affordability and QS are still categories best and all others are categories good. The yearly increase in population in 2022 as compared to 2012 in USA found 7.70%, which indicates that USA is managing its population

Table 4. CPA of GFSI ranks, scores and population changes for China.

Years	GFSI rank of China	GFSI and its components score of China					Yearly % increase in population in 2022 as compared to 2012
		GFSI score	Affordability	Availability	Quality & safety	Sustainability & adaptation	
2012	49 (Normal)	60.5 (Good)	65 (Good)	64.5 (Good)	64.8 (Good)	45.8 (Normal)	4.06%
2022	25 (Good)	74.2 (Good)	86.4 (Best)	79.2 (Good)	72 (Good)	54.5 (Normal)	

Source: Author's categorization based on GFSI scores and ranks ranges.

Table 5. CPA of GFSI ranks, scores and population changes for USA.

Years	GFSI rank of USA	GFSI and its components score of USA					Yearly % increase in population in 2022 as compared to 2012
		GFSI score	Affordability	Availability	Quality & safety	Sustainability & adaptation	
2012	5 (Best)	76.7 (Good)	87 (Best)	65.8 (Good)	88.2 (Best)	63.8 (Good)	7.70%
2022	13 (Best)	78 (Good)	87.1 (Best)	65.1 (Good)	88.8 (Best)	69.4 (Good)	

Source: Author's categorization based on GFSI scores and ranks ranges.

and account a moderate increase in its population. This comparative analysis suggests that while the United States experienced a slight decline in its GFSI rank from 2012 to 2022, the overall food security remained at a good level. All components are consistent strengths, contributing to the nation's food security. The increase in annual population may indicate a substantial threat for future food security considerations.

Table 6 presents a comparative analysis of the GFSI ranks and scores for Indonesia alongside the annual population changes. In 2012, Indonesia held the 62nd position in the GFSI ranking and it categorizing as weak. The overall GFSI score was 55.4, falling within the normal range. The affordability score is 69 (good), availability score 47 (normal), QS reached 59.1 (normal) and SA scored 43 (normal). Indonesia's GFSI rank slightly declined to 63, still categorized as weak. The overall GFSI score showed improvement, reaching 60.2 and moving into the good category. Examining the components, affordability increased to 81.4 (best), availability reached 50.9 (normal), QS maintained a normal range at 56.2 and SA is 46.3 (normal). The yearly increase in population in 2022 as compared to 2012 in Indonesia found 10.34%. The comparative analysis indicates an overall improvement in Indonesia's GFSI score and it is moving from the normal range in 2012 to the good range in 2022. This positive trend is particularly evident in the affordability component, which shifted from a good to a best rating. The reduction in annual population growth may positively impact food security by easing the pressure on resources. While Indonesia has made progress in enhancing its GFSI score but still ranks weak. There is warrant attention in needed for sustained improvement in all its components except affordability.

Table 7 presents a comparative analysis of the GFSI ranks and scores for Pakistan along with the corresponding annual population changes. In 2012, Pakistan is ranked 94th on the GFSI and it is indicating a relatively poor level of food security. The overall GFSI score for the country is 43.5, categorized as normal. The specific component scores are 47.5 for affordability (normal), 39.2 for availability (weak)

Table 6. CPA of GFSI ranks, scores and population changes for Indonesia.

Years	GFSI rank of Indonesia	GFSI and its components score of Indonesia					Yearly % increase in population in 2022 as compared to 2012
		GFSI score	Affordability	Availability	Quality & safety	Sustainability & adaptation	
2012	62 (Weak)	55.4 (Normal)	69 (Good)	47 (Normal)	59.1 (Normal)	43 (Normal)	10.34%
2022	63 (Weak)	60.2 (Good)	81.4 (Best)	50.9 (Normal)	56.2 (Normal)	46.3 (Normal)	

Source: Author's categorization based on GFSI scores and ranks ranges.

and 52.3 for QS (normal). The SA component scored 34.2 and indicating a weak performance. The yearly increase in population in 2022 as compared to 2012 in Pakistan found 17.35%, which indicates that Pakistan is majorly increasing its population. This trend of unproductive population growth may become a significant indicator of food insecurity in Pakistan. Comparing this to 2022, there has been a slight improvement in Pakistan's GFSI ranking, moving up to 84th place, but still at poor. Slights improvements are observed in the component scores, with affordability rising to 59.9 (normal), availability improving to 58.3 (normal), QS increasing to 49.4 (normal) and SA reaching 37.7 and still weak. This comparative analysis reveals that while there has been slight progress in certain aspects of food security in Pakistan between 2012 and 2022, but the challenges are persist. The slights improvements in affordability and availability are positive indicators, but QS and SA still require more attention. The increases in the population are negatively hitting the food security and ranking it on poor.

4. DISCUSSION

This study explored the relationship between population changes and key components of the Global Food Security Index (GFSI) across the top five populous countries (India, China, USA, Indonesia and Pakistan) using Comparative Performance Analysis (CPA), ANOVA and the Theory of Categorization (ToC). The findings of this study offer important insights into how population changes intersect with the status of GFSI and its components (availability, affordability, QS and SA). The results of the study support the previous literature suggesting that rapid population growth can strain food systems, particularly in low and middle income countries [30, 31]**.** The significant differences found in GFSI scores and population growth rates by ANOVA, validate the hypothesis that population dynamics are non-trivially associated with food security performance [32, 33]. The Theory of Categorization applied innovatively in this study, provided a comparative framework to classify countries and lead to more actionable interpretations for true policy decision. India reflects the complexities of balancing the economic and demographic pressures. The increase in population in India found 11.47% in 2022 as compared to 2012. Improvements in QS and availability suggest the effectiveness of agricultural and regulatory interventions, while the status of affordability is normal. This aligns with previous findings [34, 35], who emphasized that economic access to food remains the most unstable component of food security. China improved its GFSI rank from 49 to 25, stabiles its population growth and reinforced the impact of sustained policy attention on food system resilience. These findings validate the earlier studies by [36, 37], who highlighted that China's strategic investments in food safety, infrastructure and rural development as key to its improved food security system. Although the GFSI ranking of the United States has declined, the country still demonstrates strong performance across all major sectors of GFSI. This suggests that its food system remains resilient and relatively stable even in the face of moderate population changes. However, the downward movement in ranking may indicate the presence of new pressures, potentially linked to climate variability, rising food prices and health related barriers that affecting access to food that have been highlighted in the Global Food Security Report [38, 39]. Indonesia's improvement from a

Table 7. CPA of GFSI ranks, scores and population changes for Pakistan.

Years	GFSI rank of Pakistan	GFSI and its components score of Pakistan					Yearly % increase in population in 2022 as compared to 2012
		GFSI score	Affordability	Availability	Quality & safety	Sustainability & adaptation	
2012	94 (Poor)	43.5 (Normal)	47.5 (Normal)	39.2 (Weak)	52.3 (Normal)	34.2 (Weak)	
2022	84 (Poor)	52.2 (Normal)	59.9 (Normal)	58.3 (Normal)	49.4 (Normal)	37.7 (Weak)	17.35%

Source: Author's categorization based on GFSI scores and ranks ranges.

normal to a good category, particularly through the best sign in affordability signifies progress likely driven by food subsidy reforms and agricultural productivity enhancements. This study aligns with Islam *et al.* [40] and Indriastuti *et al.* [41], that continued progress in all categories of GFSI is needed for long term strategies to attain food security. Pakistan remains in the poor GFSI category and highlighting persistent food security challenges. Despite marginal progress in affordability and availability, the increasing population growth rate is continuously offsetting the gains. The weak performance in sustainability and adaptation reflects structural issues in climate resilience and agricultural resource management practices. This situation aligns with the findings of Aziz [42] and Behera *et al.* [43], who found that food security in Pakistan is increasingly vulnerable due to poor governance and climate variability. The combined application of the CPA and ToC approaches helped to identify key priority areas for policy intervention. China and the USA exemplify relatively successful integration of food policy and demographic control, while Pakistan and Indonesia illustrate the need for comprehensive strategies to address food security threat. In short, these findings suggest that although the rapid population growth remains a fundamental challenge for the food security but its impact varies significantly from county to country based on national policy responses, economic conditions and climate resilience capacities. Therefore, policymakers should adopt localized strategies that prioritize the most lagging components of GFSI informed by periodic CPA assessments and categorization models like ToC.

5. CONCLUSIONS

The rising global population trend poses a significant challenge to achieving food security. This study applied CPA to assess the interaction between population growth and components of the GFSI using Analysis of Variance (ANOVA) and Theory of Categorization **(**ToC**)** for the most five populous countries (India, China, USA, Indonesia and Pakistan). GFSI scores range from 1 to 100 and higher scores are considered better and vice versa, where GFSI ranks also span from 1 to 100 and higher ranks are considered worse and vice versa. The study introduced the innovative approach of ToC that categorize the GFSI scores and ranks into distinct groups such as poor, weak, normal, good and best. ANOVA results indicate that there are statistically significant differences exist between the means of GFSI score and population changes among the top five populous countries. Despite the marginal drop in GFSI rank from 68th to 67th, India has shown slight progress in GFSI scores and its components. While availability and QS have moved from normal to good, SA has improved from weak to normal. However, affordability has declined, highlighting the need to address economic accessibility of food. China has made commendable steps in enhancing its food security profile and ranked 25th from 49th, reflected significant improvements in GFSI scores and its component. The stabilized population growth suggests successful alignment between food security measures and demographic trends. The USA experienced a slight decline in GFSI rank from 5th to 13th. Despite this, overall food security remained at a good level comparing with others countries, with consistent strengths in all components. Indonesia stands at 63rd and still falls in weak category in spite that it has shown overall improvement in its GFSI score, moving from a normal to a good category. The affordability component significantly improved, shifting from good to best. Despite progress, sustained attention is needed for improvement in all components except affordability to strengthen food security in Indonesia. Pakistan stands at 84th position and falls in poor category. Pakistan has seen marginal improvements in GFSI ranking and component scores, particularly in affordability, availability and QS, However, challenges persist as it still falls in normal category and for sustainability and adaptation in weak category. The slight increase in the population growth rate remains serious a concern for food security. Countries should use this study to determine priority sectors for attention in the Global Food Security Index (GFSI) and consider extending similar assessments to other nations.

6. CONFLICT OF INTEREST

All authors declared no conflict of interest.

7. FUNDING STATEMENT

No funding was received to conduct this research.

8. AUTHORSHIP CONTRIBUTION

All authors have equal contributions.

9. ETHICAL STATEMENT

This work does not include any studies involving human or animal subjects.

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