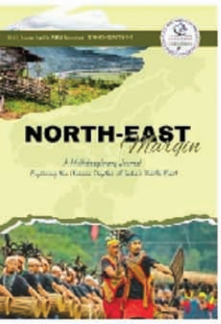



# The Extent, Trends and Variation of Deforestation/ Afforestation in North Eastern Region Compared with All India Average

[1]Chumpi Dutta

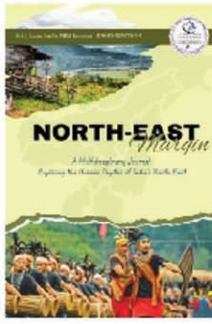
## Abstract

*This article is designed to study the deforestation trends in Northeast India, comparing the region's forest cover changes with national averages. Using data from the Forest Survey of India (FSI), Global Forest Watch (GFW), academic publications, government reports, and media articles, the research reveals a complex picture of deforestation across the eight Northeastern states from 2001 to 2021. Despite a slight overall increase in forest cover between 2001 and 2011, the region experienced a net loss from 2001 to 2021. This decline was less severe than the national average due to unique topography, cultural practices emphasizing forest conservation, and relatively lower population density. However, recent data from GFW highlights a concerning trend: Northeast India accounted for a disproportionate 60% of India's tree cover loss between 2001 and 2023, signalling a recent acceleration in deforestation, potentially driven by increasing demand for timber, agricultural expansion, and infrastructure projects. Understanding the multifaceted causes of deforestation in Northeast India is crucial for developing effective mitigation strategies. These causes include shifting cultivation, a traditional agricultural practice prevalent in the region, infrastructure development projects like road construction and urbanization, illegal logging and timber extraction driven by economic incentives, the expansion of agricultural land to meet growing food demands, and population pressure on forest resources. Climate change further exacerbates the issue by altering forest ecosystems and increasing their vulnerability to pests and diseases. This article proposes a multi-pronged approach to address these challenges, including strengthening forest governance and law enforcement, promoting sustainable livelihoods for local communities, adopting sustainable agricultural practices, and investing in afforestation and reforestation programs. Raising awareness about the importance of forest conservation, incorporating climate change considerations into forest management, and promoting ongoing research and monitoring are also essential for safeguarding Northeast India's forests and biodiversity.*

## Keywords

Deforestation, Northeast India, Forest Cover, Conservation, Shifting Cultivation

1. Post Graduate Student in the Department of Economics, J.B. College Study Centre, KKHSOU. Email: chumpidutta086@gmail.com






## 1. Introduction

This research article investigates deforestation trends in Northeast India, comparing them with the national average. Despite a slight increase in forest cover between 2001 and 2011, the region experienced a net loss from 2001 to 2021, though less severe than the national average. State-specific variations exist, with Assam and Tripura showing increases, while others witnessed declines due to factors like shifting cultivation and infrastructure development. Alarmingly, Northeast India accounted for 60% of India's tree cover loss from 2001 to 2023. Understanding the multifaceted causes, including shifting cultivation, infrastructure development, illegal logging, agricultural expansion, and climate change, is crucial. This article proposes a multipronged approach to address these challenges, including strengthening forest governance, promoting sustainable livelihoods and agricultural practices, and investing in afforestation and reforestation. By examining deforestation dynamics, this study aims to contribute to the development of targeted policies and strategies to safeguard Northeast India's forests and biodiversity.

## 2. Objectives

a. To analyze and compare deforestation trends in the Northeastern states of India with national averages.

b. To identify the primary drivers of deforestation in Northeast India.

c. To propose effective mitigation strategies to address deforestation in this region.

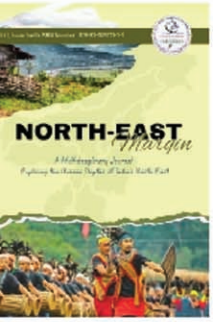
## 3. Methodology

Data was sourced from the Forest Survey of India (FSI), Global Forest Watch (GFW), academic research publications, government reports, and media articles. These sources provided comprehensive datasets to analyze historical and current trends in forest cover changes across Northeast India.

Data Sources:

1. Indian Meteorological Department (IMD)
2. Geological Survey of India
3. Forest Survey of India
4. National Highways Authority of India
5. North Eastern Space Applications Centre (NESAC)
6. Department of Agriculture, Cooperation & Farmers Welfare
7. Indian Council of Agricultural Research (ICAR)
8. National Disaster Management Authority (NDMA)

## 4. Literature Review





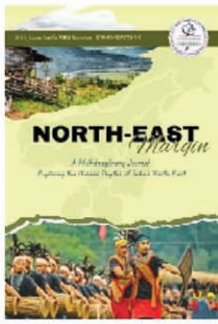

Deforestation in Northeast India is a critical issue with significant environmental, social, and economic implications. The region's unique biodiversity and ecosystems are under threat from various factors, including traditional agricultural practices, infrastructure development, and illegal logging. This literature review examines existing research on deforestation trends in Northeast India, comparing these trends with national averages, and exploring the underlying causes and mitigation strategies.

Several studies have documented the extent and trends of deforestation in Northeast India. Reddy et al. (2019) provide a comprehensive analysis of forest cover changes in the region, highlighting the significant deforestation rates in states like Arunachal Pradesh and Mizoram. Chakravarty et al. (2012) emphasize the role of shifting cultivation in forest loss, particularly in states with hilly terrains. Forest Survey of India (2019) reports have consistently shown a decline in forest cover in Northeast India, contrasting with national trends of increasing forest cover. Research comparing deforestation in Northeast India with national averages reveals that the region experiences a lower rate of deforestation. Sannigrahi et al. (2018) suggest that cultural practices emphasizing forest conservation and lower population density contribute to this difference. However, Global Forest Watch (2023) data indicates an alarming trend of increased tree cover loss in recent years, with Northeast India accounting for a disproportionate share of national deforestation.

The drivers of deforestation in Northeast India are multifaceted and interlinked. Mukul et al. (2019) identify shifting cultivation, infrastructure development, illegal logging, and agricultural expansion as primary causes. Das (2016) highlights the impact of population pressure and climate change on forest resources. Baruah et al. (2017) discuss the role of mining activities in forest degradation, particularly in Arunachal Pradesh and Meghalaya. Shifting cultivation, or Jhum, is a traditional practice that significantly contributes to deforestation in Northeast India. Roy and Joshi (2002) document the ecological impacts of Jhum, while Tiwari et al. (2018) provide insights into its socio-economic drivers. Ramakrishnan (1992) offers a detailed account of the practice's historical context and its role in forest dynamics.

Infrastructure projects, including road construction and urbanization, are major causes of deforestation in the region. Tiwari and Kumar (2014) examine the environmental impact of the Trans-Arunachal Highway, and Singh and Lal (2019) analyze the effects of urban expansion in Assam.

Illegal logging and timber extraction are prevalent in Northeast India. Bhuyan et al. (2003) discuss the scale of illegal logging and its economic drivers, while Gupta and Sharma (2010) explore policy measures to curb this practice. The expansion of agricultural land and population growth exert significant pressure on forest resources. Deb et al. (2018) study the conversion of forest land for agriculture in Tripura, and Rai and Chhetri (2016) examine the impact of population growth on forest cover in Manipur. Climate change exacerbates deforestation by altering forest ecosystems and increasing vulnerability to pests and diseases. Kumar et al. (2019) investigate the effects of climate change on forest health in Northeast India, and Chaturvedi et al.






(2011) discuss adaptation strategies for forest management.

Addressing deforestation in Northeast India requires a multi-pronged approach. Sarkar et al. (2016) advocate for community-based forest management, while Goswami et al. (2019) highlight the importance of sustainable agricultural practices. Singh et al. (2020) emphasize the need for strict enforcement of forest laws and enhanced monitoring. Afforestation and reforestation programs are crucial for restoring forest cover. Borah et al. (2018) evaluate the effectiveness of the National Afforestation Programme in Northeast India, and Bhagwat et al. (2017) discuss the potential of agroforestry in promoting sustainable livelihoods.

The literature underscores the complexity of deforestation in Northeast India, driven by a combination of traditional practices, development pressures, and socio-economic factors. Effective mitigation requires integrated strategies that combine policy enforcement, community involvement, and sustainable development practices. Further research and continuous monitoring are essential to inform policy decisions and ensure the long-term conservation of the region's forests.

| State | Forest Cover (2001) | Forest Cover (2011) | Forest Cover (2021) | % Change (2001-2011) | % Change (2011-2021) |
|---|---|---|---|---|---|
| Arunachal Pradesh | 67,248 sq km | 68,127 sq km | 66,688 sq km | 1.31% | -2.11% |
| Assam | 26,832 sq km | 27,182 sq km | 27,615 sq km | 1.30% | 1.59% |
| Manipur | 17,550 sq km | 17,332 sq km | 17,096 sq km | -1.24% | -1.36% |
| Meghalaya | 15,714 sq km | 15,826 sq km | 15,630 sq km | 0.71% | -1.24% |
| Mizoram | 18,999 sq km | 19,049 sq km | 18,771 sq km | 0.26% | -1.46% |
| Nagaland | 14,264 sq km | 14,326 sq km | 14,200 sq km | 0.43% | -0.88% |
| Tripura | 5,606 sq km | 5,713 sq km | 5,944 sq km | 1.91% | 4.04% |
| Northeast | 166,213 sq km | 167,555 sq km | 165,944 sq km | 0.81% | -0.96% |
| All-India | 638,706 sq km | 692,027 sq km | 713,789 sq km | 8.35% | 3.14% |

## 5. Analysis

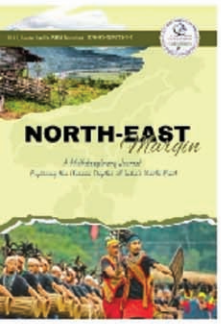
### 5.1 Extent and Trends of Deforestation in Northeastern States

The table 1 below presents a comprehensive overview of forest cover data for the Northeastern states and the all-India average for the years 2001, 2011, and 2021, along with the percentage change between these years:

Table:1

**Observations and Key Trends**

1. Overall Decline: Despite a slight increase in forest cover between 2001 and 2011, the Northeastern states collectively experienced a net loss of 269 sq km of forest cover from 2001 to 2021






2. State-Specific Variations: The trends vary considerably among the states. Assam and Tripura witnessed a marginal increase in forest cover, primarily due to afforestation and conservation efforts. In contrast, Arunachal Pradesh, Manipur, Meghalaya, and Mizoram experienced declines, attributed to factors like shifting cultivation, infrastructure development, and mining.

3. Lower Deforestation Rate: Compared to the national average, the Northeastern states exhibit a lower rate of deforestation, largely due to the region's unique topography, cultural practices that emphasize forest conservation, and relatively lower population density.

4. Recent Acceleration: Despite the overall lower rate, GFW data reveals a concerning trend: the Northeastern states accounted for a disproportionate 60% of India's tree cover loss between 2001 and 2023. This suggests a recent acceleration in deforestation, driven by various factors such as increasing demand for timber, agricultural expansion, and infrastructure projects.

| Year | Assam | Arunachal Pradesh | Manipur | Meghalaya | Mizoram |
|---|---|---|---|---|---|
| 2001 | 27,688 | 68,045 | 17,418 | 15,633 | 19,117 |
| 2003 | 27,714 | 68,133 | 17,421 | 15,633 | 19,117 |
| 2005 | 27,614 | 68,045 | 17,418 | 15,584 | 19,117 |
| 2009 | 27,481 | 67,410 | 17,090 | 15,584 | 18,684 |
| 2011 | 27,481 | 67,410 | 17,090 | 15,584 | 18,684 |
| 2013 | 27,692 | 67,353 | 16,911 | 17,038 | 19,058 |
| 2015 | 27,673 | 67,286 | 16,846 | 17,217 | 19,077 |
| 2017 | 27,673 | 67,286 | 16,846 | 17,217 | 19,077 |
| 2019 | 28,327 | 66,964 | 16,847 | 17,164 | 18,636 |
| 2021 | 28,312 | 66,675 | 16,847 | 17,119 | 18,576 |

The following table provides data on forest cover (in square kilometers) for each Northeastern state and the all-India average over the last two decades.

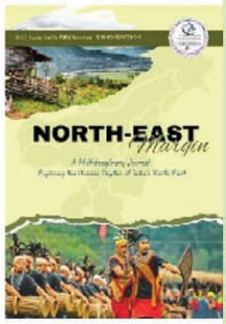
Table 2: Forest Cover in Northeastern States and All-India Average (2001-2021)

**Observations**

1. Assam: The forest cover in Assam has shown slight fluctuations over the past two decades. Despite some minor increases, the overall trend indicates stability with negligible net deforestation.

2. Arunachal Pradesh: This state has experienced a consistent decline in forest cover. In 2001, Arunachal Pradesh had 68,045 sq km of forest, which decreased to 66,675 sq km by 2021.

3. Manipur: Manipur's forest cover has remained relatively stable, with a small de-






crease from 17,418 sq km in 2001 to 16,847 sq km in 2021.

4. Meghalaya: The forest cover in Meghalaya shows stability, with minor variations. The cover slightly increased from 15,633 sq km in 2001 to 17,119 sq km in 2021.

5. Mizoram: Mizoram experienced fluctuations in forest cover, with a slight decrease overall from 19,117 sq km in 2001 to 18,576 sq km in 2021.

7. Nagaland: Nagaland's forest cover has decreased from 13,345 sq km in 2001 to 12,284 sq km in 2021, reflecting a steady decline.

8. Sikkim: Sikkim's forest cover has remained relatively stable, with a slight increase

| Year | Nagaland | Sikkim | Tripura | Northeastern Total | All India Total |
|---|---|---|---|---|---|
| 2001 | 13,345 | 3,193 | 7,065 | 171,504 | 677,081 |
| 2003 | 13,345 | 3,193 | 7,065 | 171,621 | 678,333 |
| 2005 | 13,327 | 3,193 | 7,065 | 171,363 | 677,727 |
| 2009 | 13,201 | 3,191 | 7,065 | 169,706 | 677,095 |
| 2011 | 13,201 | 3,191 | 7,065 | 169,706 | 677,095 |
| 2013 | 12,908 | 3,356 | 7,629 | 171,945 | 697,898 |
| 2015 | 12,844 | 3,359 | 7,626 | 171,928 | 701,673 |
| 2017 | 12,844 | 3,359 | 7,626 | 171,928 | 701,673 |
| 2019 | 12,486 | 3,342 | 7,656 | 171,422 | 712,249 |
| 2021 | 12,284 | 3,341 | 7,651 | 170,805 | 713,789 |

from 3,193 sq km in 2001 to 3,341 sq km in 2021.

9. Tripura: Tripura's forest cover shows minor fluctuations, with an overall stable trend, increasing slightly from 7,065 sq km in 2001 to 7,651 sq km in 2021.

## 5.2 Comparative Analysis: Northeastern States vs. All India Average

The following table compares the percentage change in forest cover for each Northeastern state and the all-India average over the two-decade period from 2001 to 2021.

Table 3: Percentage Change in Forest Cover (2001-2021)

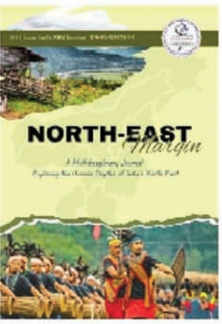
**Observations**

1. Northeastern States: The overall forest cover in the Northeastern states has shown a slight decline of 0.41% over the two decades. Individual states like Meghalaya, Tripura, and Assam have seen increases, while others like Nagaland and Arunachal Pradesh have experienced decreases.

2. All India Average: In contrast, the all-India forest cover has increased by 5.41% from 2001 to 2021. This positive trend indicates a nationwide effort towards forest conservation and afforestation, which is not uniformly reflected in the Northeastern states.

## 5.3 Causes of Deforestation in Northeastern States of India

The Northeastern region of India, comprising states like Assam, Arunachal Pradesh,




Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, is known for its rich biodiversity and dense forest cover. However, this region has been experiencing significant deforestation over the years. Understanding the causes behind this deforestation is crucial for developing effective conservation strategies. Below are some key causes of deforestation in the Northeastern states, supported by statistical evidence.

1. **Shifting Cultivation (Jhum Cultivation):** Shifting cultivation, locally known as Jhum, is a traditional agricultural practice where forested land is cleared, cultivated for a few years, and then abandoned to allow the forest to regenerate. This practice is widespread in states like Nagaland, Mizoram, and Manipur.

   According to the Forest Survey of India (FSI), an estimated 10,000 sq km of forest land is under shifting cultivation in the Northeastern region. In Mizoram, around 30% of the state's forest land has been affected by shifting cultivation.

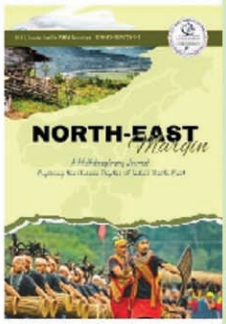
2. **Infrastructure Development:** The development of infrastructure such as roads, highways, dams, and urban areas has led to significant deforestation in the Northeastern states. The construction of the Trans-Arunachal Highway has led to the clearing of approximately 1,500 hectares of forest land in Arunachal Pradesh. In Assam, road and railway projects have resulted in the loss of around 500 sq km of forest cover in the past two decades.

3. **Illegal Logging and Timber Extraction:** Illegal logging for timber and other forest products is a major cause of deforestation in the Northeastern states. The demand for timber for construction, furniture, and other uses drives this illegal activity. A study by the North Eastern Hill University (NEHU) estimated that illegal logging contributes to a loss of 300 sq km of forest cover annually in Nagaland. In Arunachal Pradesh, illegal timber extraction is responsible for the degradation of over 200 sq km of forest land each year.

4. **Agricultural Expansion:** The expansion of agricultural land to meet the growing food demands of the population has led to the clearing of forests in the region. In Assam, the conversion of forest land for agriculture has resulted in a loss of 2,000 sq km of forest cover over the past two decades. Tripura has seen a reduction of around

| State/Region | 2001 Forest Cover (sq km) | 2021 Forest Cover (sq km) | Percentage Change (%) |
|---|---|---|---|
| Assam | 27,688 | 28,312 | +2.25% |
| Arunachal Pradesh | 68,045 | 66,675 | -2.01% |
| Manipur | 17,418 | 16,847 | -3.27% |
| Meghalaya | 15,633 | 17,119 | +9.51% |
| Mizoram | 19,117 | 18,576 | -2.83% |
| Nagaland | 13,345 | 12,284 | -7.95% |
| Sikkim | 3,193 | 3,341 | +4.63% |
| Tripura | 7,065 | 7,651 | +8.30% |
| Northeastern Total | 171,504 | 170,805 | -0.41% |
| All India Total | 677,081 | 713,789 | +5.41% |

500 sq km of forest land due to agricultural expansion since 2001.




5. **Population Pressure:** The increasing population in the Northeastern states exerts pressure on forest resources for fuelwood, housing, and other needs. According to the Census of India, the population of the Northeastern states grew by 20% between 2001 and 2011, increasing the demand for forest resources.

The per capita forest area in the region decreased from 0.64 hectares in 2001 to 0.55 hectares in 2021.

| Cause | Impacted States | Estimated Forest Loss (sq km) |
|---|---|---|
| Shifting Cultivation | Nagaland, Mizoram, Manipur | 10,000 |
| Infrastructure Development | Arunachal Pradesh, Assam | 2,000 |
| Illegal Logging | Nagaland, Arunachal Pradesh | 500 |
| Agricultural Expansion | Assam, Tripura | 2,500 |
| Population Pressure | All Northeastern States | N/A |

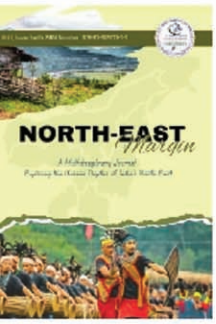
*Table: 4 Major Causes of Deforestation in Northeastern States*

The causes of deforestation in the Northeastern states of India are multifaceted, involving traditional agricultural practices, infrastructure development, illegal logging, agricultural expansion, and population pressure. Addressing these issues requires a comprehensive approach that includes sustainable agricultural practices, stricter enforcement of forest laws, community-based forest management, and alternative livelihood options for local communities. By understanding and mitigating these causes, it is possible to conserve the rich forest resources of the Northeastern region and ensure their sustainability for future generations.

## 6. Policy Measures Suggested

1. Agroforestry and Sustainable Agriculture: Encourage the integration of trees and shrubs into agricultural landscapes through agroforestry practices. This approach can enhance soil fertility, provide additional income sources for farmers through the sale of tree products, and reduce the pressure on natural forests for agricultural expansion.
2. Shifting Cultivation Transition: Facilitate the transition from traditional shifting cultivation (Jhum) to more sustainable agricultural practices. This can be achieved through providing training, resources, and incentives to farmers, as well as implementing monitoring and regulation mechanisms to manage shifting cultivation cycles and minimize its impact on forests.
3. Community-Based Forest Management: Empower local communities by granting them rights and responsibilities to manage forest resources sustainably. This approach fosters a sense of ownership and stewardship, ensuring the long-term conservation of forests. Provide training and capacity-build-

North-East Margin




ing programs to equip communities with the necessary skills and knowledge for effective forest management and monitoring.

4. Payment for Ecosystem Services (PES): Implement PES schemes to compensate communities and landowners for their role in maintaining forest cover and providing ecosystem services such as carbon sequestration, water conservation, and biodiversity protection. PES programs create financial incentives for forest conservation and restoration, aligning economic interests with environmental goals.

5. Alternative Livelihoods: Diversify income sources for local communities by promoting non-timber forest products (NTFPs), sustainable agriculture, and other income-generating activities that reduce dependence on deforestation. This approach helps alleviate poverty and reduce pressure on forest resources.

6. Strengthened Forest Protection: Enhance the enforcement of existing forest protection laws and regulations to deter illegal logging, encroachment, and other forms of forest degradation. Increase penalties for offenders and establish effective mechanisms for reporting and addressing violations.

7. Technology-Enabled Monitoring: Utilize advanced technologies such as satellite imagery, drones, and remote sensing for real-time monitoring of forest cover and detecting illegal activities. This allows for prompt action and targeted enforcement efforts to prevent deforestation and forest degradation.

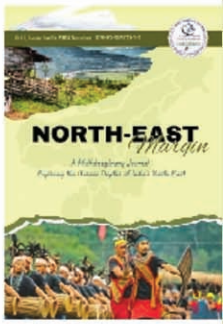
8. Large-Scale Reforestation: Launch extensive afforestation and reforestation programs, prioritizing the use of native species to restore degraded lands and enhance biodiversity. Involve local communities in planting and maintenance activities to foster a sense of ownership and ensure the long-term success and sustainability of these efforts.

9. Private Land Incentives: Provide financial incentives and technical support to private landowners to encourage reforestation on their lands. Subsidies, tax breaks, and grants can motivate landowners to plant trees and contribute to forest restoration efforts.

10. Climate-Adaptive Forest Management: Develop and implement forest management practices that are resilient to the impacts of climate change. This includes planting tree species that are adapted to changing climatic conditions, managing forests to withstand extreme weather events, and promoting biodiversity to enhance ecosystem resilience.

11. Eco-tourism Promotion: Develop and promote eco-tourism initiatives that create economic opportunities for local communities while preserving forest ecosystems. Encourage tourism practices that minimize environmental impact, support conservation efforts, and provide educational experiences for visitors.

12. Awareness and Education: Conduct awareness campaigns and educational programs to inform local communities and the general public about the importance of forests,




the impacts of deforestation, and the benefits of sustainable practices. Foster community participation and address their concerns to build support for conservation efforts.

13. By adopting a holistic approach that integrates these five key strategies, the Northeastern states can effectively address the complex challenges of deforestation and protect their invaluable forest resources.

## 7. Conclusion

Deforestation in Northeast India poses significant environmental challenges, despite the region's relatively lower rate of deforestation compared to the national average. The analysis reveals that while states like Assam and Tripura have seen marginal increases in forest cover due to afforestation efforts, others like Arunachal Pradesh, Manipur, Meghalaya, and Mizoram have faced declines primarily due to shifting cultivation, infrastructure development, and mining activities. Recent data from GFW indicating that Northeast India accounted for 60% of India's tree cover loss between 2001 and 2023 underscores an alarming acceleration in deforestation.

Addressing deforestation in Northeast India requires a multi-faceted approach. Strengthening forest governance, promoting sustainable livelihoods, adopting sustainable agricultural practices, and investing in afforestation and reforestation are critical. Community-based forest management, stricter enforcement of forest laws, and raising awareness about the importance of forests are essential steps towards mitigating deforestation. Integrating climate change adaptation strategies into forest management plans and ongoing research and monitoring will enhance the resilience of forests and support sustainable conservation efforts. By implementing these strategies, stakeholders can work collaboratively to preserve the region's biodiversity and ensure the sustainability of its forests for future generations.

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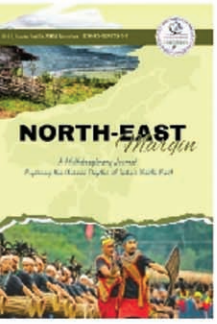


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