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Perceptions and Impacts of Deforestation, Industrialization, and Climate Change on the Chota Nagpur Region: A Survey-Based Study

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ABSTRACT

This study explores perceptions of deforestation, climate change, and environmental impacts in the Chota Nagpur region. A survey of 226 respondents reveals significant concerns about deforestation's role in altering weather patterns, biodiversity, and water resources. Notably, 74.4% believe deforestation contributes to weather changes, and 88.9% are worried about its impact on biodiversity. Additionally, 86.7% agree that deforestation and land use changes affect water availability. The data also indicates strong beliefs that industrialization and mining contribute to environmental pollution, with 88.5% supporting this view. Furthermore, 86.4% of respondents are aware of global climate change impacts on local agriculture and water resources. These findings highlight widespread recognition of environmental challenges and underscore the urgency for effective mitigation strategies and sustainable practices in the region.

Keywords: Deforestation, Climate Change, Environmental Impact, Chota Nagpur, Sustainable Practices

I. INTRODUCTION

The Chota Nagpur region, particularly the Ranchi district, has experienced notable climate changes over recent decades. These changes are driven by a combination of natural and anthropogenic factors. Natural factors include the region’s unique topography and geological characteristics, which influence local weather patterns. However, the predominant drivers of climate change are human activities, particularly deforestation, mining, and urbanization. Deforestation for agriculture, timber, and mining disrupts the local ecosystem, leading to increased greenhouse gas emissions and reduced carbon sequestration. Mining activities, extensive in the Chota Nagpur plateau, contribute significantly to soil degradation and water pollution, altering local climate conditions. Urbanization in Ranchi has led to the urban heat island effect, where concrete and asphalt absorb and retain heat,

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raising temperatures in the city compared to surrounding rural areas. Industrialization and increased vehicular emissions further exacerbate air pollution, contributing to climate change. Socio-economic factors, such as population growth and economic development, drive these activities, highlighting the need for sustainable practices. Addressing these issues requires comprehensive policies focusing on reforestation, sustainable mining practices, and the development of green urban infrastructure to mitigate climate change impacts in the Ranchi district and the broader Chota Nagpur region.

1.1 Overview of The Chota Nagpur Region

The Chota Nagpur region, located in eastern India, is a plateau known for its unique geological and ecological characteristics. Spanning parts of the states of Jharkhand, Bihar, Odisha, and West Bengal, it covers an area of approximately 65,000 square kilometers. The plateau's topography is diverse, featuring a mix of hills, valleys, and flat terrains, with altitudes ranging from 300 to 900 meters above sea level. The region is rich in mineral resources, including coal, iron ore, and mica, making it a significant contributor to India's mining industry. The climate of Chota Nagpur varies from tropical to subtropical, characterized by hot summers, a monsoon season, and mild winters. Average annual rainfall ranges from 1,200 to 1,600 millimeters, primarily concentrated during the monsoon months from June to September. This seasonal rainfall supports the region's dense deciduous forests, which are home to a variety of flora and fauna, including several endangered species. The region's forests also play a crucial role in sustaining the livelihoods of indigenous communities through the provision of forest products and agricultural opportunities.

1.2 Significance of The Study

Studying the causes and factors influencing climate change in the Chota Nagpur region, focusing on Ranchi district, is vital due to its broad environmental, economic, and social impacts. This research is essential for crafting effective mitigation and adaptation strategies suited to the region's unique conditions. The area's rich biodiversity and natural resources face risks from climate change, necessitating targeted conservation efforts. Additionally, the local economy, heavily reliant on agriculture, mining, and forestry, is vulnerable to climate shifts, requiring resilience strategies. This study also addresses the socio-economic effects on indigenous and marginalized communities, informing inclusive policies to protect their livelihoods and promote equitable growth.

1.3 Identification of Main Factors Influencing Climate

- ✓ **Deforestation:** Deforestation is one of the most significant factors influencing climate change in the Ranchi district. The extensive clearing of forests for agriculture, urban development, and mining activities has drastically reduced the region's natural carbon sinks. Forests play a critical role in sequestering carbon dioxide, and their removal leads to higher levels of greenhouse gases in the atmosphere. Additionally, deforestation disrupts local water cycles, leading to altered precipitation patterns and increased soil erosion, which further exacerbate climate change impacts.

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- ✓ **Mining Activities:** Ranchi's rich mineral deposits make mining a key economic activity. However, the environmental cost is high. Mining operations lead to land degradation, deforestation, and water pollution. The removal of vegetation cover and topsoil disrupts natural carbon absorption processes and increases emissions. Mining also alters the landscape, creating conditions that can lead to increased temperatures and altered local climate conditions.

- ✓ **Urbanization:** The rapid urbanization of Ranchi has contributed significantly to local climate change. The expansion of built-up areas creates urban heat islands, where concrete and asphalt surfaces absorb and retain heat, raising local temperatures. Increased vehicular traffic and industrial activities contribute to higher levels of air pollution and greenhouse gas emissions. Urbanization also strains water resources and infrastructure, which can lead to inefficient energy use and further environmental degradation.

- ✓ **Agricultural Practices:** Traditional and modern agricultural practices in Ranchi contribute to climate change in several ways. Slash-and-burn farming leads to deforestation and soil degradation. The use of chemical fertilizers and pesticides releases nitrous oxide, a potent greenhouse gas. Over-irrigation can deplete water resources and alter local hydrological cycles, affecting regional climate patterns. Sustainable agricultural practices are essential to mitigate these impacts.

- ✓ **Industrialization:** The growth of industrial activities in Ranchi contributes to increased emissions of greenhouse gases and pollutants. Industries such as steel, cement, and manufacturing release large amounts of carbon dioxide, methane, and other harmful gases into the atmosphere. Industrial waste disposal and inefficient energy use further exacerbate environmental pollution and climate change.

- ✓ **Socio-Economic Factors:** Population growth and economic development are underlying drivers of deforestation, mining, urbanization, and industrialization. The increasing demand for land, water, and energy resources leads to environmental degradation. Socio-economic factors also influence consumption patterns, waste generation, and energy use, all of which have direct and indirect impacts on the climate.

1.4 Objective

To assess the perceptions and impacts of deforestation, industrialization, and climate change on environmental sustainability in the Chota Nagpur region.

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2. LITERATURE REVIEW

Author	Year	Research Area	Location	Methodology	Findings
Gulati & Rai	2024	Climate Variability	Chotanagpur Plateau	Mann-Kendall test, Sen's slope estimator, data from 1982–2012	Decreasing rainfall trend, increase in maximum temperature, decreasing minimum temperature; potential adverse effects on agriculture.
Kumar et al.	2023	Urban Climate	Ranchi, Urban and Peri-urban	LANDSAT satellite images (2000–2014), correlation of LST with LULC	Increased built-up land, rise in high-temperature zones, urban heat islands; urban areas cooler than peri-urban due to barren land and rock outcrops.
Ghosh & Bera	2023	Geomorphology	Chota Nagpur Plateau	Digital elevation model (DEM), satellite imagery, terrain attributes classification	High-accuracy geomorphological map; useful for regional planning and natural hazards management.
Lal & Lal	2023	Water Quality and Monsoon Impact	Ranchi	Physicochemical analysis of water (APHA guidelines)	Significant alteration in water quality post-monsoon; Kanke Lake more affected than Ranchi Lake; eutrophication observed due to anthropogenic acidification.
Bera et al.	2022	Groundwater Scarcity	Chotanagpur Plateau	Groundwater monitoring data (1996–2017), Mann-Kendall trend analysis, SPI, exponential smoothing	Declining groundwater table trend, prediction of future groundwater depression pockets; major factors include dry farming and rapid land use changes.
Prasad	2023	Agro-Climatic Planning	North Chotanagpur Plateau	Analysis of natural resources (land, soil, water, climate) and agro-climatic suitability	Agro-climatic suitability assessment for sustainable agricultural development; emphasizes natural resource-based planning.
Ekka et al.	2021	Forest Dynamics	South Chota Nagpur	Satellite imagery, secondary data sets	Decline in incredibly dense forests; rapid population growth and industrialization leading to forest cover degradation.
Tigga & Malini	2014	Drought and Hydrological Disasters	Chotanagpur Plateau	Analysis of precipitation data, study of environmental changes	Drought occurrences linked to climate change, land-use changes, and urbanization; increased temperature due to aerosol emissions and greenhouse effect aggravating droughts.

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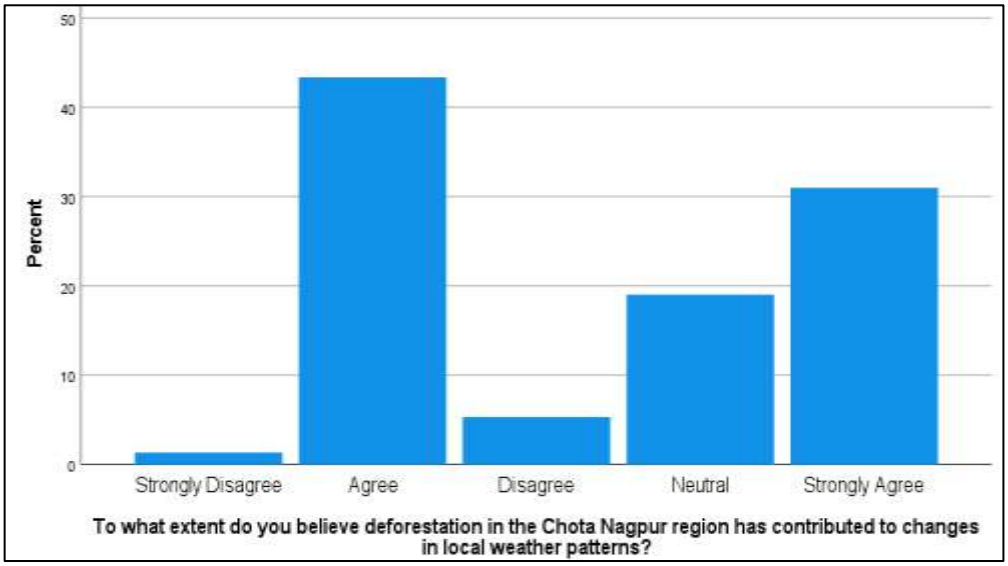
3. SURVEY CONDUCTED IN THE CHOTA NAGPUR

The study utilized a structured questionnaire to gather data from 226 respondents in the Chota Nagpur region. The survey included questions on perceptions of deforestation, climate change, and their impacts on local weather patterns, biodiversity, water resources, and agricultural productivity. Responses were quantified using frequency and percentage distributions. Statistical analysis was performed to determine the level of agreement or disagreement among respondents regarding various environmental issues. The data provided insights into community awareness and concerns, highlighting the perceived effectiveness of current policies and the need for sustainable practices to mitigate environmental challenges in the region.

4. ANALYSIS OF DATA (PRIMARY DATA)

This study performed an in-depth analysis of the environmental perceptions and concerns among residents of the Chota Nagpur region, utilizing a comprehensive survey method. The data collected provided a detailed understanding of how deforestation, industrialization, and climate change are perceived to impact local weather patterns, biodiversity, water resources, and agricultural productivity. Statistical analysis of survey responses revealed significant consensus on the negative effects of these activities, emphasizing the urgent need for effective environmental policies and sustainable practices. Below is the representation of collected survey in Bar chart through SPSS.



A significant 74.4% of respondents believe deforestation in the Chota Nagpur region has altered local weather patterns, while only 6.6% disagree. The neutral stance of 19.0% suggests some uncertainty. Overall, the data indicates a strong perception of the link between deforestation and weather changes.

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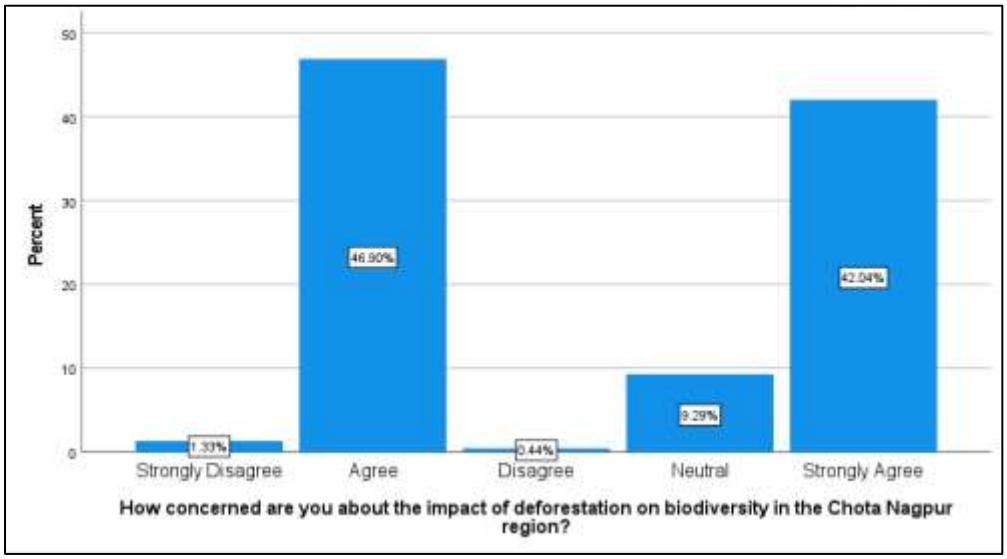
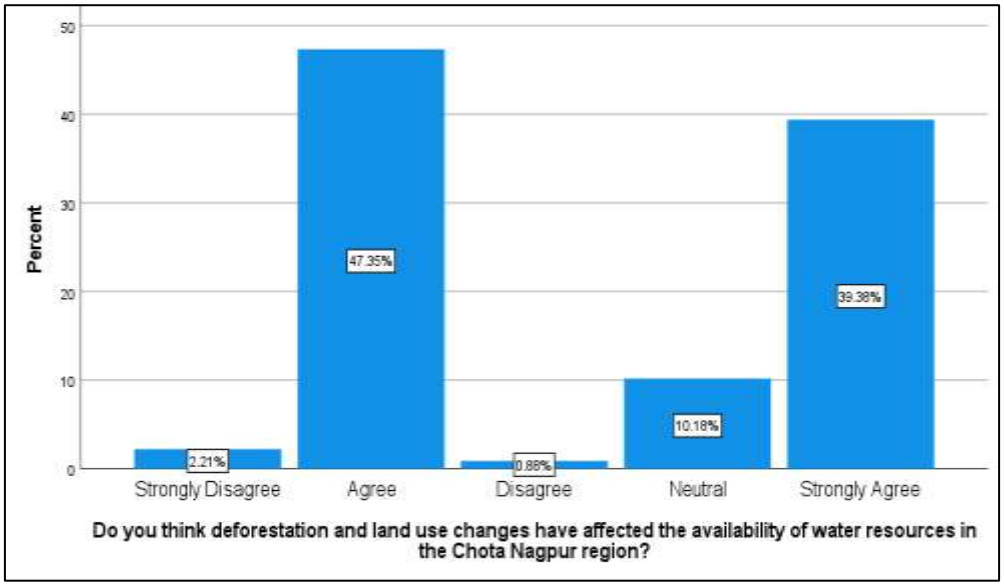


A substantial 88.9% of respondents express concern about deforestation's impact on biodiversity in the Chota Nagpur region, with only 1.7% disagreeing. Neutral responses account for 9.3%, indicating general consensus on the detrimental effects of deforestation on biodiversity.



A strong 86.7% of respondents believe deforestation and land use changes have impacted water resources in the Chota Nagpur region. Minimal disagreement (3.1%) and 10.2% neutral responses highlight a consensus on the negative effects of these environmental changes on water availability.

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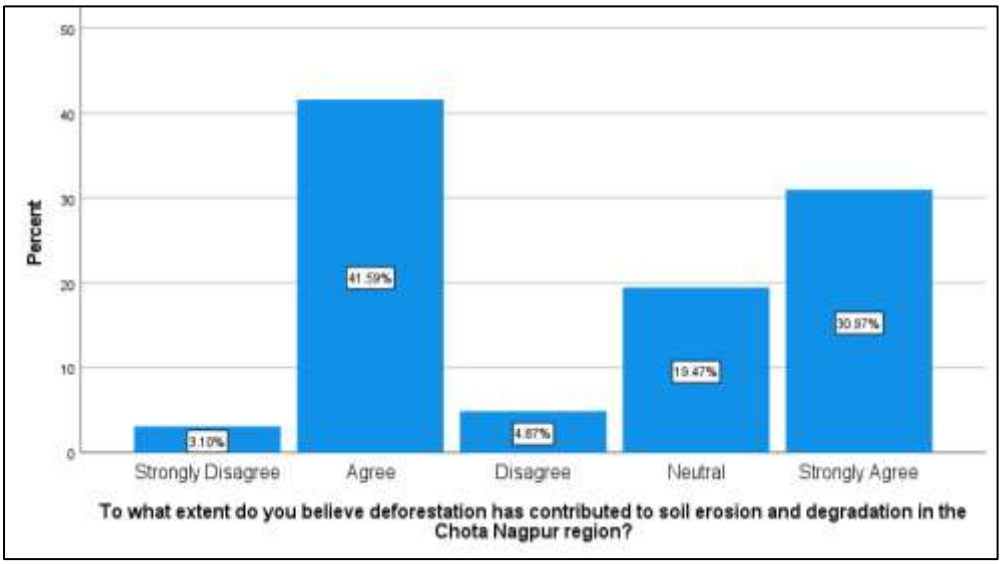
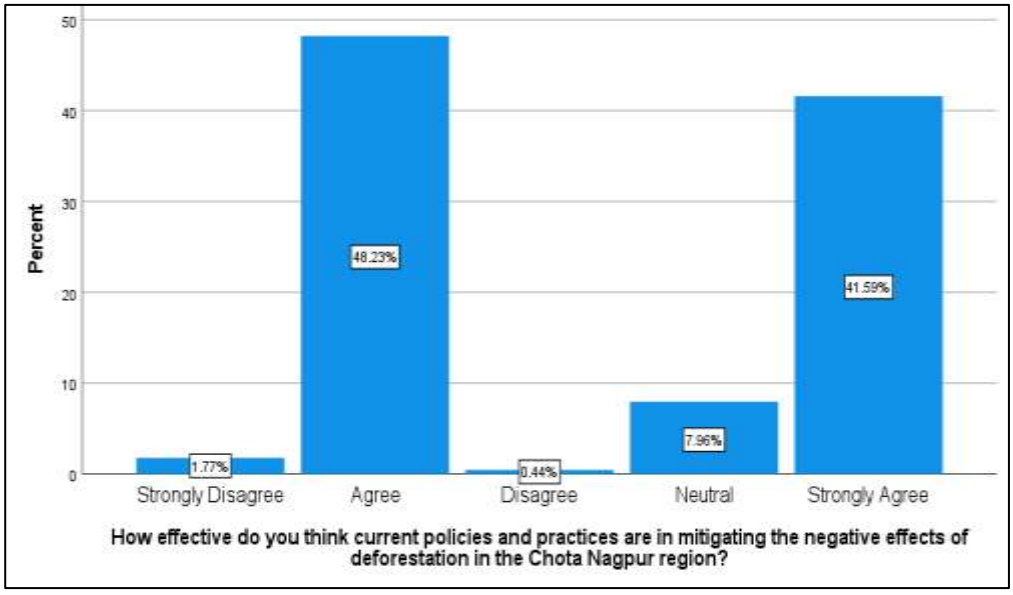


A significant 72.6% of respondents believe deforestation contributes to soil erosion and degradation in the Chota Nagpur region, while 8.0% disagree. Neutral responses (19.5%) indicate some uncertainty, but overall, there is a strong belief in the negative impact of deforestation on soil health.



A majority of 89.8% of respondents agree that current policies effectively mitigate deforestation's negative effects in the Chota Nagpur region. Only 2.2% disagree, and 8.0% remain neutral, suggesting a generally positive perception of current deforestation mitigation efforts.

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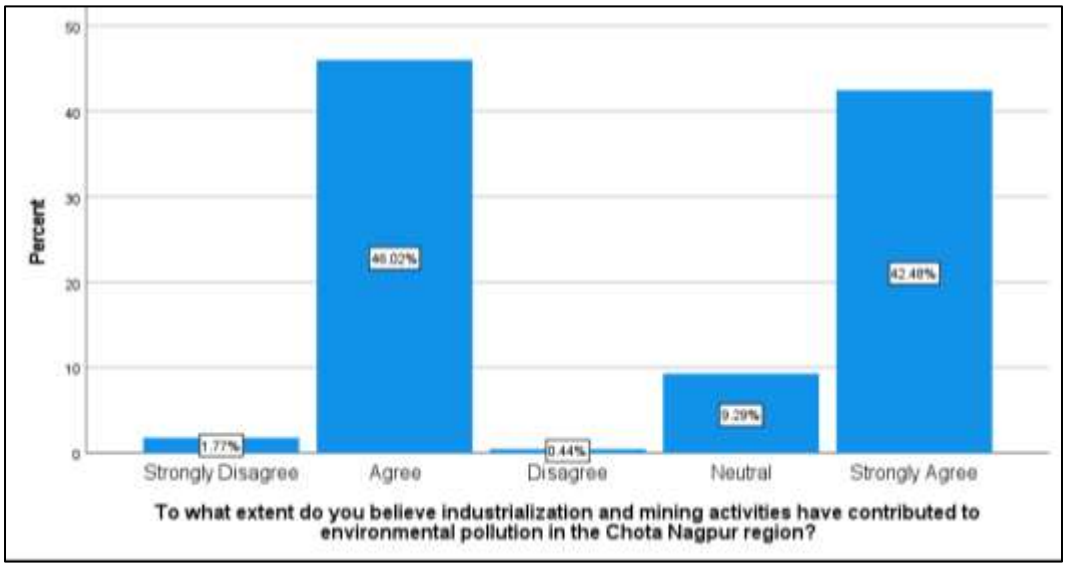
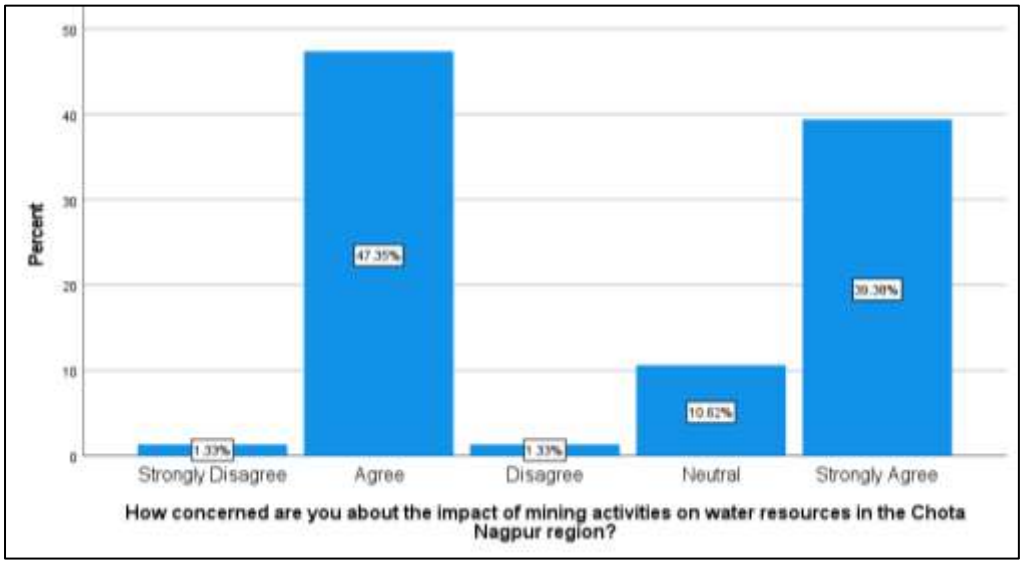


A strong majority of 88.5% of respondents believe industrialization and mining contribute to environmental pollution in the Chota Nagpur region. Minimal disagreement (2.2%) and 9.3% neutrality indicate widespread recognition of the pollution problem linked to these activities.



A significant 86.7% of respondents express concern about mining's impact on water resources in the Chota Nagpur region, with minimal disagreement (2.6%) and 10.6% neutral responses, reflecting a strong consensus on the negative effects of mining on water.

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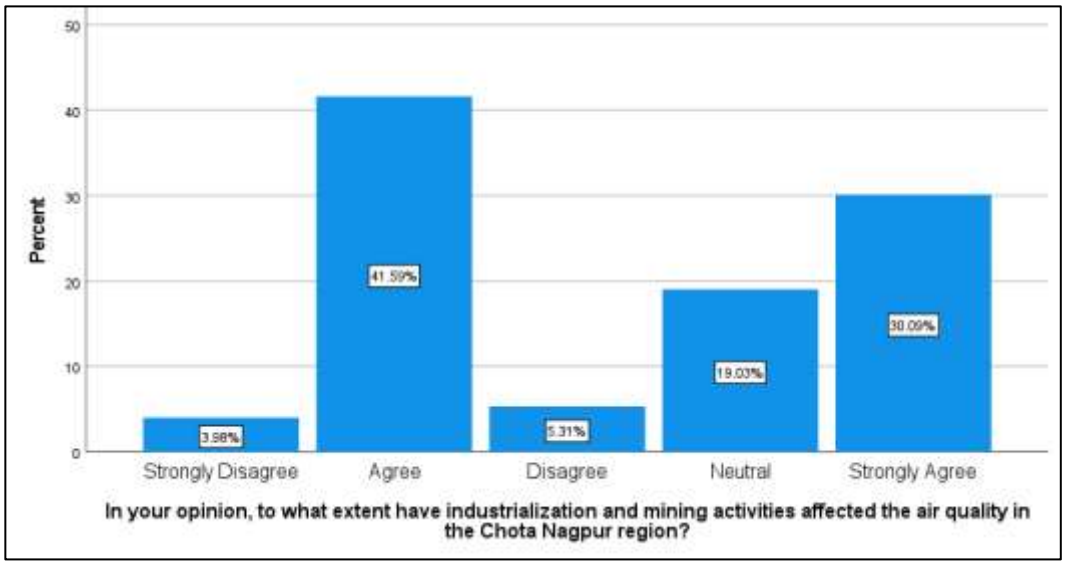
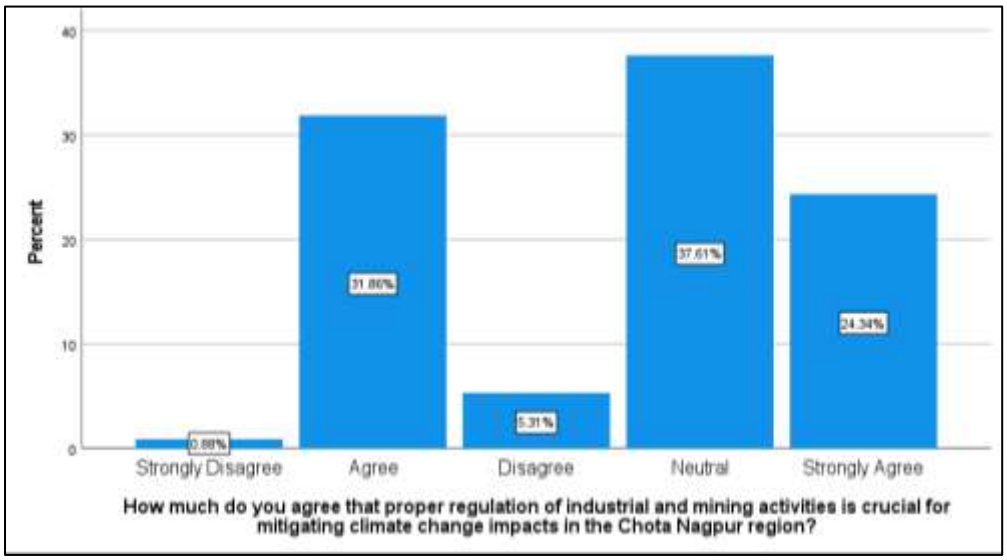


A majority of 71.7% of respondents believe industrialization and mining negatively affect air quality in the Chota Nagpur region. With 9.3% disagreement and 19.0% neutral responses, there is a significant consensus on the adverse impact on air quality.



A majority of 56.2% of respondents agree on the necessity of regulating industrial and mining activities to mitigate climate change impacts, with minimal disagreement (6.2%) and a significant 37.6% neutral responses, indicating widespread support for regulatory measures.

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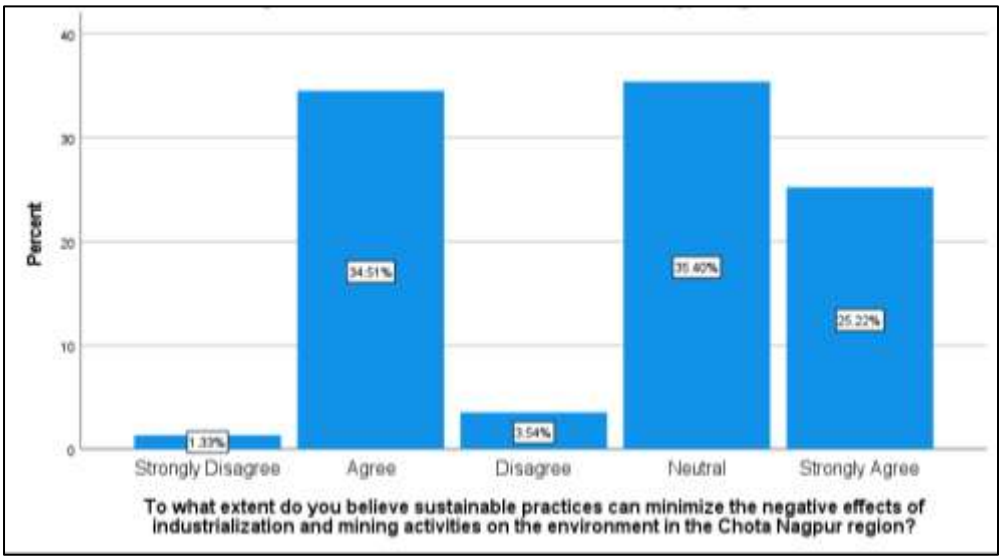
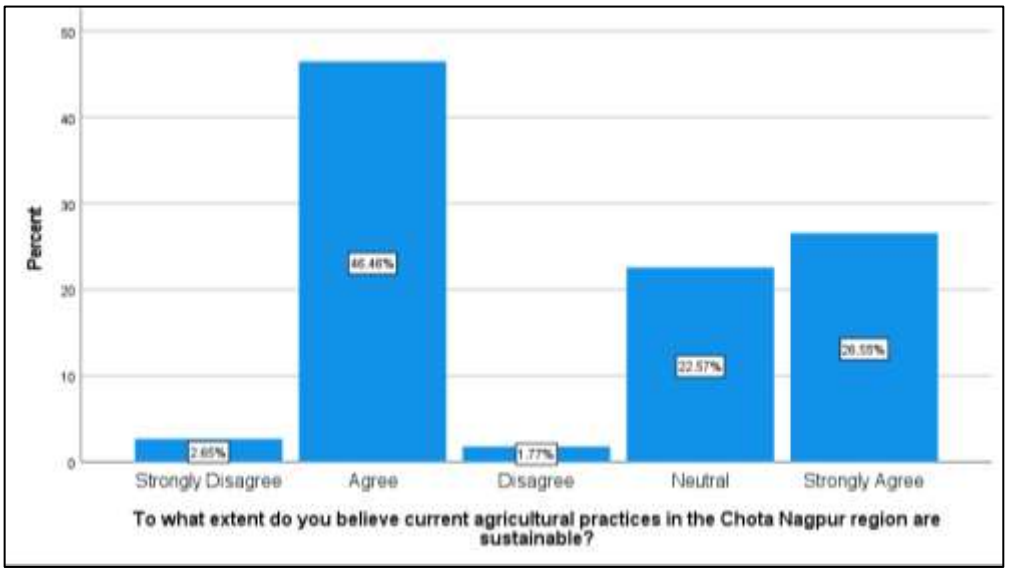


A majority of 59.7% of respondents believe sustainable practices can mitigate industrialization and mining's negative effects, while 4.8% disagree and 35.4% are neutral, indicating a mix of optimism and uncertainty about the effectiveness of sustainable practices.



A significant 73.0% of respondents view current agricultural practices in the Chota Nagpur region as sustainable, with only 4.5% disagreeing and 22.6% neutral, reflecting general confidence in the sustainability of these practices.

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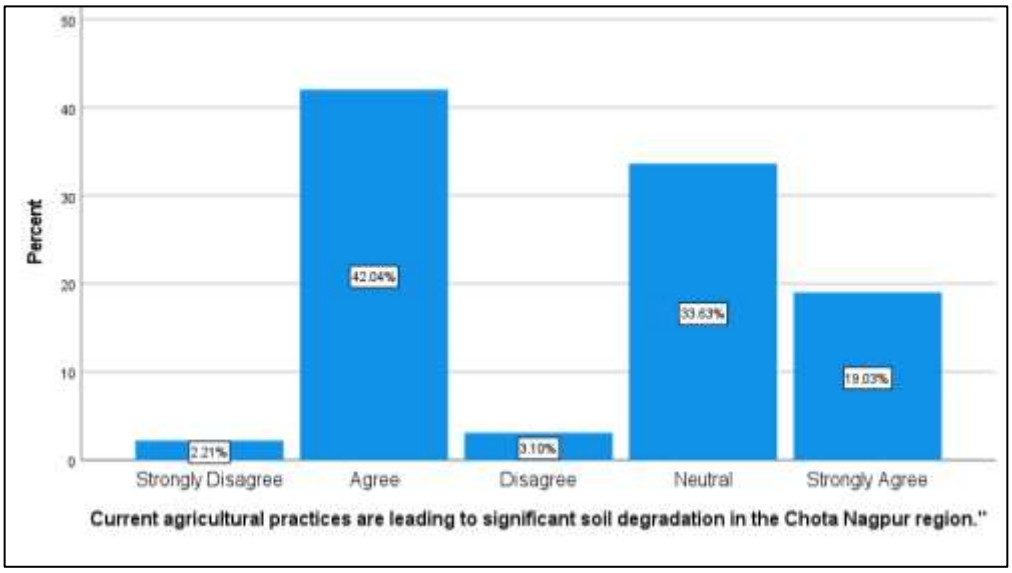
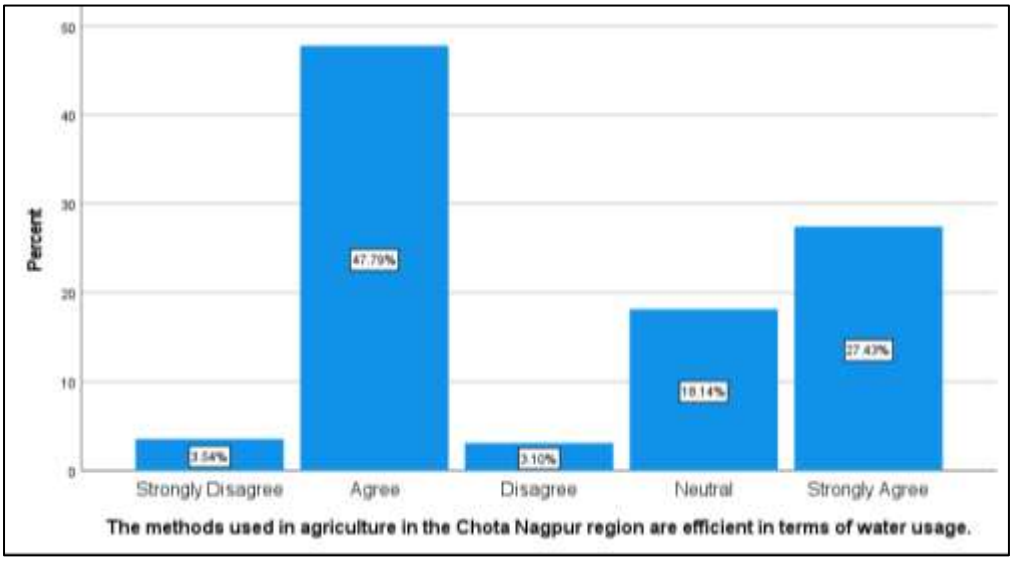


A majority of 61.0% of respondents believe current agricultural practices cause soil degradation in the Chota Nagpur region, while 5.3% disagree and 33.6% remain neutral, highlighting significant concern about the impact on soil health.



A majority of 75.2% of respondents perceive agricultural methods as efficient in water usage, while 6.6% disagree and 18.1% are neutral, indicating general confidence in water efficiency in local agriculture.

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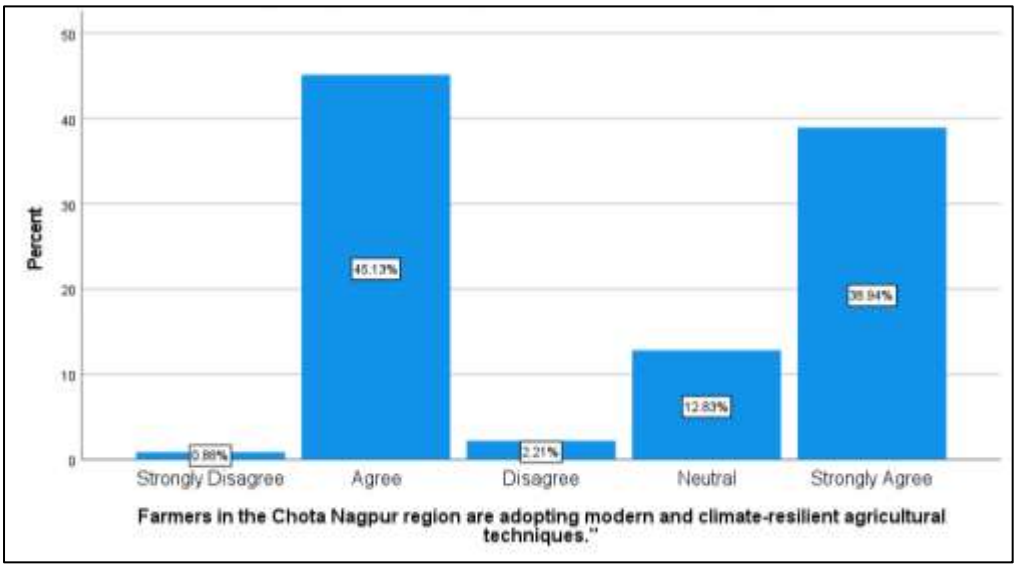
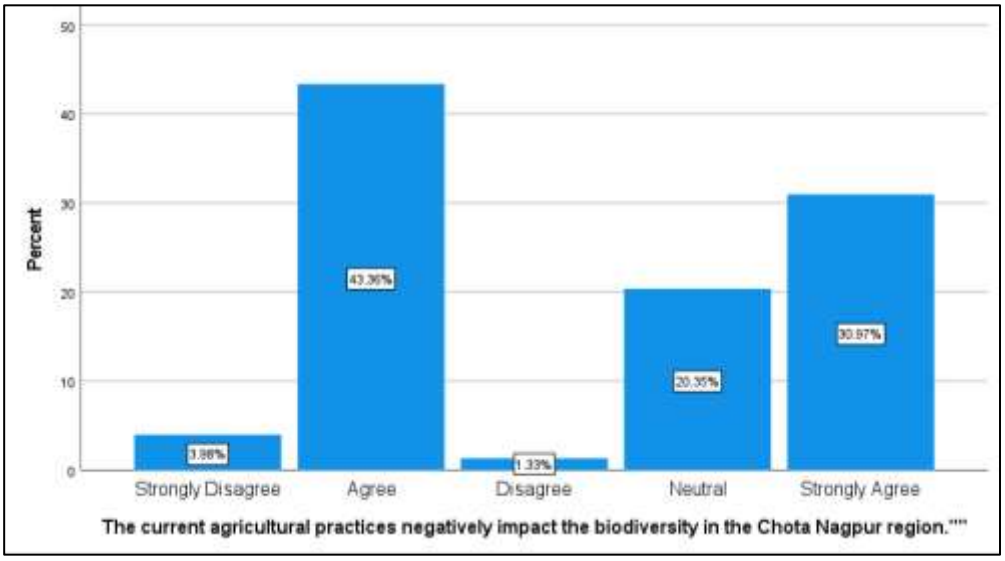


A significant 84.0% of respondents believe farmers in the Chota Nagpur region are adopting modern, climate-resilient techniques, with minimal disagreement (3.1%) and 12.8% neutrality, reflecting a positive shift towards climate adaptation in agriculture.



A strong majority of 74.4% of respondents believe current agricultural practices harm biodiversity in the Chota Nagpur region, with minimal disagreement (5.3%) and 20.4% neutrality, indicating widespread concern for biodiversity conservation.

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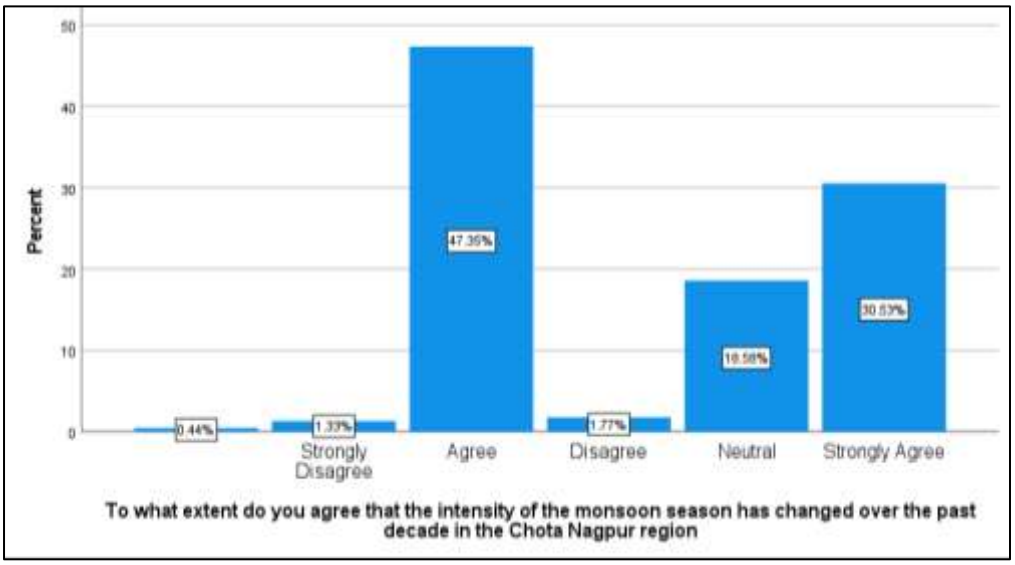
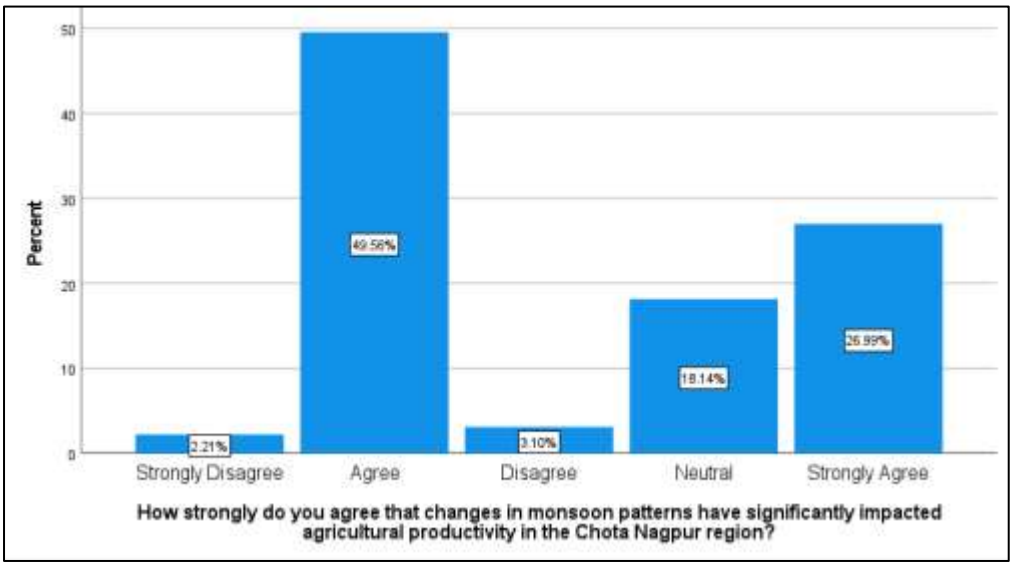


A substantial 77.8% of respondents agree that monsoon intensity has changed in the Chota Nagpur region over the past decade, with minimal disagreement (3.1%) and 18.6% neutrality, indicating strong perception of altered monsoon patterns.



A significant 76.6% of respondents believe changes in monsoon patterns have impacted agricultural productivity in the Chota Nagpur region, with minimal disagreement (5.3%) and 18.1% neutrality, highlighting concerns about monsoon variability affecting farming.

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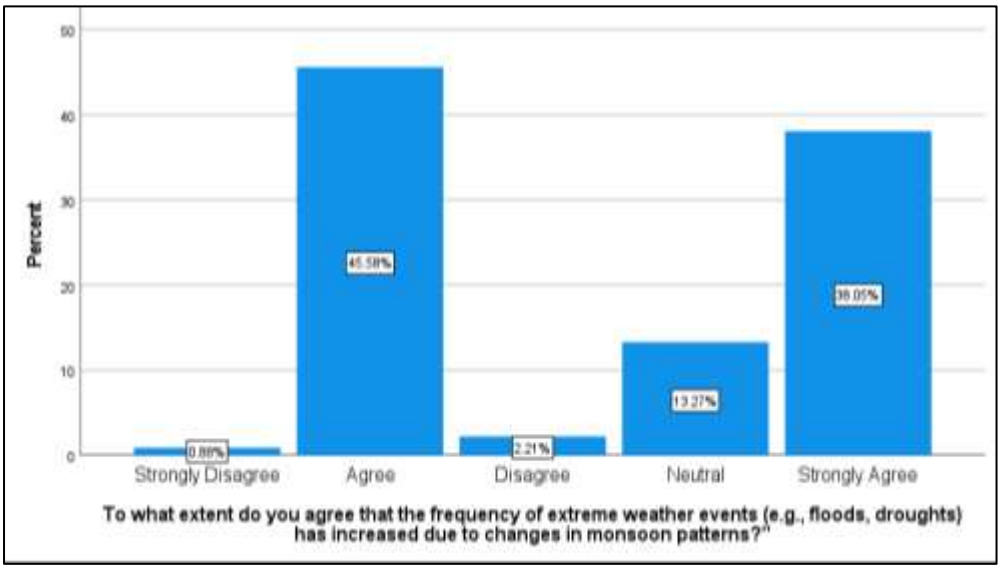
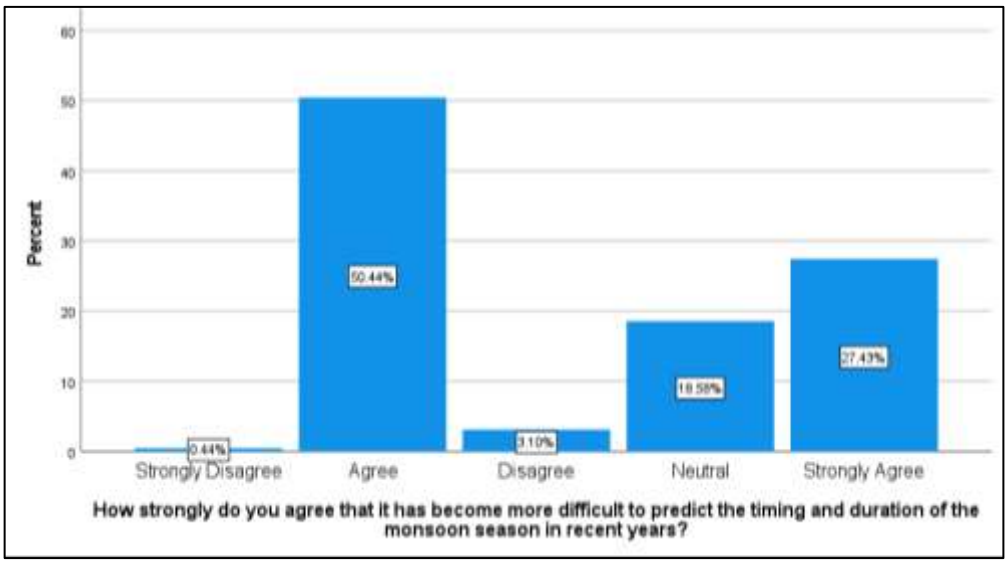


A strong 83.7% of respondents agree that extreme weather events have increased due to monsoon pattern changes, with minimal disagreement (3.1%) and 13.3% neutrality, indicating widespread recognition of climate-induced weather anomalies.



A significant 77.8% of respondents find monsoon prediction more challenging recently, with minimal disagreement (3.5%) and 18.6% neutrality, reflecting concerns over increasing unpredictability of monsoon patterns.

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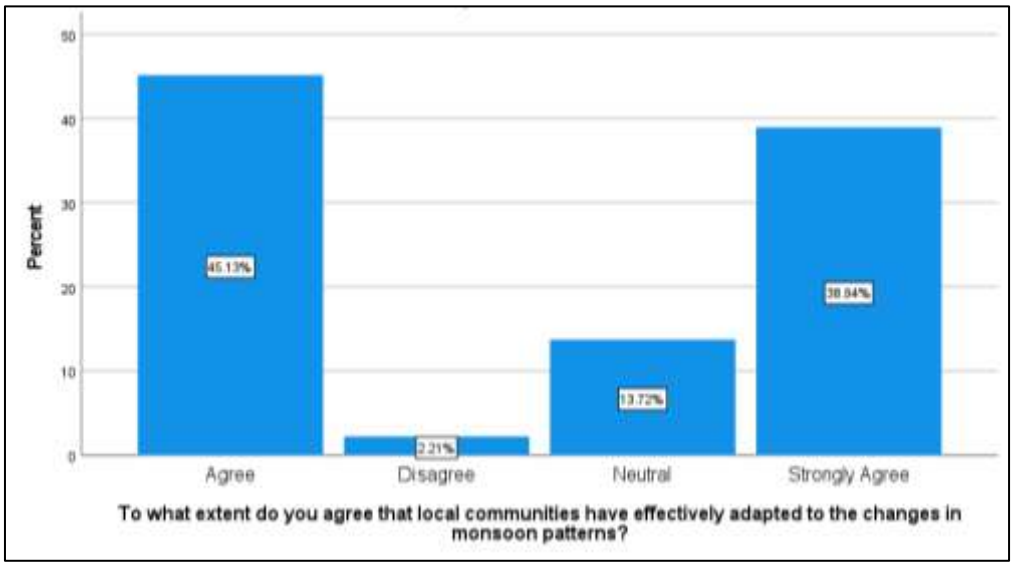
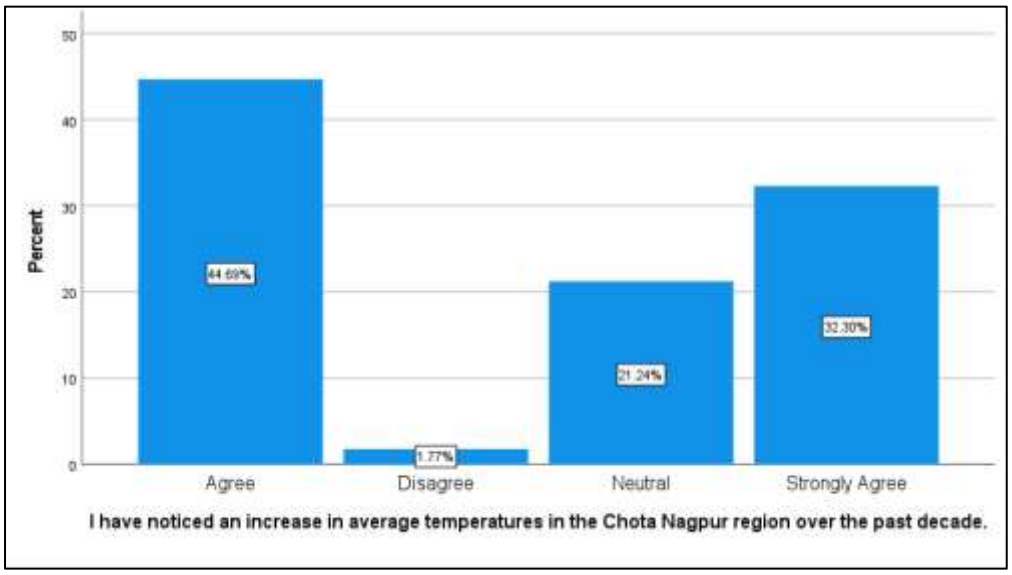


A majority of 84.0% of respondents agree that local communities have adapted to monsoon changes, with minimal disagreement (2.2%) and 13.7% neutrality, indicating positive perception of adaptation efforts but some uncertainty.



A substantial 76.9% of respondents perceive an increase in average temperatures in the Chota Nagpur region over the past decade, with minimal disagreement (1.8%) and 21.2% neutrality, indicating widespread recognition of rising temperatures.

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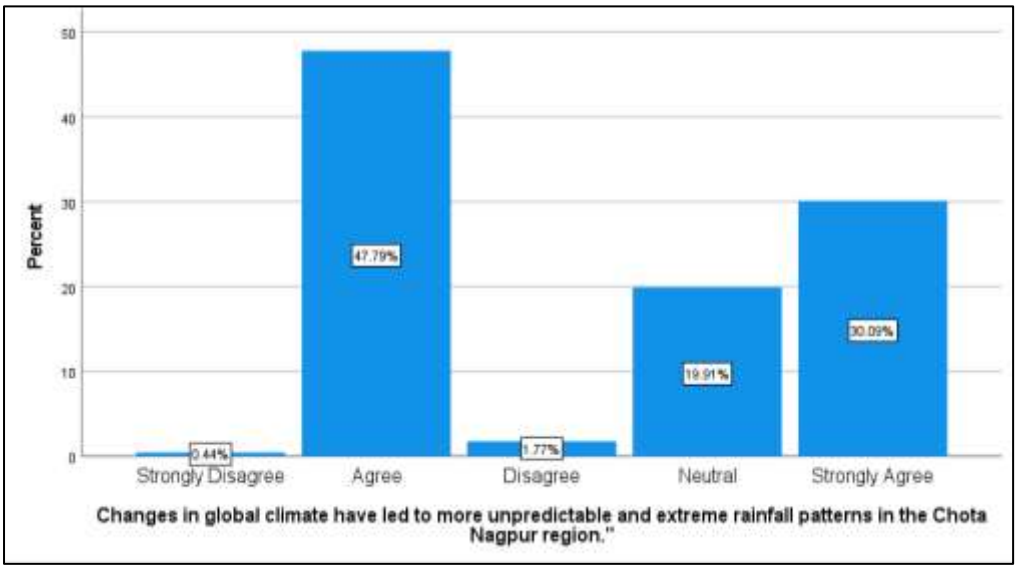
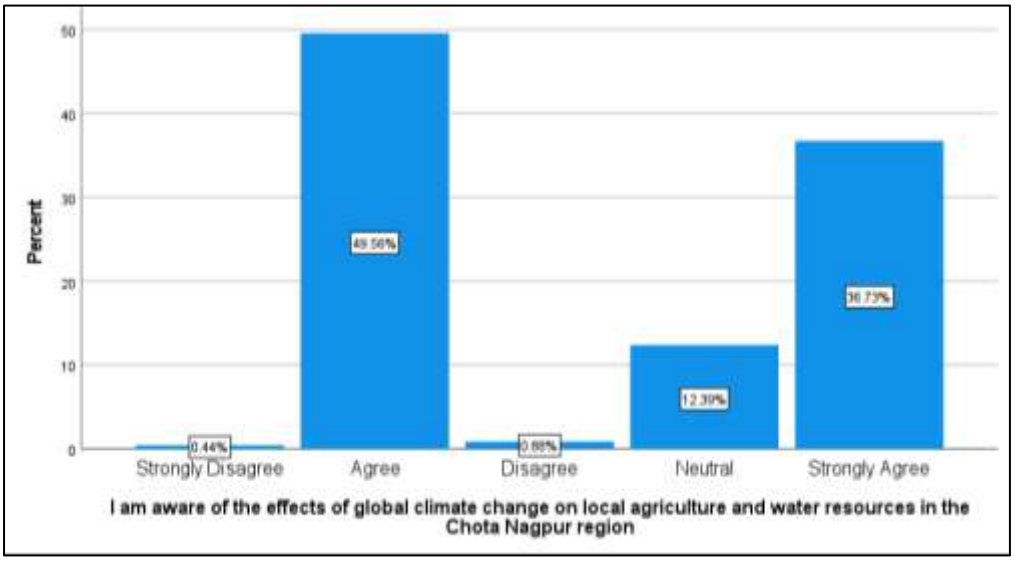


A significant 77.9% of respondents believe global climate changes have caused unpredictable and extreme rainfall in the Chota Nagpur region, with minimal disagreement (2.2%) and 19.9% neutrality, indicating strong concern for rainfall variability.



A substantial 86.4% of respondents are aware of global climate change effects on local agriculture and water resources, with minimal disagreement (1.3%) and 12.4% neutrality, indicating high awareness of climate impacts.

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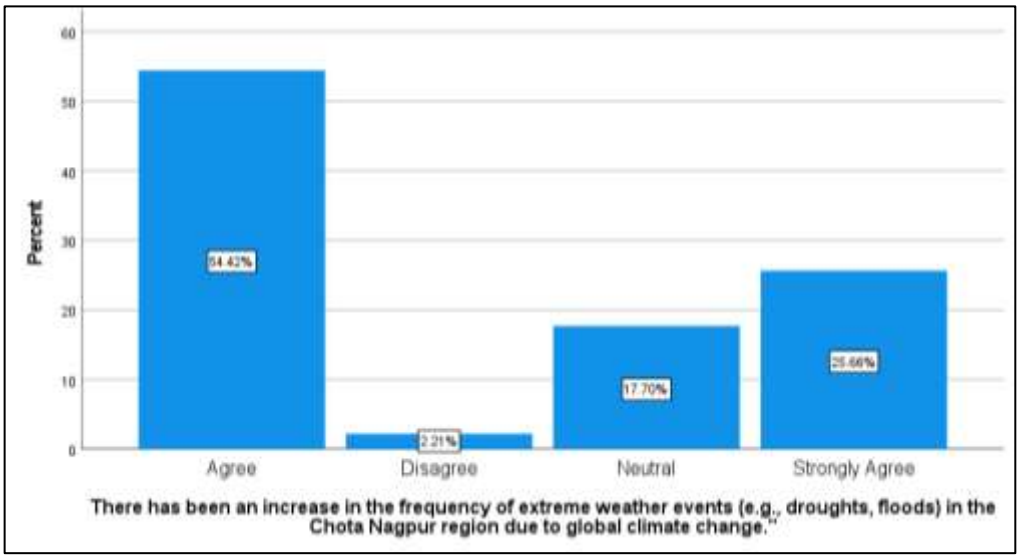
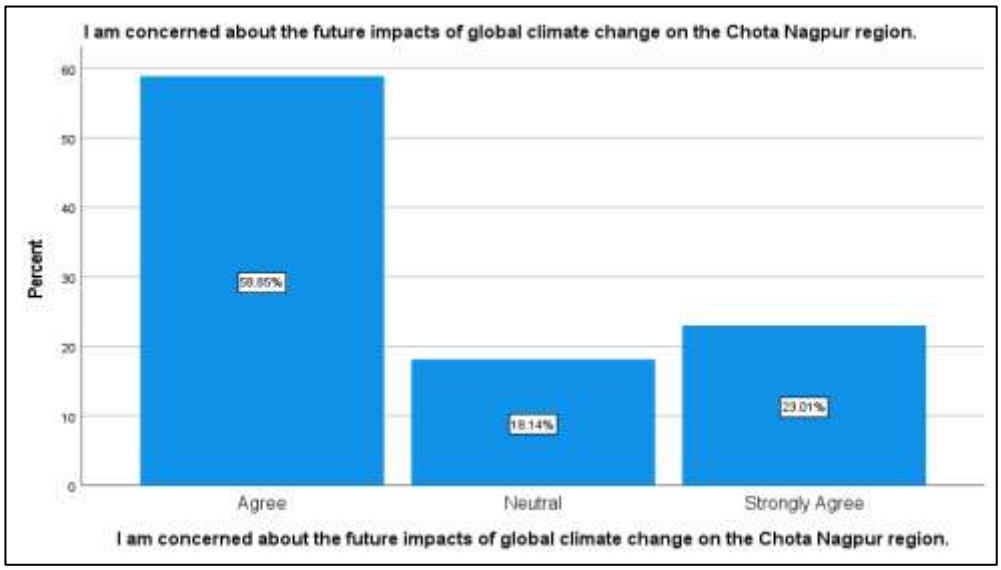


A significant 80.1% of respondents agree that extreme weather events have increased due to global climate change, with minimal disagreement (2.2%) and 17.7% neutrality, highlighting recognition of climate-induced weather changes.



A substantial 81.8% of respondents express concern about future climate change impacts on the Chota Nagpur region, with 18.1% neutrality, indicating strong apprehension about long-term climate effects.

5. SUMMARY

The findings revealed significant concerns about the environmental changes affecting the area. A majority of respondents (74.4%) believe that deforestation has contributed to changes in local weather patterns, while 88.9% express worry about its negative impact on biodiversity. Additionally, 86.7% agree that deforestation and land use changes have adversely affected water availability.

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Environmental pollution due to industrialization and mining activities is also a major concern, with 88.5% of respondents recognizing their contribution to pollution. Awareness of global climate change effects on local agriculture and water resources is high, with 86.4% of participants acknowledging these impacts. The frequency of extreme weather events, such as floods and droughts, is perceived to have increased due to changes in monsoon patterns, as agreed by 83.7% of respondents. Regarding agricultural productivity, 76.6% believe that changes in monsoon patterns have significantly affected farming outcomes. Despite these challenges, 89.8% of respondents feel that current policies are effective in mitigating the negative effects of deforestation. Additionally, 59.7% believe that sustainable practices can reduce the adverse effects of industrialization and mining. These findings highlight the urgent need for effective environmental policies and sustainable practices to address the region's environmental challenges.

6. FINDINGS

The findings underscore the importance of community awareness and involvement in addressing and mitigating environmental challenges. This approach enabled a robust evaluation of regional environmental issues through the lens of local perceptions and highlighted areas for policy improvement and sustainable development.

i. Deforestation and Weather Patterns: 74.4% of respondents believe deforestation has contributed to changes in local weather patterns.
ii. Impact on Biodiversity: 88.9% express concern that deforestation negatively impacts biodiversity.
iii. Water Resources: 86.7% agree that deforestation and land use changes affect water availability.
iv. Environmental Pollution: 88.5% believe industrialization and mining contribute to environmental pollution.
v. Climate Change Awareness: 86.4% are aware of the effects of global climate change on local agriculture and water resources.
vi. Extreme Weather Events: 83.7% agree that the frequency of extreme weather events has increased due to changes in monsoon patterns.
vii. Monsoon Intensity: 77.8% believe the intensity of the monsoon season has changed over the past decade.
viii. Agricultural Productivity: 76.6% agree that changes in monsoon patterns significantly impact agricultural productivity.
ix. Policy Effectiveness: 89.8% believe current policies effectively mitigate deforestation's negative effects.
x. Sustainable Practices: 59.7% believe sustainable practices can mitigate the negative effects of industrialization and mining.

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7. CONCLUSION

The survey results indicate a strong consensus among respondents regarding the negative impacts of deforestation, industrialization, and climate change on the Chota Nagpur region's environment. There is significant concern about altered weather patterns, biodiversity loss, and water resource depletion. The data underscores the necessity for implementing effective policies and sustainable practices to address these environmental challenges. Engaging local communities and raising awareness about sustainable methods can foster better adaptation and resilience against climate impacts.

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