Perception of Climate Change of Secondary Level Students in Mechinagar, Jhapa, Nepal

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ABSTRACT

The understanding of climate change among youth is essential for influencing future action. This study assessed climate change understanding, issues, believed consequences, and reported actions among 95 secondary school students in Mechinagar, Jhapa, Nepal, through a survey, and studied 40 years (1982-2022) of local temperature and precipitation data applying Mann-Kendall, Sen's Slope, and additional statistical methods. Results showed very high student awareness (95%) and concern (70.5% "very serious") over climate change, mostly attributable to human actions (80%). Significant school-level participation in mitigation activities (85%) indicated that students were very willing to take action in response to perceived heightened local consequences, such as sudden temperature fluctuations (72%), and heavy rainfall (36%). Meteorological analysis indicated a statistically significant increase in annual rainfall (+24.89 mm/year, p<0.001), largely driven by enhanced monsoon precipitation with high variability and short-term persistence. However, over this study period, there was not a significant long-term trend in the yearly mean temperature (p=0.2785). Student's perceptions differ with regard to long-term temperature increases, but they are consistent with the observed rise in rainfall intensity and variability. These results demonstrate a high level of young involvement, but they also highlight the need for local data-based, nuanced climate education, with a special emphasis on adaption tactics for the hydrological change management of the region.
Keywords: *Climate Change Perception, Student Awareness, Climate Trends, Rainfall, Temperature, Mann-Kendall, Nepal, Jhapa*

Introduction

As the world grapples with the existential threat of climate change, the awareness and understanding of this phenomenon among future generations are crucial for mitigating its impacts (IPCC, 2022). Secondary school students, in particular, are

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at a pivotal stage of knowledge formation, influencing both their personal behaviors and future societal decisions. Climate change is one of the most pressing global challenges of the 21st century, with profound implications for ecosystems (De La Fuente & Williams, 2023; Malhi et al., 2020), economies (Adom, 2024; IPCC, 2014), and human well-being (Abbas et al., 2022; Adger et al., 2022). Its impacts are disproportionately felt by vulnerable populations, particularly in developing countries where adaptive capacity is often limited (Adom, 2024). Nepal, with its challenging geography and socio-economic dynamics, is among the world's most climate-vulnerable nations (NAP, 2021), facing glacial melt, erratic rainfall patterns, and increasing frequency of natural disasters (Pandey et al., 2024; Upadhayaya & Baral, 2020). These challenges threaten not only livelihoods but also long-term sustainable development goals (Devkota et al., 2017; UNDESA, 2024).

Since 1880, the global average temperature has risen by over 1°C, with nearly two-thirds of this warming occurring after 1975 at a rate of 0.15–0.2°C per decade (Hansen et al., 2010). Nearly half of global greenhouse gas emissions from 1850 to 2020 were released after 1990 (Dhakal et al., 2022), intensifying the need for urgent mitigation (Peters et al., 2020). Nepal ranks among the world's most climate-vulnerable countries due to its challenging geography, resource-dependent and largely impoverished population, and weak institutional capacity to address climate challenges (Amadio et al., 2023). Under various climate change scenarios, Nepal's mean annual temperature is expected to rise by 1.3–3.8°C by 2060 and 1.8–5.8°C by 2090, with annual precipitation decreasing by 10–20% nationwide (McSweeney et al., 2010). These changes, combined with non-climatic stressors such as earthquake risks, hinder the country's efforts to enhance human development, reduce poverty, and meet basic needs (Upadhayaya & Baral, 2020). In the Hindu Kush Himalaya region, elevation-dependent warming could lead to a 2°C temperature rise by 2100, even if global warming is capped at 1.5°C (Wester et al., 2019). For Nepal, with its diverse topography and climate zones, the impacts of climate change are particularly pronounced, threatening its ecosystems, biodiversity, and livelihoods (De Souza et al., 2015; Turner & Annamalai, 2012).

To address these challenges, Nepal envisions achieving socio-economic prosperity by building a climate-resilient society (NCCP, 2019). Nepal has accelerated adaptation by implementing the National Environment Policy (2019), National Climate Change Policy (2019), Environment Protection Act (2019), Environment Protection Regulation (2020), National Adaptation Program of Action (NAPA) (2010), Framework on Local Adaptation Plans of Action (LAPA) (2019), Disaster Risk Reduction National Strategic Plan of Action 2018 – 2030, Fifteenth Plan By 2025, (2019/2020-2023/2024), and other national strategies and action plans along with National Adaptation Plan (NAP, 2021). Government of Nepal has determined to incorporate climate change-related education in all secondary schools and 2,000 climate change adaptation resource persons will be mobilized locally (NDC, 2020).

In this context, understanding the perceptions of youth, particularly secondary-level students, is of paramount importance. Research shows that environmental education significantly enhances environmental knowledge (g = 0.953, large effect), attitudes (g = 0.384, small to moderate effect), intentions (g = 0.256, small effect), and self-reported behavior (g = 0.410, small to moderate effect) (Van De Wetering et al., 2022). Young people represent the future stewards of environmental sustainability, and their understanding of climate change is critical for fostering adaptive and mitigative actions (Hohenhaus et al., 2023). Their perceptions influence not only their own behavior but also the broader societal discourse on climate action (Van De Wetering et al., 2022). However, it remains unclear whether their views align with the scientific realities of climate change or are shaped by misinformation, cultural beliefs, and local experiences (Fritz et al., 2024).

Mechinagar, Jhapa, situated in the lowland Terai region of Nepal, exemplifies the vulnerabilities associated with climate change. Rising temperatures, unpredictable rainfall, and recurrent floods directly affect its agricultural economy and livelihoods (G. P. Bhandari et al., 2013; Silwal et al., 2020). Despite these challenges, limited research has been conducted to understand how students in such regions perceive climate change and how these perceptions compare to actual climate data and impacts. This gap is particularly significant given the crucial role of education in shaping informed and proactive citizens.

This study aims to fill the research gap by assessing the perceptions of secondary-level students in Mechinagar regarding climate change and comparing these perceptions with actual climatic trends. By doing so, the study seeks to identify knowledge gaps and factors influencing student views, with the objective of informing localized, evidence-based climate education and policy to empower youth as proactive agents of change.

Materials and Methods

Study Area

Mechinagar Municipality, located in the eastern part of Nepal within Jhapa District (Province No. 1), spans 192.85 square kilometers at an elevation of 100–400 m asl. Situated 475 km southeast of Kathmandu and 115 km east of Biratnagar, it serves as a key economic and administrative hub. It is known for its agricultural productivity, growing rice, maize, tea, and cardamom. Mechinagar features diverse topography, ranging from fertile plains and river valleys in the south to rolling hills and the Himalayan foothills in the north. The subtropical climate experiences hot summers (up to 40°C), mild winters (as low as 8°C), and seasonal rainfall, with high winds in spring and moderate rain in June and July.

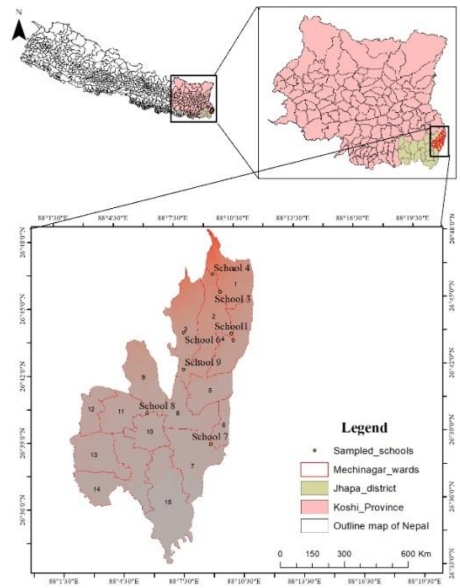

Figure 1: Study Area Map with sampled locations

Despite its natural resources, including fertile soil, forests, and waterways, Mechinagar faces challenges such as human-elephant conflict, deforestation, soil erosion, water pollution, and vulnerabilities to climate change, including erratic rainfall and increased natural disasters. Mechinagar municipality is also commonly known for the common route for wild elephants migrating between Nepal and India. This has created a huge wildlife conflict since decades and are widely documented (Acharya et al., 2016; Shrestha & Koirala, 2015). The Mechi River watershed serves as a vital water resource in the region, playing a crucial role in sustaining the ecosystem and supporting the livelihoods of local communities and wildlife. This transboundary river, shared between Nepal and India, is fed by tributaries such as the Ninda, Timai, and Hadiya rivers, which originate in the Mahabharat range, situated just above the Chure landscape. The geology of the area can be classified into the Lesser Himalaya group, Siwalik group (Lower, Middle, and Upper Siwalik), and Terai-Quaternary group, based on rock types and characteristics (B. P. Bhandari & Dhakal, 2021; Dhital, 2015). Its geographical diversity, agricultural reliance, and exposure to climate change impacts make it an ideal location for studying the perceptions and realities of climate change.

Research Design

This study used an integrative quantitative approach to assess and compare secondary level student perceptions of climate change with objectively measured historical climate trends in the Mechinagar region. The design involved collecting primary quantitative data on student perceptions via surveys and analyzing secondary quantitative time-series climate data for the corresponding geographical area. The primary aim of combining these quantitative datasets was to evaluate the degree of alignment or discrepancy between subjective perceptions and empirical climate reality within the study population. This approach is distinct from standard mixed-methods designs that typically integrate primary qualitative and quantitative data streams.

Population and Sampling

Target Population:

The target population comprised all students enrolled in grades 9 through 12 during the 2023-2024 (2080 BS) academic year in secondary schools (both government and private) officially registered and operating within the administrative boundaries of Mechinagar Municipality.

Sampling Frame:

This study employs a cross-sectional survey design to analyze the secondary student population within Mechinagar Municipality, obtained from the Mechinagar Municipality Education Section (Total students: 4,424). The sample size for the study is calculated using Cochran's formula for finite populations (Cochran, 1977).

$$n_0 = \frac{Z^2 . p . (1 - p)}{E^2}$$

Where:

- n_0: Initial sample size
- Z: Z-score for desired confidence level (Z=1.96 for 95% confidence)
- p: Proportion of the population (p=0.5 for maximum variability)
- E: Margin of error (E= 0.10)

With a confidence level of 95% (Z=1.96), a maximum variability (p=0.5), and a margin of error of 10% (E=0.10), the initial sample size (n_0) is approximately 95. After applying the finite population correction, the final sample size is adjusted to 95 respondents, ensuring adequate representation of the population. The representation of male and female students in the survey was equitable with 52% female and 48% male, with the mean age of 16 years.

Sampling Design and Procedure:

A multi-stage stratified random sampling procedure was employed to select student participants.

Stage 1: School Stratification and Selection

Schools listed in the sampling frame were first stratified based on type (Government vs. Private). Within each stratum, schools were selected using simple random sampling.

Stage 2: Class Selection within Schools

Within each selected school, we obtained lists of classes for the target grades (9 and 10). One class from each grade level (9 and 10) present in the selected school was chosen using simple random sampling.

Stage 3: Student Selection

All students present in the selected classes on the day of the survey administration were invited to participate. Informed consent was obtained from the school administration and participating students in verbal and written way. Participation was voluntary and anonymous.

Data Collection

Perception Data (Questionnaire Survey):

Primary data on student perceptions were collected using a structured, self-administered questionnaire. The questionnaire was developed based on existing literature relevance in the local context.

It included sections on:

- Demographic information (age, grade, gender, school type).
- Awareness and sources of information about climate change.
- Perceptions of local changes in temperature, precipitation, and extreme weather events (using Likert scales and categorical questions).
- Beliefs about the causes and consequences of climate change.

The questionnaire was administered in both English and Nepali Language during regular school hours.

Climate Reality Data (NASA POWER):

Historical climate data representing the 'reality' aspect were obtained from the NASA Prediction of Worldwide Energy Resources (POWER) project (https://power.larc.nasa.gov/). Daily time-series data for key meteorological variables, including maximum temperature (Tmax, °C), minimum temperature (Tmin, °C), and precipitation (mm/day), were acquired for the period 1982 to 2023. Data were extracted for a grid cell (or averaged over multiple cells) encompassing the geographical coordinates of Mechinagar Municipality, Jhapa (Latitude: 26.7083° N, Longitude: 88.1573° E). The spatial resolution of the NASA POWER data used was 0.5° x 0.625°.

Data Analysis

Data entry and Checking

The data collected during questionnaire survey and SLDs were entered in the excel sheets for detailed analysis.

Meteorological data analysis

For the analysis of meteorological data, MS excel was used for visualizing the trends of rainfall and precipitation and questionnaire responses were analysed usng Kobotoolbox and R Open source software. Similarly, ArcGIS was also used for visualizing the trends and scenarios of rainfall and precipitation map in the study area.

Climate Reality Data Analysis

Data Processing:

Daily NASA POWER data (Tmax, Tmin, Precipitation) were aggregated into monthly and annual averages (for temperature) or sums (for precipitation) for the period 1982-2023. Quality checks were performed to identify any missing data or outliers, although NASA POWER data are typically pre-processed.

Trend Analysis:

Long-term trends in annual and seasonal (e.g., pre-monsoon, monsoon, post-monsoon, winter) temperature (mean, max, min) and precipitation were assessed using the non-parametric Mann-Kendall (MK) test, which is robust to non-normally distributed data and outliers commonly found in climatological time series. The magnitude of significant trends (slope) was estimated using the Theil-Sen slope estimator. Trends were considered statistically significant if the MK test p-value was < 0.05.

ITA (Innovative Trend Analysis)

The ITA method, proposed by (Şen, 2012) divides any given hydro meteorological time series into two equal halves, and then sort both sub-series in ascending order. In the Cartesian coordinate system, the first half of the time series(x_i) is plotted on the horizontal axis, while the second half (y_i) is placed on the vertical axis. The 1:1 line represents a no-trend baseline, separating increasing trends (scatter points above the line) from decreasing trends (scatter points below the line) (Şen, 2012). If the scatter points display a non-monotonic trend, indicating a mix of different trends within the time series, the data is grouped into distinct clusters.

Hydro-meteorological data can be categorized into "low," "medium," and "high" groups by segmenting the data's variation range into three distinct intervals (Almazroui & Şen, 2020). This classification facilitates trend detection, such as identifying high rainfall linked to flooding or low rainfall associated with drought, with proper implications for water resource management (Öztopal & Şen, 2017). The straight-line trend slope plotted by the ITA can be calculated according to the following expression (Şen, 2017; Wang et al., 2020).

$$s = \frac{2(y_2 - y_1)}{n}$$

Where y_1 and y_2 are the arithmetic averages of the first and second half of the dependent variable, and n is the number of data.

Integration of Perception and Climate Data

The comparison between student perceptions and climate reality was primarily conducted through narrative synthesis and juxtaposition. Key findings from the perception surveys regarding perceived trends were systematically compared against the statistically analyzed historical climate trends derived from NASA POWER data.

Results

Student Perceptions, Attitudes, and Concerns Regarding Climate Change

Awareness and Understanding

A high level of awareness regarding climate change was observed among the surveyed students across various schools in the Mechinagar area (Table 1). Specifically, 95% of respondents reported having heard or learned about climate change through sources including school curricula, the internet, radio, and television. Familiarity with key terms was strong, with 95% recognizing "Climate Change" and 85% recognizing "Global Warming." A substantial majority (83%) indicated they had received and understood formal education on the topic. Regarding perceived causes, 80% of students attributed climate change primarily to human activities, while 10% cited natural causes, and the remaining 10% believed both human activities and natural processes were main drivers. Furthermore, nearly all participants perceived an increase in extreme climate events and related effects within their local municipalities over the last decade.

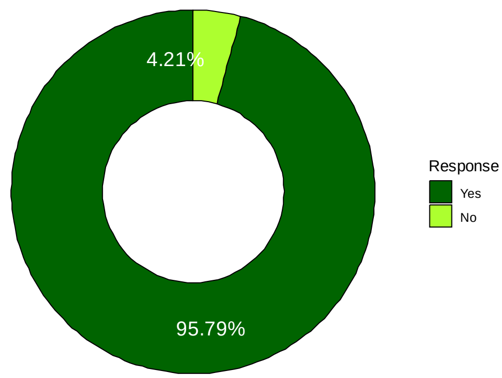

Figure 2: Information about climate change

Distribution of Respondents Across Sampled Schools

Table 1: Distribution of Respondents Across Sampled Schools

Name of the School (Abbreviation)	Frequency of respondents	Percentage of respondents
UEMS, MNP1	12	12.63
TESS, MNP3	12	12.63
AA, MNP4	11	11.58
SSSS, MNP4	11	11.58
SJSS, MNP3	11	11.58
SVVA, MNP4	10	10.53
SMJSS, MNP2	10	10.53
SBMV, MNP3	9	9.47
SPSS, MNP1	9	9.47

Perception of Local Climate Impacts

Students reported observing specific changes they associated with climate change. A significant majority (72%) perceived more frequent abrupt temperature changes. Increased frequency of severe rainfall events and growing water scarcity were each noted by 36% of respondents (respondents could likely select multiple impacts). Additional effects identified included loss of fertile soil and aquifer depletion. These perceptions of increased local climate impacts align with findings from previous studies highlighting public concern about climate change consequences (De Rivas et al., 2024; Tvinnereim et al., 2020).

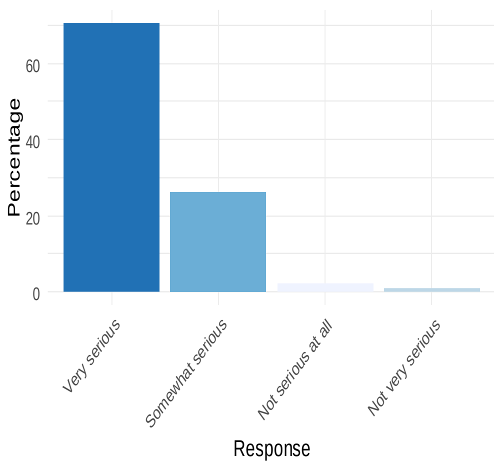

Figure 4: Respondents on the seriousness of climate change

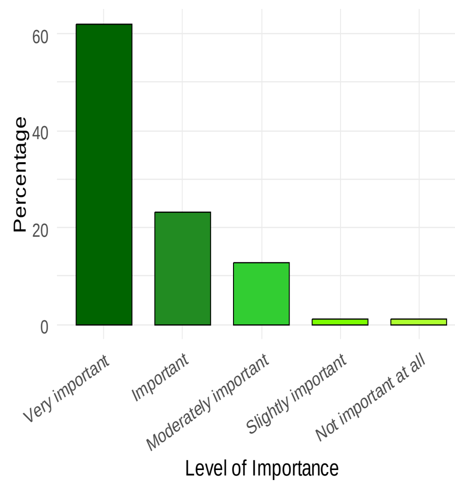

Figure 3: Respondents on importance to address the climate change issue

Attitudes and Willingness to Act

The survey indicated significant concern among students regarding climate change. A large majority (70.53%) perceived climate change as a "very serious" issue (Figure 3), with over a third (35.79%) expressing the highest possible level of concern. Correspondingly, 62.11% considered addressing climate change to be highly important (Figure 4), highlighting the perceived urgency among the younger generation. This concern translated into a stated willingness to act; 45.26% rated their willingness at the highest level (5 on a 5-point scale), and an additional 24.21% rated it as 4 out of 5 (Figure 6). Only a small minority displayed lower levels of concern or willingness to engage in climate action.

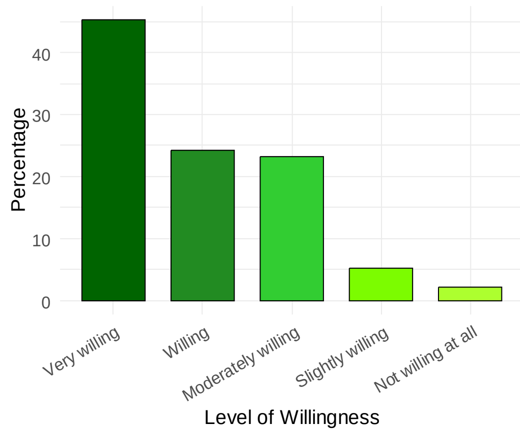

Figure 5: Respondents on willingness to address the climate change issue

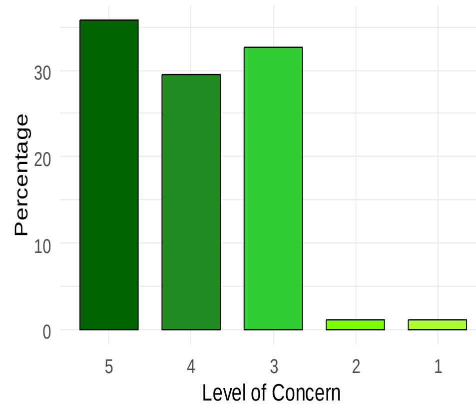

Figure 6: Respondents on level of concern regarding the climate change issue (1=not concerned at all, 5=very concerned)

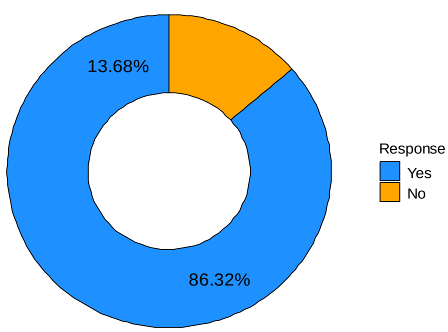

Figure 7: Participation in climate related

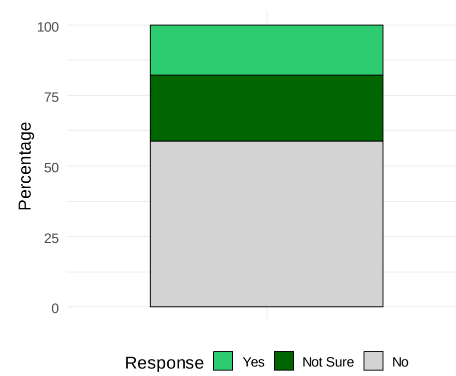

Figure 8: Involvement of government and local authorities to address climate

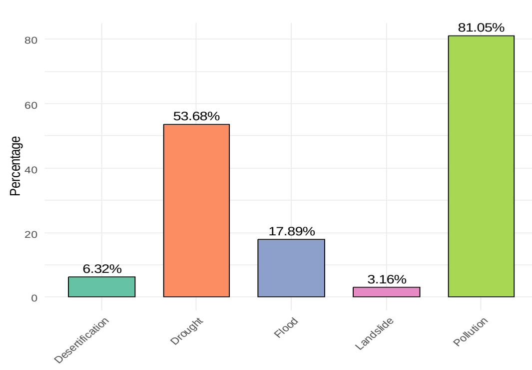

Figure 9: Climate change related challenges in Jhapa

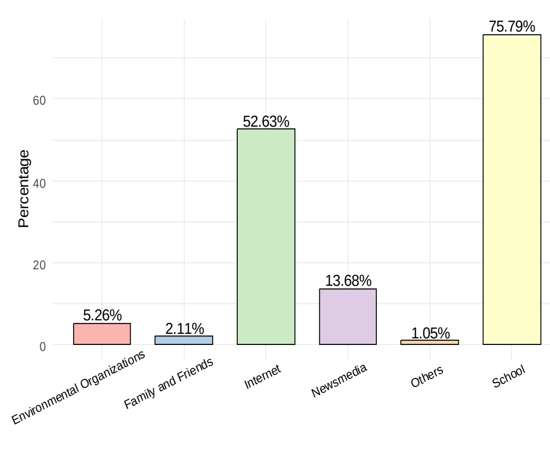

Figure 10: Information dissemination related to climate change

Climate Change Mitigation and Adaptation Efforts

Reported Actions and Local Initiatives

A majority (65%) of student respondents reported taking personal steps to reduce their environmental footprint, citing actions such as reducing energy consumption, using public transport, and minimizing waste. At the institutional level, most surveyed schools (85%) were reportedly involved in climate-related activities, including tree planting, creating green spaces, conducting awareness campaigns, delivering environmental education, and organizing cleanup efforts. Students also identified government-led adaptation and mitigation initiatives observed locally, such as the distribution of improved cooking stoves (ICS), prioritization of local agricultural production, riverbank stabilization projects, afforestation programs, and electrification intended partly for elephant risk control.

Perceived Local Challenges

Respondents identified pollution, drought, and floods as significant climate-related challenges currently facing the Mechinagar region of Jhapa (Figure 9).

Observed Climate Trend Analysis in Jhapa (1982-2022)

Temperature Trends

Analysis of temperature data for Jhapa district spanning 40 years (1982-2022) revealed an annual mean temperature of 24.35°C. The highest annual mean temperature recorded during this period was 25.29°C (1994), and the lowest was 23.55°C (2020). Visual inspection of the time series (Figure 12) suggested variable patterns, potentially including a period of slower change between 1994-2010 and a possible increase after 2011. However, statistical analysis using the Mann-Kendall test and Sen's slope estimator for the entire 40-year period indicated no statistically significant trend in annual mean temperature ($z = -1.0837$, $p = 0.2785$). The calculated Sen's slope was slightly negative (-0.0072 °C/year), suggesting overall stability in the long-term mean temperature despite annual fluctuations and potential shorter-term variations. Monthly analysis (Figure 15, Figure 25, Figure 26) confirmed the expected seasonal pattern, with May and June being the hottest months and strong positive correlations between temperatures of consecutive months. While a gradual long-term warming influence related to climate change might be expected, the 40-year trend for this specific location did not show a statistically significant increase in the annual mean. Figure 13 suggests Mechinagar experiences the highest average annual temperatures within the Jhapa district

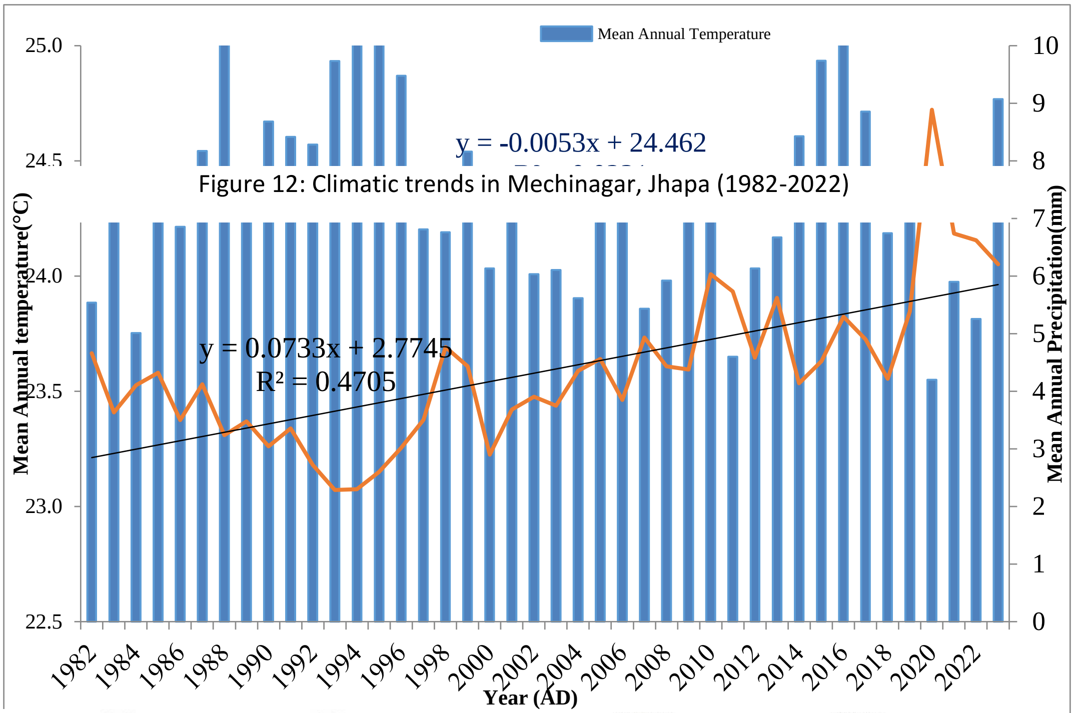

Figure 12: Climatic trends in Mechinagar, Jhapa (1982-2022)

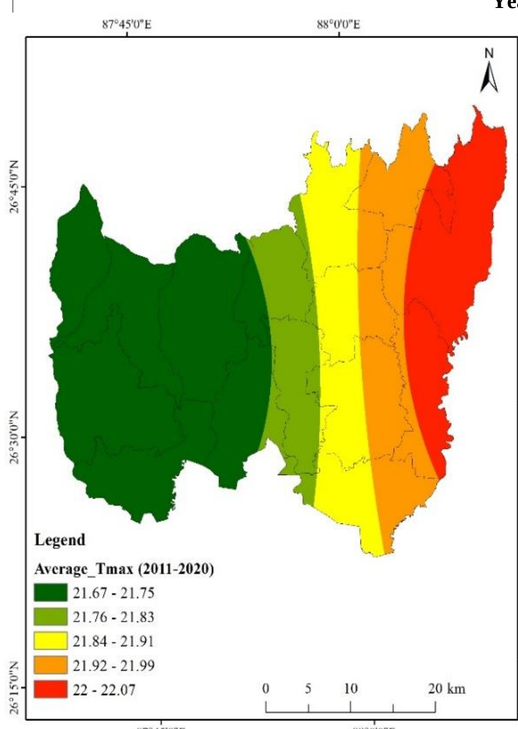

Figure 13: Temperature map of Jhapa district (2011-2020)

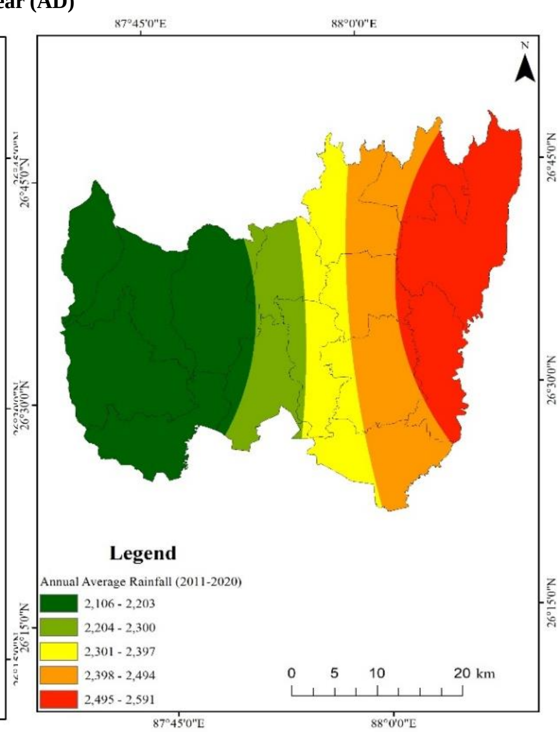

Figure 14: Precipitation Map of Jhapa (2011-2020)

Precipitation Trends

In contrast to temperature, precipitation analysis showed significant changes. Annual rainfall exhibited high fluctuation but a statistically significant increasing trend over the 1982-2022 period (Figure 12). Total annual rainfall increased from 1701.61 mm in 1982 to 2265.75 mm in 2022. The Mann-Kendall test confirmed this significant increasing trend ($z = 4.6601$, $p < 0.001$), with Sen's slope estimating an average increase of approximately 24.89 mm per year. Rainfall variability was high, with the highest annual total recorded in 2020 (3252.98 mm) and the lowest in 1993 (834.42 mm). Other notably high rainfall years included 2021, 2022, and 2010, while 1994, 1995, and 2000 were relatively dry. Figure 14 indicates that the Mechinagar area receives the highest average annual rainfall within Jhapa district.

Seasonal Patterns and Rainfall Characteristics

Monthly data (Figure 15) shows July receives the highest precipitation, followed by other monsoon months (June, August, September), with significantly lower rainfall during the cold, dry winter. Innovative Trend Analysis (ITA) graphs further supported the increasing annual rainfall trend and indicated increasing trends across all seasons, particularly pronounced during the pre-monsoon and monsoon periods (Figure 17, Figure 18). While winter rainfall also showed an overall increase, it appeared less steep or potentially included declining periods within the overall upward trend. Autocorrelation function (ACF) analysis of annual rainfall (Figure 24) revealed significant positive autocorrelation for the first few lags (up to lag 5), indicating persistence (years with high/low rainfall tend to be followed by years with similar conditions). This persistence diminishes over longer time scales. Further analysis confirmed that the increasing annual rainfall trend is primarily driven by increases during the monsoon months (June-September), which exhibit strong inter-monthly correlations (Figure 21, Figure 23). Seasonal correlations also highlighted a link between pre-monsoon and monsoon rainfall (Figure 22).

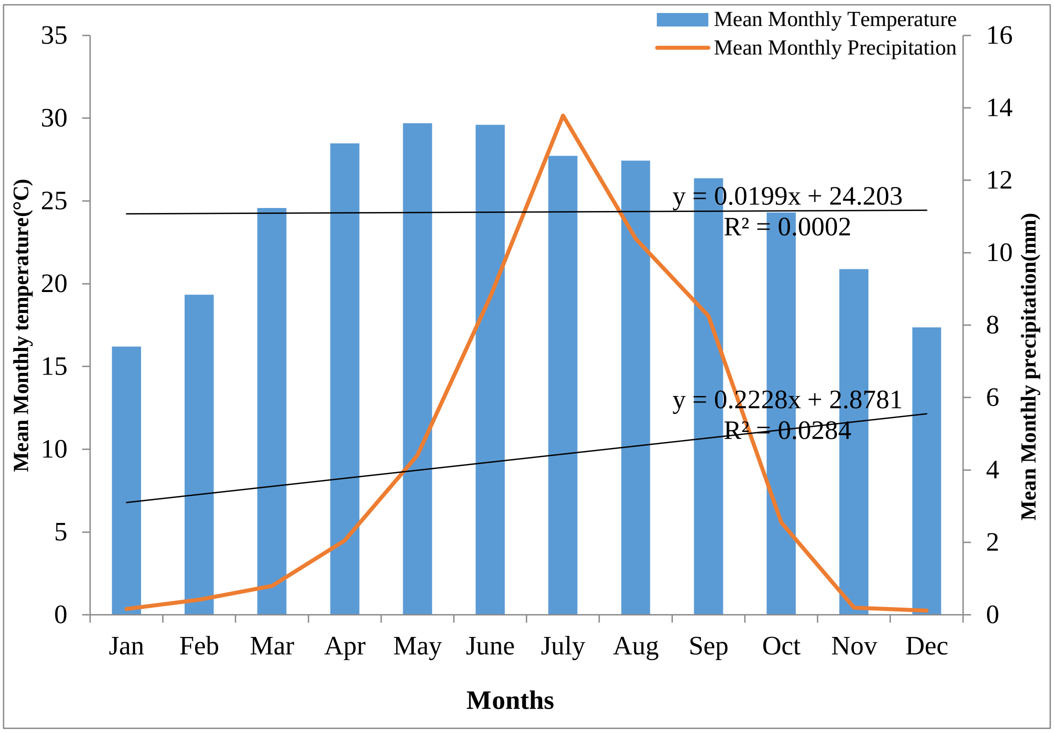

Figure 15: Long term Monthly Climate trends in Mechinagar, Jhapa (1982-2022)

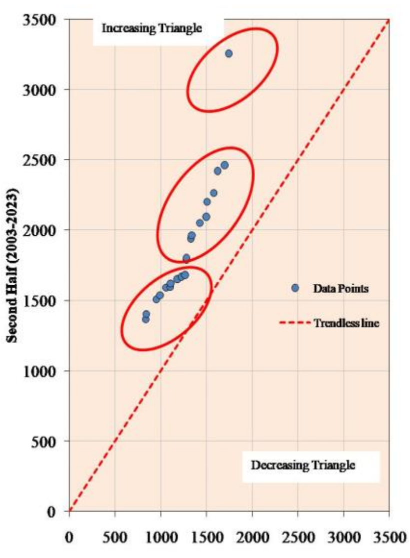

Figure 16: Annual ITA

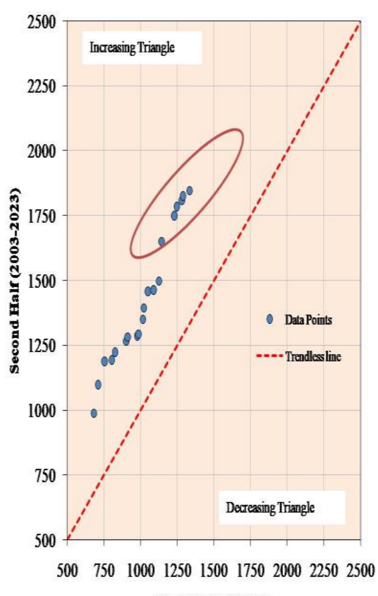

Figure 18: Monsoon ITA

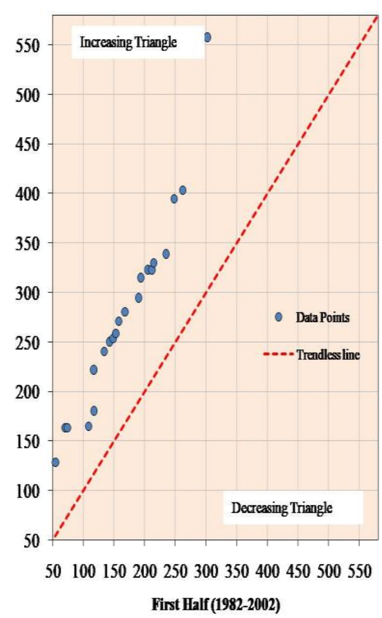

Figure 17: Pre-Monsoon ITA

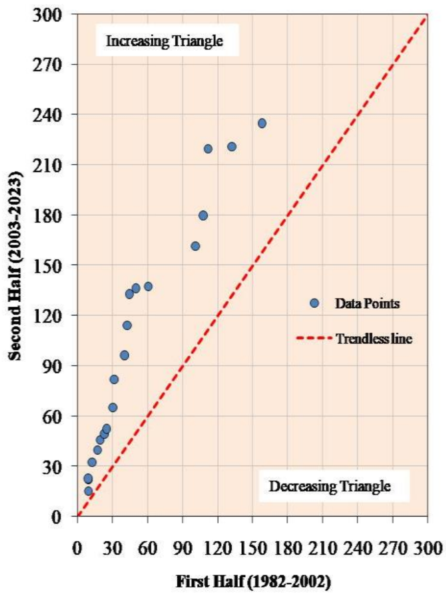

Figure 19: Post-Monsoon ITA

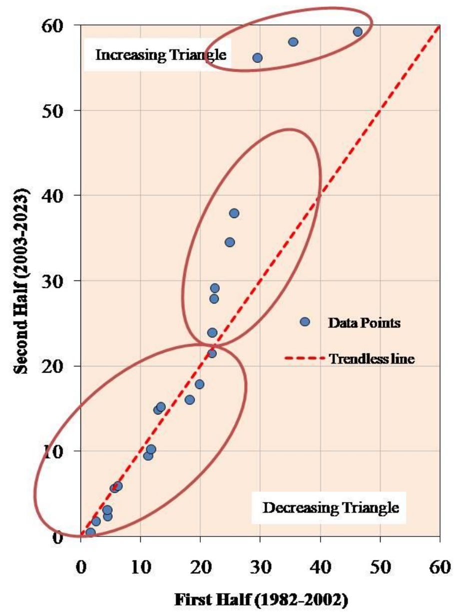

Figure 20: Winter ITA

Summary of Statistical Trend Tests

The Mann-Kendall and Sen's Slope results are summarized below:

Parameter	Rainfall	Temperature
Mann-Kendall z-value	4.6601	-1.0837
Mann-Kendall p-value	0.000003161 (significant)	0.2785 (not significant)
Kendall’s tau (τ)	0.5006	-0.087 (likely)
Sen’s Slope	24.89 units/year (positive)	-0.0072 units/year (negative)
Overall Trend	Significant increasing trend	No significant long term trend

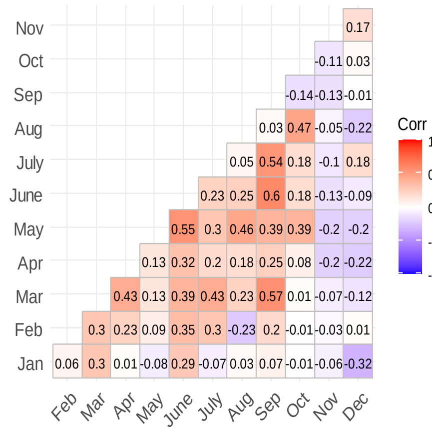

Figure 21: Correlation Plot of monthly rainfall trends of 40 years

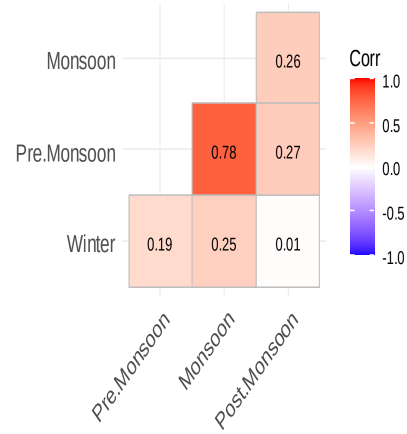

Figure 22: Correlation plot of seasons

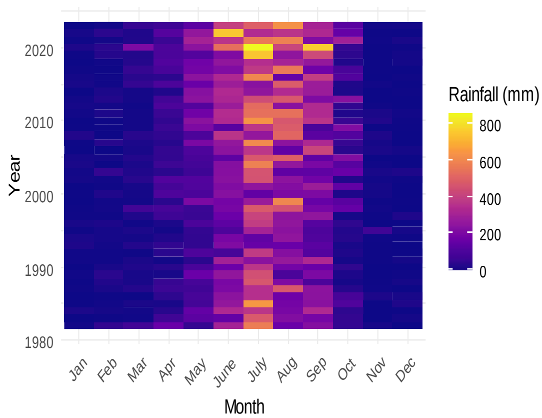

Figure 23: Heatmap of Monthly Rainfall

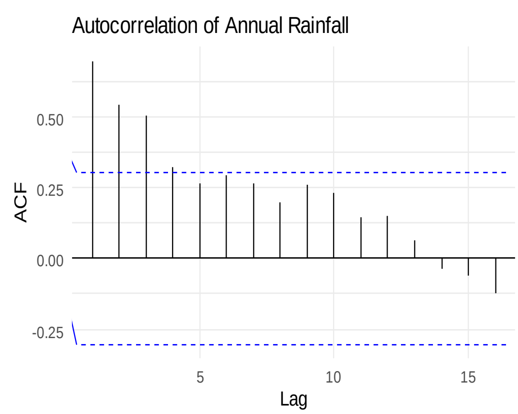

Figure 24: Autocorrelation of annual rainfall trends

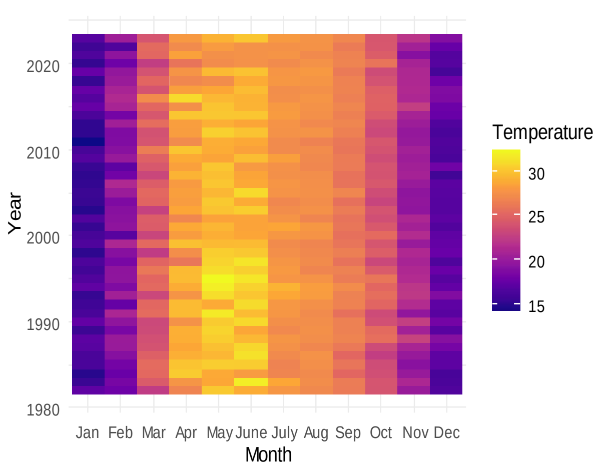

Figure 25: Heatmap of monthly temperature

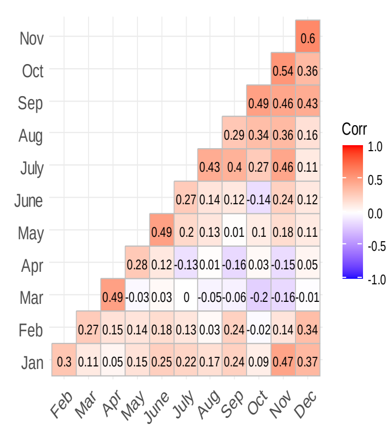

Figure 26 Correlation matrix of monthly temperature

Discussion

This study provides valuable insights into the interplay between student perceptions of climate change and observed climatic trends in the Mechinagar municipality of Jhapa, Nepal. The findings show a high degree of climate change awareness, concern, and perceived seriousness among secondary level students, consistent with growing global youth engagement on the issue (De Rivas et al., 2024; Tvinnereim et al., 2020). This awareness appears to be linked to a strong expressed readiness to take action and participate in mitigation initiatives at both the individual and school levels, which is encouraging which is supported by other studies by Kolenatý et al. (2022) and Pickering et al. (2020).

One important finding is that the observed climatological data and student perceptions of local climate impacts partially coincide. Students perceived an increase in the frequency of extreme events, temperature fluctuations, severe rainfall, and water scarcity (CDCC Consortium, 2023). A statistically significant increase in annual rainfall (~24.9 mm/year) is confirmed by the 40-year meteorological data analysis. This increase is predominantly driven by intensified pre-monsoon and monsoon precipitation and is characterized by high variability and short-term persistence (DHM, 2017).

This is inline with the perception of an increase in severe rain events and has the potential to exacerbate perceived challenges such as soil erosion (the loss of fertile soil) and floods. Afforestation and riverbank stabilization are two examples of government adaptation initiatives that seem relevant to mitigating these hydrological impacts as per the respondents.

On the other hand, there is a noticeable difference in temperature. In spite of anticipated seasonal cycles and inter-annual variability, the long-term (1982–2022) examination of annual mean temperature revealed no statistically significant trend, despite student perceptions of increasingly frequent abrupt temperature fluctuations. Student perceptions may be more susceptible to daily temperature variations, short-term heatwaves, or shifts in seasonal timing than to the long-term annual average trend, therefore this disparity does not necessarily invalidate it.

Different places experience global warming in different ways, and local variables (such as irrigation, aerosols, and changes in land use) can influence regional temperature patterns (IPCC, 2021). Although the current 40-year statistical evidence suggests that the mean is stable, the map indication of a potential temperature increase after 2011 demands additional research with updated data or segmented trend analysis. This emphasizes the significance of conveying the differences between various climatic indicators (mean vs. extremes, fluctuations vs. long-term trends) in climate education (Rummukainen, 2012; Seneviratne et al., 2012).

The strong positive autocorrelation observed in annual rainfall suggests a degree of predictability in the short term (multi-year persistence), which could be useful for managing water resources and agricultural planning, though the overall increasing pattern and high variation present significant challenges. The dominant role of the monsoon season in driving the annual rainfall rise highlights the region vulnerability to monsoon dynamics, which are known to be influenced by climate change (Luo et al., 2024; Maharjan et al., 2025).

The mentioned local issues of pollution, drought, and flooding highlight the need for strong adaptation methods based on water management, disaster risk reduction, and sustainable land use. This study results on student engagement and school-based initiatives (tree planting, awareness campaigns) are optimistic. However, the efficacy of these activities in addressing a key observable climate trend like increasing, erratic rainfall etc. and perceived issues such as floods, drought, pollution requires additional research.

Conclusion

In conclusion, this study demonstrates an anxious and aware student population in Mechinagar, Jhapa, who perceive major local climate consequences. Although these perceptions are consistent with the observed substantial increase in rainfall and its variability, they are inconsistent with the statistically stable long-term mean temperature trend. This highlights the necessity for specialised climate education and adaptation initiatives that address the specific, data-driven vulnerabilities of the region, especially with altered hydrological patterns.

Author Contribution Statement

The authors confirm contribution to the research article as follows:

Bhattarai, C. and Maskey, R.: Study conception and design. Bhattarai, C: Data collection, Analysis and interpretation of results, draft manuscript preparation. Maskey, R..: Writing-review and supervised the paper. All authors reviewed the results and approved the final version of the manuscript.

Declaration of competing interest

The authors have no conflicts of interest to declare. All co-authors have seen and agree with the contents of the manuscript and there is no financial interest to report. We certify that the submission is original work and is not under review at any other publication.

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