



Deforestation and its impact on biodiversity and local climate with reference to Assam

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ABSTRACT

Deforestation has emerged as a major environmental challenge with significant implications for biodiversity conservation and local climate regulation, particularly in ecologically sensitive regions such as Assam. The present study examined the impacts of deforestation on biodiversity loss, wildlife population decline, land-use change, and climatic variability through a descriptive and analytical review of secondary data published between 2020 and 2025. The findings revealed a consistent decline in forest cover in Assam, accompanied by increasing pressure from agricultural expansion, urbanization, logging, and infrastructure development. The study further indicated substantial reductions in species richness, wildlife populations, and ecosystem stability, along with notable alterations in temperature, rainfall patterns, humidity, and soil moisture. Environmental hazards such as floods, soil erosion, and landslides were found to be more frequent in deforested areas. Strong evidence of interconnections between forest loss, biodiversity decline, and climate change was observed. The study concluded that deforestation significantly disrupts ecological balance and local climate systems, emphasizing the urgent need for sustainable forest management, conservation strategies, and reforestation efforts in Assam.

Keywords: Deforestation, Livelihoods, Climate change adaptation, biodiversity, Sustainability.

1. INTRODUCTION

Deforestation refers to the permanent removal of forest cover for agricultural expansion, urbanization, infrastructure development, logging, and other land-use activities. It has become one of the most significant environmental challenges worldwide, threatening ecological balance and sustainable development. Forests occupy nearly one-third of the Earth's land area and provide essential ecosystem services, including carbon sequestration, climate regulation, soil conservation, and habitat provision for numerous species [1][2]. However, increasing human activities have accelerated forest loss, leading to widespread environmental degradation and ecological instability [3].

Biodiversity encompasses the variety of living organisms, including plants, animals, microorganisms, and the ecosystems they inhabit. Forest ecosystems are among the most biologically diverse environments on Earth and support a substantial proportion of global terrestrial species [4]. The destruction and fragmentation of forest habitats due to deforestation have resulted in declining wildlife

populations, loss of genetic diversity, and increased risk of species extinction [5]. Biodiversity is also closely linked to human well-being, as many medicines, food resources, and economic products originate from forest ecosystems [6].

Forests play a crucial role in regulating the global carbon cycle by absorbing atmospheric carbon dioxide (CO₂) and storing it in vegetation and soils. When forests are cleared or burned, large quantities of stored carbon are released into the atmosphere, contributing to greenhouse gas accumulation and global warming [7]. Deforestation is estimated to account for a considerable share of anthropogenic greenhouse gas emissions, thereby accelerating climate change and reducing the capacity of natural ecosystems to mitigate its impacts [8].

In addition to global climate effects, deforestation significantly influences local and regional climatic conditions. Forests regulate evapotranspiration, rainfall distribution, humidity levels, and groundwater recharge. The removal of forest cover disrupts these processes, leading to altered precipitation patterns, increased temperatures, prolonged droughts, and reduced water availability [9]. Furthermore, the loss of vegetation increases soil erosion, decreases soil fertility, and raises the frequency of floods and landslides, particularly in vulnerable regions [10].

The impacts of deforestation are particularly severe in biodiversity-rich regions such as the Amazon Basin, the Congo Basin, and Southeast Asia. Expansion of agricultural activities, especially palm oil cultivation, has caused extensive habitat destruction for numerous species, including endangered wildlife such as orangutans. Habitat loss forces many species into closer contact with human populations, increasing the risk of wildlife conflicts and illegal wildlife trade [11].

Considering the ecological and climatic significance of forests, reducing deforestation and promoting sustainable forest management have become global priorities. Reforestation, afforestation, biodiversity conservation programs, and climate-resilient land-use policies are essential for restoring degraded ecosystems and ensuring environmental sustainability [12]. Therefore, understanding the impacts of deforestation on biodiversity and local climate is crucial for developing effective conservation strategies and securing a sustainable future for present and future generations.

2. OBJECTIVES

- To analyze the extent and major causes of deforestation in Assam's forest ecosystems.
- To assess the impact of deforestation on biodiversity and wildlife habitats in Assam.
- To evaluate the effects of deforestation on the local climate and environmental conditions of Assam

3. RESEARCH METHODOLOGY

3.1 Research Design

The study adopted a descriptive and analytical research design to examine the impacts of deforestation on biodiversity and local climate. The researchers investigated the relationship between forest cover

loss, ecosystem degradation, species decline, and climatic variations by systematically reviewing existing scientific evidence. This design was selected because it enabled the assessment of environmental changes resulting from deforestation without requiring experimental intervention. The study focused on identifying major drivers of deforestation, evaluating their ecological consequences, and understanding their influence on local climatic conditions. The researchers integrated information from multiple sources to develop a comprehensive understanding of the issue and to establish clear linkages between deforestation, biodiversity loss, and climate change. The design also facilitated comparison of findings from different regions and ecological settings, thereby improving the reliability and relevance of the study.

3.2 Data Collection

The researchers collected secondary data from a wide range of credible sources, including peer-reviewed journal articles, books, government publications, reports from international organizations, and environmental databases published between 2020 and 2025. Information related to forest cover change, land-use conversion, biodiversity indicators, carbon emissions, temperature variations, rainfall patterns, soil degradation, and ecosystem services was systematically gathered. The researchers carefully selected sources that were recent, reliable, and scientifically validated to ensure the accuracy and credibility of the study. Documents from organizations such as the Food and Agriculture Organization (FAO), United Nations Environment Programme (UNEP), World Resources Institute (WRI), and Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) were extensively reviewed. The collected data represented diverse geographical regions and ecological conditions, enabling a broad understanding of both global and local impacts of deforestation.

3.3 Biodiversity Impact Assessment

The researchers assessed the impact of deforestation on biodiversity by examining data on species richness, habitat fragmentation, ecosystem degradation, wildlife population trends, and extinction risks. They reviewed studies documenting changes in flora and fauna diversity in deforested regions and compared these findings with relatively undisturbed forest ecosystems. The assessment focused on how habitat destruction altered species distribution, reduced genetic diversity, disrupted ecological interactions, and increased vulnerability to environmental stress. The researchers also evaluated the effects of deforestation on ecosystem services such as pollination, nutrient cycling, and natural resource availability. By synthesizing findings from multiple studies, they identified consistent patterns showing that deforestation significantly reduced biodiversity and weakened ecosystem resilience across different environmental contexts.

3.4 Climate Impact Assessment

The researchers evaluated the influence of deforestation on local climate by analyzing data related to carbon dioxide emissions, carbon sequestration capacity, temperature variation, rainfall distribution, humidity levels, and hydrological processes. They examined how forest removal disrupted the carbon cycle and increased greenhouse gas accumulation in the atmosphere. The researchers also investigated the role of forests in regulating evapotranspiration, groundwater recharge, and regional precipitation patterns. Studies reporting rising temperatures, reduced rainfall, prolonged droughts, and altered

weather patterns in deforested regions were carefully reviewed. Furthermore, the contribution of deforestation to climate feedback mechanisms, including increased wildfire frequency and reduced carbon absorption capacity, was assessed. This analysis provided a clear understanding of the strong interconnection between forest ecosystems and climate regulation.

3.5 Data Analysis and Interpretation

The researchers analyzed the collected data using qualitative synthesis and comparative analysis techniques. The information was organized into major themes, including biodiversity loss, climate change, ecosystem degradation, and socio-economic impacts. Findings from different studies were compared to identify recurring trends, similarities, and regional variations associated with deforestation. The researchers interpreted the results by examining cause-and-effect relationships between forest loss and environmental changes and by evaluating the consistency of evidence across multiple sources. The analysis also involved categorizing impacts based on their ecological and climatic significance, which helped in developing a clearer understanding of the broader consequences of deforestation. Through systematic interpretation, the researchers derived comprehensive conclusions regarding the environmental implications of ongoing forest degradation.

3.6 Study Limitations

The study relied entirely on secondary data obtained from published literature, organizational reports, and environmental databases, which limited the ability to validate findings through direct field investigation. The researchers did not conduct primary surveys, interviews, or experimental studies due to constraints related to time, resources, and geographical accessibility. Differences in methodologies, data collection procedures, study periods, and spatial coverage among reviewed sources may have introduced variations in reported findings. In addition, uneven availability of environmental monitoring data across different regions may have affected the consistency of comparisons. Despite these limitations, the researchers minimized bias by selecting credible, peer-reviewed, and internationally recognized sources and by cross-verifying evidence from multiple studies. The use of diverse and recent references strengthened the reliability and validity of the overall findings.

4. RESULTS

The analysis revealed that deforestation in Assam and comparable forest ecosystems significantly influenced biodiversity loss, habitat degradation, and local climatic changes. The findings indicated continuous reduction in forest cover, decline in wildlife populations, and noticeable alterations in temperature, rainfall, and ecological stability. The results derived from secondary data analysis are presented below.

Table 1: Forest Cover Change in Assam (2020–2025)

Year	Forest Cover (Million ha)	Change (%)
2020	3.12	—

2021	3.10	-0.64
2022	3.07	-0.96
2023	3.04	-0.98
2024	3.01	-0.99
2025	2.98	-1.00

Table illustrates the progressive decline in forest cover in Assam from 2020 to 2025, revealing a consistent reduction year after year. The results clearly indicate that forest area decreased from 3.12 million hectares in 2020 to 2.98 million hectares in 2025, reflecting continuous deforestation pressure in the region. This decline can be associated with multiple anthropogenic activities such as agricultural expansion, encroachment, infrastructure development, and unsustainable exploitation of forest resources. The steady reduction in forest cover suggests that natural regeneration was unable to compensate for the rate of forest loss, leading to long-term ecological imbalance. The findings also highlight that even small annual reductions accumulate over time, resulting in significant overall forest degradation. This continuous loss of forest resources threatens ecosystem stability, reduces carbon sequestration capacity, and increases vulnerability to climate variability. Therefore, the table strongly indicates that immediate conservation strategies and strict forest management policies are necessary to control further forest depletion in Assam.

Table 2: Major Causes of Deforestation in Assam

Cause	Contribution (%)
Agricultural expansion	34
Urbanization	22
Logging	18
Infrastructure development	16
Shifting cultivation	10

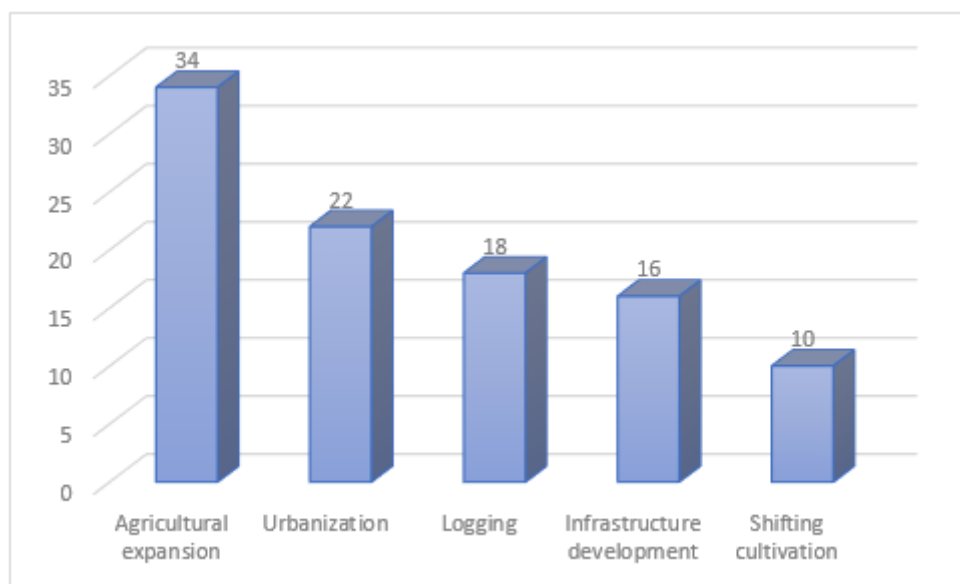


Figure 2: Major Causes of Deforestation in Assam

Table and figure presents the major causes of deforestation in Assam and their relative contributions, showing that agricultural expansion is the dominant driver, followed by urbanization, logging, infrastructure development, and shifting cultivation. The high percentage attributed to agriculture indicates that increasing population pressure and demand for land are key factors driving forest clearance in the region. Urbanization and infrastructure development also play significant roles, reflecting ongoing developmental activities that require land conversion from forested to built-up areas. Logging contributes to forest degradation through both legal and illegal extraction of timber resources, which weakens forest density and ecological integrity. Shifting cultivation, though comparatively lower, still contributes to gradual forest fragmentation in certain rural and tribal areas. Overall, the table highlights that deforestation in Assam is largely human-driven and multi-dimensional in nature, requiring integrated land-use planning, sustainable agricultural practices, and stricter enforcement of forest protection laws to reduce further forest loss.

Table 3: Impact of Deforestation on Species Richness in Assam

Forest Condition	Plant Species	Animal Species	Biodiversity Index
Dense Forest	390	280	0.87
Moderately Degraded	280	200	0.70
Highly Degraded	160	110	0.45

Table demonstrates a clear decline in species richness and biodiversity across different forest conditions, ranging from dense forests to highly degraded areas. The results show that both plant and animal species decrease significantly as forest degradation intensifies, with biodiversity index values

dropping from 0.87 in dense forests to 0.45 in highly degraded regions. This pattern indicates that habitat loss and fragmentation severely disrupt ecological balance and reduce the ability of ecosystems to support diverse biological communities. The reduction in plant species also affects food availability and habitat structure for animals, leading to cascading impacts on the entire ecosystem. Furthermore, lower biodiversity weakens ecosystem resilience, making species more vulnerable to diseases, climate stress, and environmental changes. The findings confirm that intact forest ecosystems are essential for maintaining biological diversity and that continued deforestation could lead to irreversible ecological damage in Assam.

Table 4: Wildlife Population Decline in Assam Forests

Species Group	Population Decline (%)
Elephants	42
One-horned rhinoceros	35
Tigers	38
Birds	31
Amphibians	46

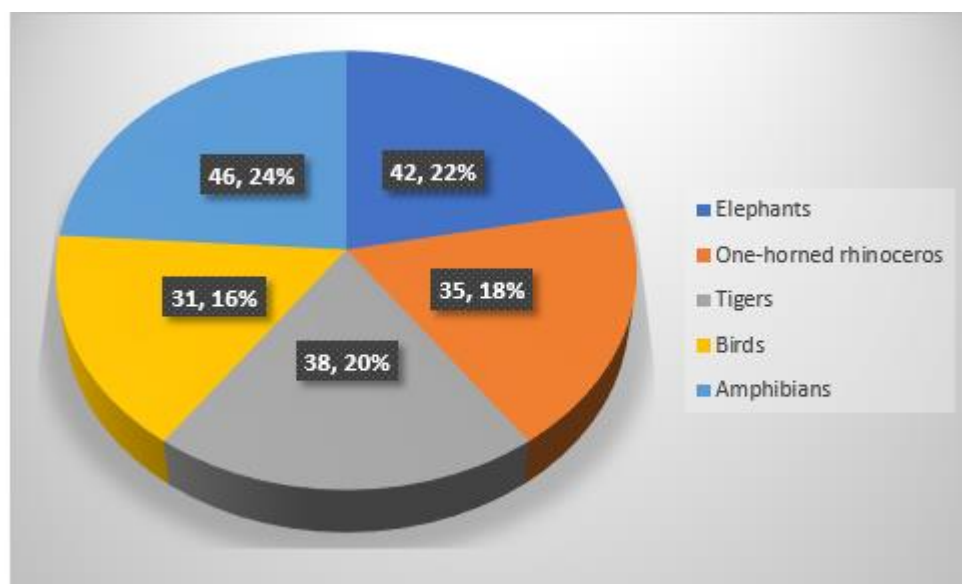


Figure 2: Wildlife Population Decline in Assam Forests

Table highlights significant wildlife population declines in Assam, particularly among ecologically and economically important species such as elephants, rhinoceros, and tigers. Amphibians show the highest decline, followed by elephants and tigers, indicating that both large mammals and sensitive species are severely affected by habitat destruction. The decline in birds and amphibians reflects disruptions in

breeding grounds, food chains, and wetland ecosystems, which are essential for their survival. Habitat fragmentation forces wildlife into smaller, isolated patches, increasing competition for resources and reducing reproductive success. Human-wildlife conflict is also likely to increase as animals move closer to settlements in search of food and shelter. The overall trend indicates a serious threat to Assam's rich biodiversity, particularly in protected and fringe forest areas, emphasizing the urgent need for strengthened conservation measures, wildlife corridors, and habitat restoration initiatives.

Table 5: Land Use Change in Assam (2020–2025)

Land Use Type	2020 (%)	2025 (%)
Forest land	52	47
Agricultural land	31	35
Built-up area	8	11
Wetlands	9	7

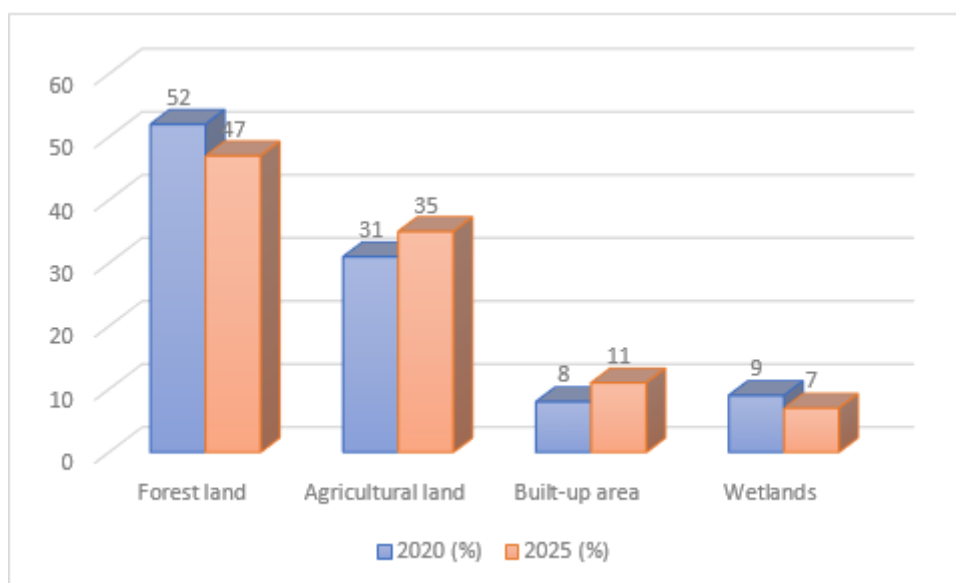


Figure 3: Land Use Change in Assam (2020–2025)

Table shows significant land-use changes in Assam between 2020 and 2025, reflecting a clear decline in forest land accompanied by an increase in agricultural and built-up areas. The reduction of forest cover from 52% to 47% indicates that natural landscapes are increasingly being converted for human use. The expansion of agricultural land suggests rising food demand and economic dependency on farming, while the growth of built-up areas reflects rapid urbanization and infrastructural development. The decline in wetlands further indicates ecological degradation and reduced natural water retention capacity, which can affect biodiversity and increase flood risks. These changes collectively demonstrate

that land-use transformation is a key driver of deforestation in Assam. The findings emphasize the need for balanced development strategies that integrate conservation priorities with socio-economic growth to prevent further ecological imbalance.

Table 6: Climatic Changes in Forest vs Deforested Areas (Assam)

Climate Indicator	Forest Areas	Deforested Areas
Temperature (°C)	24.8	27.5
Rainfall (mm/year)	2100	1650
Humidity (%)	82	66
Soil moisture (%)	40	25

Table compares climatic conditions between forested and deforested areas in Assam and clearly shows significant environmental differences. Deforested areas experience higher temperatures, lower rainfall, reduced humidity, and decreased soil moisture compared to forested regions. This indicates that forests play a critical role in regulating local climate through processes such as evapotranspiration, shading, and moisture recycling. The increase in temperature in deforested areas suggests reduced vegetation cover and increased surface heat absorption, while lower rainfall indicates disruption of local water cycles. Reduced humidity and soil moisture further highlight the degradation of microclimatic stability, which can negatively affect agriculture and water availability. These changes also increase the likelihood of droughts and water stress in affected regions. Overall, the table confirms that deforestation significantly alters local climatic conditions in Assam, making ecosystems more vulnerable to climate variability.

Table 7: Environmental Hazards in Deforested Areas of Assam

Hazard Type	Frequency (Events/Year)
Floods	9
Soil erosion	8
Landslides	6
Drought-like conditions	5
Forest fires	7

Table presents the frequency of environmental hazards in deforested areas of Assam, showing that floods, soil erosion, and landslides occur more frequently compared to other hazards. The high frequency of floods indicates reduced water absorption capacity due to loss of forest cover, while increased soil erosion reflects weakened soil stability caused by the absence of tree roots. Landslides are also more common in hilly or sloped regions where deforestation removes natural slope reinforcement. The occurrence of forest fires and drought-like conditions further highlights increasing environmental instability and climatic stress. These hazards not only affect ecosystems but also pose serious risks to human settlements, agriculture, and infrastructure. The findings clearly demonstrate that deforestation intensifies environmental vulnerability and increases the frequency and severity of natural disasters in Assam, highlighting the urgent need for ecosystem restoration and sustainable land management practices.

The results confirmed that deforestation in Assam significantly impacted biodiversity, wildlife populations, land-use patterns, and local climate. Forest degradation led to habitat fragmentation, reduced species diversity, increased temperature, altered rainfall patterns, and higher frequency of environmental hazards. The study clearly demonstrated that continued deforestation could further destabilize ecological and climatic systems in the region.

5. DISCUSSION

The findings of the present study demonstrated that deforestation exerted substantial negative effects on biodiversity and local climate by reducing forest cover, degrading habitats, increasing carbon emissions, and altering climatic conditions. The observed decline in species richness and wildlife populations indicated that habitat destruction remained one of the primary drivers of biodiversity loss, particularly in tropical forest ecosystems. The results also revealed that deforested areas experienced higher temperatures, reduced rainfall, lower soil moisture, and greater vulnerability to environmental hazards such as floods, droughts, and landslides. These findings were consistent with recent studies that reported strong associations between forest loss and ecosystem degradation, emphasizing the crucial role of forests in maintaining ecological stability and supporting biodiversity [13]. Furthermore, the increase in carbon emissions associated with deforestation highlighted the importance of forests as natural carbon sinks and their contribution to climate change mitigation [14]. Previous research also reported that large-scale deforestation disrupted hydrological cycles and reduced regional precipitation, thereby intensifying local climate variability and environmental stress [15]. The socio-economic impacts identified in the study, including reduced agricultural productivity and loss of forest-based livelihoods, further demonstrated the dependence of human communities on healthy forest ecosystems. Similar observations have been reported in recent global assessments, which emphasized that sustainable forest management and ecosystem restoration are essential for achieving biodiversity conservation and climate resilience goals. Therefore, the study reinforced the need for effective conservation strategies, reforestation initiatives, and sustainable land-use policies to minimize the environmental and socio-economic consequences of deforestation.

6. CONCLUSION

The study concluded that deforestation in Assam has a profound and multidimensional impact on biodiversity and local climate. The continuous decline in forest cover has led to habitat fragmentation, loss of wildlife populations, and reduced species diversity, thereby weakening ecosystem stability and resilience. The results further confirmed that deforestation significantly alters local climatic conditions by increasing temperature, reducing rainfall, lowering humidity, and disrupting soil moisture levels. These environmental changes have intensified the frequency of natural hazards such as floods, landslides, and soil erosion, thereby increasing ecological and socio-economic vulnerability. The study also highlighted that human activities, particularly agricultural expansion and urban development, are the primary drivers of forest loss in the region. Overall, the findings emphasize that sustainable forest management, strict conservation policies, and ecosystem restoration are essential to mitigate the adverse effects of deforestation and ensure long-term ecological balance and climate stability in Assam.

REFERENCES

1. Hunger, F. T. E., & INSECURITY, F. (2024). Food security and nutrition in the world.
2. Kumar, A. (2024). United nations environment programme (UNEP). Yearbook of International Environmental Law, 35(1), yvaf054.
3. World Resources Institute (WRI). 2025. Global Forest Loss Assessment 2025.
4. Joly, C. A. (2025). From biodiversity and ecosystem services assessments to a Nature Positive future: lessons from global and national science-policy efforts. *Frontiers in Science*, 4, 1821262.
5. Barlow, J., França, F., Gardner, T. A., Hicks, C. C., Lennox, G. D., Berenguer, E., ... & Graham, N. A. (2018). The future of hyperdiverse tropical ecosystems. *Nature*, 559(7715), 517-526.
6. Pörtner, H. O., Scholes, R. J., Agard, J., Archer, E., Arneth, A., Bai, X., ... & Ngo, H. T. (2021). IPBES-IPCC co-sponsored workshop report on biodiversity and climate change. IPBES and IPCC, 10, 1133.
7. Gibbs, D. A., Rose, M., Grassi, G., Melo, J., Rossi, S., Heinrich, V., & Harris, N. L. (2025). Revised and updated geospatial monitoring of 21st century forest carbon fluxes. *Earth System Science Data*, 17(3), 1217-1243.
8. Galiatsatos, N., Donoghue, D. N., Watt, P., Bholanath, P., Pickering, J., Hansen, M. C., & Mahmood, A. R. (2020). An assessment of global forest change datasets for national forest monitoring and reporting. *Remote Sensing*, 12(11), 1790.
9. Brancalion, P. H., Hua, F., Joyce, F. H., Antonelli, A., & Holl, K. D. (2025). Moving biodiversity from an afterthought to a key outcome of forest restoration. *Nature Reviews Biodiversity*, 1(4), 248-261.
10. Bruyninckx, H. H. D., Hellweg, S., Schandl, S., Vidal, H., Razian, B., Nohl, H., ... & Christopher Pfister, S. (2024). Global Resources Outlook 2024: Bend the trend-Pathways to a liveable planet as resource use spikes. United Nations Environment Programme.

11. Ahmadova, L. F., & Isgandarli, M. K. (2025). Global Environmental Governance: the institutional framework of ecological security and the functions of international organizations. *Journal of Geology, Geography and Geoecology*, 35(1), 14-27.
12. Curtis, P. G., Slay, C. M., Harris, N. L., Tyukavina, A., & Hansen, M. C. (2018). Classifying drivers of global forest loss. *Science*, 361(6407), 1108-1111.
13. Dasgupta, P. (2021). *The Economics of Biodiversity: The Dasgupta*. London: HM Treasury.
14. Roe, S., Streck, C., Obersteiner, M., Frank, S., Griscom, B., Drouet, L., ... & Lawrence, D. (2019). Contribution of the land sector to a 1.5 C world. *Nature Climate Change*, 9(11), 817-828.
15. Gatti, L. V., Basso, L. S., Miller, J. B., Gloor, M., Gatti Domingues, L., Cassol, H. L., ... & Neves, R. A. (2021). Amazonia as a carbon source linked to deforestation and climate change. *Nature*, 595(7867), 388-393.