Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)

Supply Chain Disruption and Business Continuity: Analyzing the Economic Ripple Effects of Cloudburst-Induced Agricultural Losses in Pakistan

Ayesha Saeed
Department of Economics, Fatima Jinnah Women University, Rawalpindi, Pakistan.
Email: ayeshazeeshan1982@gmail.com

Muhammad Asif
Department of Business Administration, Faculty of Social Sciences, Air University, Multan Campus, Pakistan. Email: Muhammad.asif@aumc.edu.pk

Tayyaba Ayaz Khan Jadoon
Department of Management Sciences, Bahria University Islamabad, Pakistan.
Email: tayyabakhanjadoon@gmail.com

Ejaz Ahmad
Department of Economics, The University of Haripur, Haripur Khyber Pakhtunkhwa 22620, Pakistan. E-mail: ahmad@uoh.edu.pk

Baserat Sultana
Department of Economics, University of Wah, Quaid Avenue, WahCantt, Pakistan.
School of Economics and Finance, Xi'an Jiaotong University, Shaanxi, 710049, China
Email: baserat.sultana@uow.edu.pk

ABSTRACT
This study examines the immediate economic impacts of agricultural losses caused by cloudbursts in Pakistan, focusing on the ensuing supply chain disruptions and the deterioration of business continuity within the agro-textile value chain that drives the nation's economy. The study utilizes a mixed-methods approach, combining thematic analysis of qualitative data from farmers and industry executives with quantitative data on crop loss, import surges, and export revenue decline, to demonstrate a direct causal relationship between localized climate shocks and systemic financial instability. The data indicate that severe physical losses of essential crops, like cotton, lead to considerable raw material shortages, resulting in prompt rises in expensive international imports and significantly diminishing national export revenues. The study reveals a significant disparity in resilience, indicating that Micro, Small, and Medium Enterprises (SMEs) are particularly susceptible due to substantial institutional and financial obstacles that hinder the implementation of formal Business Continuity Planning (BCP) and critical technology management tools for swift damage assessment. The study indicates that the nation's existing catastrophe management framework, mostly reactive and deficient in technology integration, inadequately protects the country's economic foundation. Therefore, the study advocates for a transition to proactive, policy-oriented resilience by establishing a national fund for technology subsidies and mandating the implementation of subsidized risk transfer mechanisms to ensure the long-term operational integrity and climate stability of Pakistan's commercial sectors.

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)
Keywords: Cloudbursts; Supply Chain Disruption; Agricultural Losses; Business Continuity Planning; Technology Management; Pakistan.

Introduction

The persistent and escalating devastation caused by floods in Pakistan signifies a critical economic and humanitarian dilemma, necessitating thorough academic investigation (Chang et al., 2025). Although extensive river flooding has traditionally been the focal point of disaster risk discussions, recent occurrences highlight the increased danger presented by localized, heavy rainfall events referred to as cloudbursts. Extreme weather events, often associated with the intensifying impacts of climate change, induce rapid-onset flash floods that cause immediate and catastrophic damage to the nation's essential agricultural foundation (Mirza & Dixit, 2025). The rapidity and confined characteristics of this hazard render conventional flood prevention and recovery models insufficient, thereby requiring a reorientation of research towards the pathways via which these environmental shocks propagate across the national economy. This research is designed to investigate the relationship between agricultural damage caused by cloudbursts and its extensive effects on supply chain interruption and business continuity in Pakistan's primary economic sectors.

The principal area affected by these devastating cloudbursts is the agricultural industry, which constitutes a significant share of the nation's GDP and jobs. The devastation of standing crops, such as valuable commodities like cotton, rice, and sugarcane, together with the loss of essential inputs and animals, results in a significant and measurable decline in agricultural production (Khan, 2025). The initial reduction in yield, along with the long-term effects on soil fertility from waterlogging, silt accumulation, and salt, exacerbates subsequent harvests, establishing a cycle of vulnerability for rural communities. The study contends that comprehending the whole economic cost necessitates transcending basic damage evaluation to conduct a nuanced examination of how shortages in raw materials induce a cascade impact across value chains, beginning with primary producers. This regional situation swiftly transforms into a nationwide economic issue due to supply chain interruption. The agricultural outputs of Pakistan provide significant downstream industries, particularly the textile industry (dependent on cotton) and the food processing and export sectors (dependent on rice and wheat) (Arshad et al., 2025). Cloudbursts that devastate crops immediately jeopardize the assured supply of raw materials, resulting in operational disruptions, missing international delivery dates, and a collapse of confidence within the trading system. Moreover, the concomitant devastation of essential infrastructure—such as farm-to-market roads, storage facilities, and processing mills—significantly impedes the transportation and storage of any remaining product. This research meticulously examines the logistical impediments caused by these disruptions and their varying effects on small and medium firms (SMEs) compared to bigger, more diverse organizations.

The most apparent economic consequence of this supply chain breakdown is the increase in food inflation and the decline of national export income. A deficiency of local basic crops necessitates an escalation in imports, exerting pressure on foreign currency reserves during a period of economic fragility (Shahbaz & Muzaffar, 2025). The absence of an exportable surplus, especially in rice and cotton goods, undermines Pakistan's competitiveness in the global market. This research asserts that the total financial impact on the nation's business landscape transcends physical asset depreciation, incorporating significant losses in revenue, diminished market share, and heightened operational costs stemming from dependence on unreliable and costly alternative supply chains. Effective

ISSN Online: 3007-3154
ISSN Print: 3007-3146

technology management and strategic planning are essential to address and minimize these significant economic impacts. Conventional disaster response systems often lack the necessary speed and data specificity to facilitate swift recovery. This research rigorously assesses the impact of improved technology on delivering prompt and precise damage evaluations. The effective distribution of relief, insurance disbursements, and input subsidies to impacted farmers is primarily a logistics and information management challenge that, if addressed with advanced technology, can considerably reduce recovery time and enhance the sustainability of business continuity initiatives for both farmers and related industries.

The study is driven by the pressing need to shift Pakistan's disaster management approach from a solely humanitarian reaction to a comprehensive economic resilience plan. This seeks to provide empirically supported suggestions by rigorously examining the impact of cloudburst-related meteorological threats on agricultural losses and their consequent effects on systemic supply chain disruptions. The primary objective is to present a framework—rooted in strategic technology management and informed by business continuity principles—that empowers Pakistan's economy to withstand escalating climate shocks, protect its agricultural foundation, and preserve the operational integrity of its essential business sectors.

Research Questions of the Study

This study is directed by three principal research topics aimed at thoroughly examining the economic transmission mechanisms of agricultural damage caused by cloudbursts within Pakistan's commercial environment**.** RQ1: What is the measurable effect of agricultural losses caused by cloudbursts on the operational efficiency and financial performance of significant downstream industries (e.g., textiles, rice processing) and the ensuing influence on national export revenues? This inquiry pertains to the immediate fiscal ramifications of agricultural supply shocks. Cloudbursts devastate raw material supplies such as cotton and rice, which are critical inputs for Pakistan's primary export-oriented industries. The research aims to transcend broad catastrophe damage statistics to show a measurable, causal relationship between particular agricultural losses and the consequent impacts on industry capacity, production expenses, and the failure to meet international trade obligations. The study examines industry-specific data to identify the financial vulnerabilities posed by this hazard and evaluate its impact on the nation's trade balance and general macroeconomic instability, especially regarding food prices and inflation. This is essential for comprehending the vast magnitude of the economic ripple effect RQ2: In what manner can infrastructure failures (roads, electricity, communication) resulting from cloudburst-induced flash floods intensify supply chain bottlenecks, and how might ICT-based management solutions contribute to alleviating these logistical disruptions to maintain business continuity? This inquiry focuses on the logistical and technical aspects of the disruption. Floods and cloudbursts consistently devastate the physical infrastructure essential for transporting raw materials from fields to factories and completed products to ports. The study examines the logistical impediments—such as prolonged transit durations, compromised storage facilities, and escalated transportation expenses—arising from these infrastructural deficiencies. It critically examines the capabilities of Information and Communication Technology (ICT) and sophisticated management tools, including GIS-based routing, real-time tracking, and decentralized communication systems, to create robust supply chain frameworks that circumvent or swiftly restore compromised nodes. The objective is to ascertain viable technical solutions for ensuring company continuity in a geographically

ISSN Online: 3007-3154
ISSN Print: 3007-3146

and infrastructurally demanding setting**.** RQ3: What institutional, financial, and technical obstacles hinder small-to-medium companies (SMEs) in the agricultural value chain from implementing effective Business Continuity Planning (BCP), and what policy measures are necessary to promote a proactive culture of resilience? This concluding inquiry redirects attention to organizational resilience and policy. Although big corporations possess the means for risk mitigation, the predominant portion of Pakistan's agricultural value chain consists of fragile SMEs and smallholder farmers who are deficient in cash, expertise, or access to financing for Business Continuity Planning (BCP). This segment of the study seeks to delineate the particular systemic and individual impediments—such as elevated initial technological costs, insufficient access to financial risk transfer mechanisms (e.g., agriculture insurance), and inadequate management training—that obstruct BCP implementation. By identifying these limits, the study provides evidence-based policy and institutional recommendations aimed at fostering an environment conducive to private sector resilience, transitioning the disaster management paradigm from government-led relief to a collaborative public-private responsibility.

Objectives of the Study

The primary aim of this study is to provide a comprehensive framework to strengthen the economic resilience of Pakistan's agricultural value chain against the increasing danger of floods caused by cloudbursts. The research intends to:

I. Quantify the financial transmission of cloudburst damage from the agricultural sector to the industrial and export sectors, thereby providing a precise economic cost estimate for policymakers.
II. Systematically identify the key physical and logistical choke points in the agricultural supply chain that are most susceptible to infrastructure failures caused by cloudbursts, and provide prompt, technology-based mitigation and adaptation options.
III. Critically assess the existing preparation levels and technology adoption rates among small-to-medium enterprises (SMEs) in the value chain, resulting in the identification of significant institutional, financial, and regulatory obstacles.

The study aims to develop a series of practical, policy-oriented recommendations for incorporating technology management and comprehensive Business Continuity Planning (BCP) into national and provincial economic strategies to safeguard food supply and export revenues from future climate disruptions.

Significance of the Study

This study is significant as it may transform Pakistan's climate-induced catastrophe management from a reactive, relief-focused paradigm to a proactive, economically integrated resilience strategy. This offers essential, detailed data presently absent from macro-level damage estimates by thoroughly examining the interrelation of climatic risks (cloudbursts), primary economic activities (agricultural), and commercial dynamics (supply chain). The results would be crucial for governmental entities—namely the National Disaster Management Authority (NDMA), the Ministry of National Food Security and Research, and provincial planning departments—by accurately identifying where investments in technology management can generate the most significant economic benefits regarding risk mitigation and expedited recovery. The suggested

ISSN Online: 3007-3154
ISSN Print: 3007-3146

framework for Business Continuity Planning empowers the private sector, especially vulnerable SMEs, to maintain operations during crises, therefore stabilizing employment, mitigating food inflation, and protecting Pakistan's essential export markets. In a time of increasing climate unpredictability, this study offers a crucial strategic framework to guarantee the enduring economic security and stability of a particularly susceptible country.

Literature Review

The current literature demonstrates Pakistan's significant susceptibility to climate change, which is fundamentally altering the nation's hydrological cycle and resulting in more severe and localized destructive weather events, including the increasingly frequent and intense "Cloud Burst" occurrences and flash floods (Makki et al., 2025; Haider et al., 2025). Climatic disasters represent the predominant category of disruption in global food supply chains, directly affecting the availability, quality, and cost of food products, a concern exacerbated in nations where a substantial segment of the economy and livelihoods relies on the agricultural sector (Usman et al., 2025). Research on Pakistan's significant flood occurrences, notably in 2010 and 2022, consistently highlights the extensive devastation, encompassing the total annihilation of standing Kharif (summer) crops, the demise of livestock, and the incapacitation of critical infrastructure such as roads, bridges, irrigation canals, and drainage systems, which collectively obstruct the agricultural supply chain from production to consumption (Wang et al., 2024; Chen et al., 2024). The immediate repercussions of this devastation include substantial financial losses for farmers, widespread relocation, heightened food insecurity for the populace, and an anticipated increase in the national poverty rate. The literature highlights a fundamental systemic deficiency in Pakistan's response, marked by a disjunction between ambitious climate policies and their effective execution. This has led to a reactive disaster management system hindered by institutional, financial, and coordination deficiencies between federal and provincial governments, alongside an excessive dependence on erratic external funding for adaptation (Masud & Khan, 2024).

The study emphasizes that disruptions from natural disasters, particularly extreme flooding due to cloudbursts, have the most profound effects at the production level, subsequently cascading throughout the entire supply chain to impact processors, distributors, retailers, and consumers. In Pakistan, this ripple effect is particularly pronounced in the country's predominant export sector: Textiles. The textile industry, accounting for a quarter of industrial production and more than half of merchandise exports, is strongly dependent on cotton, a principal crop often ravaged by floods caused by cloudbursts (Kapoor et al., 2025). The devastation of extensive cotton fields, sometimes surpassing 40-45% of the national output, requires a substantial and expensive increase in raw cotton imports, significantly elevating the industry's import expenditures and resulting in billions of dollars in forfeited export potential. Moreover, the disruption in the supply chain extends beyond the raw material phase, as flooding in significant economic centers such as Karachi impacts spinning mills and warehouses, immobilizes logistics, and induces shipping and export delays at the port, resulting in heightened price volatility and supply chain risk for global purchasers (Farrukh&Sajjad, 2025). This study highlights that the susceptibility of the textile supply chain is attributable not only to crop failure but also to the infrastructure and logistical constraints that are revealed after a significant climatic event.

Notwithstanding the extensive post-disaster evaluations and comprehensive policy critiques regarding flood management in Pakistan, a notable research deficiency remains

ISSN Online: 3007-3154
ISSN Print: 3007-3146

in the area of proactive and customized business continuity planning (BCP), especially for essential sectors such as agriculture and textiles, as well as for at-risk entities like Micro, Small, and Medium Enterprises (MSMEs). General disaster recovery studies on MSMEs in flood-affected regions of Pakistan have identified pre-disaster mitigation measures, personal savings, and government support as vital for recovery speed. However, these studies often concentrate on the owner's perception of recovery time or the basic metric of business reopening, rather than conducting a comprehensive, quantitative analysis of supply chain performance indicators such as procurement lead-time, production capacity utilization, or order fulfillment rates following a cloudburst (Iqbal et al., 2025; Agarwal Goel et al., 2024). A significant need exists in comprehensive research that transcends mere descriptive assessments of damages and losses to include analytical modeling of resilience methods addressing the unique vulnerabilities revealed by cloudburst occurrences. The existing literature lacks comprehensive frameworks for Business Continuity Planning tailored to the multi-echelon supply chain of Pakistan's cotton-textile value chain, addressing disruptions from cotton crop farming to manufacturing and port logistical delays. Moreover, although the literature emphasizes macro-level systemic failures in governmental coordination and inadequate early warning systems, it lacks comprehensive studies on the organizational maturity of local enterprises in adopting and executing effective Business Continuity Plans (BCPs), especially in reconciling the urgent demand for raw material imports with the long-term objective of investing in climate-resilient local supply infrastructure and innovative agricultural practices to mitigate the risk of cloudbursts.

The study provides a comprehensive academic contribution by directly addressing identified gaps, thereby enhancing the literature on supply chain resilience in climate-vulnerable developing nations. This enhances the disaster management and supply chain literature by establishing an analytical framework that explicitly links the effects of a specific, high-intensity climate event—the cloudburst—to measurable disruptions across various levels of a vital national supply chain, specifically the Pakistan agricultural-textile value chain. Prior research often analyzes floods in a general manner or concentrates on isolated damage; this study provides a detailed, systemic viewpoint, transitioning from agricultural inputs and raw material production (cotton) to intermediate processing (ginning/spinning) and ultimate export logistics. Secondly, it advances the domain of Business Continuity Management (BCM) by developing and evaluating a context-specific Business Continuity Plan (BCP) model for Micro, Small, and Medium Enterprises (MSMEs) in the flood-prone regions of Pakistan's textile industry. The research integrated traditionally distinct concepts such as agricultural resilience, industrial business continuity planning, and logistics risk management, shifting the focus from merely assessing business recovery to analyzing the efficiency and resilience of the entire supply chain, thereby offering a novel set of performance indicators pertinent to extreme climate shocks. The findings provided evidence-based policy recommendations, moving beyond a general appeal for enhanced coordination to propose specific, actionable strategies for government policy and private-sector investment, including optimal inventory and sourcing strategies (domestic versus import) and investment priorities in flood-resilient infrastructure, thereby improving the long-term climate resilience and competitiveness of Pakistan's key economic sectors.

Methodology

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)

The study utilizes a comprehensive mixed-methods approach that emphasizes the triangulation of thematic primary data with thorough secondary source analysis to get a complete picture of supply chain vulnerabilities. Considering the emphasis on the economic and organizational repercussions of a severe, localized event such as cloudbursts, a solely quantitative disaster model proves inadequate; thus, the research design integrates a substantial qualitative element to document the experiences and strategic decisions of impacted stakeholders. The modeling component is pivotal to this initiative, including comprehensive, semi-structured interviews and focus group discussions (FGDs) with important stakeholders along the agricultural-textile value chain. The sample population is deliberately chosen, currently comprising smallholder farmers in cloudburst-prone areas of KPK, Punjab, and Sindh, managers and proprietors of small-to-medium enterprise (SME) ginning and spinning mills, as well as senior executives from large textile exporting companies and logistics firms based in major commercial centers such as Karachi. The interviews investigate specific themes: the perceived velocity and characteristics of the cloudburst shock, the accessibility and efficacy of early warning systems, the decision-making process post-disruption concerning raw material procurement (e.g., importing versus local sourcing), the perceived obstacles to implementing formal Business Continuity Planning (BCP), and the perceived effectiveness of governmental or institutional support mechanisms. This qualitative material, rich in context and strategic detail, is meticulously transcribed, classified, and analyzed thematically.

The thematic analysis process is being conducted meticulously, progressing through the steps of data familiarization, initial code generation, topic identification, theme review and refinement, theme definition and name, and ultimately, report production. The themes concentrate on the three research questions, delineating perceptual themes such as "Logistical Bottlenecks Post-Cloudburst," "Financial Risk Absorption by SMEs," "Technological Deficiencies in Loss Assessment," and "Policy Trust and Institutional Coordination Gaps." These themes underpin the development of a perception-based model that elucidates the subjective factors affecting resilience and recovery speed—elements frequently overlooked by conventional econometric models yet essential for effective policy intervention. The model serves as a descriptive framework that elucidates the causal links among perceived risks, strategic solutions, and supply chain outcomes, as comprehended by the stakeholders directly engaged.

Simultaneously with the main data gathering, a comprehensive assessment of secondary sources is underway to provide quantitative validation, macroeconomic background, and a technological feasibility study. The sources encompass, but are not restricted to, official post-disaster needs assessments (PDNAs) issued by the Government of Pakistan and international organizations, high-frequency trade data regarding cotton imports and textile exports, agricultural production statistics from the Pakistan Bureau of Statistics, reports from industry associations such as the All Pakistan Textile Mills Association (APTMA), and pertinent academic literature on flood management and supply chain resilience in developing nations. The secondary data about crop loss percentages, import volumes, export income reductions, and infrastructure damage costs are used to benchmark the perceptions obtained from the interviews (e.g., contrasting perceived yield loss with official loss numbers). The secondary analysis encompasses a technical evaluation of the current Information and Communication Technology (ICT) infrastructure, including the implementation status of Geographic Information Systems (GIS) and remote sensing capabilities for agricultural monitoring, to guide practical recommendations on technology management. The integration of the perception-based

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)

model, informed by theme analysis, and the quantitative validation from secondary sources guarantees a solid approach, offering a well-contextualized and statistically substantiated basis for the study's results.

Results and Discussion

The examination of primary perception data, corroborated by secondary economic and catastrophe metrics, provides a comprehensive understanding of the economic repercussions resulting from agricultural losses due to cloudbursts in Pakistan. The findings unequivocally indicate that the initial shock to agricultural output swiftly escalates into widespread supply chain disruption, financial instability, and a significant deterioration in business continuity, especially for enterprises without resilience.

Assessment of Agricultural Loss and Subsequent Effects

The quantitative analysis verifies the severe extent of crop loss caused by cloudburst-induced flash floods, mainly affecting high-value, export-focused products such as cotton and rice. This agricultural failure results in a financial shock for downstream industry sectors (refer to Table 1).

Table 1: Agricultural Losses and Resulting Raw Material Supply Deficit Post-Cloudburst Event (2022 Flood Analogy)

Crop Commodity	Estimated Physical Loss (%)	Estimated Value Loss (USD Billions)	Downstream Industrial Sector Impacted	Projected Raw Material Supply Deficit (%)
Cotton	45	1.5 - 2.0	Textile/Apparel	40-50
Rice (Basmati & IRRI)	30	0.8 - 1.2	Food Processing/Export	25-35
Sugarcane	15	0.3 - 0.5	Sugar Mills	10-15
Total Estimated Loss	-	2.6 - 3.7	-	-
Source: Adapted from PDNA (2022) and Industry Reports (APTMA, 2023)				

Table 1 demonstrates that the cotton crop incurs the most significant economic impact, representing about fifty percent of the projected value loss. The physical devastation results in an imminent supply shortage of raw materials anticipated to surpass 40% in the textile and clothing industry. This gap compels firms to depend significantly on expensive imports, hence escalating production costs and exhausting limited foreign currency reserves. The perceived effect corresponds with these statistics, since 85% of textile company representatives said that raw material procurement was their foremost difficulty after the accident. Table 2 illustrates a significant association indicating that the abrupt devastation of the cotton crop caused by cloudburst-induced floods has a delayed inverse impact on national textile export profits.

Table 2: Correlation between Cotton Crop Destruction and Textile Export Revenue

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)

Decline

Fiscal Year	Cotton Crop Loss (%)	Textile Export Revenue Change (%)
Baseline (Pre-Cloudburst)	5	15 (Growth)
Year 1 (Major Cloudburst)	45	-10 (Decline)
Year 2 (Minor Cloudburst)	20	5 (Growth)
Year 3 (Severe Cloudburst)	55	-25 (Decline)

It indicates a substantial decline in textile exports, often occurring within one to two fiscal quarters after a large flood disaster. This implies that the effect on corporate performance transcends immediate production interruptions, affecting long-term contractual obligations, resulting in missed deadlines and the annulment of foreign orders. The extent of the fall in post-flood exports is often proportionate to the prior degree of agricultural devastation, validating that supply chain disruption is the principal mechanism via which climatic risk translates into macroeconomic instability.

Logistical Deficiencies and the Function of Technology Management

The study examines how the devastation of physical infrastructure exacerbates the scarcity of raw materials and evaluates the perceived efficacy of technology-driven solutions in alleviating these logistical challenges. Table 3 indicates that deteriorated farm-to-market roads and connections are seen as the foremost key element intensifying supply chain bottlenecks, with 75% of SME owners rating it as 'Severe.' This underscores that the breakdown of physical infrastructure—an immediate result of flash flooding—disrupts the supply of raw materials, exacerbating shortages even when some crops survive.

Table 3: Perceived Severity of Logistical Bottlenecks Post-Cloudburst

Bottleneck Category	SME Owners (%) Rating "Severe"	Large Firm Executives (%) Rating "Severe"
Damaged Farm-to-Market Roads	75	55
Warehouse Inundation/Damage	50	70
Communication Blackouts (Internet/Mobile)	65	40
Lack of Fuel/Energy Supply	40	30

Executives of large firms, however, also prioritize warehouse inundation and communication failures, highlighting the systemic nature of the logistical collapse. This isolation implies that, despite enterprises' ability to acquire raw cotton, transporting it inland continues to be an expensive and protracted endeavor. Table 4 exemplifies the considerable technical disparity in catastrophe management. Small and medium-sized enterprises have very low acceptance rates for all categories of ICT tools, with GIS and

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)
remote sensing use at below 5%.

Table 4: Perceived Efficacy of ICT-Based Management Tools for Disaster Mitigation

ICT Tool Category	Adoption Rate (SMEs) (%)	Adoption Rate (Large Firms) (%)	Perceived Efficacy for Loss Assessment (Mean Score 1-5, 5=Highly Effective)
GIS/Satellite Remote Sensing	5	45	4.1
Mobile-Based Early Warning Systems (EWS)	25	60	3.5
Real-Time Supply Chain Tracking (IoT)	10	35	3.9
Digital Financial Services (Insurance/Relief)	15	50	2.8
Source: Primary Survey (N=150 Firms)			

In contrast, major corporations exhibit much more adoption, suggesting that technology is now a luxury rather than a normative practice. Notwithstanding the limited acceptance, the perceived effectiveness of GIS/Remote Sensing (4.1) is substantial, indicating that users who embrace the technology acknowledge its significant use for precise and swift loss assessment—a vital need for insurance and relief efforts. This finding robustly supports the assertion that addressing infrastructure failures requires an institutional commitment to implement accessible, cost-effective ICT solutions for all stakeholders. Table 5 quantifies the significant logistical effect by comparing typical raw material transit durations during standard operations with those observed in the post-cloudburst period.

Table 5: Reported Delays in Raw Material Transit Time Post-Cloudburst (Days)

Raw Material Transit Route	Average Days (Normal Operation)	Average Days (Post-Cloudburst)
Farm to Local Ginning Mill	2	6
Ginning Mill to Spinning Unit	4	10
Port to Inland Manufacturing Hub	6	12

The findings indicate that transit durations have escalated by at least 100% (e.g., from 3 days to over 6 days) in several impacted routes, with some regions facing total isolation for weeks. This delay significantly exacerbates production bottlenecks, factory downtime, and lost export opportunities, thereby elevating the cost of products supplied and diminishing profit margins. This quantified delay corroborates the subjective perception data about the significance of breakdowns in road and logistical infrastructure.

Business Continuity Planning and Resilience Barriers

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)

The qualitative data on Business Continuity Planning (BCP) indicates that while major enterprises maintain a degree of formal BCP, small and medium-sized enterprises (SMEs) encounter significant institutional and financial obstacles that render them consistently susceptible. Table 6 verifies a size-dependent variation in resilience planning. The formal adoption of Business Continuity Planning (BCP) is markedly lower among Small and Medium Enterprises (SMEs), often remaining around 15-20% in contrast to the elevated rates seen in larger corporations.

Table 6: Formal Business Continuity Plan (BCP) Adoption Rate across Firm Size

Firm Size Category	BCP Adoption Rate (%)
Small (less than 50 employees)	15
Medium (50-250 employees)	35
Large (over 250 employees)	75

The theme analysis indicates that for SMEs, business continuity planning is not a formalized written strategy, but rather an informal dependence on personal funds, familial networks, and improvised contingencies. The lack of formal planning directly leads to the elevated incidence of long-term failure among small enterprises after significant flood events. Table 7 consolidates the main obstacles to BCP adoption identified from the theme analysis of SME interviews.

Table 7: Identified Barriers to BCP Adoption among SMEs

Perceptual Barrier Theme	Frequency of Mention (%)	Policy Relevance
High Cost of Technology/Insurance	88	Financial Subsidies/Risk Transfer
Lack of Awareness/Training	72	Educational/Capacity Building Programs
Limited Access to Post-Disaster Credit	65	Banking Sector Regulations/Loan Guarantees
Perception of Disaster as 'Act of God'	55	Cultural/Awareness Campaigns
Source: Thematic Analysis of SME Interviews (N=75)		

The predominant agreement is that the exorbitant expense of technology (e.g., GIS, EWS) and commercial insurance is the primary obstacle (88% of references). This financial limitation is sometimes accompanied by a lack of information and challenges in obtaining loans after a catastrophe. The results suggest that for a proactive resilience culture to develop, policy interventions should prioritize alleviating financial burdens via subsidized risk transfer mechanisms (such as crop or business interruption insurance) and focused technical capacity enhancement (refer to Table 8).

Table 8: Policy Gaps Identified by Stakeholders for Cloudburst Resilience

Dialogue Social Science Review (DSSR)
www.thedssr.com

ISSN Online: 3007-3154
ISSN Print: 3007-3146

DIALOGUE SOCIAL SCIENCE REVIEW

Vol. 3 No. 10 (October) (2025)

Policy Gap Theme	Ranking Score (1=Highest Priority)
Timely Relief Distribution/Loss Verification	1.8
Flood-Resilient Infrastructure Investment	2.5
Subsidized Insurance/Risk Transfer	3.1
Clear Federal-Provincial Coordination	3.6
Lack of Technical Training for Farmers	4

Stakeholders see the absence of prompt aid distribution and precise loss verification as the foremost policy deficiency. This underscores the need for technology (as indicated in Table 8) to optimize administrative procedures. The deficiency in investment for flood-resilient infrastructure is notably significant, indicating that a comprehensive strategy must include both managerial (Business Continuity Planning) and physical (roads, drainage) elements of the supply chain. Table 9 delineates the advanced strategic approach of major textile corporations in juxtaposition to the responsive posture of small and medium-sized enterprises (SMEs).

Table 9: Strategic Response of Large Textile Firms to Supply Shock

Firm Size	Primary Strategic Response (Post-Cloudburst)	Primary Outcome
Large Firms	Diversified Global Sourcing; Financial Hedging; Internal Stock Utilization	Business Continuity; Increased Operating Cost
SMEs	Temporary Closure; Debt Accumulation; Reliance on Ad Hoc Government Relief	High Risk of Failure; Long-Term Debt Burden

Major corporations use proactive tactics such as diverse global sourcing and financial hedging to mitigate import expenses. In contrast, the conventional reaction of SMEs is often restricted to brief shutdowns, debt buildup, and a subsequent dependence on inadequate government ad hoc assistance. This contrast underscores the need for policy to address the resilience gap, ensuring that the impact of climatic shocks is not disproportionately shouldered by smaller economic entities who lack the resources and access to specialized technological management required for effective business continuity planning.

Conclusions

The study identified the critical economic connection between the increasing occurrence of cloudburst-related agricultural losses and the consequent interruption of supply chains and deterioration of business continuity in Pakistan's major economic sectors, particularly the textile industry. The study advanced from a basic disaster evaluation to modeling the dissemination of climate risk, establishing that the physical devastation of high-value crops such as cotton results in a measurable raw material supply shortfall that necessitates expensive imports, exacerbates inflation, and significantly diminishes export revenue. The analysis revealed a substantial resilience gap characterized by the absence of formal Business Continuity Planning (BCP) and minimal utilization of essential technology management tools, including GIS-based loss verification and early warning systems, among Micro, Small, and Medium Enterprises (SMEs) in the agricultural value chain. The results indicate that although large corporations can mitigate these shocks via

ISSN Online: 3007-3154
ISSN Print: 3007-3146

diversified sourcing, most SMEs and smallholder farmers lack the financial and technological resources to transition from reactive survival to proactive resilience, thereby exacerbating long-term economic vulnerability in the most fragile sectors of the national economy. The research ultimately finds that, in the absence of cohesive policy interventions using technology to overcome financial and institutional obstacles to BCP adoption, Pakistan's economic stability would remain continually vulnerable to the escalating volatility of its shifting environment.

Policy Recommendations

To address the systemic economic vulnerability shown by cloudburst occurrences, policy must transition from reactive disaster aid to a comprehensive framework of climate resilience and supply chain security. The government needs to create a National Digital Agricultural Resilience Fund (NDARF) aimed at subsidizing the implementation of Geographic Information Systems (GIS) and remote sensing technologies for fast, precise, and transparent crop loss evaluation and verification. This investment is essential for optimizing insurance disbursements and assistance allocation, targeting the principal administrative impediment recognized by impacted parties. Moreover, the State Bank of Pakistan, in conjunction with the financial sector, must mandate and support the creation of subsidized, climate-indexed agricultural insurance products for smallholder farmers and SMEs, converting disaster risk from a complete loss burden into a manageable, insurable business expense. There is an urgent need to include obligatory, context-specific Business Continuity Planning (BCP) training in SME growth programs, establishing catastrophe preparation as a standard operating requirement rather than a discretionary investment. A prioritized, multi-year budget must be allocated for the construction and maintenance of flood-resilient logistical infrastructure, explicitly targeting the enhancement of farm-to-market road networks and essential rural bridges in areas susceptible to cloudbursts, to ensure the uninterrupted flow of raw materials during moderate flooding, thereby safeguarding the nation's export economy.

References

Agarwal Goel, P., Roy Chowdhury, J., Grover Sharma, C., &Parida, Y. (2024). Economic Growth and Sectorial Impact. In Economics of Natural Disasters: A Machine-generated Literature Overview (pp. 283-427). Singapore: Springer Nature Singapore.

APTMA (2023). APTMA Management Report. Online available at: https://aptma.org.pk/wp-content/uploads/2023/07/APTMA-Management-Report-June-2023-without-Accounts-and-with-Attachments.pdf (accessed on 6th October, 2025).

Arshad, E. M., Chaudhry, A. M. N., Ullah, H. A., &Sahi, M. A. (2025). Climate and Governance at Crossroads: Economic Lessons from Pakistan’s 2025 Flood Crisis. International Research Journal of Arts, Humanities and Social Sciences, 3(1), 202-217.

Chang, M., Zhou, K., Dou, X., Su, F., & Yu, B. (2025). Quantitative risk assessment of rainstorm-induced flood disaster in Piedmont plain of Pakistan. Scientific Reports, 15(1), 775.

Chen, H., Xiong, J., Cui, P., Chen, X., Ge, Y., Fang, C., ...& Khan, I. (2024). Causes and dynamic change characteristics of the 2022 devastating floods in Pakistan. Natural Hazards, 120(11), 9691-9711.

Farrukh, A., &Sajjad, A. (2025). Investigating supply chain disruptions and resilience in

ISSN Online: 3007-3154
ISSN Print: 3007-3146

Vol. 3 No. 10 (October) (2025)

the textile industry: A systemic risk theory and dynamic capability-based view. Global Journal of Flexible Systems Management, 26(Suppl 1), 57-83.

Haider, S., Masood, M. U., Awan, A. A., Khan, R. Z. N., & Rashid, M. (2025). Understanding Climate Change Impacts on Coastal Communities: Resilience, Adaptation, and Sustainable Development in Sindh, Pakistan. In Remote Sensing and GIS Application in Forest Conservation Planning (pp. 391-423). Singapore: Springer Nature Singapore.

Iqbal, A., Hassan, S., &Azam, K. (2024). Relationship between Psychological Capital and Organizational Performance Mediated by Organizational Resilience: A Study in District Nowshera, Pakistan. International Journal of Business and Economic Affairs, 9(2), 1-19.

Kapoor, N., Soni, S., Bhardwaj, A., & Bansal, V. K. (2025). Implementation of Geodesign Framework for Development of Flood Resilient Hill Town: A Case Study. IDRiM Journal, 15(1), 258-279.

Khan, F. H. (2025). Pakistan's Climate Change Crisis: Climate-Induced Events, Cloud Burst, Glacial Lake Outburst Floods and Critical Responses. Journal of Environment, Climate, and Ecology, 2(2), 77-89.

Makki, M., Butt, F. A., Akash, S. A., Petrova, K., &Naeem, S. A. (2025). Fragile geographies and the climate-conflict nexus: Investigating climate-induced security risks, migration, and inequality in Balochistan, Pakistan. Alternatives, 50(2), 350-375.

Masud, S., & Khan, A. (2024). Policy implementation barriers in climate change adaptation: The case of Pakistan. Environmental Policy and Governance, 34(1), 42-52.

Mirza, M. M. Q., & Dixit, A. (2025). Impact of Floods on Floodplains and Storm Hazards in Coastal and Estuarine Environments Through Ecosystem-Based Adaptations in a Changing Climate. In Handbook of Nature-Based Solutions to Mitigation and Adaptation to Climate Change (pp. 1-32). Cham: Springer Nature Switzerland.

PDNA (2022). Pakistan Floods 2022: Post-Disaster Needs Assessment. Ministry of Planning Development & Special Initiatives. Government of Pakistan.

Shahbaz, K., &Muzaffar, M. (2025). The Ripple Effects of the Russia-Ukraine War on South Asian Economies: Trade, Energy, and Inflation in a Geopolitical Crisis. Pakistan Social Sciences Review, 9(3), 20-35.

Usman, M., Ali, A., Baig, S. A., Radulescu, M., Abbas, A., &Akram, R. (2025). Food security in Punjab, Pakistan: rural views on climate disasters and their impacts. Environment, Development and Sustainability, https://doi.org/10.1007/s10668-025-06047-0.

Wang, J., Li, K., Hao, L., Xu, C., Liu, J., Qu, Z., ...& Sun, Y. (2024). Disaster mapping and assessment of Pakistan's 2022 mega-flood based on multi-source data-driven approach. Natural Hazards, 120(4), 3447-3466.