

Measuring Food Security in Pakistan: A Multidimensional Index Approach

Haleema Sadia^{1,*}, Safia Bibi², Jawad Ahmad Azeez¹

Affiliations

1. School of Economics,
International Islamic
University, Islamabad
2. Independent Researcher

*Corresponding Author Email:
haleema.sadia@iiu.edu.pk

Timeline

Received: Jan 26, 2026

Revised: Mar 21, 2026

Accepted: Mar 21, 2026

Published: Mar 22, 2026

DOI

<https://doi.org/10.55603/jes.v5i1.a2>



Abstract

Food security is a key element of the self-sufficiency of agricultural countries. This paper constructs various dimensional and a composite multidimensional annual food security index for Pakistan from 1980 to 2023. Food security is not a simple phenomenon. This study considered a multidimensional framework to accurately capture its complex nature. The authors used Principal Component Analysis to develop food security indices for Pakistan. The composite index comprises four dimensions. These are food availability, access, utilization, and stability. The study took 6 indicators for food availability, 3 for food access, 1 for food utilization, and 4 for food stability over the period 1980-2023. The authors extracted data from World Development Indicators and the Food and Agriculture Organization database for the first three dimensions. The stability indicators are constructed by the authors. The dimensional index of food availability exhibits modest progress. The food access index has improved over the years, yet food utilization has not. This caused severe malnutrition and low dietary diversity. Natural disasters, economic shocks, and overreliance on food imports have destabilized the food supply and exacerbated food insecurity. Overall, food insecurity is still a pervasive issue in the country. The authors conducted a robustness analysis to develop dimensional and composite food security indices using factor analysis. The results confirm robustness to the aggregation technique. The authors suggest that agricultural investments and initiatives to build resilience to climate shocks may help to address food insecurity. Moreover, the government may implement targeted food subsidy programs for low-income households to address deeply rooted food insecurity, thereby helping to achieve SDGs 2 and 3. The non-availability of longitudinal data on various indicators of food utilization confined the analysis to only one indicator.

Keywords: Food security, Food availability, Food access, Food utilization, Food stability, Principal Component Analysis, Factor Analysis

JEL Classification: Q18, O13, I32

1. Introduction

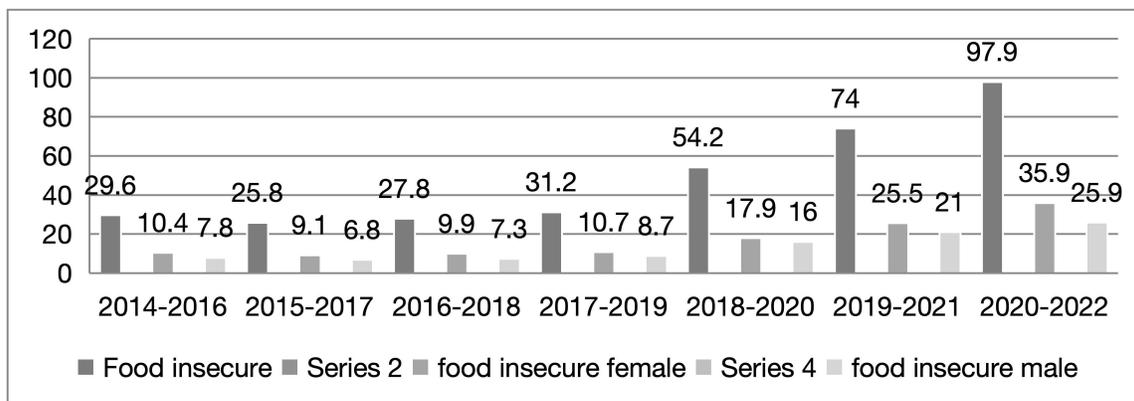
South Asia is an agriculturally important region. It supports the livelihood and food of millions of individuals. Despite the small farmland that comprises 5 percent of the world's total land, the region produces enough to cater to over 20 percent of the world's population. Approximately one-third of the world's poor reside in South Asia, and the majority rely on the rural farming sector (Hanjra & Qureshi, 2010). Before the COVID-19 pandemic, approximately 649 million people in South Asia faced food insecurity (FIN), and 271 million were severely affected (Citaristi, 2022). Pakistan, the fifth most populous country in the world, also faced the issue of FIN despite being an agricultural economy. The growing population, water shortages, climate change, inadequate use of technology, and disruptions in energy supply have exacerbated FIN in Pakistan (Khurshid & Abid, 2024).

The concept of food security (FS) can be traced to the period after World War II, when the United Nations established the Food and Agriculture Organization (FAO) in 1945. FAO is expected to enhance the situation with FS, poverty, hunger, and, hence, sustainable development. Early FS remained an imprecise concept, referring to the ready availability of food to address hunger and deprivation. The problem of FS was brought to the forefront during the 1970s food crisis, when global food prices rose, thereby reducing food

accessibility. The entitlement approach, according to Sen (1981), holds that famines are not only a matter of fear of food supply or availability, but also of failure to access food. In turn, FAO (1996) formalized the notion of FS to include the availability of adequate, harmless, and nutritious food for all. Therefore, the general definition comprises four dimensions, which are food availability, access, use, and stability. FS, hence, becomes a complex problem not only related to production, but also consumption, distribution, and affordability (FAO, 2002; Shaw, 2007).

The Figure 1 shows the average FIN status in the last 10 years in Pakistan. It presents gender-wise figures in millions and reveals that FIN has worsened in Pakistan

Figure 1: State of Food Security in Pakistan



Source: Author's construction

The figure unveils that women are more food insecure than men. The difference between the total food-insecure population and the sum of gender-specific FIN reflects transgender population. Rising FIN in Pakistan has led to increased food prices and an erosion of society's purchasing power. This ultimately led to more people falling below the poverty line, as evidenced by the latest Global Hunger Index (GHI), which ranked the country 109th out of 127 countries in 2024. Moreover, the hunger score in the same year was 27.1, indicating a serious hunger problem and severe FIN (Welthungerhilfe & Concern Worldwide, 2024). Thus, the country is far from achieving the goal of zero hunger (SDG 2) by 2030. Poverty further contributes to malnutrition, despite individuals spending a substantial share of their income on food (Nelson et al., 2018). Thus, the country also compromised on the goal of good health and well-being (SDG 3). Thus, poverty, malnutrition, and poor health outcomes tend to contribute to FIN in the country.

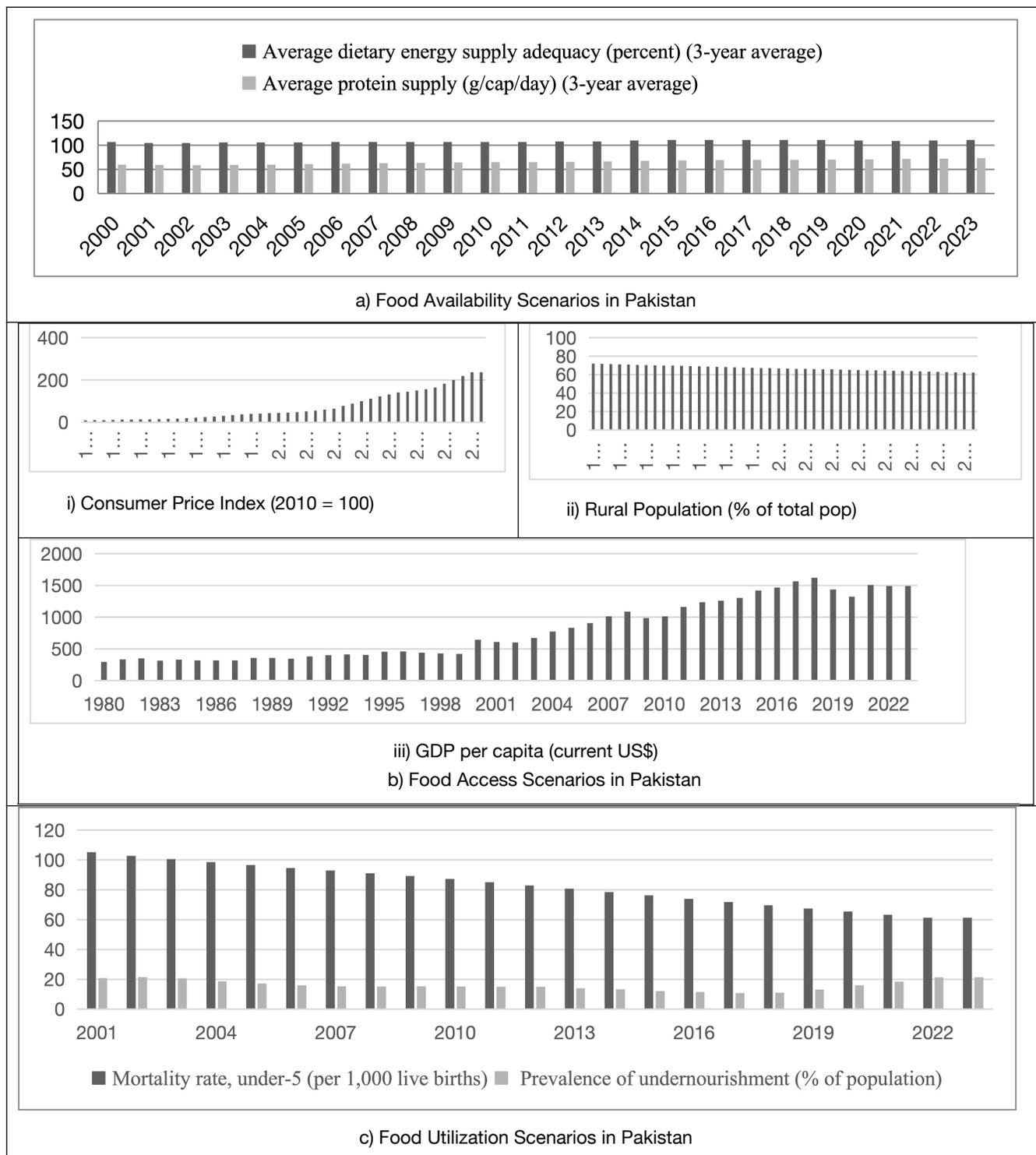
Figure 2 plots the four dimensions of FS in Pakistan. These are food availability (*FAV*), access (*FAC*), utilization (*FUT*), and stability (*FST*). A steady supply of energy and protein in the country has improved *FAV* over time (Henchion et al., 2017). However, substantial regional disparities still exist (Ahmed et al., 2023). *FAC* is declining partly due to rising food prices and/or poverty. Low income and inflation erode purchasing power, making it difficult to afford sufficient food and maintain a healthy life. *FUT* has improved due to better healthcare and low child mortality. However, a substantial degree of undernourishment remains (Nadem et al., 2024; Headey & Ruel, 2023). The final dimension of FS is *FST*. It worsened with excessive volatility in food production, climate change, and dependence on imports (Rahman et al., 2021b). Altogether, FIN is a pressing concern in the country, which requires long-term solutions, better policies, and innovative agricultural methods to assist low-income farmers.

The individual dimensions do not represent the state of FS in the country. This study adds to the existing literature, which relies on a single dimension to gauge the state of FIN in the country. It aims to develop a multi-dimensional index of food security (FSI) for Pakistan. It allows a more rigorous evaluation of the causes of FS and optimal policy interventions. It may also serve as a significant barometer for evaluating country's progress in meeting SDG 2 and SDG 3. In line with FAO methodology, this study provides a comprehensive assessment of FIN at the country level for the longitudinal data. Our study is a refinement of the assessment FIN by

Measuring Food Security in Pakistan: A Multidimensional Index Approach

considering multiple dimensions that provide a clearer picture than GHIs, which rely solely on food accessibility and ignore other dimensions of FIN. Further, the study helps the Ministry of National Food Security and Research by proposing an immediate action plan to enhance the FS vital to reducing poverty.

Figure 2: Dimensions of Food Security in Pakistan



Source: Author's Construction

2. Literature Review

The FS literature is quite varied in the countries covered, the indicators considered, and the methods used. Some of the authors analyzed the condition of FS on provincial and district levels. For instance, Hussain and Routray (2012) reported that most of the food supply comes from Punjab and Sindh, whereas the NWFP faces a severe FIN issue. Food producers are experiencing shortages due to non-delivery, illegal trade, low producers' income, and natural disasters. Rahman et al. (2021a) also reported differences in FS between different provinces in Pakistan. According to Qadir et al. (2022), nutrition and food security have dropped, particularly for non-farming families. Nevertheless, they did not see a substantial improvement in the availability and access. The study by Safdar et al. (2023) evaluated FS in the Nowshera district in Pakistan. The authors exploited primary data for four dimensions: financial access, physical access, utilization, and sustainability. They found a high level of intra-district variation. Tehsil Jangeera and Pabbi are the most food-insecure rural locations.

A pioneering body of literature considered the single-dimensional evaluation of FS. For instance, Bashir et al. (2007) reported that food deprivation arises from the prevalence of FIN among low-income earners in Pakistan. Webb et al. (2006) also looked at the access dimension of FS at the household level. The authors collected qualitative data and discovered that vulnerable households are highly FIN. The World Food Programme (2008) introduced the Food Consumption Score (FCS) as a measure of FUT. These scores assign a weight to each food group based on its nutritional value. These scores may help rank low, borderline, or acceptable food-consumption patterns in households. The findings revealed that FCS is an effective tool for evaluating FS. Likewise, Ibok et al. (2019) examined the stability dimension of FS at the household level in Nigeria. The authors argued that custom indicators often overlook important risks and household responses to food-based shocks. Likewise, Khan and Yanxia (2023) evaluated FIN at the provincial level in Pakistan using the FCS, Minimum dietary energy needs, and FIN access scales. They argued that assessing the broader issue of FIN through a single factor may lead to misleading conclusions.

Some researchers gauged FIN through global and national-level hunger indices (HIs). In this connection, Wiesmann (2006) constructed cross-country HI to monitor time-varying hunger and ranked countries by hunger level. The global HIs combine three indicators, namely, the proportion of the undernourished population, the proportion of underweight children, and the child mortality rate. The findings affirmed a high prevalence of hunger, especially in South Asia and Sub-Saharan Africa. Deitchler et al. (2011) used the Household Hunger Scale (HHS) to study food accessibility across various cultural contexts. The research divided the sampled countries into three categories, namely little to no hunger, moderate hunger, and severe hunger. The authors conclude that HHS provides a precise and user-friendly assessment of FS.

A recent strand acknowledged the complexity of the FIN problem by relying on multi-dimensional framework. This strand argued that a single dimension doesn't fairly assess the state of FS. In this context, Pangaribowo et al. (2013) reviewed different indicators of food and nutrition security (FNS) to monitor the short- and long-term outcomes related to food access, availability, and nutrition. They relied on four indicators, namely, dietary diversity, household food access scores, calorie intake, and child growth. The results showed that there is no general indicator of FNS. Similarly, Singh and Chattopadhyay (2025) constructed a six-dimensional FSI for aged adults in India. They concluded that states that perform well on the FSI have low rates of malnutrition. Their research identified regional differences and suggested specific nutrition interventions.

The literature review indicates that FAC is a far more significant impediment to FS than FAV. Therefore, the condition of FIN in Pakistan can be better evaluated by employing a multi-dimensional approach to FS. This research aims to build four-dimensional indices and a composite FSI for Pakistan. The constructed index would help to evaluate the state of FIN and accordingly design policies that can solve the problem of FIN.

3. Methods and Materials

The theoretical basis for constructing multidimensional FSI relied on different viewpoints. First is *the Neo-Malthusian Theory* proposed by Malthus (1798). It claimed that uncontrolled population growth and limited

Measuring Food Security in Pakistan: A Multidimensional Index Approach

availability of natural resources contribute to environmental damage and, hence, intensify FIN. Second, *the entitlement approach*, attributed to Sen (1981), holds that the FIN problem arises from poverty, unemployment, and social inequality rather than merely a supply-side concern. This demand approach highlights the role of purchasing power and social entitlement in influencing the household FS. Third, Maxwell (1992) argued that the FS paradigm accounts for economic, social, and institutional factors that influence access to adequate food.

Moreover, producing sufficient food may not ensure its affordability, availability, and acceptance by all groups in society. These theoretical foundations help us build dimensional and an overall FSI of Pakistan. The dimensional indices of FS are FAV, FAC, FUT, and FST. FAV denotes food availability through local production, imports, reserves, and/or food aid. High crop yields, arable land area, and cereal production enhance FS (World Food Program, 2009). According to FAO (1996), FAC refers to physical, economic, and social access to food. Factors contributing to FAC are income level, inflation, GDP per capita, and rural development. FUT is the nutritional value and food safety. This relies on access to clean water, good sanitation, and food-handling skills (FAO, 1996; Ehuwa et al., 2021). Finally, FST indicates the sustainability of the food system in terms of the availability, access, and catering to food demand in a particular period.

3.1 Data and Econometric Procedure

The study initially considered a broad list of indicators to capture the dimensions of FIN. However, limited data availability prior to 2000 constrained the analysis to 14 FS indicators across four dimensions. The dataset spans from 1980 to 2023. Table 1 reports components of FS, their measurements, and data sources.

Table 1: Measurement and Data Sources for Food Security Index

Dimensions of FS	Components	Measurement/Description	Data Sources
Food Availability (FAV)	Arable Land (AL)	Land suitable for growing crops, measured in terms of hectares per person	WDI, WB
	Cereal Yield (CY)	Amount of cereal crop produced, measured in KG per capita. A barometer of agricultural productivity.	WDI, WB
	Permanent Cropland (PC)	Land for cropping that does not require replantation after every harvest, measured as % of land area	WDI, WB
	Food Production Index (FPI)	It tracks the volume of agricultural food production, measured in terms of 2014-2016 = 100.	WDI, WB
	Cereal production (CP)	Quantity of cereal crops harvested, measured in terms of (kg per capita)	WDI, WB
	Land under cereal production (LCP)	It refers to the harvested area measured in terms of hectares per person. Cereals include wheat, rice, maize, barley, etc.	WDI, WB
Food Access (FAC)	Consumer Price Index (CPI)	It tracks consumers' average costs.	WDI, WB
	Gross Domestic Product (GDP)	GDP per capita (current US\$)	WDI, WB
	Rural Population (RP)	Rural Population as % of total population	FAO
¹ Food Utilization (FUT)	Mortality Rate (MR)	Under-5 (per 1,000) mortality rate	WDI, WB

¹ Initially, we planned to use two sub-indices to construct FUT, but data for one of the indices—prevalence of undernourishment (% of the population)—was unavailable before 2000. These forced us to skip this dimension and consider only one dimension in FUT.

Food Stability (FST)	Variability of food production index	Variability is computed over a five-year reference period through standard deviation.	The author's construction
	Variability of the consumer price index		
	Variability of area harvested		
	Import Dependency Ratio	Proportion of food imports relative to domestic supply, measured as a percent of the 3-year average	The author's construction

In the second stage, each dimensional index obtained is normalized before developing the composite index. A composite FSI index for Pakistan is obtained via PCA by combining the normalized sub-indices of each dimension. Finally, the computed FSI is normalized again to assign a common scale that makes it more interpretable. For robustness, the study also develops dimensional indices and a composite FSI using two-stage *Factor Analysis (FA)*.

4. Results and Discussion

The study uses a two-stage PCA and FA to measure FS in Pakistan from 1980 to 2023. The study accounts for four dimensions of FS: FAV, FAC, FUT, and FST. Table A1 in the appendix presents the PCA and FA results for three sub-dimensions of FS. Columns (2) to (4) document results for PCA, whereas columns (5) to (7) report results for FA. The authors construct the *FAV* index using the first two principal components and the first two principal factors having eigenvalues greater than one. Arable land per person, representing the first component, alone explains 68.99% of the total variance under PCA and FA. This suggests its importance in determining FAV. These findings are consistent with Foley et al. (2011).

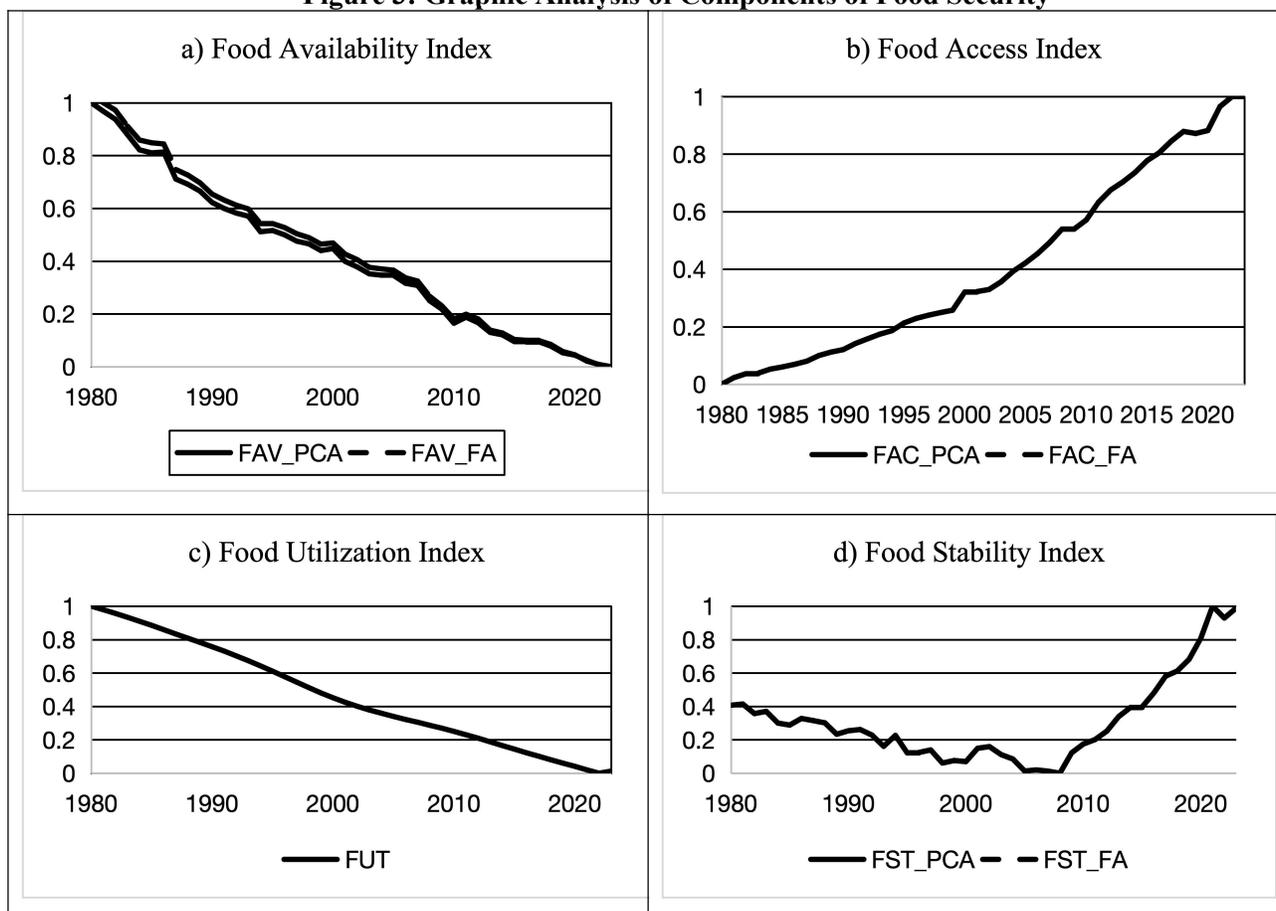
Component 2, cereal yield per capita, explains 24.58 percent and 25.48 percent variation under PCA and FA, respectively. The first two components cumulatively explain 93.57% and 94.47% of the variance in the FAV index. The consumer price index (CPI) alone captures 95.45 per cent of the variance under both aggregation schemes for FAC. Inflation reduces purchasing power and limits FAC, particularly for low-income groups (Barrett, 2010). In the case of FUT, the authors faced data limitations. Consequently, this study considers only a single indicator of FUT, the mortality rate. The FST index comprises four components. The food production index explains 64.45% of the variation under both aggregation schemes. Likewise, unpredictable rainfall, shortages, and climate-related disruptions cause volatility in crop production, ultimately lowering FSTI (Chandio et al., 2020).

Figure 3 plots the patterns of FAV, FAC, FUT, and FST from 1980 to 2023. Panel (a) visualizes FAV that follows a downward trend, with minor annual fluctuations. Changing agricultural practices, urban sprawl, land-use patterns, and climate variability tend to lower FAV. FAV stayed moderate in the 1980s owing to diverse seed varieties and fertilizer use in response to the Green Revolution (Evenson & Gollin, 2003). The country faced urbanization pressures and declining arable land in the 1990s. Further climate conditions became unfavorable. These factors cumulatively lessened FAV. (Abbas et al., 2021). Such trends indicate the necessity of sustainable land management and the investment in climate-resilient agriculture in the long run to achieve long-term FAV. By the start of the 2000s, low adoption rate of technological innovations and persistent climatic vulnerabilities continued to halt FAV. Excessive flooding, temperature fluctuations, CO2 emissions, and population increase disturbed the crop cycle. These problems continued to challenge long-term development. Panel (b) plots FAC, the second component of FSI. This dimensional index accounts for economic and demographic characteristics of FS. The economic factors are GDP per capita and CPI, whereas the demographic factor is rural population. The index revealed an upward trend from 1980 to 2023, indicating stable economic conditions and smooth food distribution between rural and urban regions. FAC improved with rising per capita. The overall upward tendency is attributed to economic growth and infrastructural investments in rural areas.

Measuring Food Security in Pakistan: A Multidimensional Index Approach

Panel (c) graphs the trend of FUT, the third element of FSI. FUT (the child mortality rate) declined from 1980 to 2023. FUT remained moderate in the 1980s owing to the persistence of dietary habits. Stable socio-economic conditions raised the society's awareness of nutritional status. Nonetheless, poor healthcare facilities contributed in decline of FUT in the early 1990s. In addition, access to quality health services remained inadequate, contributing to poor general health due to malnutrition (Haddad et al., 1999). The country joined the Scaling Up Nutrition (SUN) movement in 2013. It aimed to raise awareness of universal nutrition and implement public health strategies (SUN, 2022). UNICEF (2018) found that despite pervasive awareness campaigns, nearly half of children under age 5 experienced moderate or severe underweight, as lack of dietary variety and sub-optimal feeding practices persisted.

Figure 3: Graphic Analysis of Components of Food Security



Source: Authors' Construction

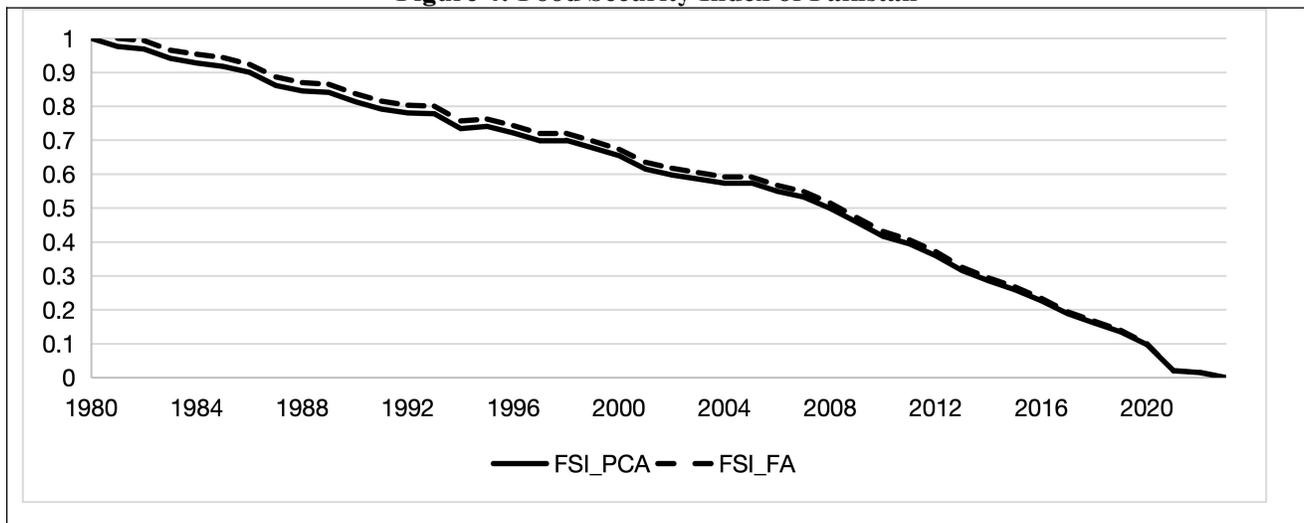
The last panel sketches the fourth dimension of FS: FST. It measures the vulnerability of a food system to exogenous shocks affecting production, prices, and food imports over time. The country experienced significant changes in the resilience and reliability of its food system during the agricultural crisis from 1980 to 2000. Many initiatives have been undertaken to mitigate the risks of market volatility and supply disruption. These are crop diversification, resilience of food system networks, and less reliance on primary food sources. The food production system has been safeguarded against fluctuations in global supply chains and economic turbulence. Highly advanced agricultural systems and improved infrastructure have played a central role in ensuring reliable and consistent food production and delivery (Pingali, 2012). FST exhibits significant instability during the 1990s. The unpredictability of food systems emanated from the global economic meltdown, financial recession, disrupted trade linkages, fluctuating exchange rates, and an escalation in import prices. The frequent occurrence of droughts and floods adversely affected agricultural production, thereby enhancing reliance on

imported food. Food systems became vulnerable to world price volatility and supply network turmoil (Favas et al., 2024).

Table A2 in the appendix reports the results for multidimensional FSI using PCA and FA. Both approaches accounted for four FS components: FAV, FAC, FUT, and FST. Using PCA and FA, FAVI, the first component alone explains 80.03% and 80.19% of the variation in FSI, respectively. Therefore, FSI is built solely on the first component whose eigenvalue exceeds 1. This proves that FAVI is the main cause of the change in FSI.

Figure 4 explains the state of FS in Pakistan spanning from 1980 to 2023. Welch and Graham (2000) argued that although the green revolution peaked in the 1980s. But the country failed to realize its potential gains primarily due to high population growth. Moreover, the primary food grain production stagnated and even decreased. Therefore, food production did not match food demand due to soaring population growth, thereby exacerbating FIN. The trend continued in the 1990s, as the country faced governance and management challenges alongside population growth. This economic crisis increased poverty and limited access to adequate and nutritious food.

Figure 4: Food Security Index of Pakistan



Source: Authors' Construction

By the start of the 2000s, the country grappled with the multidimensional issues of FS. It became self-sufficient in the production of staple food. However, poverty, infrastructure gaps, and regional imbalances deprived a large segment of the population of access to adequate, healthy food. Additionally, climate change and high population growth multiplied the problem of FIN. The FIN issue persisted in the 2010s. Zafar et al. (2024) reported that the catastrophic floods damaged 17 million acres of farmland, killed over 200,000 animals, and affected staple crops such as cotton, rice, and sugarcane. Fahad et al. (2024) stated that structural barriers in the agricultural sector involve a lack of federal-provincial collaboration, agricultural innovation, poor farmer-agribusiness connectivity, and farmers' inability to adopt productive farming techniques. All these factors contributed to the FIN problem in the country.

5. Conclusion and Policy Recommendations

The paper builds dimensional and aggregate FS indices for Pakistan over the period 1980-2023. The study applied PCA to derive dimensional indices for FAV, FAC, and FST. The study documented mixed tendencies across four dimensions of FS. FAV and FUT have declined nationwide over the years. FAC has improved, whereas FST has declined. The multidimensional FSI showed a persistent decline over the sampled period. The study also constructed the dimensional and overall FSI by using FA. The findings are robust to the aggregation methods. The findings suggest that the country has made little progress towards SDG2 and 3 owing

Measuring Food Security in Pakistan: A Multidimensional Index Approach

to the persistence of FIN. The authors propose proactive investments in agricultural modernization to combat economic and climatic shocks. The government may focus on food subsidies and conditional cash transfers to ameliorate the quality of nutritious FAC, particularly for low-income families. The country should improve its irrigation system to consistently produce a diverse range of food.

The availability of consistent data posed a serious challenge in this research, particularly for FUT. Improved data availability may help to conduct more rigorous analysis of FIN scenario. Future research may include agency and sustainability dimensions to develop FSI, as employed by Singh and Chattopadhyay (2025) for India. Similarly, readily available provincial and district-level data can facilitate disaggregated assessments of the FS scenario.

Acknowledgments

The authors express gratitude to the respected referees, reviewers, and editors for their valuable feedback. Moreover, all remaining errors are our own.

Data Availability Statement.

Data is self-collected from published (secondary) sources, and will be provided on demand.

Funding:

This research has received no external funding.

Conflict of Interest Disclosure Statement:

There is no conflict of interest among the authors of the study.

Ethical Approval:

This research article has not violated any ethical standards.

Author Contributions

Haleema Sadia: Conceptualization, Methodology, Data Curation, Software, Writing – original draft preparation, Writing – reviewing and editing.

Safia Bibi: Conceptualization, Software, Writing – reviewing and editing.

Jawad Ahmad Azeez: Conceptualization, Formal analysis, Writing - reviewing and editing.

References

- Abbas, S., Kousar, S., & Khan, M. S. (2021). Climate Change as a Precursor to Food Security: Empirical Evidence over Punjab Regions, Pakistan. <https://doi.org/10.21203/rs.3.rs-852972/v1>
- Ahmed, M., Asim, M., Ahmad, S., & Aslam, M. (2023). Climate Change, Agricultural Productivity, and Food Security. In *Global agricultural production: Resilience to climate change* (pp. 31-72). Cham: Springer International Publishing.
- Barrett, C. B. (2010). Measuring Food Insecurity. *Science*, 327(5967), 825-828. <https://doi.org/10.1126/science.1182768>
- Bashir, M. K., Bajwa, Z. N., Bakhsh, K., Maqbool, A., & Chattha, M. W. A. (2007). Food security perspectives in Pakistan. In *Proceedings of the International Conference on Productivity and Growth in Agriculture: Strategies and Interventions*. pp 150-156. University of Agriculture, Faisalabad, Pakistan (Vol. 150).
- Chandio, A. A., Magsi, H., & Ozturk, I. (2020). Examining the Effects of Climate Change on Rice Production: Case Study of Pakistan. *Environmental Science and Pollution Research*, 27, 7812-7822. <https://doi.org/10.1007/s11356-019-07486-9>
- Citaristi, I. (2022). World Food Programme WFP. In *the Europa Directory of International Organizations* (pp. 302-306). Routledge.
- Deitchler, M., Ballard, T., Swindale, A., & Coates, J. (2011). Introducing a Simple Measure of Household Hunger for Cross-Cultural Use. *Washington, DC: Food and Nutrition Technical Assistance II project, AED*.

- Ehuwa, O., Jaiswal, A. K., & Jaiswal, S. (2021). Salmonella, Food Safety, and Food Handling Practices. *Foods*, 10(5), 907. <https://doi.org/10.3390/foods10050907>
- Evenson, R. E., & Gollin, D. (2003). Assessing the Impact of the Green Revolution, 1960 to 2000. *Science*, 300(5620), 758-762. <https://doi.org/10.1126/science.1078710>
- Fahad, S., Basit, A., Iqbal, N., Akram, N., Orakzai, J. K., & Islam, M. U. (2024). Evaluation of Implementation Strategies of Food Security in Pakistan. *Khyber Journal of Public Policy*, 3(1): 178-218
- FAO. (1996). Rome Declaration on World Food Security and World Food. *Food and Agriculture Organization*, Rome, Italy.
- FAO. (2002). The State of Food Insecurity in the World. <http://www.fao.org/3/y7352e/y7352e00.htm>
- Favas, C., Cresta, C., Whelan, E., Smith, K., Manger, M. S., Chandrasenage, D., ... & Goudet, S. (2024). Exploring Food System Resilience to the Global Polycrisis in Six Asian Countries. *Frontiers in Nutrition*, 11, 1347186. <https://doi.org/10.3389/fnut.2024.1347186>
- Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., ... & Zaks, D. P. (2011). Solutions for a Cultivated Planet. *Nature*, 478(7369), 337-342. <https://doi.org/10.1038/nature10452>
- Haddad, L., Kennedy, E., & Sullivan, J. (1994). Choice of Indicators for Food Security and Nutrition Monitoring. *Food Policy*, 19(3), 329-343. [https://doi.org/10.1016/0306-9192\(94\)90079-5](https://doi.org/10.1016/0306-9192(94)90079-5)
- Hanjra, M. A., & Qureshi, M. E. (2010). The Global Water Crisis and Future Food Security in an Era of Climate Change. *Food Policy*, 35(5), 365-377. <https://doi.org/10.1016/j.foodpol.2010.05.00>
- Headey, D., & Ruel, M. (2023). Food Inflation and Child Undernutrition in Low- and Middle-Income Countries. *Nature Communications*, 14(1), 5761. <https://doi.org/10.1038/s41467-023-41543-9>
- Henchion, M., Hayes, M., Mullen, A. M., Fenelon, M., & Tiwari, B. (2017). Future Protein Supply and Demand: Strategies and Factors Influencing a Sustainable Equilibrium. *Foods*, 6(7), 53. <https://doi.org/10.3390/foods6070053>
- Hussain, A., & Routray, J. K. (2012). Status and Factors of Food Security in Pakistan. *International Journal of Development Issues*, 11(2), 164-185. <https://doi.org/10.1108/14468951211241146>
- Ibok, O. W., Osbahr, H., & Srinivasan, C. (2019). Advancing a New Index for Measuring Household Vulnerability to Food Insecurity. *Food Policy*, 84, 10-20. <https://doi.org/10.1016/j.foodpol.2019.01.011>
- Jolliffe, I. T., & Cadima, J. (2016). Principal Component Analysis: A Review and Recent Developments. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 374(2065), 20150202. <https://doi.org/10.1098/rsta.2015.0202>
- Khan, M., & Yanxia, Z. (2023). Rethinking Food Insecurity Assessment Methods: Evidence from Khyber Pakhtunkhwa, Pakistan. *Lahore Journal of Economics*, 28(2), 41-76. <https://doi.org/10.35536/lje.2023.v28.i2.a3>
- Khurshid, N., & Abid, E. (2024). Unraveling the Complexity! Exploring Asymmetries in Climate Change, Political Globalization, and Food Security in the Case of Pakistan. *Research in Globalization*, 8, 100220. <https://doi.org/10.1016/j.resglo.2024.100220>
- Malthus, T. R. (1798). *An Essay on the Principle of Population: The 1803 Edition*. Yale University Press.
- Maxwell, S. (1992). Neglected Issues in the Counterpart Fund Debate. *ids bulletin*, 23(2), 13-21. <https://doi.org/10.1111/j.1759-5436.1992.mp23002003.x>
- Nadeem, M., Anwar, M., Adil, S., Syed, W., Al-Rawi, M. B. A., & Iqbal, A. (2024). The Association between Water, Sanitation, Hygiene, and Child Underweight in Punjab, Pakistan: An Application of Population Attributable Fraction. *Journal of Multidisciplinary Healthcare*, 17, 2475-2487. <https://doi.org/10.2147/JMDH.S461986>
- Nelson, G., Bogard, J., Lividini, K., Arsenault, J., Riley, M., Sulser, T. B., ... & Rosegrant, M. (2018). Income Growth and Climate Change Effects on Global Nutrition Security to Mid-Century. *Nature Sustainability*, 1(12), 773-781. <https://doi.org/10.1038/s41893-018-0192-z>
- Pangaribowo, E. H., Gerber, N., & Torero, M. (2013). Food and Nutrition Security Indicators: A Review. *ZEF Working Paper No. 108*. <http://dx.doi.org/10.2139/ssrn.2237992>
- Pearson, K. (1901). Principal Components Analysis. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 6(2), 559.
- Pingali, P. L. (2012). Green Revolution: Impacts, Limits, and the Path Ahead. *Proceedings of the National Academy of Sciences*, 109(31), 12302-12308. <https://doi.org/10.1073/pnas.0912953109>

Measuring Food Security in Pakistan: A Multidimensional Index Approach

- Qadir, A., Arshad, M., & Rafique, M. (2022). Representative Farming and Non-Farming Communities as a Dynamic Mirror of Unidimensional Poverty in Pakistan. <https://doi.org/10.21203/rs.3.rs-2033130/v1>
- Rahman, I. U., Khattak, S. W., Israr, M., & Hashim, S. (2021a). A Multi-Dimensional Analysis of Food Security Situation in Pakistan: The Way Forward. *Sarhad Journal of Agriculture*, 38(1): 170-178. <https://dx.doi.org/10.17582/journal.sja/2022/38.1.170.178>
- Rahman, I. U., Iftikhar, S. F., Khattak, S. W., & Ali, W. (2021b). South Asian Experience of Trade Liberalization: Implications for Food Security. *Sarhad Journal of Agriculture*, 37(1), 52-63. <http://dx.doi.org/10.17582/journal.sja/2021/37.1.52.63>
- Safdar, M. H., Hussain, N., & Abbas, Q. (2023). Exploring the Multi-Dimensional Factors Influencing Food Security: A Case Study of District Nowshera, Pakistan. *Journal of Development and Social Sciences*, 4(3), 832-840. [https://doi.org/10.47205/jdss.2023\(4-III\)76](https://doi.org/10.47205/jdss.2023(4-III)76)
- SUN. (2022). *Pakistan Country Profile*. Scaling Up Nutrition <https://scalingupnutrition.org/sites/default/files/2023-08/pakistan-en.pdf>
- Sen, A. (1981). *Poverty and Famines: An Essay on Entitlement and Deprivation*. Oxford University Press.
- Shaw, D.J. (2007). World Food Summit, 1996. In *World Food Security* (pp 347-360). Palgrave Macmillan, London. https://doi.org/10.1057/9780230589780_35
- Singh, A., & Chattopadhyay, A. (2025). Six-Dimensional Food Security Index Across States in India: Does It Associate with Malnutrition Among Older Adults? *Food Security*, 1-14. <https://doi.org/10.1007/s12571-025-01527-7>
- UNICEF. (2018). *National Nutrition and Health Survey (NNHS) 2018*. NBS, UNICEF.
- Webb, P., Coates, J., Frongillo, E. A., Rogers, B. L., Swindale, A., & Bilinsky, P. (2006). Measuring Household Food Insecurity: Why It's so Important and Yet So Difficult to Do. *The Journal of Nutrition*, 136(5), 1404S-1408S. <https://doi.org/10.1093/jn/136.5.1404S>
- Welch, R. M., & Graham, R. D. (2000). A New Paradigm for World Agriculture: Productive, Sustainable, Nutritious, Healthful Food Systems. *Food and Nutrition Bulletin*, 21(4), 361-366. <https://doi.org/10.1177/156482650002100404>
- Wiesmann, D. (2006). [A Global Hunger Index: Measurement Concept, Ranking of Countries, and Trends](#), *Food Consumption and Nutrition Division Discussion Paper No 212*, International Food Policy Research Institute.
- Welthungerhilfe & Concern Worldwide. (2024). *Global Hunger Index 2024: How Gender Justice Can Advance Climate Resilience and Zero Hunger*. Retrieved from <https://www.globalhungerindex.org/pdf/en/2024/Pakistan.pdf>.
- World Food Program. (2008). *Food Consumption Analysis: Calculation and Use of the Food Consumption Score in Food Security Analysis, Vulnerability Analysis and Mapping Branch*, Rome, Italy
- World Food Program. (2009). *Hunger and markets. World Hunger Series*. Vol. 3. Earthscan
- Zafar, Z., Zubair, M., & Fahd, S. (2024). Extreme Weather Events and Their Socioeconomic Impacts: A Remote Sensing-Based Analysis of Flood Damages. *Global and Earth Surface Processes Change*, 1, 100001. <https://doi.org/10.1016/j.gespch.2024.100001>

APPENDIX

Table A1: Results for Principal Component and Factor Analysis for Sub-indices of Food Security

Method	Principal Component Analysis			Factor Analysis		
Components	Eigenvalue	Proportion	Cumulative Proportion	Eigenvalue	Proportion	Cumulative Proportion
<i>Food Availability Index (FAVI)</i>						
Component 1	4.1392	0.6899	0.6899	4.13943	0.6899	0.6899
Component 2	1.5289	0.2458	0.9357	1.52881	0.2548	0.9447
Component 3	0.2723	0.0454	0.9811	0.27238	0.0459	0.9906
Component 4	0.3808	0.0089	0.9900	0.03797	0.0054	0.9960
Component 5	0.1636	0.0067	0.9967	0.01633	0.0025	0.9985
Component 6	0.0924	0.0033	1	0.00508	0.0015	1
<i>Food Access Index (FAI)</i>						
Component 1	2.86338	0.9545	0.9545	2.86338	0.9545	0.9545
Component 2	0.0880622	0.0294	0.9839	0.08806	0.0296	0.9841
Component 3	0.0485591	0.0161	1	0.04856	0.0159	1
<i>Food Stability Index (FSTI)</i>						
Component 1	2.57803	0.6445	0.6445	2.57803	0.6445	0.6445
Component 2	0.955841	0.239	0.8835	0.95584	0.2370	0.8815
Component 3	0.409239	0.1023	0.9858	0.40924	0.1029	0.9844
Component 4	0.0568877	0.0142	1	0.05689	0.0156	1

Source: Authors' Construction

Table A2: Results of Principal Component and Factor Analysis for Food Security Index

Method	Principal Component Analysis			Factor Analysis		
Components	Eigenvalue	Proportion	Cumulative Proportion	Eigenvalue	Proportion	Cumulative Proportion
<i>Food Availability Index (FAVI)</i>						
Component 1	3.201267	0.8003	0.8003	3.20767	0.8019	0.8019
Component 2	0.777042	0.1943	0.9946	0.77197	0.1930	0.9949
Component 3	0.01612	0.004	0.9986	0.01486	0.0037	0.9986
Component 4	0.005571	0.0014	1	0.00551	0.0014	1.0000

Source: Authors' Calculations