



Solutions for indoor air pollution during the herding season in Bumthang, Bhutan

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Tripod Fire



Bukhari

INTRODUCTION

- Domestic biomass burning is a major environmental health challenge in the Global South – and open tripod fires pose a considerable health risk
- Rural households in Bhutan predominantly burn biomass for heat and energy – and despite major national electrification efforts, many mountain communities do not have access to any infrastructure services during their nomadic seasons

OBJECTIVES

- Explore the indoor air pollutant (IAP) exposure profile of the *Brokpa* communities of Bumthang, Bhutan
- Conduct an IAP-relevant health assessment for these communities
- Meet a critical environmental health need expressed by these communities in the form of a stove distribution effort
- Further investigate the energy behaviors and environmental health needs of these communities

METHODS

- Low-cost 2.5-um particulate matter (PM_{2.5}) active sensors
- Passive air pollutant samplers
- Community questionnaires
- Clinical evaluations of community members

INNOVATIVE ASPECTS

- Use of FreshAir clips
- Use of low-cost air pollution sensing technology in a remote and resource-constrained setting
- Demonstrate real value of new low-cost sensors for community-based research

RESULTS

Table 1. Peak and average PM_{2.5} concentrations measured during field work burn scenarios.

| Metric | Metric | Bukhari (n=4) | Tripod Fire (n=22) |
|--|--------|---------------|--------------------|
| Fine Particulate Matter Peak Concentration (ug/m ³) | Min | 2.1 | 409.2 |
| | Med | 46.2 | 1318.6 |
| | Mean | 43.2 | 1263.3 |
| | Max | 78.2 | 2341.9 |
| Fine Particulate Matter Average Concentration (ug/m ³) | Min | 0.1 | 25.6 |
| | Med | 13.5 | 250.5 |
| | Mean | 11.7 | 344.6 |
| | Max | 19.7 | 1101.9 |

Table 2. Respiratory symptoms reported by participants.

| Recurring symptoms | Prevalence (n=23) |
|---|-------------------|
| Frequent runny nose, coughs, or cold | 36 % |
| Repeated headaches | 84 % |
| Repeated upper respiratory tract infections | 24 % |
| Lower respiratory tract infection (acute) | 12 % |
| Chronic lower respiratory problems | 4 % |
| Repeated itchy skin | 28 % |
| Repeated itchy eyes or eye infections | 96 % |

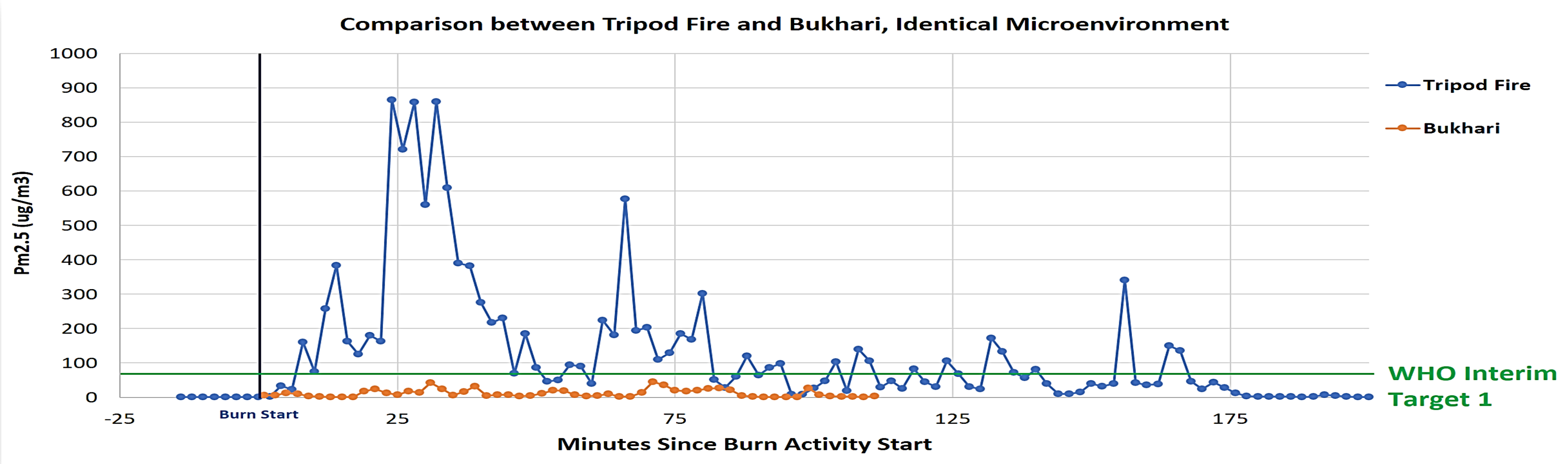


Figure 1. Comparison of indoor particulate matter concentrations resulting from an open tripod fire and a *bukhari* stove.

CONCLUSIONS

- Bukhari* demonstrated vastly superior pollution performance than tripod fires, approaching WHO interim guidelines
- Community members have unacceptably high rates of health problems possibly associated with IAP
- Community members are exposed to high levels of several priority pollutants, including PAHs as well as non-combustion-associated compounds such as pesticides, phthalates, and flame retardants.
- Preliminary data warrants a more rigorous, deeper, and broader environmental health risk assessment for these and similar communities
- Evidence of acceptability and effectiveness justifies broader stove distribution efforts
- Methodological abilities demonstrated in difficult research context; evidence in support of broader, systematized community IAP monitoring
- Good community and researcher partnerships built for future work

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