Exposure to air pollution in both indoor and outdoor environments was assessed in a representative population in rural Northern Tanzania. Participants in the research included miners of the mineral tanzanite and members of their families, such as women, who are exposed to biomass fuels when cooking. Both residents’ and miners’ exposure to particulate matter (PM) was tested and recorded, in total 800 hours of data were collected monitoring levels of PM$_{10}$ (particulate matter 1-10 microns in diameter), the threshold for respirable particles. Residents and miners were regularly exposed to PM levels well above the World Health Organization (WHO) guideline for PM exposure (50 μg/m$^3$), raising risk of COPD (chronic obstructive pulmonary disease) and other health ailments. This policy note provides a summary of findings from the research and recommendations for improving air quality in Tanzania.
The Challenge:

- 20% of people identified with COPD (chronic obstructive pulmonary disease) globally do not have a history of smoking*, and it is often an undiagnosed condition.
- Air pollution inside mines and in homes are also both potentially large contributing factors to COPD.
- Most of the mines in the study had very poor ventilation systems prolonging high PM$_{10}$ levels.
- Rapid urbanisation, poor ventilation and heating of homes, the use of biomass fuels and poor working practices are also risk factors.
- Miners have very long shifts, often 12 hours.
- Workers have no personal protection (e.g. dust masks) and no dust suppressant or ventilation practices in mines are followed.

In this project two measurement campaigns on ‘at high risk’ groups were undertaken using portable aerosol monitoring instruments. One in residences of the Maswa region of Tanzania, the other in 15 mines of the Mererani region close to Mount Kilimanjaro.

Facts about the study:

- As many as 1 million artisanal and small-scale miners may operate in Tanzania as a whole across all mining sectors$^1$.
- Mines extract tanzanite gem stone embedded in quartz rock by blasting the rocks in deep mine shafts.
- Participants in Maswa were asked to maintain a time activity diary to link PM levels with particular type of activities. They were asked questions relating to previous exposure.
- Advanced statistical techniques were applied to establish causal relationship between exposure to PM and effects on respiratory function.
- Monitoring was carried out in two general locations, close to active drilling operations, and towards the rear of mining shafts.

What is COPD?

- COPD is a lung disease characterised by a persistent blockage of airflow from the lungs.
- It is a potentially life threatening, but often under diagnosed condition.
- Symptoms include breathlessness, sputum or mucus in airways and chronic coughing.
- These symptoms tend to progress in severity, eventually leading to daily activities becoming problematic for the sufferer.
- Inflammatory response to dust depends on many factors, including size of particles, chemical composition and overall surface area.
- Even with early diagnosis, the condition may not be completely reversible.


**Key findings:**

- **Indoor residential data** shows that residents were in an environment that exceeded PM$_{10}$ concentrations of 100 μg/m$^3$ 45% of the time.

- **Mine daytime levels** of PM$_{10}$ were found to regularly exceed 1000 μg/m$^3$, these levels were recorded 56% of the time near drilling activities.

- **Exposure to indoor and outdoor air pollution** was found to be high.

- **In mines extremely high levels were recorded**, exceeding the upper cut-off (20,000 μg/m$^3$) of the monitoring instruments.

- **Such events occurred in a third of surveys at mine locations**. Each event could last several hours.

- **Whilst only one of the fifteen mines** examined was in breach of UK COSHH limits for maximum workplace dust levels, **worker protection at all mines was minimal**.

- **Average concentrations** recorded at the mines were higher than those from residences, but only by a factor of 1% in the case of ‘indoor’ residential levels versus ‘rear-of-shaft’ mine levels.

- **For outdoor levels**, events were shorter still around 8 minutes for events above 100 μg/m$^3$, 5 minutes for those above 1000 μg/m$^3$.

**Outcomes & recommendations:**

- **Air pollution in mines could be reduced** by over 90% if miners are provided with masks and water sprinklers during blasting operations.

- **Sufficient ventilation systems** need to be put in place to allow fresh air to enter the mines reducing exposure to high PM$_{10}$ levels.

- **A new analytical tool** has been developed to analyse portable air monitor data.

- **The project has produced descriptive** and advanced statistical analyses, charts, frequency distribution, occurrence of peaks and their duration.

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www.ncl.ac.uk/media/wwwnclacuk/instituteforsustainability/TanzaniaIfSFinalReport.pdf