CHAPTER 19

National Food Security Transformation in South Asia: Trends, Vulnerabilities, and Policy Pathways

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Abstract

Food security in South Asia remains a critical development challenge despite substantial advances in agricultural production and economic growth. This chapter reviews the conceptual evolution, theoretical foundations, measurement approaches, and empirical evidence relating to national food security, with a particular focus on Pakistan, India, and Bangladesh. It traces the transition from traditional supply-oriented perspectives toward multidimensional frameworks that incorporate availability, access, utilization, stability, agency, and sustainability. The chapter examines major theoretical approaches, including Malthusian, entitlement, livelihoods, and food systems perspectives, while highlighting the growing influence of the Sustainable Development Goals and resilience-based thinking in contemporary food security discourse. The review further evaluates the strengths and limitations of existing food security indicators and composite indices, emphasizing the need for national-level measures capable of capturing long-term structural change. Attention is given to econometric and modelling approaches, including ARDL, VECM, GARCH, and composite index methodologies, as tools for understanding food security dynamics over time. The regional evidence underscores the importance of climate change, demographic pressure, governance, and policy interventions in shaping food security outcomes across South Asia. Country-specific experiences reveal contrasting development trajectories, with Bangladesh demonstrating significant progress, India facing persistent nutrition paradoxes, and Pakistan confronting increasing vulnerabilities associated with climate shocks and institutional constraints. The chapter concludes by identifying major gaps in measurement, dynamic analysis, and comparative policy research, providing a strong foundation for a multidimensional and longitudinal assessment of national food security in South Asia.

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1. Introduction

Food Security is one of those ideas that seems simple at first, that everyone should have enough to eat but it turned out to be surprisingly deep and complex the more you look at it. Over the past few decades, the way we understand and define food security has changed quite a lot, moving from a simple focus on whether a country grows enough food to a much broader question about whether people can get, afford and benefit from food that is available. This section traces that journey.

1.1. Definition and Evaluation of the concept

The earliest thinking about food security from the 1940's through the 1970s was mostly about national food supply. Governments and international organizations measure food security by looking at how much food a country produced, if production was enough to feed the population, the country was considered food secure.

This made sense in the context of post war reconstruction and threat of famine, when simply producing enough food was the main challenge. The focus was on agriculture and self-sufficiency: growing more wheat, growing more rice, and the problem is solved.

That view changed fundamentally in 1981 when the Nobel-Prize-winning economist Amartya Sen published his landmark book Poverty and Famines. Sen showed through careful historical analysis that some of the worst famines in history including the 1943 Bengal famine happened not because there was less food available, but because poor people could not afford it. Food was in the market; they just had no money to access it. Sen called this the 'Entitlement approach', the idea that food security depends on people's entitlement to food, not just on whether food exists (Sen, 1983). This shifted the entire conversation from supply to access.

Building on this insight, the Food and Agriculture Organization of the United Nations (FAO) developed the definition of food security that is still used today, formally adopted at the 1996 World Food Summit: food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2008). This definition organizes food security around four pillars: Availability (is there enough food), Access (can people afford food), utilization (does the food they eat nourish them), and stability (is food security consistent over time, or does it collapse during droughts, floods, and economic crises).

More recently, scholars have argued that even four pillars are not enough. A fifth-dimension Agency has been added in some frameworks, recognizing that people and governments need the power to make meaningful decisions about their food systems, not just passively receive whatever food is available or accessible (FAO, 2020). For a comparative study of three very different countries like Pakistan, India, and Bangladesh, this evaluation in thinking matters a great deal, it means we need a framework that captures not just food quantities, but food system, policies, governance, and sustainability.

1.2. Levels of Food Security analysis

Food security can be studied at various levels like global, regional, national, community, household and individual. Each level tells a different part of the story. A country might produce more than food nationally, while millions of people in certain regions or social groups still go hungry. India is a striking example it regularly exports food grains and holds enormous government stocks, yet it ranks near the bottom of global hunger indices. This tells us that national level food availability, though important, does not automatically translate into food security for every citizen.

So why focus on the national level at all? Because national governments are once who set food policies, manage food reserves, regulate markets, and decide how much to import or export. National level analysis Is essential for understanding how these decisions shape the food security of an entire population over time (Clapp, 2017). It is also the level at which international comparisons are most meaningful and at which data is most consistently available across countries. For Pakistan, India and Bangladesh, three countries that share historical roots but have followed very different development paths, National level comparative analysis offers a uniquely valuable insight into what works and what does not.

The Sustainable Development Goal 2 (Zero Hunger) also frames food security explicitly at the national level, setting targets for government to achieve and report on. This makes national food security analysis not just academically interesting but policy relevant in most direct sense (United Nations, 2015).

1.3. National Food Security vs Food and Nutrition Security

One important distinction that has grown in importance over recent decades is the difference between food security which means having enough calories to eat and food and nutrition security which means having access to food that is nutritious and safe. A person can be calorically sufficient but still be malnutrition if their diet lacks iron, zinc, vitamin A or other micronutrients. This condition, sometimes called hidden hunger, is extremely common in South Asia (IFPRI, 2014).

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Pakistan, India and Bangladesh all have high rates of micronutrients deficiency even in populations that are not technically undernourished in caloric terms. India's nutrition paradox, high food production, high malnutrition it's one of the most discussed puzzles in development economics. Bangladesh has reduced hunger dramatically but still faces anemia and stunting. Pakistan diet quality especially in rural areas remains poor despite adequate grain supplies. These patterns suggest that for studying national food security in South Asia must go beyond calories and include dimensions of nutrition quality, dietary diversity and utilization which is precisely what the six-dimension model used in the study is designed to do.

2. Theoretical Perspectives and Analytical Frameworks

Over the years, researchers and policymakers have approached food security from a variety of theoretical perspectives. Each framework emphasizes a different dimension of the problem while inevitably overlooking others. Understanding these perspectives is important because they shape both the interpretation of food insecurity and the policy responses designed to address it. This section reviews the major theoretical approaches and discusses their strengths and limitations, particularly in relation to the dynamic, comparative, and national-level analysis undertaken in this study.

2.1. Classical and Neo-Malthusian Perspective

The oldest and perhaps most intuitive explanation of food insecurity is rooted in the Malthusian perspective, which argues that population growth tends to outpace food production, eventually leading to shortages and famine. Thomas Malthus first articulated this argument in 1798, and variations of his theory have reappeared repeatedly in debates on food security and resource scarcity (Malthus, 1798).

In the South Asian context, population pressure remains a significant concern. India, Pakistan, and Bangladesh together account for a population approaching 1.9 billion people, all dependent on a limited and increasingly constrained agricultural land base (FAO, 2023). Pakistan's annual population growth rate of approximately 2.4 percent is among the highest in Asia, placing continuous pressure on food production systems and natural resources (Pakistan Bureau of Statistics, 2023).

However, while the neo-Malthusian perspective is useful for understanding long-term resource constraints, it does not adequately explain why food insecurity can worsen dramatically within a single year due to floods, droughts, or price shocks. Nor can it explain why one country may achieve significant improvements in food security while a neighboring country with similar natural resource endowments does not. Dynamic comparative analysis therefore requires theoretical frameworks capable of capturing change over time and variation across countries, something that the Malthusian framework alone cannot provide.

2.2. Entitlement, Livelihoods, and Food Systems Approaches

A major shift in food security thinking came with Sen's entitlement approach, which redirected attention from food production to food access. As discussed earlier, Sen argued that people experience hunger not because food is unavailable, but because they lack the economic, social, or legal means to obtain it. This insight fundamentally transformed both the academic understanding of food insecurity and the design of food policy. The central proposition that people go hungry not because food does not exist, but because they cannot access it through income, social networks, or legal rights, remains as relevant today as when Sen first introduced it (Sen, 1983).

Building on Sen's work, the Sustainable Livelihoods Framework (SLF), developed during the 1990s by researchers at the Institute of Development Studies in Sussex, provided a broader understanding of food security. The framework conceptualizes food security as an outcome of the assets available to households and communities, including natural, physical, human, social, and financial capital, together with the context of vulnerability in which these assets are utilized (Chambers & Conway, 1991). SLF was particularly important because it situated food security within the broader context of livelihoods, recognizing that the ability to obtain food depends on overall economic and social conditions rather than on food markets alone.

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More recently, the food systems approach has gained increasing prominence. Rather than focusing narrowly on food production or market access, this framework examines the entire "farm-to-fork" chain, encompassing production, processing, distribution, retail, and consumption, as well as the environmental, economic, and social factors influencing each stage (HLPE, 2017). The food systems perspective is especially valuable in the era of globalization, where food networks are highly interconnected and disruptions in one part of the world, as demonstrated during the COVID-19 pandemic, can have significant implications for food security thousands of miles away.

2.3. Food Security in the SDG and Food Systems Discourse

The adoption of the Sustainable Development Goals (SDGs) in 2015, particularly SDG 2 (Zero Hunger), brought renewed international attention to food security. SDG 2 commits countries to ending hunger, achieving food security, improving nutrition, and promoting sustainable agriculture by 2030 (United Nations, 2015). The significance of this framework lies in its emphasis on sustainability, which introduces a long-term environmental dimension that was largely absent from earlier approaches. Food security is no longer viewed solely in terms of whether people have enough food today; it also depends on whether agricultural and ecological systems can continue to provide sufficient food in the future.

This sustainability perspective is highly relevant to Pakistan, India, and Bangladesh. Pakistan's groundwater tables are declining rapidly because of excessive irrigation; India's Green Revolution regions are experiencing severe soil degradation, while aquifers in Punjab are being depleted at unsustainable rates; and Bangladesh's coastal agricultural lands are increasingly threatened by salinity intrusion resulting from rising sea levels. These are not distant or hypothetical risks but measurable and immediate threats to long-term national food security capacity that must be incorporated into any serious analytical framework for the region (Immerzeel *et al*., 2010; Pingali, 2012; Kabir & Cramb, 2019). This is one of the principal reasons why the present study extends beyond the traditional four pillars of food security by incorporating sustainability as an additional analytical dimension.

2.4. Dynamic Perspectives on Food Security

One of the most important, yet often overlooked, characteristics of food security is that it is inherently dynamic. A country that appears food secure during a year of favorable rainfall may experience a severe food crisis during a drought. Similarly, a nation that achieves food self-sufficiency through technological advances such as the Green Revolution may see those gains erode over time if investment in agriculture declines. External shocks, including global commodity price spikes, pandemics, and political instability, can dramatically alter a country's food security status within a relatively short period.

The concept of food security dynamics refers to this temporal dimension and encompasses three key elements: long-term trends (is food security improving or deteriorating over time?), volatility (how much does food security fluctuate from year to year?), and structural breaks (are there sudden and persistent changes caused by major events such as the 2007-2008 global food price crisis or the COVID-19 pandemic?) (Barrett, 2010; Headey & Fan, 2010).

Most existing studies of food security in South Asia adopt a cross-sectional perspective, measuring food security at a single point in time and comparing countries accordingly. Relatively few studies have explicitly examined the dynamics of national food security over an extended period. Addressing this gap is one of the principal objectives of the present study, which employs time-series methods specifically designed to capture long-term trends, volatility, and structural changes over time.

2.5. Measurement of Food Security: Indicators and Composite Indices

Measuring a multidimensional concept such as food security is inherently challenging. Over the past several decades, researchers and international organizations have developed a wide range of indicators and composite indices, each capturing different aspects of the concept. Understanding the strengths and limitations of these measurement approaches is essential for justifying the methodological choices adopted in this study.

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Dimensions and Indicators of Food Security

Each of the four classical pillars of food security, availability, access, utilization, and stability, can be measured using a variety of indicators. Food availability is typically assessed through measures such as food production, crop yield per hectare, per capita caloric supply from food balance sheets, and the cereal import dependency ratio. Food access is commonly measured using indicators such as poverty rates, household food expenditure shares, food price indices, and market integration measures. Utilization is generally evaluated through nutritional outcomes, including rates of stunting, wasting, and anemia, as well as dietary diversity scores and access to clean water and sanitation. Stability is measured through year-to-year variability in production and caloric supply, cereal price volatility, and the frequency and severity of food supply shocks (Deitchler *et al*., 2010).

A major systematic review by Rafael Pella (2024) found that most food security measurement studies focus primarily on household-level indicators, particularly calorie intake and dietary diversity. In contrast, national-level indicators, especially those related to stability and utilization, remain relatively underdeveloped. This presents a significant challenge for comparative national-level analysis because much of the available data was not designed for the scale of analysis required by policymakers. The present study addresses this limitation by constructing a national-level composite index using indicators drawn from all six dimensions of its analytical framework.

Household-Level Measures

The most widely used food security measurement tools operate at the household level. The Household Food Insecurity Access Scale (HFIAS) and the Food Insecurity Experience Scale (FIES) are experience-based measures that ask respondents directly about their experiences of food insecurity, including whether they worried about having enough food, reduced meal sizes, or went to bed hungry (Arellano & Bond, 1991; Coates *et al*., 2007; Ballard *et al*., 2011; Ahmad *et al*., 2015). These instruments are highly effective for identifying vulnerable households and targeting social protection and safety-net programs.

However, household-level measures have important limitations when used for national-level comparative analysis. They are sensitive to differences in survey methodology, cultural interpretation of questions, and recall periods, making cross-country comparisons difficult. In addition, they require dedicated household surveys that are not conducted annually in all countries, creating significant gaps for time-series analysis. Most importantly, for the purposes of this study, household-level measures do not adequately capture the broader policy, governance, and structural dimensions of national food security, such as strategic food reserve management, trade policy effectiveness, and the long-term sustainability of food systems.

National-Level and Cross-Country Measures

For comparative national-level analysis, the most widely used composite indicator is the Global Food Security Index (GFSI), published annually by Economist Impact (formerly the Economist Intelligence Unit). The GFSI evaluates countries across four broad dimensions: affordability, availability, quality and safety, using a weighted combination of approximately 68 indicators drawn from international data sources (Economist Impact, 2022). The index currently covers more than 113 countries and facilitates direct cross-country comparison.

Another widely cited measure is the Global Hunger Index (GHI), published annually by Concern Worldwide and Welthungerhilfe. The GHI combines four indicators, undernourishment, child wasting, child stunting, and child mortality, into a composite score intended to capture multiple dimensions of hunger. Like GFSI, it provides a useful basis for international comparison and trend analysis.

Although both indices are valuable, they also have well-documented limitations. The GFSI employs a fixed weighting scheme that may not adequately reflect the varying importance of indicators across different country contexts, while its treatment of the stability dimension remains less developed than its affordability and availability components (FAO,2020). GHI, meanwhile, relies entirely on child and nutrition-related indicators, meaning that it captures food security largely through the lens of nutritional outcomes rather than

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overall national food system performance. Critically, neither index explicitly incorporates agency, defined as a government's capacity to formulate and implement autonomous food policies, or sustainability, referring to the long-term viability of agricultural systems, as formal analytical dimensions. Consequently, while the present study uses GHI scores for external validation, it develops an independent Food Security Index capable of capturing the full six-dimensional framework.

Methodologies for Constructing Composite Food Security Indices

Constructing a composite index such as a National Food Security Index requires a series of methodological decisions, each of which can significantly influence the results. The first major decision concerns normalization, that is, how to make indicators measured in different units, such as tons of wheat, percentages of population, or millimeters of rainfall, directly comparable. Two common methods are z-score normalization, which standardizes indicators around their mean values and standard deviations, and min-max normalization, which rescales indicators to a range between zero and one. Both methods have advantages: z-score normalization preserves the relative distribution of values across countries, whereas min-max normalization is often more intuitive for index construction (Nardo *et al*., 2005).

The second key methodological issue is weighing or determining the relative importance assigned to each indicator. The simplest approach is equal weighting, which assumes that all indicators contribute equally to food security. However, this assumption may not be justified when indicators differ substantially in relevance or data quality. More advanced approaches, such as Principal Component Analysis (PCA) and Factor Analysis, derive weights from the statistical structure of the data itself, assigning greater importance to indicators that explain a larger share of the variation in food security outcomes (Nicoletti *et al*., 2000).

A third methodological consideration concerns the treatment of time. Most existing composite food security indices are cross-sectional, providing only a snapshot of food security for a single year and offering little insight into how conditions evolve over time. The present study addresses this limitation by constructing a time-series composite index covering the period from 2000 to 2025. This approach enables the explicit analysis of long-term trends, volatility, and structural breaks, representing a methodological contribution that remains largely absent from the existing South Asian food security literature.

3. Econometric and Modelling Approaches to Food Security Dynamics

Constructing a composite food security index is only the first step in understanding national food security performance. To examine how food security evolves over time, identify its underlying drivers, and compare trajectories across countries, formal statistical and econometric techniques are required. This section reviews the principal modelling approaches used in the literature and explains why the combination of methods adopted in this study is particularly appropriate for addressing the research objectives.

3.1. Time Series and Panel Approaches

Time series econometric models are specifically designed to analyze changes in a variable over time and to estimate the relationships between that variable and its determinants across multiple periods. Among the most widely used approaches in economic research are the Autoregressive Distributed Lag (ARDL) model and its nonlinear extension, the Nonlinear Autoregressive Distributed Lag (NARDL) model. These techniques are frequently employed to investigate both short-run and long-run relationships between variables, such as the links between food prices and food security or between agricultural productivity and national food availability (Pesaran *et al*., 2001).

The ARDL framework is particularly suitable for the present study because it can accommodate variables with different orders of integration, allowing both stationary and non-stationary series to be analyzed within a unified framework. Moreover, it enables the simultaneous estimation of short-run dynamics and long-run equilibrium relationships, making it highly effective for analyzing the evolution of food security over time.

Vector Autoregression (VAR) and Structural Vector Autoregression (SVAR) models provide another important set of tools for studying dynamic interactions among multiple variables. For example, climate

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shock may reduce agricultural production, which in turn influences food prices and ultimately affects food access and availability. VAR and SVAR models are well suited to capturing these complex interdependencies because they allow multiple variables to interact simultaneously over time (Sims, 1980).

Closely related is the Vector Error Correction Model (VECM), which is designed to capture long-run equilibrium relationships among integrated variables while modelling short-run adjustments toward that equilibrium. VECM is therefore particularly valuable for analyzing structural changes and long-term trends in national food security across decades.

3.2. Volatility and Risk Modelling

One of the most important dimensions of food security, and one that conventional time series models often fail to capture adequately, is volatility. Food security is not only defined by its average level but also by the extent to which it fluctuates over time. Periods characterized by global commodity price spikes, climate shocks, or geopolitical disruptions often experience much greater instability than relatively stable periods. From a policy perspective, this distinction is critical because a country may exhibit an acceptable average level of food security while simultaneously facing severe year-to-year fluctuations that complicate planning and social protection efforts.

To model this changing variability, researchers increasingly employ Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models. Originally developed for financial market analysis, GARCH models have been widely adapted for studies of food price volatility and food security because they explicitly account for time-varying variance and the clustering of high-volatility periods (Engle, 1982; Bollerslev, 1986).

A recent study by Kousar *et al*. (2024) applied multivariate GARCH models to food security indices for South Asian countries and found significant evidence of volatility clustering and spillover effects among Pakistan, India, and Bangladesh. These findings highlight the importance of incorporating volatility-sensitive analytical techniques when studying regional food security dynamics. Building on this literature, the present study employs GARCH-type models to analyze the volatility dimension of national food security across the three countries during the post-globalization period.

3.3. Composite Indices with Advanced Weighting and Dynamic Properties

A growing body of literature integrates composite index construction with dynamic econometric analysis. Rather than treating food security indices as static measures, these studies construct multidimensional national food security indices and then apply time series methods to examine how they evolve over time, identify the factors driving those changes, and assess whether countries are converging toward or diverging from similar levels of food security.

This integrated methodological approach forms the foundation of the present study. By combining advanced index construction techniques with dynamic econometric modelling, the analysis moves beyond simple cross-sectional comparisons and provides a deeper understanding of long-term national food security trajectories and their underlying determinants.

3.4. Machine Learning and Systems Approaches

In recent years, machine learning techniques have increasingly been applied to food security analysis. Methods such as Random Forests, XGBoost, and Neural Networks have been used to predict the onset of food crises, classify levels of food insecurity within early warning systems, and identify the most influential drivers of food insecurity from large and multidimensional datasets (Martini *et al*., 2022). These approaches are especially valuable for predictive tasks where the number of potential explanatory variables is large and the relationships among them are highly nonlinear.

However, machine learning methods are less well suited to the primary objectives of the present study, which include constructing a theoretically grounded composite index, analyzing long-run trends and dynamics, and

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generating policy-relevant comparative insights. The principal strength of machine learning lies in prediction rather than causal explanation or structural interpretation.

For this reason, the study relies primarily on a classical econometric framework that combines PCA-based weighted index construction, ARDL/VECM time series modelling, and GARCH volatility analysis. This methodological combination is better aligned with the objective of producing transparent, interpretable, and policy-relevant findings for a comparative assessment of national food security across Pakistan, India, and Bangladesh.

4. Food Security in South Asia: Regional Evidence

South Asia presents a unique and complex food security challenge. Despite possessing enormous agricultural potential, fertile river deltas, extensive irrigation systems, and a highly experienced farming population, the region continues to host some of the largest food-insecure populations in the world. Understanding this regional context is essential for interpreting the country-specific findings of the present study and for placing national food security trends within a broader comparative framework.

4.1. Structural Drivers of Food Insecurity in South Asia

Several structural characteristics of South Asia's geography, demography, and economic development have shaped the food security outcomes of Pakistan, India, and Bangladesh. Population pressure remains one of the most significant factors. With a combined population approaching 1.9 billion and among the highest population densities globally, the region has very limited scope for expanding agricultural land. Consequently, food security must increasingly be achieved through improvements in productivity and yield intensification on existing farmland (FAO, 2023). This reality places immense pressure on irrigation infrastructure, soil quality, and water resources, challenges that are becoming even more acute under climate change.

Dependence on irrigation is another major structural vulnerability. Pakistan's agricultural production relies almost entirely on the Indus River irrigation system, the largest contiguous irrigation network in the world. Any disruption to this system, whether caused by upstream water disputes with India, glacial retreat, or failures in canal infrastructure, can have immediate and severe consequences for national food production (Qureshi *et al*., 2009). Similarly, India's Green Revolution heartland in Punjab and Haryana depends heavily on groundwater irrigation, where aquifer levels are declining at alarming rates. In Bangladesh, Boro rice cultivation, which accounts for more than half of annual rice production, depends largely on tube-well irrigation, making it highly sensitive to both the quality and availability of groundwater resources.

At the regional level, several institutional efforts have sought to strengthen collective food security mechanisms. The SAARC Food Bank, established in 2007, was intended to provide a shared regional food reserve that member countries could access during emergencies. In practice, however, the initiative has remained largely ineffective due to persistent political tensions, particularly between Pakistan and India, which have hindered meaningful activation and cooperation. Likewise, the South Asia Food and Nutrition Security Initiative (SAFANSI), supported by the World Bank, has promoted regional research collaboration and policy dialogue but has had only limited operational impact. Moreover, South Asia remains one of the least economically integrated regions in the world. High trade barriers restrict the movement of food commodities across borders, preventing surpluses in one country from efficiently addressing shortages in another.

4.2. Climate Change, Shocks, and Vulnerability

Climate change has already emerged as one of the most influential drivers of food security dynamics in South Asia, and its impacts are expected to intensify significantly over the coming decades. All three countries examined in this study face serious but distinct climate-related risks.

Pakistan is perhaps the most acutely vulnerable. It ranks among the ten countries most affected by climate-related disasters globally, and the catastrophic floods of 2010 and 2022, which submerged approximately

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one-fifth and one-third of the country, respectively, caused billions of dollars in agricultural losses and displaced millions of farming households (National Disaster Management Authority (NDMA), 2022).

India faces increasing risks from heat stress affecting wheat and rice production, increasingly erratic monsoon patterns, and the accelerating retreat of Himalayan glaciers that supply water to the river systems upon which northern Indian agriculture depends (Lobell *et al*., 2011; Kumar *et al*., 2014; Lentz *et al*., 2021). Bangladesh, meanwhile, is highly vulnerable to cyclone intensification, seasonal flooding, and the gradual inundation of coastal farmland due to rising sea levels. Some estimates suggest that up to 17 percent of Bangladesh's land area could be permanently flooded by 2050 (Intergovernmental Panel on Climate Change (IPCC), 2022).

Importantly, climate shocks do not occur in isolation. They interact with pre-existing economic and structural vulnerabilities and can create long-lasting disruptions to national food security trajectories. The 2022 floods in Pakistan, for example, not only reduced agricultural output during that year but also damaged irrigation infrastructure, depleted household savings and productive assets, and triggered a surge in food price inflation that continued through 2023 and 2024. Understanding the interaction between climate shocks and food security dynamics, particularly how these shocks influence both the level and volatility of food security, forms a central component of the econometric analysis undertaken in this study.

4.3. Regional Policy Responses and Cooperation

Despite the common nature of many food security challenges across South Asia, regional policy cooperation has remained limited. Most food security strategies continue to be designed and implemented at the national level, with relatively little cross-border coordination or institutional collaboration.

A notable example is India's unilateral decision to impose wheat export bans during the 2007–2008 food price crisis and again in 2022. These measures had immediate adverse effects on neighboring countries, particularly Pakistan and Bangladesh, both of which were seeking wheat imports during these periods. However, no effective regional mechanism existed to coordinate policy responses or mitigate the resulting supply disruptions (Mitra & Josling, 2009).

The limited degree of regional cooperation represents not only a practical policy challenge but also an important gap in academic literature. Very few studies have examined the food security dynamics of Pakistan, India, and Bangladesh simultaneously within a unified analytical framework capable of generating coordinated regional policy insights. Most comparative research focuses either on pairs of countries or relies on highly aggregated South Asian averages that conceal important national differences.

The present study contributes directly to addressing this gap by conducting a rigorous, parallel, and methodologically consistent comparative analysis of all three countries. By employing a common conceptual framework and harmonized time-series data, the study seeks to generate evidence that can inform both national and regional food security policymaking.

5. Country-Specific Literature: Pakistan, India, and Bangladesh

Each of the three countries examined in this study has followed a distinct food security trajectory shaped by its unique geography, political economy, agricultural resource base, and policy choices. This section reviews the country-specific literature on Pakistan, India, and Bangladesh, focusing on their food security experiences, institutional responses, key determinants, and emerging challenges. The discussion provides the contextual foundation for the comparative analysis presented in subsequent chapters.

5.1. National Food Security in Pakistan

Pakistan's food security experience can largely be described as a story of unrealized agricultural potential. The country possesses one of the world's largest contiguous river-based irrigation systems, fertile agricultural plains in Punjab and Sindh, and a substantial rural labor force. It was also among the earliest adopters of Green Revolution technologies during the 1960s, achieving near self-sufficiency in staple food production by the early 1970s. Despite these advantages, however, Pakistan continues to face persistent food

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security challenges. According to the 2023 Global Hunger Index (GHI), the country ranked 102nd out of 125 countries, with its food system increasingly strained by water scarcity, macroeconomic instability, and recurrent climate-related shocks.

Pakistan's food security policy has historically been shaped by the need to balance two competing objectives: maintaining affordable food prices for urban consumers while ensuring sufficiently attractive producer prices to encourage agricultural production. This balance has largely been managed through government procurement of wheat at support prices, strategic storage in public warehouses, and distribution through subsidized channels (Dorosh & Salam, 2008). Since the adoption of the 18th Constitutional Amendment in 2010, responsibility for agriculture and food security has shifted from the federal government to the provincial governments. While this devolution has created opportunities for provincial innovation and localized policy responses, it has also introduced new challenges for national food security governance.

Empirical evidence suggests that Pakistan's food security is highly sensitive to fluctuations in domestic wheat prices, agricultural terms of trade, rural poverty, and climatic variability. The devastating floods of 2022, which affected crops over more than 3.5 million hectares, highlighted the vulnerability of the country's food system by disrupting agricultural production, damaging infrastructure, and exacerbating food price inflation. Although the literature on Pakistan's food security is extensive, it remains fragmented. Few studies have systematically examined long-term national food security trends using consistent methodologies, and none have conducted such an analysis within a rigorous comparative framework alongside India and Bangladesh.

5.2. National Food Security in India

India's food security experience is characterized by a notable paradox. The country is one of the world's largest producers and exporters of cereals, maintains the largest publicly managed grain stock system globally, and routinely exports millions of tons of food grains. Yet, despite these achievements, India continues to face serious hunger and malnutrition challenges. The 2023 Global Hunger Index ranked India 111th out of 125 countries, and the FAO estimates that more than 195 million people remain undernourished (FAO, 202).

India has developed the most comprehensive food security policy architecture in South Asia. The enactment of the National Food Security Act (NFSA) in 2013 established a legal entitlement to subsidized food grains for approximately 800 million people through the Targeted Public Distribution System (TPDS), administered by the Food Corporation of India (FCI). Under this system, wheat and rice are procured from farmers at government-declared minimum support prices and distributed to eligible households at highly subsidized rates. The effectiveness of this model has generated extensive scholarly debate. Proponents argue that it has prevented widespread food deprivation and strengthened state accountability for food provision, whereas critics highlight significant leakages, substantial fiscal costs, and limited nutritional outcomes relative to public expenditure (Gulati *et al*., 2020).

The dynamics of India's food security since 2000 have been influenced by three interrelated factors: long-term trends in agricultural productivity, climate-induced production variability, and the policy environment encompassing export controls, input subsidies, and the TPDS. Time-series studies indicate that while national food availability has remained relatively stable at high levels, the access and utilization dimensions of food security continue to exhibit significant spatial disparities and temporal volatility (Kumar *et al*., 2014; Pingali *et al*., 2019).

5.3. National Food Security in Bangladesh

Bangladesh's food security trajectory represents one of the most remarkable development successes of the past half century. At independence in 1971, the country emerged from a devastating liberation war with a severely damaged economy, widespread food shortages, and an agricultural sector in disarray. Frequently characterized at the time as a "basket case," Bangladesh appeared to have limited prospects for achieving food self-sufficiency. However, by the early 2000s the country had attained self-sufficiency in rice

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production, and by 2023 it ranked 81st in the Global Hunger Index with a "moderate" hunger score, outperforming its South Asian neighbors.

This transformation has been driven largely by sustained investments in agricultural research and technological innovation, particularly through the development and widespread adoption of high-yielding rice varieties by the Bangladesh Rice Research Institute (BRRI) and the International Rice Research Institute (IRRI). The expansion of Boro (winter irrigated) rice cultivation effectively introduced a third annual rice crop, substantially increasing national production. Furthermore, the development of flood-tolerant rice varieties through collaboration with IRRI significantly reduced crop losses associated with seasonal flooding (Mackill *et al*., 2012).

Despite these achievements, Bangladesh's food system remains exposed to several structural vulnerabilities. The country relies heavily on wheat imports, making its food access dimension particularly sensitive to global commodity price fluctuations and supply chain disruptions. The Russia-Ukraine conflict in 2022, for example, disrupted international wheat markets, increased import costs, and contributed to substantial domestic food price inflation. In the longer term, climate change poses perhaps the greatest challenge to Bangladesh's food security. Rising sea levels, increased cyclone intensity, and the progressive salinization of coastal agricultural land threaten to undermine the country's hard-earned gains in agricultural productivity and food self-sufficiency.

5.4. Comparative Insights across Pakistan, India, and Bangladesh

Comparative studies examining food security across Pakistan, India, and Bangladesh remain surprisingly limited, despite the countries shared historical, geographical, and developmental characteristics. Most existing comparative analyses focus on pairs of countries, commonly India and Bangladesh or India and Pakistan, while broader South Asian studies often rely on highly aggregated regional averages that obscure important country-level differences. The relatively few studies that examine all three countries together are generally descriptive, presenting side-by-side statistics without employing a formal analytical or econometric framework to assess differences in food security dynamics.

A recent contribution by Kousar *et al*. (2024) represents an important exception. Using a multivariate GARCH framework, the study explicitly compares food security volatility across South Asian countries. However, its focus is limited to volatility, and the analysis covers only a relatively short time horizon. To date, no study has developed a multidimensional national food security index for Pakistan, India, and Bangladesh simultaneously, tracked its evolution over the entire post-2000 period, analyzed its determinants using panel econometric techniques, and benchmarked the results against Global Hunger Index (GHI) scores. Addressing this gap constitutes one of the principal contributions of the present study.

The available comparative literature nevertheless reveals several common patterns. Since 2000, all three countries have improved the availability dimension of food security, largely driven by gains in agricultural productivity, although the pace of improvement has been slower in Pakistan and India than in Bangladesh. Progress in food access has been more uneven. Bangladesh has achieved faster reductions in poverty and greater improvements in access to food, whereas Pakistan continues to face persistent challenges, particularly in rural areas and among female-headed households. With respect to stability, all three countries have become increasingly vulnerable to external food price shocks and climate-related production volatility during the post-globalization period (FAO, 2023). These shared trends, coupled with important structural differences, underscore the value of adopting a common analytical framework for comparative assessment and policy learning across the three countries.

6. Identified Research Gaps

The preceding review of the literature reveals a clear pattern: although there is a substantial body of research on food security in South Asia, several important conceptual, methodological, and policy-related gaps remain. Existing studies have generated valuable insights into specific dimensions of food security, yet they often address these dimensions in isolation and lack an integrated comparative perspective. This section

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synthesizes these shortcomings and identifies three interconnected research gaps that the present study is designed to address.

6.1. Gaps in Measurement and Index Construction

The first major gap concerns the measurement of national food security. As discussed throughout this chapter, the existing literature is dominated by household-level assessment tools, such as the Household Food Insecurity Access Scale (HFIAS), the Food Insecurity Experience Scale (FIES), and dietary diversity indicators. While these instruments are highly effective for assessing household vulnerability, they are not designed for national-level comparative analysis.

At the national level, the two most widely used composite measures are the Global Food Security Index (GFSI) and the Global Hunger Index (GHI). However, both indices have important limitations. The GFSI relies on predetermined and largely subjective weighting schemes, while the GHI focuses primarily on child nutritional outcomes rather than overall national food system performance. Moreover, neither index explicitly incorporates agency defined as the capacity of governments to pursue autonomous and effective food policies or sustainability, which reflects the long-term viability of agricultural and food systems.

For Pakistan, India, and Bangladesh, no existing study has developed a methodologically rigorous national food security index covering the full period from 2000 to 2025 using statistically derived weighting techniques, such as Principal Component Analysis (PCA) or entropy methods, within a comprehensive six-dimensional framework encompassing availability, access, utilization, stability, agency, and sustainability. This methodological gap has important practical implications. Without such a tool, policymakers lack a robust mechanism to monitor changes in national food security over time, identify strengths and weaknesses across different dimensions, and benchmark national performance against comparable countries using a consistent analytical framework.

6.2. Gaps in Dynamic and Comparative Analysis

The second major gap relates to the dynamic and comparative analysis of food security. Much of the existing South Asian literature adopts a cross-sectional approach, examining food security at a single point in time or comparing countries using static indicators. Such studies rarely investigate how food security evolves over time, what factors drive these changes, or whether the trajectories of Pakistan, India, and Bangladesh are converging or diverging.

The post-2000 period, referred to in this study as the post-globalization era, has been characterized by profound structural transformations affecting regional food systems. These include the completion of trade liberalization processes, the global food price crises of 2007–2008 and 2010–2011, the COVID-19 pandemic (2020–2022) and its aftermath, the Russia–Ukraine conflict beginning in 2022, and the accelerating impacts of climate change. Collectively, these events have generated structural breaks and heightened volatility in food security trends that cannot be adequately captured using conventional cross-sectional methods.

Addressing these dynamics requires the application of advanced time-series and panel econometric techniques, including ARDL/NARDL, VECM, and GARCH models, which can analyze long-run relationships, short-run adjustments, and volatility patterns. However, these approaches have been employed in only a limited number of South Asian food security studies and, to date, have not been applied comprehensively across Pakistan, India, and Bangladesh within a unified comparative framework.

6.3. Gaps in Policy-Oriented Comparative Research

The third major gap exists at the policy level. Even where rigorous empirical analyses of national food security are available, they are generally country-specific and do not readily translate into comparative policy lessons. Consequently, policymakers have limited evidence to guide cross-country learning. For example, a policymaker in Bangladesh seeking to understand the implications of Pakistan's wheat reserve management system, or the trade-offs associated with India's Public Distribution System, has relatively little systematic and comparable empirical evidence on which to draw.

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This limitation is significant because many of the most effective food security interventions emerge through the adaptation of successful policies and institutional arrangements from comparable contexts. The absence of a common analytical framework for evaluating food security performance across Pakistan, India, and Bangladesh means that cross-country policy learning remains largely informal and unsystematic.

The present study addresses this gap by employing a unified conceptual framework, a consistent multidimensional food security index, and harmonized time-series datasets across all three countries. By combining rigorous comparative analysis with policy-oriented interpretation, the study aims to generate evidence that not only advances academic understanding but also supports informed, evidence-based policymaking and regional learning in South Asia.

7. Conclusion

The literature reviewed in this chapter demonstrates that food security has evolved from a narrow concern with aggregate food production to a multidimensional concept encompassing access, utilization, stability, agency, and sustainability. Contemporary scholarship increasingly recognizes that ensuring food security requires not only sufficient food supplies but also resilient institutions, effective governance, inclusive policies, and environmentally sustainable production systems.

A key insight emerging from the review is that food security is inherently dynamic. It changes over time in response to demographic pressures, market fluctuations, climate variability, technological change, and policy interventions. Events such as the global food price crisis, the COVID-19 pandemic, and recent climate-related disasters have highlighted the vulnerability of national food systems and the need for analytical frameworks capable of capturing long-term trends as well as short-term disruptions.

The review also reveals an important imbalance in existing literature. Much of the available research remains focused on household-level indicators and cross-sectional assessments, while comparatively little attention has been devoted to the long-run evolution of national food security or to systematic comparisons across countries. For South Asia in particular, studies that examine Pakistan, India, and Bangladesh within a common conceptual and methodological framework are limited, despite the shared historical, geographical, and developmental characteristics of these countries.

Another significant finding is the inadequacy of existing national food security measures for capturing the full complexity of modern food systems. Widely used indices such as the Global Food Security Index and the Global Hunger Index provide valuable benchmarks but do not fully account for dimensions such as institutional capacity, policy autonomy, and environmental sustainability. Similarly, while recent advances in econometric modelling and machine learning have expanded the analytical toolkit available to researchers, there remains a need for approaches that combine rigorous statistical analysis with clear policy relevance and interpretability.

The evidence from Pakistan, India, and Bangladesh further illustrates that improvements in food availability alone are insufficient to guarantee broader food and nutrition security. Persistent challenges related to poverty, dietary quality, climate vulnerability, water scarcity, and governance continue to shape national outcomes. At the same time, differences in policy choices and institutional arrangements across the three countries offer valuable opportunities for comparative learning and regional cooperation.

Overall, the literature points to the need for an integrated, multidimensional, and longitudinal approach to national food security analysis. Such an approach should combine diverse indicators into a comprehensive framework, account for temporal dynamics and structural change, and facilitate meaningful cross-country comparison. By addressing these gaps, future research can generate stronger empirical evidence to support resilient, inclusive, and sustainable food security policies across South Asia and contribute to the broader objective of achieving Zero Hunger under the Sustainable Development Goals.

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