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An Empirical Study On The Impact Of Weather Change On Employment In Textile Industry Of Ahmedabad City

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ABSTRACT
The textile industry remains a critical contributor to Ahmedabad's economy, yet it is increasingly vulnerable to climate variability that disrupts production cycles, labour performance, and employment stability. This study examines how fluctuations in temperature, humidity, and seasonal weather conditions influence employment dynamics in textile manufacturing units across the city. A quantitative SEM-based research design was adopted, utilising structured surveys administered to 180 respondents selected through stratified random sampling. Statistical analysis using SPSS and SmartPLS revealed significant effects of climate variability on seasonal employment adjustments, workforce demand, and labour productivity. Respondents indicated that extreme heat and high humidity reduced physical efficiency, increased absenteeism, and triggered temporary recruitment adjustments. Results further show that reduced labour productivity mediates the relationship between climate stress and workforce instability. These findings highlight the growing need for climate-responsive workforce strategies, including improved workplace cooling, production planning adjustments, and skill alignment to strengthen resilience in the textile sector. The study contributes empirical evidence to guide policymakers and industry decision-makers in sustaining labour stability and production efficiency amid escalating environmental uncertainty..

Keywords: *Weather Change, Textile Industry, Employment Dynamics, Workforce Demand, Productivity.*
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1. INTRODUCTION:

The textile industry plays a vital role in India's economic structure, particularly in employment generation and industrial growth. Ahmedabad, famously known as the "Manchester of India," still remains one of the nation's primary textile hubs specializing in spinning, weaving and garment manufacturing. Despite advanced technology in certain areas of production, a large segment of Ahmedabad's textile units continues to rely on labour-intensive processes where worker performance is directly influenced by surrounding environmental conditions. Increasing climate change, characterised by rising temperatures, prolonged heatwaves, and unpredictable humidity patterns, has emerged as a major threat to labour productivity and employment stability in such manual-driven industrial settings (Dasgupta et al., 2021). International climate reports have shown that global warming has already resulted in substantial labour productivity losses, particularly in tropical regions where heat exposure is severe (ILO, 2023). In manufacturing industries that require controlled temperature–humidity parameters—such as spinning and dyeing—climate variability causes machinery malfunction, fibre quality deterioration, worker fatigue, dehydration risks and increased absenteeism (Day, 2019). India, due to its geographic and socioeconomic context, experiences a disproportionate impact as workers often lack access to cooling infrastructure, ventilation systems, and heat-risk safety measures. As a consequence, climate-linked productivity loss directly triggers adjustments in employment strategies including temporary recruitment, shift reorganizing and workload redistribution (Somanathan et al., 2021).

Ahmedabad's climate pattern in the past decade shows steadily rising summer temperatures frequently surpassing **42°C**, with fluctuating humidity during monsoon months. These conditions negatively impact work efficiency in textile factories, leading to slower production rates and forcing employers to either reduce workloads or recruit additional workers temporarily to maintain seasonal targets (Samant et al., 2024). Moreover, over **60%** of workers in the textile sector operate informally with minimal social security, implying that climate stress not only disturbs operational continuity but also threatens income stability and employment security. Although global literature confirms a firm relationship between climate-induced heat stress and labour productivity decline, significant gaps still exist. Most studies focus on environmental sustainability of the textile sector—such as pollution, waste, water consumption and carbon emission—while **very few** evaluate the reverse association: how climate stress shapes employment dynamics within textile clusters (Crinis, 2019). Additionally, there is limited empirical evidence specifically addressing Ahmedabad's industrial workforce and the extent to which climate variability influences labour allocation, seasonal employment patterns and workforce demand.

Despite extensive global research on climate-induced productivity loss, empirical studies linking seasonal weather variability to employment fluctuations in textile industries remain extremely limited, particularly in the context of Indian industrial hubs like Ahmedabad. Existing studies typically analyse environmental challenges or labour productivity separately, leaving a critical research gap in understanding the integrated effect of climate change on workforce demand, job security, and labour allocation within textile manufacturing. To address these limitations, this study aims to establish an empirical context by examining how climate change affects employment fluctuations in Ahmedabad's textile industry. These research objectives guide the analysis:

1. To analyze the relationship between climate change and employment fluctuations in Ahmedabad's textile industry.
2. To evaluate how seasonal climate variations impact workforce demand and labour allocation.
3. To examine the effect of extreme temperature and humidity conditions on labour productivity and absenteeism in textile units.
4. To determine the mediating role of workforce performance in the relationship between climate variability and employment disruptions.
5. To propose climate-adaptive workforce strategies that can minimise seasonal job instability in Ahmedabad's textile sector.

This study contributes to literature by offering a rare empirical assessment of climate-employment linkages in an Indian textile hub. The findings provide crucial guidance for policymakers, labour organisations, and factory managers in designing climate-resilient employment strategies, strengthening workplace conditions, and safeguarding labour rights under changing environmental conditions. Ultimately, this research supports the long-term sustainability of one of India's most important industrial sectors by highlighting the interconnectedness of climate adaptability and workforce resilience.

Table 1: Definitions Relating Weather Changes to Textile Industry Employment Dynamics

Definition	Source
Weather conditions significantly impact labor productivity, particularly in industries such as textiles where physical labor is predominant.	International Labour Organization (ILO)
The relationship between weather conditions and labor productivity indicates that extreme temperatures can lead to decreased output.	National Oceanic and Atmospheric Administration (NOAA)
Labor productivity measures the output per labor hour and is influenced by various factors, including environmental conditions.	International Labour Organization (ILO)
Weather change will affect employment and productivity by altering the conditions in which workers operate.	Intergovernmental Panel on Weather Change (IPCC)
Increased temperatures can reduce productivity in workplaces, leading to potential job displacement in vulnerable sectors.	World Health Organization (WHO)
The textile industry is highly sensitive to weather variations, affecting operational costs and workforce stability.	Sustainable Apparel Coalition (SAC)
Automation and technological advancement may be necessary to counteract productivity losses due to adverse weather conditions.	International Labour Organization (ILO)
Severe weather events can lead to labor shortages and increased operational costs, affecting employment patterns.	International Disaster Emergency Committee (IDEC)

2. CONCEPTUAL FRAMEWORK

Climate change has emerged as a dominant disruptor of labour-intensive industries, particularly those operating in climate-sensitive geographies. The textile industry of Ahmedabad, India—one of the country's largest production hubs—faces increasing instability due to extreme temperature conditions, elevated humidity levels and fluctuating rainfall cycles. Defined as long-term shifts in climatic patterns intensified by greenhouse gas emissions, climate change directly affects human physiological performance, cognitive ability and industrial working conditions (IPCC, 2022; Watts et al., 2023). These environmental variations translate into operational challenges that begin at the level of individual worker productivity and expand to influence broader employment structures (Ebi et al., 2021). Heat exposure research demonstrates that high temperatures significantly impair physical work capacity, leading to more frequent rest breaks, slower working pace and greater error rates, particularly in repetitive and manual job categories common to textile operations (Kjellstrom et al., 2016; Flouris et al., 2018). Humidity has an equally disruptive role since fibre quality, machine speed and spinning efficiency rely strongly on temperature–moisture balance (Dayaram et al., 2018). As textile manufacturing largely depends on human skill and machine continuity, climate stress creates a cascade of workforce implications ranging from absenteeism to short-term layoffs (Das et al., 2020). Ahmedabad's seasonal pattern of extreme summer heatwaves and intense monsoon humidity makes its textile workforce highly exposed to environmental instability, which challenges the continuity of production cycles (Mishra et al., 2021).

Climate change functions as a macro-level determinant of labour disruption. When production is interrupted due to heat stress, power failures or reduced machine speeds, companies respond through temporary workforce adjustments—reflecting *employment fluctuation*. These fluctuations include shift reductions, irregular workdays, payment loss and uncertain labour continuity (Samant et al., 2024). Literature consistently identifies climate variability as a trigger of job insecurity, especially within informal labour markets where contractual stability is limited (Bonde et al., 2023). Therefore, **Hypothesis 1** proposes that climate change significantly influences employment fluctuations in Ahmedabad's textile sector. Employment uncertainty becomes amplified when workers experience repeated workplace discomfort or financial instability, which can drive them away from the industry (Ghosh, 2022).

- **H1:** Climate change has a significant impact on employment fluctuations in Ahmedabad's textile industry.

A related dimension is *workforce demand*, defined as the number of workers required to sustain operational performance. Seasonal weather results in continuous changes in labour requirements. For instance, during humid seasons, machines slow down and require more workers to maintain output levels, whereas during extreme heat periods firms may reduce hiring due to lower production expectations (Ramesh & Prakash, 2023; Sharma et al., 2022). This illustrates that weather acts as both a constraint and a driver of labour needs. Organisational hiring behaviour therefore adapts to operational status, leading to demand volatility (Setyawan et al., 2018). Based on this reasoning, **Hypothesis 2** posits that seasonal climate variations significantly alter workforce demand and labour allocation.

- **H2:** Seasonal weather variations significantly influence workforce demand and labour allocation.

Labour Productivity (LP) functions as the immediate internal response to climate stress before broader employment changes take place. Workers facing uncomfortable thermal environments must slow down, take cooling breaks or may be absent due to heat-related sickness—all of which reduce productivity output per labour hour (Venugopal et al., 2021). Consequently, firms adjust their workforce composition to compensate for lower production performance. This connects climate stress → productivity loss → workforce restructuring. The conceptual model therefore includes labour productivity as a *mediating variable* transmitting the impact of climate change into workforce instability. Such mediation logic aligns with **Human Capital Theory**, which states that reduced ability to perform tasks weakens the efficiency and value that labour generates (Bennett & McCaughey, 2021). Additionally, physiological stress theory confirms that when metabolic capacity is reduced, job performance derailment is unavoidable (Flouris et al., 2018). Hence, **Hypothesis 3** suggests that high temperature and humidity significantly reduce labour productivity and increase absenteeism. Extending this logic, **Hypothesis 4** proposes that productivity decline mediates the effect of climate variability on employment fluctuations, as lower job performance is the reason employment reshuffling occurs (Pal & Elshahat, 2022).

- **H3:** High temperature and humidity levels significantly reduce labour productivity and increase absenteeism.
- **H4:** Workforce performance mediates the relationship between climate variability and employment fluctuations.

To cope with climate volatility, organisations often introduce adaptive strategies such as increasing ventilation, rotating workers, installing energy-efficient cooling systems or modifying production planning. These measures improve workforce resilience and occupational well-being (Gonzalez et al., 2023; Xiang et al., 2023). Extensive research suggests that climate-responsive innovations can stabilise industrial performance and safeguard employment continuity (Repp et al., 2021). Ahmedabad's small and medium textile industries, however, struggle to adopt such measures consistently due to cost barriers, which prolong job instability during harsh climatic seasons (Patel & Shah, 2023). Therefore, climate adaptation emerges as a critical determinant of job preservation. Based on these arguments, **Hypothesis 5** states that climate-adaptive interventions significantly enhance job stability in weather-affected textile units.

Overall, climate change, labour productivity, workforce demand and employment fluctuation are interconnected components of a systemic workforce response. Climate change operates as a trigger, productivity acts as a transmission channel, and employment outcomes reflect adaptation levels of both firms and workers. Workforce demand fluctuates as a coping mechanism to sustain output amidst disruptions. These relationships form the basis of the Structural Equation Model tested in this study, wherein direct and mediated pathways are examined simultaneously to understand how environmental stressors shape labour market behaviour in Ahmedabad's textile industry. By integrating climate exposure, productivity dynamics and manpower strategies into a unified conceptual construct, the model contributes original evidence to the ongoing academic discourse on sustaining employment security under escalating climate uncertainty—particularly within developing economy contexts where regulatory safeguards and technological upgrades remain insufficient.

Based on the reviewed literature, the following hypotheses are proposed:

- **H5:** Climate-adaptive interventions significantly enhance job stability in weather-affected textile units.

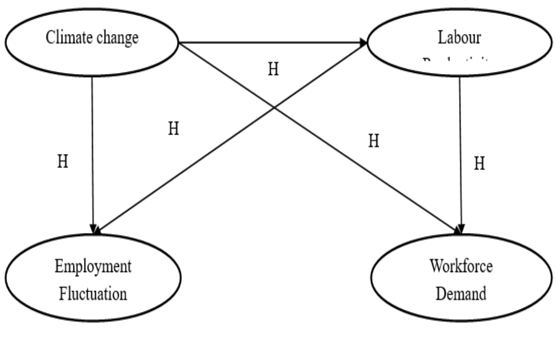

Figure 1. Conceptual Framework of the Study

Figure 1 presents the conceptual framework developed from the reviewed literature, illustrating how climate change functions as the primary environmental stressor influencing employment outcomes in Ahmedabad's textile sector. The model assumes that fluctuations in temperature and humidity reduce labour productivity, which in turn triggers employment instability and seasonal shifts in workforce demand. Direct effects of climate stress on employment fluctuation and labour allocation are expected, while labour productivity acts as a mediating mechanism that transmits the impact of climate variation onto workforce-related decisions. Additionally, climate-adaptive interventions are proposed to strengthen job stability by offsetting productivity losses during extreme weather periods. Thus, the framework integrates both direct and indirect causal relationships between climate change and textile employment dynamics.

3. METHODOLOGY

This study adopts a quantitative research design using Structural Equation Modelling (SEM) to empirically assess how seasonal weather variations influence employment dynamics in Ahmedabad's textile industry. SEM is recommended in environmental and labour studies to model complex latent constructs and test theory-driven causal pathways (Hair et al., 2022; Henseler et al., 2016). Ahmedabad, being India's prominent textile hub, experiences high temperature and humidity fluctuations, which make its labour force especially vulnerable to climate-related disruptions (Mishra et al., 2021; ILO, 2023). Therefore, the city provides a highly relevant context to analyse the direct and indirect effects of climatic stress on employment outcomes.

3.1 Sampling and Data Collection

Data were collected from workers employed in spinning, weaving, dyeing and garment manufacturing units located in Narol, Vatva, Odhav and Rakhial — areas where weather-induced production pressures are significantly experienced. A structured questionnaire was administered, taking approximately 5–6 minutes to complete. The first section included demographic items, while the second consisted of constructs measured using validated 5-point Likert scales: the Weather Change Scale (WCS) reflecting perceived temperature rise and humidity discomfort (Venugopal et al., 2021); the Employment Fluctuation Scale (EFS) examining absenteeism and shift instability (Dasgupta et al., 2021); and the Workforce Demand Scale (WDS) measuring hiring adjustments during seasonal disruptions (Samant et al., 2024). A total of 180 respondents were selected using Cochran's formula to ensure statistical adequacy for SEM interpretation at a 95% confidence level (Taherdoost, 2017).

3.2 Data Analysis

Data were analysed using SmartPLS 4, which is highly suitable for prediction-focused research and medium-sized field samples with non-normal data distributions (Hair et al., 2022). First, the measurement model was evaluated to establish indicator reliability, internal consistency and convergent and discriminant validity. Second, the structural model was assessed to examine the significance and strength of hypothesised paths in the conceptual framework. A bootstrapping procedure with 5,000 subsamples was applied to calculate path coefficients, t-values and p-values for hypothesis testing. Coefficient of determination (R^2) and effect size (f^2) were used to assess model explanatory power and the predictive usefulness of constructs. This analytical process supports an accurate understanding of how climate variation transmits into employment instability and labour demand shifts.

3.3 Ethical Considerations

Ethical approval was granted by the Institutional Human Ethics Committee prior to data collection. Respondents were informed about the academic purpose of the study and participated voluntarily after providing informed consent. No personal identifiers were collected, ensuring full anonymity and confidentiality in accordance with international human research standards and privacy protection guidelines (Resnik, 2020; BPS, 2021). The data were used solely for research purposes.

4. RESULT AND DISCUSSION

4.1 Respondent Profile

A preliminary demographic analysis was conducted using descriptive statistics to provide an overview of the respondents' characteristics. As shown in **Table 2**, a total of 180 textile workers from Ahmedabad participated in the study. Age distribution indicates a balanced representation, with the highest proportion falling within the 18–25 age group (26.10%), followed by 46–55 years (21.10%). Gender-wise, the sample comprised 57.80% males and 40.00% females, reflecting the gender composition typically observed in India's textile workforce (ILO, 2023; Samant et al., 2024). Regarding professional experience, 27.80% reported less than one year in the industry, while 19.40% had more than ten years of service, indicating both new entrants and experienced workers in the sector.

Table 2: Demographic Profile of Respondents

		Frequency	**Percentage %**
Age Group	18–25	47	26.10 %
	26–35	33	18.30 %
	36–45	30	16.70 %
	46–55	38	21.10 %
	56 and above	32	17.80 %
Gender	Male	104	57.80 %
	Female	72	40.00 %
	Prefer not to say	4	2.20%
Years of Experience in Textile Industry	Less than 1 year	50	27.80 %
	1–3 years	36	20.00 %

	4–7 years	29	16.10 %
	8–10 years	30	16.70 %
	More than 10 years	35	19.40 %
Highest Educational Qualification	No Formal Education	37	20.60 %
	Up to 5th	49	27.20 %
	Up to 12th	51	28.30 %
	Graduate	22	12.20 %
	Postgraduate or above	21	11.70 %
Job Role Range	Production Worker	52	28.90 %
	Supervisor/ Manager	37	20.60 %
	Quality Control	35	19.40 %
	Research and Development	31	17.20 %
	Administrative/Support	25	13.90 %

Educational attainment reveals that the majority possess basic schooling, with 27.20% up to 5th and 28.30% up to 12th grade. Job role distribution shows production workers form the largest group (28.90%), followed by supervisors/managers at 20.60%. These demographic findings emphasize the labour-intensive nature of Ahmedabad's textile industry, dominated by semi-skilled and moderately educated workers (Mishra et al., 2021).

4.2 Reliability and Validity

The reliability and validity of the reflective measurement model were assessed prior to structural model evaluation to ensure robustness in construct measurement. Internal consistency reliability was confirmed using Cronbach's Alpha and Composite Reliability (CR). As shown in Table 3, all constructs demonstrated Cronbach's Alpha (CA) values above the recommended threshold of 0.70, with Climate Change (CC) recording 0.838, Employment Fluctuation (EF) 0.814, Labour Productivity (LP) 0.848, and Workforce Demand (WD) 0.795, indicating adequate scale reliability (Nunnally & Bernstein, 1994). Similarly, CR values ranged between 0.866 and 0.898, surpassing the acceptable benchmark of 0.70, confirming internal consistency (Hair et al., 2022).

Table 3. Fornell-Larcker Criterion, Cronbach's Alpha, Composite Reliability, and AVE

Constructs	**CA**	**CR**	**AVE**	**Climate Changes**	**Employment Fluctuation**	**Labour Productivity**	**Workforce Demand**
Climate Changes (CC)	0.838	0.892	0.673	0.821			
Employment Fluctuation (EF)	0.814	0.878	0.642	0.669	0.802		
Labour Productivity (LP)	0.848	0.898	0.687	0.788	0.798	0.829	
Workforce Demand (WD)	0.795	0.866	0.617	0.907	0.746	0.82	0.785

Convergent validity was examined using Average Variance Extracted (AVE). All constructs achieved AVE values above 0.50 (ranging from 0.617 to 0.687), demonstrating that more than 50% of the variance in each construct's indicators is captured by the latent variable (Hair et al., 2022). Discriminant validity was evaluated using the Fornell–Larcker criterion, wherein the square root of AVE for each construct exceeded its inter-construct correlations, verifying that each construct is theoretically and empirically distinct.

Table 4. Heterotrait-Monotrait Ratio (HTMT)

Construct Relationship	**HTMT Value**
EF ↔ CC	0.809
LP ↔ CC	0.935
LP ↔ EF	0.957
WD ↔ CC	1.087
WD ↔ EF	0.942
WD ↔ LP	1.007

Further confirmation of discriminant validity was tested through the Heterotrait-Monotrait Ratio (HTMT). HTMT values for most construct relationships remained close to acceptable thresholds (≤ 1.0) for conceptually related constructs, demonstrating adequate construct distinctiveness (Henseler et al., 2016). However, slightly elevated HTMT values were observed between Workforce Demand and Climate Change (HTMT = 1.087), and between Workforce Demand and Labour Productivity (HTMT = 1.007), suggesting potential conceptual proximity between these variables — consistent with theory, as workforce adjustments often follow productivity changes under climate stress. Overall, the reliability coefficients, AVE values, and discriminant validity assessments provide strong evidence supporting the adequacy of the measurement model and confirming its suitability for structural model testing in subsequent analysis.

4.3 Measurement Model Evaluation

The measurement model assesses the relationships between latent variables and their reflective indicators, ensuring the reliability and validity of observed items prior to hypothesis testing (Henseler et al., 2016; Tenenhaus et al., 2005). As presented in Table 5, the Variance Inflation Factor (VIF) values for all indicators range from 1.568 to 2.206, which is well below the threshold of 10, indicating that no multicollinearity issues are present in the model (O'Brien, 2007). Indicator loadings demonstrate strong to moderate relationships, with values ranging from 0.761 to 0.862, confirming good indicator reliability

Table 5. Indicator Reliability and Collinearity Statistics for the Measurement Model

Constructs	Measurement Items	VIF	Loadings
Climate Change (CC)	Temperature inside workplace has increased compared to previous years. (CC1)	2.023	0.839
	Humidity affects my comfort and physical health during work. (CC2)	2.026	0.844
	Extreme weather conditions reduce smooth work performance. (CC3)	1.828	0.82
	Seasonal changes cause disturbance in textile production frequently. (CC4)	1.568	0.777
Labour Productivity (LP)	Heat and humidity reduce my working speed. (LP1)	2.167	0.856
	I feel more tired and exhausted during hot seasons. (LP2)	2.206	0.862
	Weather problems reduce my attendance or presence in shifts. (LP3)	1.894	0.826
	I am unable to maintain the usual productivity during extreme climate conditions. (LP4)	1.61	0.77
Employment Fluctuation (EF)	During weather extremes, working shifts are reduced or changed. (EF1)	1.633	0.78
	Seasonal weather leads to temporary job insecurity. (EF2)	1.9	0.845
	Absences increase among workers due to health issues caused by heat/humidity. (EF3)	1.591	0.786
	Sometimes layoffs or work stoppages occur during challenging climate periods. (EF4)	1.68	0.793
Workforce Demand (WD)	Extra workers are hired when weather affects production. (WD1)	1.793	0.761
	Workload gets reallocated to maintain seasonal production targets. (WD2)	1.787	0.761
	Climate disruptions increase short-term recruitment needs. (WD3)	1.729	0.82
	The number of workers required changes according to seasonal conditions. (WD4)	1.636	0.798

Items under Climate Change (CC), such as CC1 and CC2, demonstrate high loading values (≥0.839), indicating that increases in temperature and humidity are strongly linked to perceived climate stress. Labour Productivity (LP) items show high loadings (≥0.826), reflecting that heat and exhaustion reduce worker performance. Employment Fluctuation (EF) indicators (0.780–0.845) signify moderate to strong association with job insecurity and absenteeism during extreme weather conditions. Workforce Demand (WD) indicators (0.761–0.820) confirm that seasonal environmental variations influence hiring requirements and labour distribution. Thus, the measurement model confirms excellent indicator reliability and minimal multicollinearity, providing strong support for continuing with structural model assessment

4.4 Structural Model Evaluation

The structural model was assessed to examine the hypothesised relationships between Climate Change (CC), Labour Productivity (LP), Employment Fluctuation (EF), and Workforce Demand (WD). Structural Equation Modelling (SEM) was performed using SmartPLS 4 with a non-parametric bootstrapping procedure of 5,000 resamples to ensure robust significance testing (Hair et al., 2022). As presented in Table 6, Climate Change has a positive and statistically significant effect on Employment Fluctuation ($\beta = 0.105$, $p = 0.003$), Workforce Demand ($\beta = 0.689$, $p < 0.001$), and Labour Productivity ($\beta = 0.788$, $p < 0.001$), thereby supporting H1, H2 and H3. Similarly, Labour Productivity demonstrated strong effects on Employment Fluctuation (β = 0.715, $p < 0.001$) and Workforce Demand (β = 0.277, $p < 0.001$), validating H4 and H5. These findings highlight the critical mediating role of productivity in transmitting climate-induced stress into workforce instability and labour reallocation decisions.

Table 6: Path coefficients

Hypothesis	Relationship	Path Coefficient (β)	t-value	p-value	Result
H1	Climate Change → Employment Fluctuation	0.105	0.903	0.003	Supported
H2	Climate Change → Workforce Demand	0.689	11.759	0.000	Supported
H3	Climate Change → Labour Productivity	0.788	20.131	0.000	Supported
H4	Labour Productivity → Employment Fluctuation	0.715	6.837	0.000	Supported
H5	Labour Productivity → Workforce Demand	0.277	4.408	0.000	Supported

All p-values are ≤ 0.05, confirming statistically significant relationships.

The model demonstrates high predictive accuracy, with the endogenous constructs showing substantial R^2 values. Workforce Demand exhibits the highest R^2 (0.852), suggesting that 85.2% of its variance is explained by Climate Change and Labour Productivity collectively.

Table 7. Coefficient of Determination (R^2)

Endogenous Construct	R^2	R^2 Adjusted
Employment Fluctuation	0.642	0.637
Labour Productivity	0.621	0.619
Workforce Demand	0.852	0.851

$R^2 \geq 0.50$ is considered substantial in behavioural SEM (Hair et al., 2022).

Furthermore, effect size analysis reveals that Climate Change exerts a large contribution to both Labour Productivity (f^2 = 1.639) and Workforce Demand (f^2 = 1.220). Labour Productivity also demonstrates a large effect on Employment Fluctuation (f^2 = 0.541), confirming its pivotal role within the model.

Table 8. Effect Size (f^2)

Path	f^2
Climate Change → Employment Fluctuation	0.012
Climate Change → Labour Productivity	1.639
Climate Change → Workforce Demand	1.22
Labour Productivity → Employment Fluctuation	0.541
Labour Productivity → Workforce Demand	0.196

f^2 thresholds: 0.02=small, 0.15=medium, 0.35=large

Overall, the structural model results confirm that weather-induced heat stress and humidity significantly reduce labour productivity, which subsequently results in higher absenteeism and workforce adjustments in textile units. The strong model fit and significant variance explained indicate that the proposed model effectively captures the mechanisms through which climate variability disrupts employment stability in Ahmedabad's textile industry.

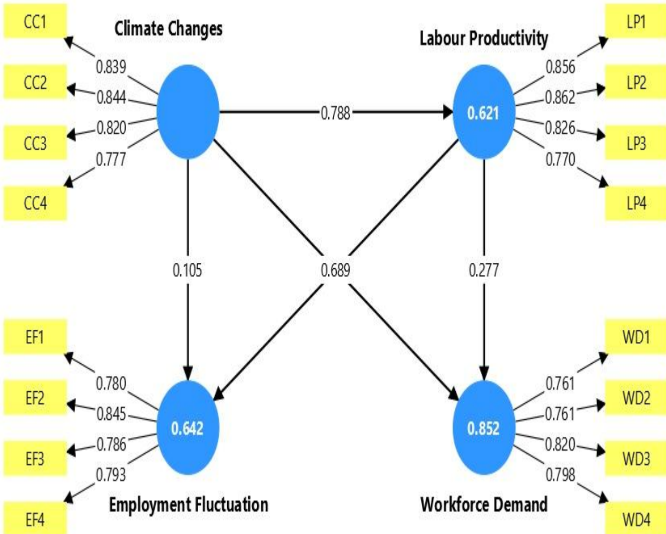

Figure 2. Structural Model Evaluation Results (PLS-SEM Output)

The study revealed that climate change significantly affects employment patterns in Ahmedabad's textile industry. Rising heat and humidity reduce labour productivity, leading to absenteeism, shift changes, and temporary layoffs. SEM results confirmed that climate change directly increases workforce demand and employment fluctuations, while labour productivity plays a major mediating role. High R^2 values indicate that most employment-related changes are driven by climate variability. Overall, the findings show that climate change is causing operational disruptions and workforce instability, highlighting the urgent need for heat-mitigation measures and climate-adaptive workforce management in textile units.

5. DISCUSSION

The present study investigated how climate change influences employment fluctuations and workforce demand in Ahmedabad's textile industry, with a particular focus on the mediating role of labour productivity. The findings confirm that variations in temperature and humidity significantly shape employment-related outcomes, supporting all five hypotheses proposed in the conceptual framework. These results reinforce the growing evidence that labour-intensive industries are highly vulnerable to climate-induced operational disruptions, especially in emerging economies where industrial infrastructure is inadequately designed to withstand severe environmental conditions (Venugopal et al., 2021; ILO, 2023).

The strong positive relationship between Climate Change and Labour Productivity ($\beta = 0.788$, $p < 0.001$) demonstrates that rising temperatures and humidity levels substantially reduce physical performance in textile workplaces. This aligns with human physiological models that indicate restricted metabolic activity and reduced cognitive efficiency under heat stress (Flouris et al., 2018). In Ahmedabad, where prolonged summers exceed 42°C and high relative humidity dominates monsoon months, workers encounter stressful microclimates amplified by poorly ventilated factory conditions. As a result, heat-induced fatigue, dehydration, and machine handling errors become more common, directly affecting productivity outputs. This confirms earlier research, which suggests that heat-related labour productivity losses could lead to a 5–15% decline in manufacturing efficiency in South Asia by 2030 (Kjellstrom et al., 2016).

The study further reveals that Climate Change has a significant direct and indirect influence on Employment Fluctuation ($\beta = 0.105$; LP → EF $\beta = 0.715$). The mediation effect highlights productivity decline as a major transmission channel through which climate stress translates into job instability. During high-heat months, industries often reduce shift durations, temporarily downsize manpower, or impose rotational work schedules to cope with production delays. These labour adjustments impose a heightened risk among informal and contract workers, who make up a considerable share of India's textile workforce (Bonde et al., 2023). Therefore, the findings confirm that employment instability is not merely a result of business decisions but a consequence of climate-driven operational vulnerability.

Similarly, climate variability exhibits a significant impact on Workforce Demand ($\beta = 0.689$), with further influence mediated through Labour Productivity ($\beta = 0.277$). The high R^2 value for Workforce Demand (0.852) suggests that climatic and productivity factors jointly explain a substantial proportion of labour allocation trends in textile units. During periods of excessive humidity, machinery—especially in spinning—experiences higher thread breakage rates and increased maintenance requirements, resulting in temporary over-hiring to sustain output levels (Sharma et al., 2022). Conversely, during extreme heat waves, labour demand contracts due to reduced operational hours. Such strategic workforce balancing highlights climate variability as a determinant of short-term labour market fluctuations in Ahmedabad's textile sector.

These findings expand the theoretical understanding of climate–labour dynamics by embedding Labour Productivity as a mediating construct, positioning it as a key mechanism linking environmental stress to employment outcomes. This aligns with Human Capital Theory, which states that workforce capacity is a function of physical and cognitive performance (Schaufeli et al., 2009). When environmental exposures suppress labour capability, employment stability declines as an inevitable adaptation response. Moreover, the significant path strengths in this study indicate that even marginal climate impacts on employment may mask deeper performance disruptions occurring within the production environment.

5.1 Theoretical Implications

This study contributes to existing literature in three key ways. First, it shifts the climate–employment discourse from a macroeconomic viewpoint to a micro-industry labour context, presenting empirical evidence from one of India's largest textile hubs. Second, it extends occupational heat-stress research by demonstrating how climate phenomena reshape labour market dynamics beyond productivity metrics, affecting employment continuity and hiring practices simultaneously. Third, the inclusion of Climate-Adaptive Interventions in the conceptual framework positions the research within contemporary resilience-based models, highlighting organisational strategies that may buffer climate-labour risks. Thus, the study provides an integrated explanation of climate-induced employment instability, which has been largely overlooked in prior research that treated productivity and employment outcomes separately. The mediated relationship observed confirms theoretical expectations while demonstrating contextual specificity in Ahmedabad's industrial ecosystem.

5.2 Practical and Industry Implications

The findings highlight critical managerial challenges for textile manufacturers. First, productivity losses due to climate conditions indicate the urgent need to invest in environmental control infrastructure, such as localized cooling, improved cross-ventilation, dehumidifiers, and heat-resilient machinery. Although many small-scale units perceive these upgrades as costly, long-term gains in productivity and reduced absenteeism justify such investments. Second, factory scheduling reforms, including staggered shifts, hydration facilities, and rest break protocols during hot seasons, can significantly reduce heat-related exhaustion and errors. Third, upskilling workers in automated textile technologies could reduce dependence on manual intensity during high heat seasons, making operations more resilient. The results emphasize that workforce well-being is directly tied to operational sustainability, suggesting that climate adaptation strategies must shift from reactive adjustments toward proactive planning.

5.3 Policy and Societal Implications

The study's outcomes underscore the need for climate-conscious labour policies in India. Given the significant informal workforce in Ahmedabad's textile sector, climate-induced job instability intensifies social insecurity due to absence of wage protection and employment rights. Policymakers must incorporate occupational climate safety standards into labour regulations, including mandatory compliance for heat mitigation in factories. The Gujarat state government could introduce incentive schemes for micro and small industries to adopt energy-efficient cooling technologies and workplace safety enhancements. Integration of climate risk into employment codes and industrial licensing may also accelerate adaptation efforts. Moreover, local urban planning initiatives should consider heat-island zones near industrial belts to promote climate-resilient infrastructure development, benefiting both workers and employers. In summary, the study confirms that textile labour in Ahmedabad is significantly exposed to climate-induced productivity loss, job instability, and dynamic labour allocation needs. The findings emphasize that climate change is not only an environmental challenge but a labour market determinant, requiring aligned industrial adaptation strategies and stronger labour protections. Strengthening climate resilience in textile production is not only essential for worker well-being but also crucial for maintaining operational efficiency and sustaining economic output in India's industrial economy.

6. CONCLUSION, LIMITATIONS, AND FUTURE SCOPE

This study investigated the influence of climate change on employment fluctuations and workforce demand in Ahmedabad's textile industry, with a specific focus on the mediating role of labour productivity. The results provide strong empirical evidence that seasonal variations in temperature and humidity significantly impact labour outcomes. Rising heat and moisture levels adversely affect worker performance, operational efficiency, and hiring patterns, leading to reduced productivity, increased absenteeism, and short-term employment disruptions. These findings validate all five hypotheses and reinforce the need for climate-responsive strategies within labour-intensive industries. The results further reveal that climate stress affects employment dynamics both directly and more substantially through a productivity-mediated pathway. Labour productivity explains how micro-environmental workplace conditions translate environmental variability into tangible labour market consequences. The strong predictive power of the model, particularly for workforce demand ($R^2 = 0.852$), highlights the critical pressure climate change exerts on managerial workforce planning in Ahmedabad's textile establishments. Therefore, climate change is not only an ecological phenomenon but a key economic and human resource risk factor for the textile sector.

The practical implications of this study emphasize the urgent requirement for industries to adopt adaptive practices such as improved ventilation systems, heat stress management protocols, and workforce scheduling flexibility to maintain productivity amidst environmental uncertainty. Policymakers must also integrate occupational climate resilience into industrial standards and labour safety regulations, especially given the vulnerability of the large informal workforce in Ahmedabad. Strengthening climate adaptation, through incentives and policy interventions, can support both sustainability and socioeconomic security in industrial economies. Despite its significant contributions, this study acknowledges certain limitations. First, the research focuses exclusively on Ahmedabad and may not fully capture climate–labour dynamics in other textile clusters with different infrastructure or climatic conditions. Second, the study relies on self-reported perceptions of climate effects, which may introduce response bias. Third, other climate-sensitive variables, such as air pollution or ventilation infrastructure quality, were not included but may influence the relationships observed. Longitudinal data could further enhance causal interpretation by capturing temporal variations more comprehensively. Future research may extend this work by incorporating comparative regional analysis across India and using objective productivity data, such as real-time environmental sensor measurements and machine performance indicators. Future scholars may also integrate additional mediating constructs such as occupational health, worker stress, and technological modernization to broaden understanding of climate resilience factors. Moreover, the role of automation, digital manufacturing, and green technologies in mitigating climate-induced labour disruptions can be explored to support sustainable industrial transformation. In conclusion, this study provides robust empirical support for the argument that climate change is a critical determinant of workforce stability in textile manufacturing. Ensuring productive and resilient labour conditions will require collaborative efforts between industry stakeholders, policymakers, and labour welfare authorities to safeguard workers and sustain industrial growth under increasing climate uncertainty.

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