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The Impact of Deforestation on Local Climates and Weather Patterns

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ABSTRACT

Deforestation, occurring mainly in tropical regions, leads to indirect impacts on weather and climate systems, including changes in rainfall patterns and surface temperatures. These alterations affect agriculture and public health globally. Ending deforestation is crucial to mitigate these effects, as it disrupts ecosystem services and exacerbates climate change. Adhering to a "Zero Deforestation" approach is imperative to preserve forests' vital role in regulating weather, climate, and biodiversity, ensuring a sustainable future for our planet and its inhabitants.

Indirect impact of Asian deforestation

Asian deforestation has far-reaching impacts: decreased rainfall in Southeast Asia, rising temperatures, altered monsoon patterns, and ocean temperature fluctuations. Coastal areas lose protection, affecting communities. Health suffers from smoke pollution. Globally, teleconnections result in altered weather patterns: decreased rainfall in Turkey, storm activity in Scandinavia, and temperature changes in Siberia, Canada, and central Africa.

1. INTRODUCTION

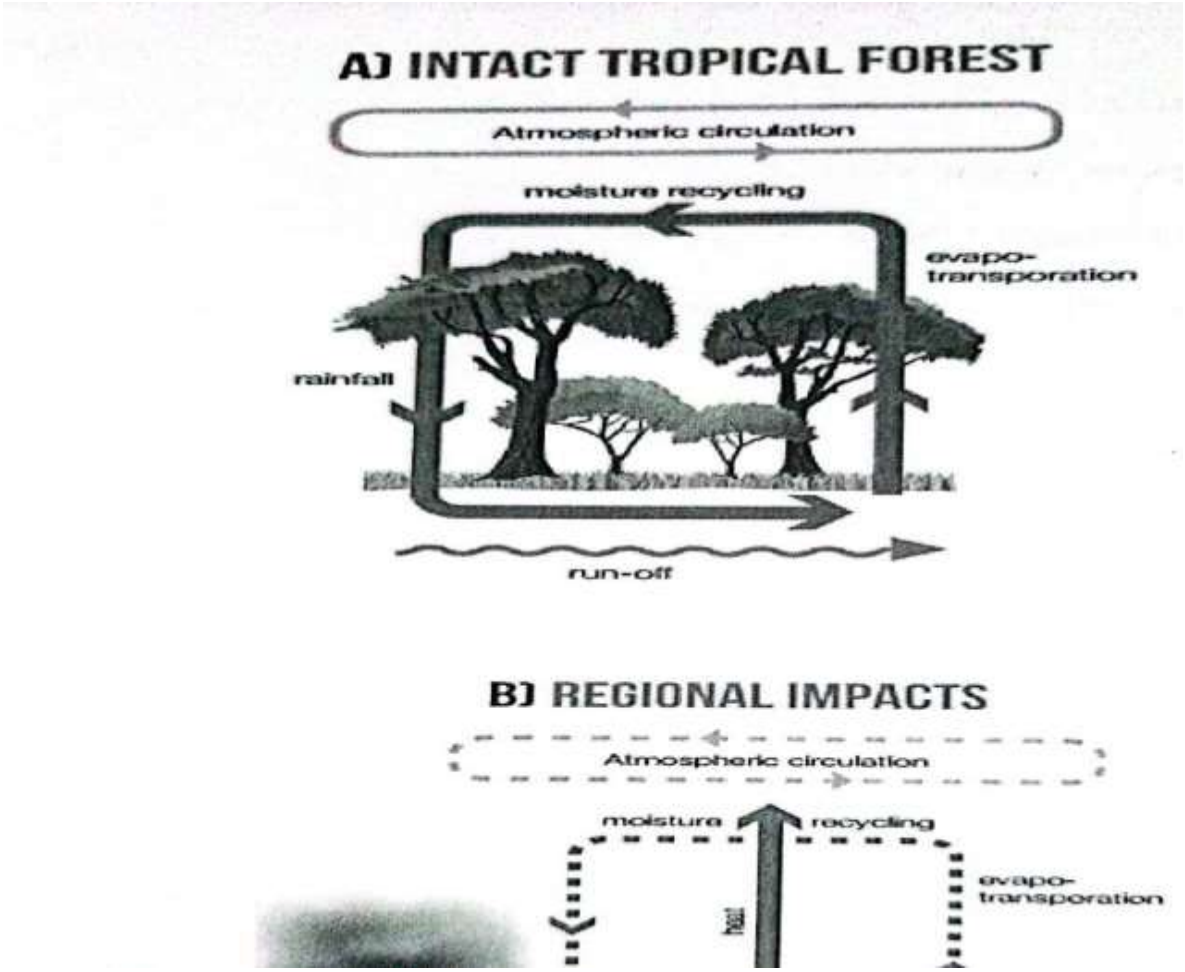
The report highlights deforestation's alarming rate, particularly in tropical regions like South America, West Africa, and Asia, impacting climate regulation and agriculture. It explores how changes in land cover affect weather patterns and discusses potential tipping points, especially in the Amazon. Modeling is crucial for understanding these complexities. The report identifies indirect impacts on agriculture and weather patterns, focusing on regions like the Amazon, Asia, Africa, and the Boreal forest.

2. INDIRECT IMPACTS OF DEFORESTATION

Deforestation significantly impacts human health, disease spread, the hydrological cycle, temperature, and agriculture. Forest fires, exacerbated by deforestation, emit smoke containing PM2.5 particles, leading to severe air pollution and health issues, especially in Southeast Asia during El Niño years.

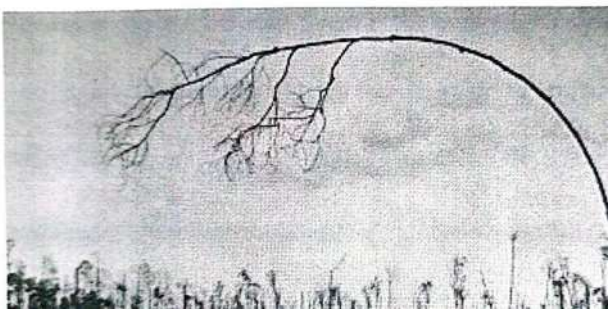
Johnston et al. (2016) estimate that fire emissions cause 125,000 deaths annually due to long-term exposure, with a spike to 300,000 during severe El Niño events. Reducing deforestation would decrease these emissions, improving air quality and health.Deforestation also heightens disease risk by increasing mosquito habitats, thereby boosting malaria transmission. Vittor et al. (2006) found that heavily deforested Amazon sites had a mosquito biting rate 278 times higher than less deforested areas. This trend is similarly observed in Africa, where increased temperatures from deforestation accelerate mosquito reproduction.The hydrological cycle is disrupted by deforestation, leading to reduced evapotranspiration and moisture circulation. This results in decreased rainfall and increased drought risk, negatively affecting agriculture and water availability (Spracklen et al., 2017). Additionally, deforestation elevates flood risks by increasing water runoff and river levels, as less rainfall is intercepted by the forest canopy (Bradshaw et al., 2018).Temperature changes due to deforestation vary by region. In tropical areas, deforestation causes warming due to reduced evapotranspiration, potentially increasing

temperatures by 2-3°C in the Amazon (Snyder, 2019). Conversely, in boreal regions, deforestation leads to cooling due to increased surface reflectance from snow (Davin & Noblet-Ducoudre, 2018)Lastly, deforestation for agriculture can be counterproductive. While intended to boost agricultural land, it can alter climate systems, leading to extreme weather, reduced crop yields, and negative impacts on agriculture-dependent economies. For instance, models show that deforestation-induced climate changes can cause significant yield reductions in Sub-Saharan Africa and Australia, undermining agricultural productivity (Voldoire & Royer, 2004; Lobell et al., 2011).



3. INDIRECT IMPACTS OF ASIAN DEFORESTATION

Asian deforestation impacts the region's climate more complexly than the Amazon due to factors like the Asian monsoon, island geography, and unique spatial features. Models show deforestation alters the regional hydrological cycle, increases surface temperatures, and changes regional circulation patterns, including monsoons. The region's location in the warm west Pacific Ocean leads to strong ocean- atmosphere feedbacks with global climate impacts via teleconnections.Deforestation in Southeast Asia predicts a reduction of 1mm/day in rainfall. For instance, a 15% decrease in Sulawesi's tropical rainforest led to a 2% drop in monthly evapotranspiration and a 21% increase in soil evaporation. Deforestation in Myanmar might create a rain shadow affecting Bangladesh and northeast India. As deforestation moves to upland areas, southern China and Vietnam could see a 20-30% decline in rainfall, while the South China Sea could experience a 30% increase. Replacingmontane forests with crops or grassland exacerbates these changes, significantly impacting river headwaters and agriculture.



Few studies on temperature change exist, but a regional 1°C increase in surface temperature is predicted due to reduced evaporative cooling. Additionally, ocean surface temperatures might fall due to weakened trade winds and reduced upwelling.Deforestation impacts the East Asian Summer Monsoon, increasing wind speed and air temperature while decreasing water vapor, weakening monsoon flow over East China. Changing forest cover to irrigated crops enhances monsoonal flow over upland Southeast Asia but weakens it over the South China Sea, contributing to decreased summer monsoon rainfall in the Indochina peninsula.Mangrove deforestation, which has seen a loss of 0.6 million hectares between 2000 and 2020, compromises coastal protection and fish nurseries, with deforested areas exhibiting higher sulphide and ammonia concentrations and lower nitrogen fixation rates, hindering forest re-establishment.Teleconnections from Asian deforestation extend its impact globally. A 66% reduction in forests could significantly decrease rainfall in regions like western Turkey and China, alter European storm tracks, and affect surface temperatures in Scandinavia. Models indicate deforestation causes a 1°C temperature drop in Siberia and increased temperatures in South America, Canada, and Central Africa, also impacting ocean currents and nutrient availability.

4. INDIRECT IMPACTS OF AFRICAN DEFORESTATION

African deforestation, covering 17% of global forests, significantly impacts local and global climates. Rainfall reduction up to 3mm/day and a 50% drop in Congo basin precipitation are notable.

Temperature rises by 1.2-4°C follow deforestation, affecting regions variably. Monsoon dynamics shift, reducing West African rainfall but intensifying it in southern equatorial Africa. Agriculture suffers from decreased rainfall and increased runoff, stressing soil water content and crop yields, especially in the Sahel and Horn of Africa. Globally, deforestation in Central Africa may reduce Midwest US rainfall by 5- 15%, impacting agricultural productivity, while increasing rainfall in the Arabian Peninsula by 15-30% .

5. INDIRECT IMPACTS OF AMAZON DEFORESTATION

Deforestation in the Amazon has profound indirect impacts. Rainfall is predicted to decrease by 10-20% across the basin, with significant reductions during both wet and dry seasons. Changes in regional rainfall patterns can extend far beyond deforested areas, as seen in southern Brazil and Rio de la Plata Basin. Hydrological changes include increased runoff and weakened water cycles, especially with extensive deforestation, raising flood risks. Surface temperatures are expected to rise by over 2°C, with more frequent extreme cold events in certain areas, particularly affecting the southern La Plata Basin. Stream temperatures in agricultural regions, such as the Xingu Basin, are significantly higher, impacting aquatic life. Agriculture, a crucial industry worth $18 billion, is likely to suffer from altered rainfall and temperature patterns, affecting crop yields. Tele-connections from deforestation may alter global weather patterns, reducing rainfall in Texas and increasing it around the Red Sea, while potentially affecting the Asian monsoon. These findings underscore the extensive and far-reaching impacts of Amazon deforestation, highlighting the need for comprehensive conservation efforts.

6. DISCUSSION AND CONCLUSION

Plants, particularly trees, cool the land through evapotranspiration, releasing moisture and influencing rainfall patterns. Deforestation disrupts this process, leading to increased local temperatures, reduced rainfall, and altered weather patterns. Numerous studies confirm these effects, including in Africa (Duku

and Hein, 2021) and the KBNP landscape (Mubalama et al., 2020). Deforestation impacts livelihoods, agriculture, and biodiversity, causing reduced crop yields and scarcity of forest products (Batumike et al.,

2021). Global models predict significant climatic changes, such as reduced rainfall, increased temperatures, and intensified weather events, due to deforestation. These changes negatively affect agriculture and water availability, and increase flood risks. While the Amazon showspronounced regional impacts, all forest regions exhibit significant teleconnections, affecting distant climates. There is consensus on deforestation's climatic impacts but variations in extent and magnitude. Ending deforestation would mitigate these effects, enhancing climate stability, public health, and agricultural productivity. Thus, conserving forests under a "Zero Deforestation" policy iscrucial for climate regulation, biodiversity conservation, and human well-being. Further research is needed to understand the full benefits of forest conservation beyond carbon sequestration.

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