

ADVANCE SOCIAL SCIENCE ARCHIVE JOURNAL
Available Online: https://assajournal.com
Vol. 05 No. 01. Jan-March 2026.Page# 8237-8247
Print ISSN: 3006-2497 Online ISSN: 3006-2500
Platform & Workflow by: Open Journal Systems
https://doi.org/10.5281/zenodo.23316385

Resilience Strategies for Sustainable Food Security in Sindh, Pakistan

Zaheer Ahmed
Department of Food Science and Technology, University of Sindh Agriculture University Tandojam, Faculty of Crop Production
zabaloch435@gmail.com
Ahsan Raza
Department of Food Science and Technology, University of Sindh Agriculture University Tandojam, Faculty of Crop Production
drahsanraza990@gmail.com
Atta Ur Rehman
Department of Department of Agriculture Education Extension & Short course, University of Sindh Agriculture University, Tando Jam, Faculty of Agriculture Social Sciences
attaurrehmanattaurrehman336@gmail.com
Murk Ghulam Sakina
Department of Freshwater Biology and Fisheries, University of Sindh, Faculty of Natural Sciences
murkmona@gmail.com
Mir Hassan Bijarani
Department of Agricultural Education, Extension & Short Courses, University of Sindh Agriculture University, Tandojam, Faculty of Agricultural Social Sciences
hassanbijarani331@gmail.com

Abstract
Sindh, Pakistan's second-largest province, occupies a paradoxical position in the national food system: it produces a disproportionate share of the country's staple and cash crops while simultaneously recording some of the highest rates of household food insecurity in Pakistan. Recurrent climate shocks, including the catastrophic 2022 monsoon floods, prolonged droughts in the province's western districts, and intensifying heatwaves, have repeatedly disrupted crop production, livestock assets, and rural incomes, compounding pre-existing socio-economic vulnerabilities. This paper synthesizes secondary data and peer-reviewed literature to examine the extent and drivers of food insecurity in Sindh, the province's structural importance to national agricultural output, and the resilience strategies that can plausibly reduce vulnerability. Drawing on Integrated Food Security Phase Classification (IPC) analyses, government and multilateral situation reports, and empirical studies of household food insecurity determinants, the paper finds that household size, dependency ratio, low education of household heads, income concentration, and exposure to compounding climatic shocks are the principal drivers of insecurity. A four-pillar resilience framework, aligned with the Food and Agriculture Organization's availability-access-utilization-stability model, is proposed, integrating climate-smart agriculture, livelihood diversification, social protection, and early-warning systems. The paper concludes that durable food security in Sindh requires coordinated investment across all four pillars rather than production-focused interventions alone.

Keywords: *Food Security, Resilience, Climate Change, Sindh, Pakistan, Sustainable Development.*

Introduction

Food security is a multidimensional concept that extends beyond the mere availability of food. It requires that all people, at all times, have physical and economic access to sufficient, safe, and nutritious food to meet their dietary needs for an active and healthy life (FAO, 1996; Sen, 1981). In Pakistan, agriculture is the backbone of the rural economy, contributing nearly one-fifth of national GDP and employing more than a third of the labour force. Yet, paradoxically, this sector is also the most vulnerable to climatic volatility, making food security a persistent challenge (Asghar & Muhammad, 2013; Aziz, Iqbal, & Butt, 2016).

Sindh province exemplifies this contradiction most sharply. As Pakistan's second most populous province and a major contributor to national agricultural output, Sindh plays a pivotal role in sustaining the country's food system. It produces a disproportionate share of staple and cash crops, including rice, cotton, and sugarcane, which are essential both for domestic consumption and export earnings. Despite this structural importance, Sindh consistently records among the highest levels of household food insecurity (Iram & Butt, 2004; Mahmood et al., 2014).

This paradox reflects the province's dual reality: while it is a breadbasket for the nation, its rural households remain highly vulnerable to poverty, climatic shocks, and weak institutional support.

Over the past decade, Sindh's rural population has endured an unusually dense sequence of climatic extremes. A multi-year drought in the province's northern and western districts eroded crop yields and livestock assets, followed by the catastrophic monsoon floods of 2022, which submerged vast tracts of agricultural land and displaced half a million people (FAO, 2022; Qamer, 2022; IDMC, 2022). More recently, successive heatwaves in 2024 and 2025 damaged standing wheat crops, reduced harvests, and triggered public-health emergencies (Dawn, 2025; APP, 2025). Each shock has interacted with pre-existing structural vulnerabilities poverty, small and fragmented landholdings, weak irrigation infrastructure, and limited access to credit and social protection to push large numbers of households deeper into food insecurity (Shair et al., 2024; Ullah et al., 2023).

The sustainability of agriculture in Sindh is therefore central to the province's food security outlook. Sustainable agriculture emphasizes practices that maintain productivity while conserving natural resources, adapting to climate change, and ensuring equitable access to food. In Sindh, this means shifting away from water-intensive crops in drought-prone districts, adopting climate-smart agriculture (CSA) techniques such as drought-resistant seed varieties, efficient irrigation systems, and soil-conservation methods, and diversifying livelihoods to reduce dependence on single income sources (Tunio, Li, & Khan, 2024; Gorst, Dehlavi, & Groom, 2018). These strategies not only enhance availability but also strengthen household resilience against shocks.

The role of agriculture in Sindh extends beyond production. It is the foundation of rural livelihoods, shaping income distribution, employment opportunities, and social stability. With nearly two-thirds of the province's population living in rural areas, agriculture is directly tied to household welfare. However, the dominance of smallholder farming, coupled with limited access to extension services, credit, and crop insurance, constrains farmers' ability to adopt adaptive practices. As a result, climate shocks translate quickly into food insecurity, with poor households often becoming net buyers of food even in agriculturally rich districts.

This paper takes stock of what is known about the scale, drivers, and consequences of food insecurity in Sindh, and asks what resilience strategies are best positioned to reduce the province's vulnerability over the coming decade. Rather than presenting new primary survey data, the study synthesizes government statistics, humanitarian situation reports, and peer-reviewed empirical studies into a coherent analytical narrative, supported by descriptive tables and figures constructed from these secondary sources (World Bank, 2022; PIDE, 2025; Presbyterian World Service & Development, n.d.; Concern Worldwide, n.d.). By situating Sindh's food security challenge within the broader framework of sustainable agriculture, the paper underscores the need for integrated resilience strategies that combine production-side interventions with social protection, livelihood diversification, and institutional stability

Objectives:

1. To examine the socio-economic determinants of food insecurity in Sindh.
2. To assess the scale of recent climate-related disruptions to Sindh's agriculture.
3. To propose a four-pillar resilience framework for sustainable food security in Sindh.

Literature Review

Conceptual Foundations of Food Security

The dominant conceptual framework used throughout this paper is the Food and Agriculture Organization's four-pillar model, which decomposes food security into availability (sufficient quantities of food produced or imported), access (the economic and physical ability of households to obtain food), utilization (the biological ability to derive nutritional benefit through adequate diet, clean water, sanitation, and healthcare), and stability (the persistence of the first three pillars over time despite shocks). This framework complements Sen's entitlement approach, which argues that famine and hunger arise less from an absolute shortage of food than from a collapse in the entitlements, income, assets, and legal or social claims, that allow individuals to command food. Sindh's experience, discussed below, illustrates both dynamics simultaneously: production shocks reduce availability, while poverty and asset loss erode access even where aggregate food supply recovers.

Determinants of Household Food Insecurity in Pakistan and Sindh

A substantial body of empirical work has examined the household-level correlates of food insecurity in Pakistan using nationally representative datasets such as the Household Integrated Economic Survey (HIES) and the Pakistan Social and Living Standards Measurement (PSLM) survey. Iram and Butt (2004) provided one of the earliest systematic assessments, arguing that household economic capacity, rather than aggregate national food availability, was the binding constraint on food security in Pakistan. Using HIES 2010–11 data, Aziz et al. (2016) found that food insecurity was more severe in Sindh than in any other province, and that larger family size, a higher dependency ratio, lower education of the household head, and smaller housing size (fewer rooms per adult equivalent) were consistently associated with insecurity; households reliant on a single income source were also more vulnerable than those with diversified livelihoods. Working with district-level rural data, Mahmood et al. (2014) similarly identified household income, education, and access to off-farm employment as key determinants of rural food security.

More recent studies using post-2018 data confirm that these patterns persist. Ullah et al. (2023), applying logistic regression to HIES 2019 data, found household expenditure patterns and socio-economic status to be the strongest predictors of food insecurity nationally. Shair et al. (2024), analysing PSLM 2019–20 data, showed that households headed by illiterate, lower-income, or migrant individuals, and larger households, faced substantially higher food-insecurity risk, while female-headed, married, and higher-income households tended to fare better due to more stable income and resource management. Taken together, this literature indicates that Sindh's food-insecurity burden is driven less by an outright scarcity of food and more by an uneven distribution of income, education, and asset ownership across its rural population.

Climate Shocks and Agricultural Disruption in Sindh

Sindh's exposure to climate extremes has intensified markedly in the past five years. Prior to the 2022 floods, an IPC analysis of vulnerable districts in Balochistan, Khyber Pakhtunkhwa, and Sindh had already classified an estimated 5.96 million people in Crisis (Phase 3) or Emergency (Phase 4) conditions between July and November 2022, a figure projected to rise to 7.2 million by early 2023 (World Bank, 2022). The floods that followed, triggered by monsoon rainfall roughly 67 percent above normal, affected 33 million people across 81 districts nationwide and destroyed or damaged over 1.2 million hectares of agricultural land in Sindh alone (Food and Agriculture Organization, 2022; World Bank, 2022). Because Sindh accounts for approximately 42 percent of national rice production, 23 percent of cotton production, and 31 percent of sugarcane production, the province's flood losses had disproportionate implications for national food supply (Qamer, 2022).

The shocks have not abated since. A heatwave in April 2024 reduced Sindh's wheat harvest by an estimated 20 percent and contributed to a wider decline in the province's agricultural output, which normally accounts for close to a quarter of Pakistan's total agricultural production (Internal Displacement Monitoring Centre, 2022). Heat and drought stress intensified further in 2024 and 2025: hospital records show 5,358 heat-related admissions and 158 livestock deaths during the 2024 heatwave, and a further 675 heatstroke cases were treated between April and May 2025. By mid-2025, an estimated 8.6 million people across 26 districts of Sindh faced heightened food insecurity from the combined effect of heat and drought risk (Dawn, 2025). A separate IPC analysis covering March–November 2024 classified 15 of Sindh's rural districts, alongside 21 in Balochistan and 11 in Khyber Pakhtunkhwa, as facing acute food insecurity, together affecting roughly 35.6 million people, or 15 percent of Pakistan's population (IPC, 2024). In the province's most drought-affected districts, where 65 to 95 percent of residents live in rural areas dependent on farming and daily-wage labour, an estimated 3 million people are directly affected by drought at any given time (Concern Worldwide, n.d.).

Climate-Smart Agriculture and Adaptive Resilience

Against this backdrop, a growing literature examines whether climate-smart agriculture (CSA) and related adaptive practices can meaningfully improve farm-level resilience. Using data from 720 crop farmers across three Pakistani provinces and an endogenous switching regression model, Tunio et al. (2024) found that farmers who adopted CSA practices, including drought-tolerant varieties, efficient irrigation, and improved soil management, achieved significantly better food performance outcomes under adverse weather than non-adopters. Gorst et al. (2018) similarly showed, using econometric analysis of Pakistani farm-level data, that adaptation measures such as changes in planting dates and crop choice measurably reduced the negative productivity

effects of climate variability. A multi-district study presented at a 2025 provincial conference on climate change and disaster resilience in Sindh reported that farmers who adopted drought-resistant crops, efficient irrigation systems, and soil-conservation techniques sustained yields roughly 30 percent higher than non-adopters during recent extreme-weather episodes (Associated Press of Pakistan, 2025). Complementary qualitative work highlights the role of local knowledge networks, extension officers, community radio, and farmer-to-farmer learning, in translating scientific climate advisories into actionable on-farm decisions (Pakistan Institute of Development Economics, 2025). Humanitarian programming has reinforced these findings at the community level: a humanitarian assistance, early recovery, and development project implemented in food-insecure districts of Sindh combined emergency food assistance with climate-smart agricultural training and livelihood diversification, reaching over 23,000 people and training 300 women in alternative livelihoods (Presbyterian World Service & Development, n.d.).

Problem Statement

Despite Sindh's structural importance to Pakistan's food supply, the province remains disproportionately food insecure, and this insecurity has been deepened rather than resolved by successive climate shocks since 2021. Existing interventions have tended to be reactive and shock-specific, humanitarian food assistance after floods, emergency livestock replacement after drought, rather than built around a coherent, forward-looking resilience strategy. This paper addresses three specific objectives: to document the extent and socio-economic determinants of food insecurity in Sindh using existing secondary data and literature: to quantify, where data permit, the scale of recent climate-related disruption to Sindh's agricultural secto: and to propose a structured, pillar-based framework of resilience strategies that could be prioritized by policymakers, development partners, and research institutions.

Methodology

This paper adopts a desk-based, secondary-data research design appropriate for a policy-oriented synthesis rather than a primary field survey. Three categories of sources were reviewed: peer-reviewed empirical studies on the determinants of household food insecurity in Pakistan, identified through searches of relevant economic and social-science journals; situation reports and technical assessments produced by the Government of Pakistan, the World Bank, the Food and Agriculture Organization, the World Food Programme, the Integrated Food Security Phase Classification partnership, and the Internal Displacement Monitoring Centre; and sector analyses of climate-smart agriculture adoption in Pakistan. Quantitative figures reported across these sources (crop production shares, district counts, population estimates, and damage assessments) were extracted, cross-checked for internal consistency, and organized descriptively into the tables and figures presented in Section 5. The analysis is descriptive and interpretive, synthesizing patterns that recur across independent sources. This approach is well suited to a resource- and time-constrained academic setting and mirrors the secondary-data synthesis method used in comparable food-security policy reviews.

Results and Discussion

Sindh's Structural Weight in National Agricultural Output

Sindh's exposure to climate shocks matters disproportionately for national food security because of the province's outsized share of key crops. As Figure 1 shows, Sindh contributes an estimated 42 percent of Pakistan's national rice production, 31 percent of sugarcane production, and 23

percent of cotton production (Qamer, 2022). A production shortfall in Sindh therefore transmits directly into national supply and price outcomes, a dynamic clearly visible after the 2022 floods, when damage to standing rice and cotton crops in the province contributed to national food-price inflation.

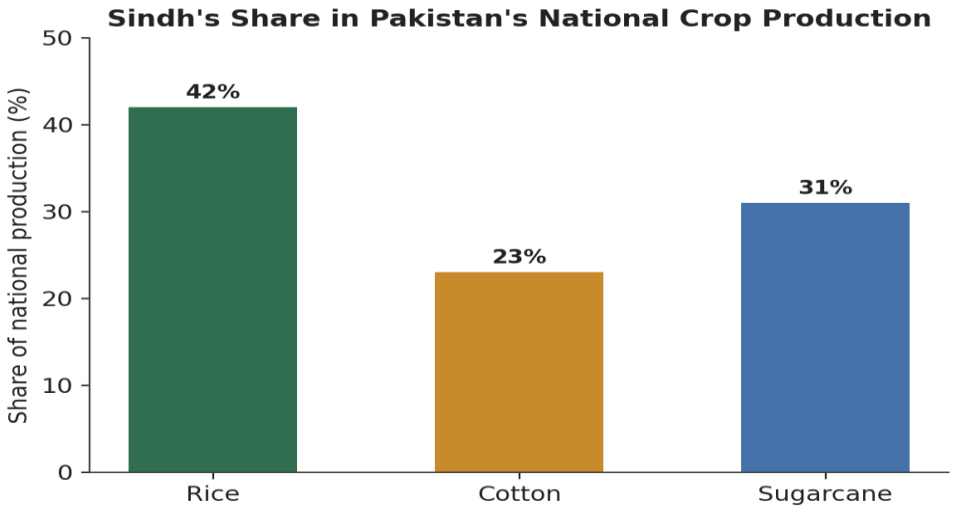


Figure 1. Sindh's share of Pakistan's national production of rice, cotton, and sugarcane. Source: constructed from Qamer (2022).

Geographic Concentration of Acute Food Insecurity

The March–November 2024 IPC analysis of 47 flood-affected and climate-vulnerable rural districts found that Sindh accounted for 15 of these districts, second only to Balochistan's 21, with Khyber Pakhtunkhwa contributing 11 (Figure 2). Collectively, these 47 districts were home to approximately 35.6 million people, roughly 15 percent of Pakistan's total population, and were characterized by high food prices, recurring climatic shocks, reduced livelihood opportunities, and livestock disease as compounding drivers of insecurity (IPC, 2024). Sindh's consistent presence among the most-affected provinces across successive IPC cycles, both before and after the 2022 floods, indicates that its food-insecurity burden reflects a structural vulnerability rather than a single transient shock.

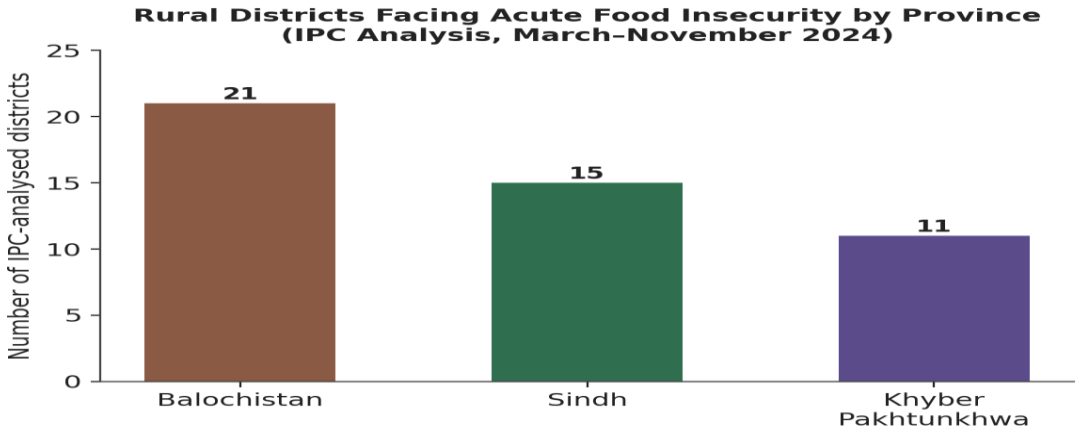


Figure 2. Number of rural districts classified as facing acute food insecurity by province, IPC analysis, March–November 2024. Source: constructed from IPC (2024).

Timeline of Recent Climate Shocks and Their Reported Impacts

Table 1 consolidates reported impacts from the major climate shocks that have struck Sindh since 2021. The sequence illustrates a pattern of compounding rather than isolated shocks: pre-flood food insecurity in 2022 was worsened by the monsoon floods later that year, and recovery was subsequently interrupted by renewed heat and drought stress in 2024 and 2025.

Period	Event	Reported impact	Source
Jul–Nov 2022	Pre-flood food-insecurity assessment	5.96 million people in IPC Phase 3–4 across 28 districts (Balochistan, KP, Sindh); projected to rise to 7.2 million by Mar 2023	World Bank (2022)
Jun–Sep 2022	Monsoon floods	33 million people affected across 81 districts nationally; over 1.2 million hectares of agricultural land damaged in Sindh	FAO (2022); World Bank (2022)
Apr 2024	Heatwave	Sindh wheat harvest reduced by an estimated 20%; ~2.5 million acres of standing crops affected across flood-recovery areas	IDMC (2022)
2024	Sustained heat stress	5,358 heat-related hospital admissions; 158 livestock deaths reported	Dawn (2025)
Apr–May 2025	Heatwave	675 heatstroke cases treated across the province	Dawn (2025)
Mar–Nov 2024	IPC acute food-insecurity analysis	15 Sindh districts among 47 nationally analysed; ~35.6 million people affected across all analysed districts	IPC (2024)
2025 (assessment)	Compounding heat and drought	~8.6 million people across 26 Sindh districts facing heightened food insecurity	Dawn (2025)

Synthesis of Household-Level Determinants

Table 2 summarizes the principal empirical studies of food-insecurity determinants in Pakistan reviewed in Section 2.2. Across data sources spanning nearly two decades (2004–2024) and different survey rounds, the same cluster of factors, household size and dependency ratio, low education of the household head, limited income diversification, and rural or migrant status, recur as significant predictors, suggesting that these are structural rather than transitory vulnerabilities that any resilience strategy must address alongside climate adaptation.

Study	Data / method	Key determinants identified
Iram & Butt (2004)	Conceptual and household economic assessment	Household economic capacity and access, not aggregate national food supply, as binding constraint

Mahmood et al. (2014)	District-level rural survey, Faisalabad	Household income, education, and access to off-farm employment
Asghar & Muhammad (2013)	Socio-economic determinants, national	Confirmed Sindh as the most food-insecure province among all provinces studied
Aziz et al. (2016)	HIES 2010–11, logit model, provincial	Family size, dependency ratio, household head's education, housing size, income diversification
Ullah et al. (2023)	HIES 2019, logistic regression, national	Household expenditure patterns and socio-economic status
Shair et al. (2024)	PSLM 2019–20, logistic regression, national	Literacy, income level, gender, marital status, household size, migration status
Tunio et al. (2024)	720 farmers, 3 provinces, switching regression	CSA adoption significantly improves food performance under adverse weather
Gorst et al. (2018)	Farm-level econometric analysis, national	Adaptation measures (planting dates, crop choice) reduce climate-related productivity losses

Resilience Strategies for Sustainable Food Security

The evidence reviewed above suggests that food insecurity in Sindh is driven jointly by climatic shocks that undermine availability and by structural socio-economic constraints that undermine access, utilization, and stability. Accordingly, resilience strategies are organized below using the FAO's four-pillar framework (Table 3), integrating agricultural, social-protection, and institutional interventions rather than treating them as separate policy tracks.

Pillar	Strategy	Supporting evidence / rationale
Availability	Scale up drought-resistant and short-duration crop varieties, efficient irrigation (drip/sprinkler), and soil-conservation techniques	Multi-district adoption study reported ~30% higher yields among adopters during extreme weather (APP, 2025); Tunio et al. (2024)
Availability	Diversify cropping away from water-intensive rice and sugarcane toward less water-stressed staples in drought-prone western districts	Sindh's outsized share of national rice/sugarcane output concentrates national risk (Qamer, 2022)
Access	Expand livelihood diversification and women's income-generation training	PWS&D HERD project trained 300 women artisans alongside 23,319 people receiving food

		and CSA support (PWS&D, n.d.)
Access	Strengthen and expand cash-transfer and safety-net coverage in high-risk districts identified by IPC analyses	15 Sindh districts among 47 nationally classified as acutely food insecure (IPC, 2024)
Utilization	Integrate nutrition-sensitive extension and specialized nutritious food distribution for children and pregnant/lactating women	WFP distribution of specialized nutritious food to children and PLW during 2022 floods response
Utilization	Invest in rural water, sanitation, and hygiene (WASH) infrastructure to reduce disease burden that undermines nutrient absorption	Compounding heat, water-scarcity, and health impacts documented in 2024–25 heatwaves (Dawn, 2025)
Stability	Strengthen early-warning systems linking PMD forecasts to farmer advisories via radio, mobile, and extension networks	Local knowledge and digital advisory networks identified as key adaptation channels (PIDE, 2025)
Stability	Promote farmer collective-action groups and improve access to credit and crop insurance	Collective action found to increase adoption of climate-adaptation strategies among smallholders

Several cross-cutting priorities emerge from this framework. First, interventions should be sequenced rather than treated as substitutes: production-side measures such as drought-resistant seed and efficient irrigation raise the ceiling on availability, but without complementary access-side measures, such as cash transfers and livelihood diversification, the poorest households, who are typically net food buyers even in rural areas, will not automatically benefit from higher aggregate output. Second, institutional coordination matters as much as technical design: the 2025 provincial conference on climate-smart agriculture explicitly called for coordinated action among government agencies, humanitarian organizations, and research institutions rather than fragmented project-based responses (APP, 2025). Third, targeting should be dynamic rather than static, using successive IPC cycles to reallocate resources toward the districts currently classified as most acutely insecure rather than relying on historical vulnerability maps that may lag behind fast-moving climate shocks.

Conclusion

Sindh occupies a pivotal yet precarious position in Pakistan's food system: while it produces a disproportionate share of rice, cotton, and sugarcane, its rural households remain among the most food insecure, a vulnerability sharply deepened by the 2022 floods and the heat and drought stress of 2024–2025. Unlike earlier studies that focused either on production shocks or socio-economic determinants in isolation, this paper integrates both dimensions within a four-pillar resilience framework. The novelty lies in demonstrating that durable food security cannot rest on production-side interventions alone; it requires simultaneous investment in

climate-smart agriculture, livelihood diversification, social protection, and institutional stability. By synthesizing recent IPC analyses, government reports, and empirical studies, the paper provides a structured basis for prioritizing resilience strategies in Sindh. Future research using primary household survey data in the province's most climate-exposed districts would help quantify the relative cost-effectiveness of these strategies and refine targeting as Sindh's climate risk profile continues to evolve.

Recommendations

To strengthen sustainable food security in Sindh, farmers should be encouraged to adopt eco-friendly practices such as compost, neem oil, farmyard manure, and yellow sticky traps through awareness campaigns, demonstrations, and regular training. Integrating multiple practices organic nutrient management, botanical pest control, and physical monitoring—can enhance cost savings and resilience. Agricultural extension services must be expanded to provide continuous guidance, while government departments and NGOs should offer financial incentives, subsidies, and technical support, particularly for smallholders.

At the community level, establishing composting units and promoting local input production can reduce costs and ensure availability of organic alternatives. Policymakers should prioritize integrated resilience strategies rather than focusing solely on production, aligning interventions with climate-smart agriculture, livelihood diversification, and social protection. Future research should involve larger samples and include socioeconomic variables such as age, education, landholding size, and income to better understand adoption drivers and refine targeting in climate-exposed districts.

References

Asghar, Z., & Muhammad, A. (2013). Socio-economic determinants of household food insecurity in Pakistan https://scispace.com/papers/socio-economic-determinants-of-household-food-insecurity-in-2vqcc0k01e

Associated Press of Pakistan. (2025, June 23). Sindh adopts climate-smart agriculture as disasters intensify; experts urge immediate action. APP. https://www.app.com.pk/domestic/sindh-adopts-climate-smart-agriculture-as-disasters-intensify-experts-urge-immediate-action/

Aziz, B., Iqbal, Z., & Butt, Z. (2016). The extent, cause and severity of household food insecurity in Pakistan: Evidence from micro data. FWU Journal of Social Sciences, 10(2), 44–57.

Dawn. (2025). Sindh's escalating heat and drought risk to food security. Dawn News. https://epaper.dawn.com/DetailImage.php?StoryImage=08_07_2025_602_002

Food and Agriculture Organization. (1996). Rome declaration on world food security. FAO. https://www.fao.org/4/w3613e/w3613e00.htm

Food and Agriculture Organization. (2022). Assessment of agricultural land damage following the 2022 floods in Sindh Province. FAO Pakistan. https://openknowledge.fao.org/server/api/core/bitstreams/193c7e46-ff20-4635-87b5-b0bc6a5a4d73/content

Gorst, A., Dehlavi, A., & Groom, B. (2018). Crop productivity and adaptation to climate change in Pakistan. Environment and Development Economics, 23(6), 679–701.

Integrated Food Security Phase Classification. (2024). Pakistan: IPC acute food insecurity analysis, March–November 2024. IPC Global Partners. https://www.ipcinfo.org/ipc-country-analysis/en/?country=PAK

Iram, U., & Butt, M. S. (2004). Determinants of household food security: An empirical analysis for Pakistan. International Journal of Social Economics, 31(8), 753–766. https://doi.org/10.1108/03068290410546011

Mahmood, S., Tabassum, A., Khan, S. A., & Jabeen, N. (2014). An investigation of determinants of food security in rural areas of Faisalabad, Pakistan. Mediterranean Journal of Social Sciences, 5(4), 676–683.

Pakistan Institute of Development Economics. (2025). Human roots of resilience: How local knowledge and smart farming drive climate adaptation in Pakistan. Discourse, PIDE. https://pide.org.pk/research/human-roots-of-resilience-how-local-knowledge-and-smart-farming-drive-climate-adaptation-in-pakistan/

Presbyterian World Service & Development. (n.d.). Seeds of resilience. Presbyterian Church in Canada. https://presbyterian.ca/pwsd/seeds-of-resilience/

Shair, W., Afzal, H., Ahmad, A., & Iftikhar, R. (2024). Exploring the determinants of food insecurity in Pakistan. Pakistan Journal of Humanities and Social Sciences, 12(3), 2681–2689.

Tunio, R. A., Li, D., & Khan, N. (2024). Maximizing farm resilience: The effect of climate-smart agricultural adoption practices on food performance amid adverse weather events. Frontiers in Sustainable Food Systems, 8, Article 1423702. https://doi.org/10.3389/fsufs.2024.1423702

Ullah, S., Abro, A. A., Mustafa, A. R., & Sibt-e-Ali, M. (2023). Determinants of food insecurity in Pakistan: An empirical investigation at household level. Pakistan Journal of Humanities and Social Sciences, 11(2), 1368–1376. https://doi.org/10.52131/pjhss.2023.1102.0444