Impacts of Wood Burning in Sawmills on Air Quality: A Case Study of Fringe Communities near the Bia Tano Forest Reserve

by

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Introduction

- Ghana's forestry sector boosts the economy by providing jobs, raw materials for industries, and supporting environmental sustainability.

- This sector faces challenges such as deforestation, sustainable practices issues, and the increase of sawmills.

Why should we be worried?

Impact of increased sawmill activities on air quality and its health and environmental effects on nearby communities, while suggesting sustainable and health-protective measures.

Trees absorb harmful chemicals and airborne particles through their leaves, enhancing air quality, reducing health risks like asthma, and improving environmental well-being

The proliferation of sawmills near forest reserves can have a significant impact on air quality through the production of particulate matter, volatile organic compounds (VOCs), and other pollutants from machinery, wood processing, and burning.

These pollutants may pose respiratory risks like asthma and therefore the need for monitoring and control

The Forgotten Threat to Air Quality from Biomass Burning

Average source contributions to $PM_{2.5}$ mass concentrations at Navrongo

Source		Mean Source Cont. ($\mu g/m^3$)	Standard Dev. ($\mu g/m^3$)	Fractional Source Cont. (%)
1	Two-stroke Engines	3.4	2.4	9.9
2	Gasoline Emissions	3.7	2.8	10.9
3	Soil Dust	12.3	6.2	35.9
4	Diesel Emissions	3.9	2.5	11.5
5	Biomass	5.4	4.4	15.8
6	Resuspended Road Dust	5.5	5.4	16.0

Source: Ofosu et al., 2013

Wood Burning

- Wood-burning releases various pollutants, including particulates, gases, and VOCs like $PM_{2.5}$ and PM_{10}, CO, PAHs, and formaldehyde.

- These impact respiratory health, contribute to smog, and acid rain with effects varying based on wood type and combustion efficiency (Begum et al., 2007; Bond et al., 2013).

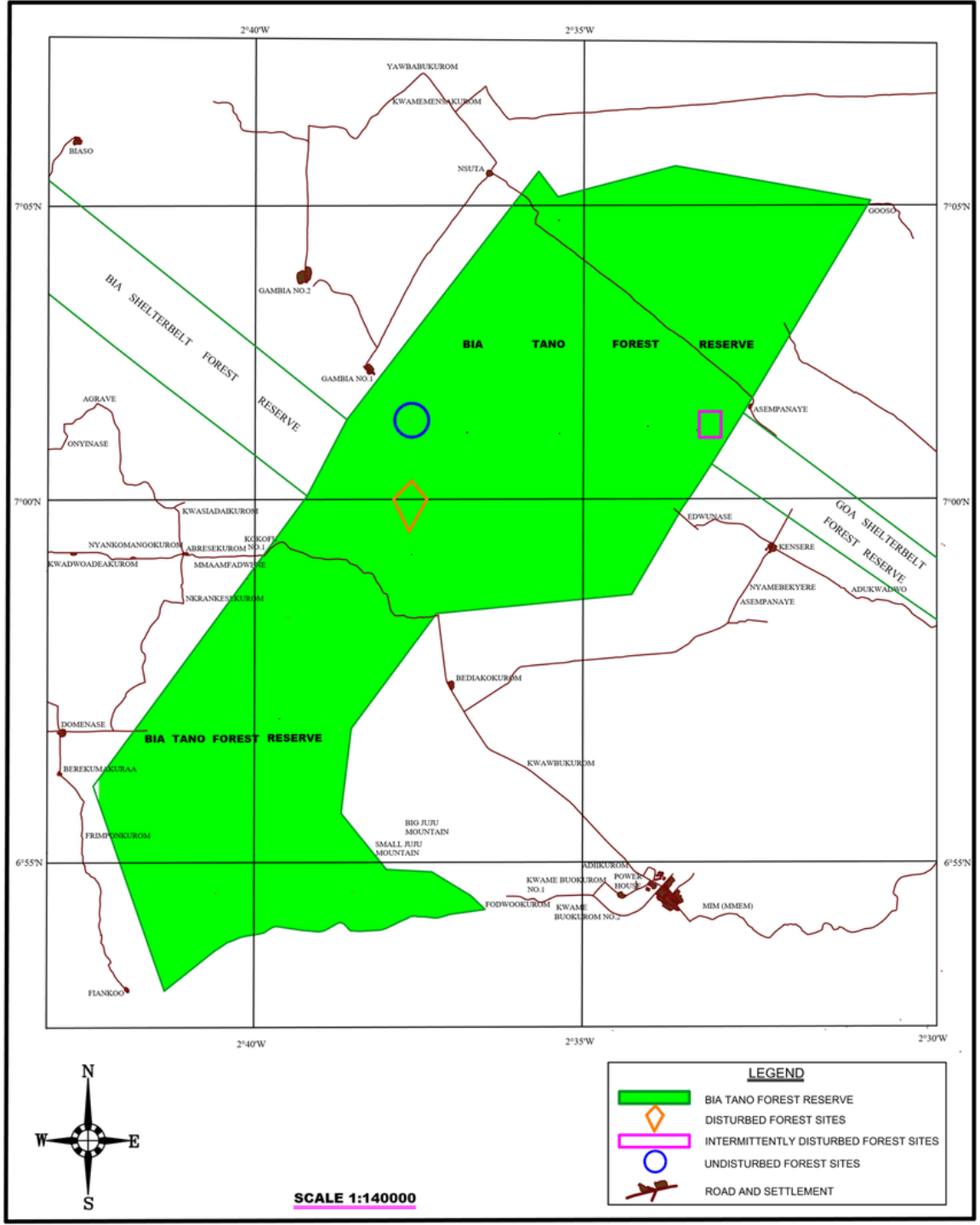

Wood Burning

Wood Type	Commonly Associated Pollutants
Softwoods	
Pine	Higher resin content: Increased VOCs, PAHs, and soot
Cedar	Higher VOCs, especially when green
Fir	Moderate levels of VOCs and PAHs
Hardwoods	
Oak	Lower PM, but can emit VOCs and PAHs
Maple	Moderate levels of VOCs, PAHs
Cherry	Often produces lower pollutants but can emit VOCs
Tropical Woods	
Teak	Can emit VOCs, PAHs
Mahogany	Potential for VOCs, PAHs, and soot
Miscellaneous	
Treated Wood	Highly dangerous: can release arsenic, chromium, and other chemicals when burned

- *The emission of these pollutants could vary depending on various factors (wood's moisture content, the combustion efficiency, and the specific conditions under which the wood was burned)*

Pathways of Exposure to the fringe Communities

- **Airborne Dispersion** (dispersed by wind currents). Atmospheric stability could play a significant role
- **Settling due to Gravity** (larger particles like sawdust may not travel far and settle closer)
- **Physical and Chemical Transformations** (eg. VOCs could react with other pollutants in the presence of sunlight to form ozone, and SO2 could react with moisture to form acid rain)
- **Waterborne Dispersion** (pollutants could be discharged into nearby water bodies directly or as runoff)
- **Attachment to larger particles** like soil/dust
- **Human activities** could also help in the spread of these pollutants



The settlements within a **5 km radius** of the Bia Tano Forest Reserve that are directly affected are **Fianko, Dominase, Kokofu, Gambia No.1, Nsuta, Tokurom, Duase, Aboagyaa, and Bediako** with a population of about **30, 000 people**.

Health Implications

Constituent	Health Effects in Children	Health Effects in the Elderly	References
Particulate Matter (PM)	• Respiratory problems like asthma • Decreased lung development • Increased susceptibility to respiratory infections	• Exacerbation of pre-existing respiratory conditions like COPD • Increased risk of heart attacks and strokes	World Health Organization (WHO)
Carbon Monoxide (CO)	• Reduced oxygen delivery to organs and tissues • Neurodevelopmental effects	• Worsening of cardiovascular diseases • Shortness of breath in chronic heart disease	U.S. Environmental Protection Agency (EPA)
Volatile Organic Compounds (VOCs)	• Eye, nose, and throat irritation • Potential neurodevelopmental effects	• Aggravation of respiratory and cardiovascular conditions	Agency for Toxic Substances & Disease Registry (ATSDR)
Polycyclic Aromatic Hydrocarbons (PAHs)	• Potential developmental impacts • Long-term exposure can increase cancer risk	• Potential exacerbation of respiratory conditions • Increased cancer risk with long-term exposure	National Institute of Environmental Health Sciences (NIEHS)
Nitrogen Oxides (NOx)	• Respiratory irritation and infections • Aggravation of asthma	• Aggravation of respiratory conditions • Increased risk of heart-related illnesses	WHO - Nitrogen Oxides
Sulfur Dioxide (SO2)	• Respiratory problems • Aggravation of asthma	• Exacerbation of pre-existing respiratory and heart conditions	WHO - Sulfur Dioxide

Environmental Implications

Constituent	Environmental Impact	Reference
Particulate Matter (PM)	• Reduced visibility (haze) • Deposition can acidify water and soils	World Health Organization (WHO)
Carbon Monoxide (CO)	• Interferes with the atmosphere's ability to cleanse itself of pollutants	U.S. Environmental Protection Agency (EPA) - Carbon Monoxide
Volatile Organic Compounds (VOCs)	• Contribute to the formation of ground-level ozone and smog • Some VOCs can lead to eutrophication of water bodies	EPA - VOCs
Polycyclic Aromatic Hydrocarbons (PAHs)	• Soil and water contamination • Potential toxicity to aquatic life	National Institute of Environmental Health Sciences (NIEHS)
Nitrogen Oxides (NOx)	• Acid rain formation Ground-level ozone and smog formation • Eutrophication of water bodies	EPA - Nitrogen Dioxide
Sulfur Dioxide (SO2)	• Acid rain formation • Harm to aquatic systems and vegetation	WHO - Sulfur Dioxide
Methane (CH4)	• Greenhouse gas leading to global warming	EPA - Methane
Carbon Dioxide (CO2)	• Major greenhouse gas contributing to global climate change	Intergovernmental Panel on Climate Change (IPCC)

Regulations & Standards/ Mitigation Strategies

To ensure environmental sustainability several regulations and legal instruments exist to curb pollution, including that from wood smoke:

- **Environmental Protection Agency Act (Act 490, 1994)**

- **Environmental Assessment Regulations (LI 1652, 1999)**- industries, including those dealing with wood, are to undergo an environmental impact assessment before commencing operations.

- **National Environmental Policy (2012)**- environmental management

- **Ghana's Forest and Wildlife Policy (2012)**-adoption of eco-friendly wood processing methods

- **Climate Change Policy (2013)**- sustainable forest management practices

- **Ghana's Clean Cooking Strategy (2012)**- transition from traditional biomass cooking methods

Recommendations & Future Actions

- Further research studies to monitor, assess, and predict the potential impacts it may have on the health of the locals- **SDG 3: Ensure healthy lives and promote well-being for all at all ages**.

- Use of clean energy sources to wood such as Briquettes for Bakers will reduce air pollution immensely from that sector- **SDG 13: Take urgent action to combat climate change and its impacts**

- Enforcement of the laws/ regulations to check illegal logging and the proliferation of sawmills especially within these settlements- **SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable**.

Conclusion

- Increased burning of sawdust activities near these fringe communities produces various dangerous pollutants that affect the air quality and the environment.

- Need for monitoring and awareness creation to save lives.

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Thank you for your attention