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Cross-Sectional ARDL Analysis to Access the Impact of Stressful Living Environment and Extreme Weather Events on Youth's Education

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Abstract: This study's primary objective is to investigate the impact of stressful living environments and extreme weather conditions on youth's education. For the fulfillment of this objective, the unique and latest methodology, such as second-generation unit root, cross-sectional ARDL, and the Westerlund approach are used on panel data taken from India and Pakistan. The cross-sectional dependency test is also employed to determine the internal correlations between cross-sections. The results indicate that there are long- as well as short-run relationships between variables. This study helps to develop policies to manage natural disasters, as well as provide the theoretical background to reduce the stressful living environment.

Keywords: stressful living environment; extreme weather events; education; cross-sectional dependency; CS-ARDL



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1. Background of the Study

This study's primary objective is to conduct an economic analysis to ascertain the effect of extreme weather events and stressful living environments on male and female education. To admire the importance of education, Oxford University also places a premium on the education of young people and their futures affected by weather events (Oxford University)¹. In this regard, this study is considered a pioneer which establishes the relationship between stressful living environments and education. Furthermore, in the literature, stressful living environment are only examined from an individual perspective, despite the fact that have a significant impact on education from a macro perspective. Therefore, this study contributes to the literature to open new horizons for social scientists, researchers, and policymakers. The tremendous amount of monsoon rain that has fallen over Pakistan has forced rivers, streams, and torrents to overflow, causing the nation to be afflicted with catastrophic floods. Riverine flooding from the major rivers, such as the Indus River, as well as flash floods in minor and tertiary rivers, including hill torrents, are the primary causes of flood damage in this region. Since the country's independence in 1947, all five of Pakistan's provinces have experienced flooding of varying degrees, including twenty instances of catastrophic flooding.

In terms of weather events, the IPCC reported a global average temperature rise between 1.8 °C and 4 °C, as a result of continuous increases in carbon and greenhouse gas emissions in the air (Groppa and Kraehnert 2017). This could result in a more dynamic global hydrological cycle, with unanticipated fluctuations in precipitation intensity, evaporation rates, and distribution, especially in education. Additionally, excessive precipitation over a short period can disrupt river flow regimes, resulting in floods, whereas insufficient

precipitation over a longer period can result in droughts. These extreme weather phenomena are the biggest threats to schoolchildren worldwide ([Ganguli and Merz 2019](#); [Melese 2016](#)). In this regard, in previous research, weather events significantly impact education ([Groppo and Kraehnert 2017](#)), but the stressful living environment is ignored.

Despite the above facts, quality education ranked under seventeen sustainable development goals demonstrates the critical nature of education.² Therefore, Pakistan is considered highly vulnerable to extreme weather disasters, while the [Germanwatch and Climate Action Network \(2013\)](#) pointed out that Pakistan is ranked eighth in the world in terms of being affected by extreme weather. [Groppo and Kraehnert \(2017\)](#) mentioned the significant impact of extreme weather events on education. Furthermore, [Jacoby and Skoufias \(1997\)](#) mentioned the rainfall condition on the attendance of school-going children. Moreover, rainfall also has a strong and positive impact on education ([Maccini and Yang 2009](#)) and also indicated that weather events affect the incomes of individuals. In this regard, the income of the household is disturbed which is a source of stress.

[Shah and Steinberg \(2017\)](#), on the other hand, discovered that increased rainfall conditions in rural India are associated with decreased educational attainment levels. Shah and Steinberg proposed that during years in which agricultural revenue is relatively high, children should participate in the job market rather than attending school. According to [Jensen \(2000\)](#), unfavorable rainfall circumstances that occurred in 1986 in Côte d'Ivoire led to a decrease in the number of children enrolled in school who were living in impacted regions. [Björkman-Nyqvist \(2013\)](#) finds comparable results after studying changes in rainfall throughout the districts of Uganda. However, these effects are only seen in females. Another body of research focuses more narrowly on severe weather occurrences. For example, [Alderman et al. \(2006\)](#) examine, with the use of data from Zimbabwe, how early childhood malnutrition brought on by a drought and a civil war might have a lasting effect on a person's ability to achieve a certain level of scholastic success in adulthood. According to the findings of the authors, a child's nutritional quality during their time spent in preschool has an influence that is both statistically significant and economically significant on the age at which they begin formal education and the total number of grades they earn as adults. According to research published in 2014 by Rosales, infants in Ecuador who were exposed to the El Nio weather phenomenon during the first trimester of their mothers' pregnancies between 1997 and 1998 had considerably worse scores on cognitive tests five to seven years after the shock. According to the findings of [Deuchert and Felfe \(2015\)](#), the probability that a kid in the Philippines would finish all of their education and have a high IQ is dramatically reduced if they are exposed to a typhoon. One such body of research that is pertinent to this topic examines how colder weather affects the academic achievement of students in the United States. Several studies make use of variations in the amount of snowfall and temperature to determine the effect that the length of classroom instruction has on students' performance on standardized achievement assessments ([Hansen and Salemi 2011](#); [Marcotte and Hemelt 2008](#)). Both unplanned school closures and teacher absences due to inclement weather have been shown to have a detrimental impact on the performance of students on standardized tests, particularly in the subject of mathematics. [Goodman \(2014\)](#) takes into consideration the nonlinear nature of snowfall and differentiates between moderate snowfall's ability to cause student absences and excessive snowfall's ability to cause unexpected school closures as a result of the phenomenon. Goodman finds no consistent association between unplanned school closures and student performance in mathematics achievement exams, in contrast to the findings of previous research; instead, poorer test scores are associated with student absences due to moderate snowfall.

This study explores the background of the study, the gap in the literature, and hypotheses in Section 2 that indicated a strong association between extreme weather and stressful living environments, and education. Section 3 discusses the entire methodology, which provides in-depth analysis criteria. Section 4 discusses the results, and Section 5 describes the conclusion, recommendations, and limitations.

2. Hypothesis Development

2.1. Extreme Weather and Education

According to the IPCC, extreme weather events such as cyclones, flooding, and drought are caused by frequent climate changes. Additionally, [Moriarty Safe Schools \(2018\)](#) mentioned that 3.7 million educators are disrupted due to extreme weather events worldwide. Furthermore, extreme weather has a strong impact and has caused damage to infrastructures and education, among other consequences ([Arora-Jonsson 2011](#); [Kousky 2016](#)). It was observed in the literature that most research has highlighted the issues of health and agricultural disasters ([Peek et al. 2018](#)), but a lack of research was found on young people's education and their futures. Furthermore, [Hansen et al. \(2021\)](#) believed that climate change is a political issue that needs to be controlled and, if left unchecked, leads to adverse health and education effects. Education and climate change are very much linked with each other. In addition [Ahmadi et al. \(2021\)](#) pointed out the issues in education system came because of extreme weather events, and concluded that education is one of the important factor which also contribute in the economic growth ([Williams 2022](#)). The importance of education can be assumed given that it is in the fourth position in the sustainable development goals for 2030 which were settled in 2015 ([Espasandín-Bustelo and Bayter 2022](#)). According to the SDG, less-developed countries must increase their education level to achieve growth. The overall world has made considerable improvement from the MDG to SDG regarding their education level and proved that developing countries do not have enough sources to deal with extreme weather event which has strong impact on the education (one of the SDGs). Therefore, the SDG is committed to ensuring quality education for all and promoting lifelong learning up to 2030. Ample research is available on teacher's availability and updating infrastructure while the literature on stressful living environments and events on the live and futures of young students is sparse. Moreover, few research articles are available in the context of Pakistan.

2.2. Stressful Living Environment and Education

Stress is a crucial and unavoidable part of life. Up to a certain level, stress is acceptable as it helps to support everyone in becoming stronger and developing their capacities accordingly ([Haslam et al. 2021](#)). The social, physical, and psychological background of individuals determines how they perceive stress and how they react to it ([Civiloti et al. 2021](#)). However, stress is taken and dealt with in different ways by different individuals ([Nelson and Bergeman 2021](#)). It is also professed that some events and situations cause people to feel pressure, rigidity, and destructive emotions which adds apprehension and antagonism to stress ([Skodol 2021](#)). However, academic stress is a kind of stress that arises due to the increased workload of assignments and the expectations of teachers. All young students are experiencing academic stress during their student life ([Upadhyaya 2021](#)). Academic stress increases when academic perception, frustration, and conflict accumulates. Stress is also generated when mental and emotional pressures are induced by the painful requirements of an educational institution. Too much academic stress leads to mental illness which is reflected in students' academic performance ([Slavinski et al. 2021](#)). Academic stress flares up when family and teacher expectations become high for the student, eventually burdening the student ([Moreno 2021](#)). Statistically, family expectations contribute to 52%, therefore, to measure the stressful living environment, mostly indicator are linked with the family expectations such as inequality, life expectancy, homicide and unemployment. In a study conducted by the American health association, out of 97,357 students in 2006, almost 32% of students reported that they received educational stress which caused them to earn low grades. Moreover, mental and physical health problems in students are generated by educational stress. Educational stress leads towards severe consequences such as a lack of confidence, suicide attempts, and a negative contribution to society. Stress absorption capacity differs from person to person and with their socioeconomic conditions ([Li et al. 2022](#)). Usually, female students can handle more stress as compared to male

students (Procope-Beckles 2022) because female students are more concerned about their performance.

2.3. Weather Events and Education

Human beings' actions mostly depend on the latest technology, but technological progress is influenced by the environment (Reyes-Calderón et al. 2022) specially for developing countries. Majority of the time, education and technology are interrelated. Therefore, it is necessary for humans to implement effective and efficient policy to reduce the risk associated with education (Hill-Jackson et al. 2022). For example, sunny weather emboldens students to change their activities such as riding a bicycle; likewise, on rainy days, students avoid walking and cycling and prefer the bus or van (Sollohub 2021). If this relationship is understood by policymakers, then it will help them to design appropriate management policies which are efficient and helpful for students (Rosch et al. 2021). These studies are usually held in European and American countries instead of developing countries such as Pakistan. This study is conducted to investigate the relationship between weather and education. Extreme weather conditions shockingly reduce the enrollment of students in education. Climate change has a significant relation with education (Chankseliani and McCowan 2021). The major impacts of climate on education arise when heavy rains, floods, winds, and hail storms take place. Droughts and high temperatures lead to poverty which decreases the education level (Ndiritu 2021). Extreme weather conditions reduce water quality which leads to different diseases and, ultimately, dropout rates increase. Along with its primary impacts, weather has secondary effects on education as well (Branco and Feres 2021). Floods, volcanoes, and storms are the most common problems that households face as a result of climate change; consequently, they migrate with their children to urban areas to enjoy a better quality of life, with education taking precedence (IseOlorunkanmi et al. 2021).

3. Methodology

The main concern of this study is to investigate the impact of stressful living environments and extreme weather events on youth's education. To fulfill the objective of this study, yearly (1972–2020) data were collected from world development indicators and a metropolitan panel of Pakistan and India. The reasons for including only two countries on the panel are as follows: Firstly, Oxford University Press presented the report in which it was mentioned that India and Pakistan are the most diverse countries where almost all extreme weather events occur. Secondly, Pakistan is a developing nation with inadequate facilities, and Bloomberg ranked Pakistan as having the sixth most stressful living environment in the world. Both countries are geographically identical and share nearly 3323 km of border. Therefore, this panel of two countries is taken into account. In addition, one of the other reasons is the objective of this study which was not to conduct a comparative study.

The stressful living environment index was calculated according to the steps of Bloomberg which involved the homicide rate, GDP per capita, income inequality, corruption, unemployment, urban air pollution, and life expectancy rate³. Principle component analysis was used to create the index of stressful living environments. Furthermore, a multivariate framework was developed by the following Equation (1):

$$Edu_{it} = f(SLE_{it}, CC_{it}) \quad (1)$$

3.1. Cross-Sectional Dependence

This study took two cross-sections of India and Pakistan; in this regard, the dependence test is important to access the common correlation and avoid wrong interpretation of results. Pakistan and India have common borders and there are many reasons that these countries are dependent on each other. Urbain and Westerlund (2006) argued that the problem of cross-sectional dependence exists where economies are strongly interlinked. To investigate the dependency among these nations, CD is employed (Chudik and Pesaran 2015).

3.2. Panel Unit Root

After the cross-sectional dependence test, a panel unit root test was employed to check the stationarity of the variable to investigate its long-run relationship. In this study, we used a second-generation unit root test because traditional or first-generation unit roots failed to provide an unbiased result if there was a cross-sectional dependence problem. In this regard, second-generation unit root tests such as CIPS (Im et al. 2003), and CADF (Pesaran 2007) are more suitable for controlling the cross-sectional dependencies and reducing the biases. The following equation is used to test the CADF:

$$\Delta y_{it} = a_i + b_i y_{i,t-1} + d_i \bar{y}_{i,t-1} + \sum_{j=0}^s d_{ij} \Delta y_{t-j} + \sum_{j=1}^s \partial_{ij} \Delta \bar{y}_{i,t-j} + e_{it} \quad (2)$$

In the above equation, the average of the cross-section is denoted as Δy , which shows the first difference and lag simultaneously. CADF is also provided as the ground for the CIPS which is based on t-statistics; the equation is presented below:

$$CIPS = N^{-1} \sum_{i=1}^N CADF_i \quad (3)$$

3.3. Cointegration Test

In the last few decades, the cointegration test garnered a lot of attention as a potential method for measuring long-run interactions among the variables with time series and cross-sectional dimensions. There are different techniques offered to access the relationships among the variables, but there is lack of attention given to scenarios with cross-sectional dependency existing in the data. In this regard, in this study, Westerlund cointegration helps provide an unbiased result in the case of CD (Westerlund 2007). Furthermore, this approach to investigating the long-run association among variables is more reliable than the traditional cointegration approach.

3.4. CS-ARDL Approach

To take into account the problem of cross-sectional dependence, Chudik and Pesaran (2015) presented the CS-ARDL approach which is used to investigate the short- as well as long-run association for the following multivariate function:

$$TEDU_{it} = f(SLE_{it}, Weather_{it}, SLE^2_{it}) \quad (4)$$

In Equation (4), i represents the cross-sections where t denotes the time series, and stressful living environment (SLE), SLE square and extreme weather events are independent variables. The data were gathered from the word bank and metropolitan website of India and Pakistan. Stressful living environment is measured by following the footsteps of Bloomberg report, used as index by employing the PCA on Annual homicide rate, GDP per capita, Income Inequality, corruption score, unemployment rate, urban air pollution and life expectancy.

$$TEdu_{it} = \alpha_i + \beta_i' Z_{it} + \mu_{it} \quad (5)$$

In Equation (5), α_i denotes the specific fixed effect of the country and β_i is known as a heterogenous co-efficient vector of the cross-section. Z_{it} is known as the regression vector and μ_{it} is the error term which is independent when the expected error is zero. Equation (6) is used as a dynamic panel ARDL:

$$TEdu_{it} = \alpha_i + \sum_{k=1}^p \phi_{i,k} TEdu_{i,t-k} + \sum_{k=0}^q \beta_i' X_{i,t-k} + \mu_{it} \quad (6)$$

Furthermore, $\mu_{it} = \bar{\omega}_i G_t + \varepsilon_{it}$, and $X_{it} = c_i + \bar{\zeta} \cdot TEdu_{it} + O' i \cdot G_t + v_{it}$, where $TEdu_{it}$ is a common unobserved factor, and μ_{it} is the error term. The main reason for the CS-ARDL is that the traditional panel ARDL technique has consistent results only if variables are integrated by level and 1st difference (Pesaran and Smith 1995; Pesaran et al. 1999).

$$\Delta TEdu_{it} = \alpha_i + \bar{\zeta}_i (TEdu_{i,t-1} - \bar{\omega}_i X_{i,t-1}) + \sum_{k=1}^{p-1} \bar{\varphi}_{i,k}^* \Delta TEdu_{i,t-k} + \sum_{k=0}^{q-1} \bar{\beta}_{i,k}^* \Delta X_{i,t-k} + \mu_{it} \quad (7)$$

By using the common correlated effects (CCE) method, the panel ARDL model was improved so that it could take into consideration the issue of cross-sectional dependency (Chudik and Pesaran 2015). After replacing the common unobserved factor with the cross-sectional average, the following equations were obtained:

$$\overline{TEdu}_t = \bar{\alpha} + \sum_{k=1}^p \bar{\phi}_k \overline{TEdu}_{t-k} + \sum_{k=0}^q \bar{\beta}_k \bar{X}_{t-k} + \bar{\omega} G_t + \varepsilon_t \quad (8)$$

As a result, the cross-sectional dependence in μ_{it} is captured by the linear combination of cross-sectional averages of the dependent and independent variables, as in Equation (10).

$$\overline{TEdu} = \bar{\alpha} = \sum_{k=1}^p \bar{\varphi}_k \overline{TEdu}_{t-k} + \sum_{k=0}^q \bar{\beta}_k \bar{X}_{t-k} + \bar{\omega} G_t + \varepsilon_t \quad (9)$$

Under CS-ARDL, the panel ARDL specification of Equation (7) becomes:

$$TEdu_{it} = \alpha_i + \bar{\zeta}_i (TEdu_{i,t-1} - \bar{\omega}_i X_{i,t-1}) + \sum_{k=1}^{p-1} \bar{\varphi}_{i,k}^* \Delta TEdu_{i,t-k} + \sum_{k=0}^{q-1} \bar{\beta}_{i,k}^* \Delta X_{i,t-k} + \mu_{it} \quad (10)$$

The number of cross-sectional averages included is given by Chudik and Pesaran (2015). This ensures that the residuals are cross-sectionally uncorrelated.

4. Results

Table 1 shows the descriptive statistics of the total education (TEDU), stressful living environment, and weather (extreme weather conditions). The concern of this study is to investigate the impact of stressful living environments and extreme weather conditions on youth's education from 1972 to 2020 in Pakistan. According to the result of the Jarque-Bera test, data were not normally distributed; therefore, quantile techniques were more appropriate for the in-depth analysis (Sharif et al. 2020).

Table 1. Descriptive statistics.

	TEDU	SLE	SLE ²	Weather
Mean	22.96887	36.75339	1726.106	15.68829
Median	16.82146	31.64657	1001.506	20.25000
Maximum	76.03895	75.66000	5724.436	51.88804
Minimum	0.000000	0.000000	0.000000	0.000000
Std. Dev.	22.81245	19.47213	1563.349	15.02613
Skewness	1.019946	0.147224	1.145955	0.702406
Kurtosis	2.955542	2.661025	3.237053	2.989435

The cross-sectional dependence test is considered important to check the dependency between cross-sections which help to select appropriate for the panel data. In this regard, Chudik and Pesaran (2015) presented the test which is presented in Table 2. Which indicated

the dependency in the cross section therefore CS ARDL test is most appropriate to fulfil the objective of study.

Table 2. Cross-sectional dependence test.

Variables	Test Statistics	Variables	Test Statistics
TEdu	5.421970 *	SLE	2.727 *
Weather	9.600701 *	SLE ²	10.321 *
FEdu	12.132 *	MEdu	12.726 *

* Significant at a level of 1%.

The results of the cross-sectional dependence test indicated that the null hypothesis, no cross-sectional dependence, is accepted, meaning there is a correlation among the cross-sections. Moreover, further analysis after the deduction of the cross-sectional test is needed to check the stationarity of the data. In this regard, the traditional panel unit root test is not suitable for the panel data if there is a cross-sectional dependency. So, second-generation CIPS and CADF unit root tests were employed to check the order of integration in Table 3.

Table 3. Second-generation unit root test.

Variables	Level	Variables	Level
CIPS			
TEdu	−2.89897	SLE	−2.57
Weather	−4.36621	SLE ²	−4.03074
FEdu	−4.48942	MEdu	−167859
CADF			
TEdu	−3.96	SLE	−2.97
Weather	−4.11	SLE ²	−2.57
FEdu	−3.96	MEdu	−3.30

Dzuds have the potential to affect schooling in several different ways. To begin, they can devastate the financial foundation of herding families. The number of families engaged in herding had a 7.4% decline between the years 1999 and 2002 (NSO 2003). A significant number of economically struggling herders relocated to Ulaanbaatar and other provincial towns in search of work. During the dzud that occurred in 2009/2010, almost forty percent of all herding families lost more than fifty percent of their herd (NEMA and UNDP 2010). The revenue that a family receives from the sale of animals and animal byproducts is reduced when livestock is lost, which may lead to a reduction in the amount of money that is available in the household budget for educational expenses (Groppo and Kraehnert 2017).

The results of the Westerlund cointegration test for the long-run relationship among the variables is shown in Table 4. These results indicated that the null hypothesis, that there is no cointegration, is rejected. According to the findings presented above, the robust *p*-value suggested that the cross-sectional dependency effect present in the data had been removed. In addition, one of the models does not have cointegration, whereas the other three models do have cointegration.

Table 4. Westerlund cointegration.

Statistics	Values	Z-Value	<i>p</i> -Value	Robust <i>p</i> -Value
G _t	−3.103	−1.628	0.051	0.000
G _a	−5.632	−1.613	0.044	0.000
P _t	−6.745	−2.601	0.006	0.000
P _a	−7.724	−0.192	0.567	0.000

The cross-sectional ARDL approach is shown in Table 5 as a unique methodology used to investigate the relationship of selected variables. Furthermore, India and Pakistan were selected as panels because these two countries are considered the world's most populated countries. The results show the short-run as well as the long-run relationships of the variables. In the long-run result, all the null hypotheses are rejected at 1%. Furthermore, to in-depth analysis square of SLE also used and results shown that there is positive impact on education. The reason of positive impact is that when stress is more than the capabilities individuals work hard to meet the demand of life.

Table 5. Cross-sectional ARDL.

	Total Education		Female Education		Male Education	
	CS-ARDL	CCE	CS-ARDL	CCE	CS-ARDL	CCE
	Co-Efficient	Co-Efficient	Co-Efficient	Co-Efficient	Co-Efficient	Co-Efficient
Long-Run Estimation						
Lr. SLE	−0.28844 ^c	6.832231 ^c	0.297 ^c	−0.138728	0.7579889	−0.4068 ^c
Lr. SLE ²	0.016856 ^c	−0.3861871 ^c	−0.003 ^c	0.01211	−0.0186963	0.01004 ^c
Lr. Weather	−1.29936 ^c	28.71626 ^c	0.8342 ^c	3.893	3.795642	−2.037 ^c
Short-Run Estimation						
ECT	−0.9409827 ^c		−0.824 ^c	-		-
L. Fedu	-	-	0.176471 ^c	-	-	-
L. Mede	-	-	-	-	0.65077 ^c	-
L. Tedu	0.0590173 ^a	-	-	-	-	-
weather	−1.220998 ^c	-	−0.686954 ^c	-	1.3256 ^c	-
SLE	−0.2686177 ^c	-	0.024481 ^c	-	0.26472 ^c	-
SLE ²	0.0158739 ^c	-	−0.00214 ^c	-	−0.00653 ^c	-

^a Significant at a level of 10%, ^b Significant at a level of 5%, ^c Significant at a level of 1%.

Furthermore, extreme weather conditions have a negative impact on education ([Ahmadi et al. 2021](#); [Hansen et al. 2021](#)). The short-run result of the study indicated that there is a short-run relationship among the data and the value of the error correction term shows the speed of adjustment. In addition, CCE results are also presented for the robustness analysis. The research for Young Lives is broken up into several separate projects, each of which investigates a different facet of poverty and inequality in the nations that we are studying. To learn more about our ongoing and completed initiatives, please click on the feature box located below. Our research topics have been rethought to reflect the fact that the people who participated in the study are now young adults, as well as to take into consideration the changing nature of the surrounding environment. Explore our three cross-cutting topics, gender and intersecting inequalities, new vulnerabilities, and methodology, in addition to our four main themes, which are education and skills, employment, health and well-being, and family lives. Twenty years of study conducted by Young Lives have resulted in the publishing of more than 800 articles that provide insights and analyses on the causes and effects of poverty and inequality for children, youth, and the process of transitioning into adulthood. Click the feature box down below to discover our most important results, or check out all of our articles. Our eyes are always fixed on the horizon, and we are constantly expanding Young Lives research. In the above table, education further segregated into male and female education, genders are directly effect by the weather.

5. Discussion, Conclusions, and Limitations

The main aim of this study was to investigate the impact of stressful living environments and extreme weather conditions on youth's education. To fulfill the objective of this study, Pakistan and India were selected as panels and we employed a unique methodology for the deduction of cross-sectional dependencies in the data. After the

deduction of CS dependencies, we employed a second-generation unit root test which was suitable to eliminate the CS issues. Furthermore, the CS-ARDL test is considered the best technique to test the hypotheses and identify the long- as well as short-run associations among the variables. The results indicated that there is a significant impact of extreme weather conditions on education. Furthermore, a stressful living environment also has a significant impact on education. In 2017, the Nepalese government endorsed the Disaster Risk Reduction and Management Act, replacing the 1982 Natural Calamity Act. The new act focused on disaster risk management by addressing the four disaster management cycles: preparedness, response, rehabilitation, and recovery. It also established a functional institutional setup from the central to the local levels for effective disaster management. However, while the revised act set out the responsibilities of the provincial governments, it failed to declare disaster-prone zones using disaster mapping (Nepal et al. 2018). Most of the existing policies also emphasized rapid-onset hazards (including floods, earthquakes, landslides, and avalanches), rather than slow-onset hazards (such as cold spells and heatwaves). It also assigned fewer responsibilities to the local governments, despite the Local Government Operation Act of 2017. At the same time, these existing disaster management policies provided more importance to recovery and response than to the preparedness and mitigation processes. Both India and Pakistan have effective early warning systems and action plans for heat-related health risks, including some that are specifically designed for use in metropolitan areas. Heat action plans lower the number of deaths caused by heat and limit the negative effects of high heat on society, such as decreased job productivity. Important lessons have been learned from the mistakes of the past, and they are now being disseminated to all of the members of the Global Heat Health Information Network, which is co-sponsored by the WMO, to strengthen capabilities in the severely affected area. The South Asia Heat Health Information Network, also known as SAHHIN, is collaborating with the Global Heat Health Information Network (GHHIN) to increase capacity and share lessons learned throughout the South Asia area. The National Disaster Management Authority in India has established a national framework for heat action plans. This authority is responsible for coordinating a network of state disaster response agencies and city leaders to get ready for rising temperatures and make sure that everyone is aware of what to do and what not to do during a heatwave. After being hit by a disastrous heatwave in 2010, the city of Ahmedabad in India became the first city in South Asia to create and put into practice a city-wide heat health adaptation the following year, in 2013. This excellent strategy has been extended to 23 states that are prone to heatwaves and now protects over 130 cities and districts. Additionally, Pakistan has made significant progress in the protection of public health. During the summer of 2015, a heatwave enveloped most of the central and northwest regions of India, as well as the eastern region of Pakistan. This heatwave was directly or indirectly responsible for the deaths of several thousand people. That served as a wake-up call, which ultimately resulted in the creation and execution of the Heat Action Plan in Karachi and other areas of Pakistan. At the local, state/provincial, or federal level, “Heat Action Plans” bring together a variety of authorities and actors to collaborate on better understanding and more effectively predicting, preparing for, and responding to excessive heat hazards. These plans may be implemented at any level. These include the provision of heat health warning systems by the National Meteorological Services, which are an essential component of these systems. The reader may peruse further information as well as samples of heat action plans on the website. Civil society organizations such as the Red Cross Red Crescent Society and the Integrated Research and Action for Development (IRADe) play an equally important part by delivering lifesaving messages and interventions to populations who are particularly susceptible. Standard plans ensure that the targeted intervention is an appropriate match and is developed for the population of a city that is particularly susceptible to the effects of heat. First, it detects the areas of the city that are most susceptible to excessive heat, then it locates the people who are at risk in these pockets, and, finally, it evaluates the type and condition of their susceptibility to

the heat. The action plans have been considerably effective in bringing down the excessive death rate.

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Notes

- ¹ <https://www.ox.ac.uk/news/features/education-under-threat-climate-change-especially-women-and-girls> (accessed 1 January 2021).
- ² <https://sdgs.un.org/goals> (accessed 1 January 2021).
- ³ <https://www.bloomberg.com/graphics/best-and-worst/#most-stressed-out-countries> (accessed 1 January 2021).

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