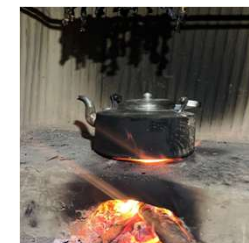




**SmokeFree  
Homes**  
NEPAL

## Results Sharing Workshop on



# Technological and Socio-economic Solutions to Reduce Indoor Air Pollution in Nepal

## Project Overview

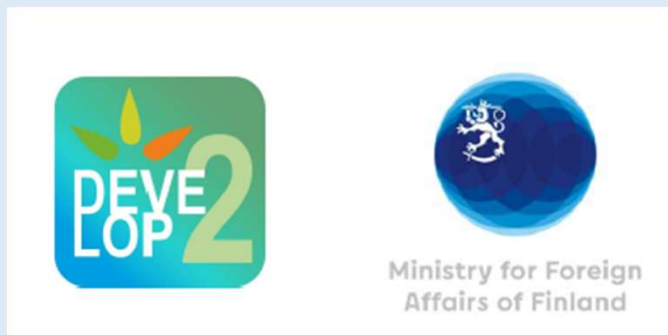
Development Research Academy Programme DEVELOP2, 2023-2026

*Prof. Rejina Maskey Byanju, PhD  
Central Department of Environmental Science  
Tribhuvan University, Nepal  
Squar Hotel, Lalitpur, April 15, 2026*



# Project Information

- Development research – DEVELOP2 (2023–2026)



- Principal investigator:  
Research Director Dr. Jarkko  
Tissari

University of Eastern Finland,  
Department of Environmental  
and Biological Sciences (UEF)





## Project partners, UEF/FINE

- **Small-Scale Combustion group**
- **Doc. Jarkko Tissari**



## SIMO – Mobile small-scale combustion simulator



UEF// University of Eastern Finland

*Curtesy: SmokeFreeHomes Nepal 1st WS, Kathmandu, Nepal JTissari*



## Project partners, UEF/IEOH

▪ **Dr. Marko Hyttinen**



### GOAL

*Mitigation of exposure and control of airborne contaminants in indoor and working environments, minimization of adverse health effects.*

### FOCUS

> *Exposure assessment*

> *Health effects*

> *Risk assessment*



UEF// University of Eastern Finland    *Curtesy: SmokeFreeHomes Nepal 1st WS, Kathmandu, Nepal JTissari*



# Project partners, KU

## Renewable and Sustainable Energy Laboratory (RSEL)

Kathmandu University



### RSEL Thematic Area

- Net zero emissions and 100% Renewables
- Energy Storage
- Building Energy Efficiency
- Circular Bio-Economy
- Clean energy transition (clean cooking, transport etc.)

Dr. Sunil P Lohani



Lead  
Renewable and Sustainable Energy Lab  
School of Engineering  
Kathmandu University

*Curtesy: SmokeFreeHomes Nepal 1st WS,  
Kathmandu, Nepal JTissari*



# Project partners, TU



**Rejina Maskey Byanju, PhD**  
Professor



Central Department of Environmental Science, Tribhuvan University  
(CDES-TU)

## Air Pollution Emission Sources Estimation



## Emission Factor and Emission Inventories: Develop country specific Emission Factors

Environmental Pollutants

Science of the Total Environment

Methane emission factors and carbon fluxes from enteric fermentation in cattle of Nepal Himalaya

Sudrey Thakral<sup>a</sup>, Pratik Bhatta<sup>a</sup>, Singh Bahadur Khari, Anandita Chakral, Pashupati Chaurhary, Ganesh Rajal, Rejina Maskey Byanju

Water Management

Estimating emissions from open burning of municipal solid waste in municipalities of Nepal

Methane release from enteric fermentation and manure management of domestic water buffalo in Nepal

Atmospheric Pollution Research

journal homepage: <http://www.journals.elsevier.com/locate/apr>

### Measurements of TSP, PM<sub>10</sub>, PM<sub>2.5</sub>, BC, and PM chemical composition from an urban residential location in Nepal

Kabindra M. Shakya<sup>a,b,\*</sup>, Richard E. Peltier<sup>b</sup>, Hasana Shrestha<sup>c</sup>, Rejina M. Byanju<sup>c</sup>

<sup>a</sup> Department of Geography at the Environment, Villanova University, PA, USA  
<sup>b</sup> Department of Environmental Health Sciences, University of Massachusetts, Amherst, USA  
<sup>c</sup> Central Department of Environmental Science, Tribhuvan University, Nepal

#### ARTICLE INFO

Article history:  
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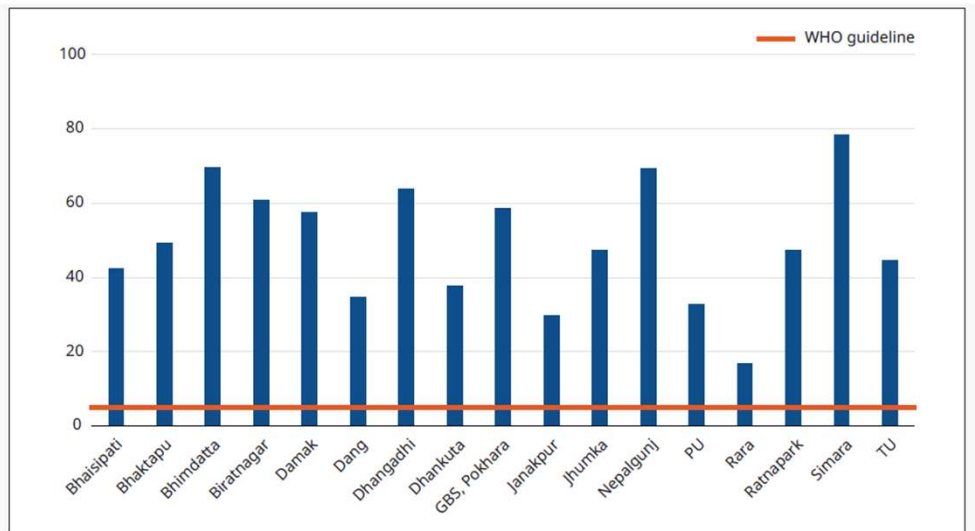
#### ABSTRACT

Particulate matter (PM<sub>2.5</sub>, PM<sub>10</sub>, and TSP), black carbon (BC), and PM constituent components were measured at a location in an urban residential neighborhood of Kathmandu Valley, Nepal. PM<sub>2.5</sub>, TSP and BC were measured during winter, and PM<sub>2.5</sub>, PM<sub>10</sub>, and their chemical composition was measured during the summer monsoon periods in 2014. Both indoor and outdoor measurements were collected during the winter season. There were a distinct seasonal profile of PM<sub>2.5</sub> concentration, with the 24-hour mean

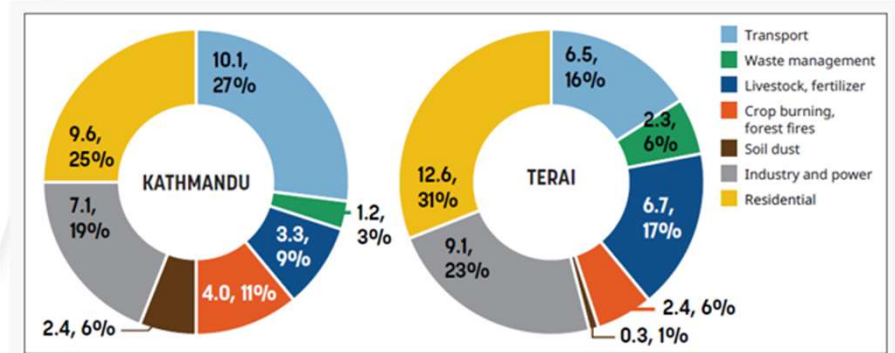
# Background

Nepal is among most polluted country

**Fig.1 :** Annual average PM<sub>2.5</sub> concentrations in the Kathmandu Valley and the Terai region



Source: World Bank based on DoE's annual reports on Status of Air Quality in Nepal, 2021 and 2023.



**Fig.3 :** Contributions of different source sectors to population-weighted annual-average PM<sub>2.5</sub> concentrations in Kathmandu and Terai in 2021 (in µg/m<sup>3</sup> and %)

(source: World Bank. 2025)

# Background contd.

Household air pollution is a silent killer in Nepal, disproportionately affecting women and children

- Globally 2.4 billion people rely on polluting solid fuels (WHO, 2022)
- Air pollution in Nepal was estimated to have led to over 48,500 premature deaths and the loss of more than 1.4 million disability adjusted life years (DALY).
- 26,000 premature deaths from PM<sub>2.5</sub> alone (nearly 12,000 from ambient exposure and more than **14,000** from household exposure- **RBC**) (World Bank, 2019).



Photo: StoveTeam International/ECPA

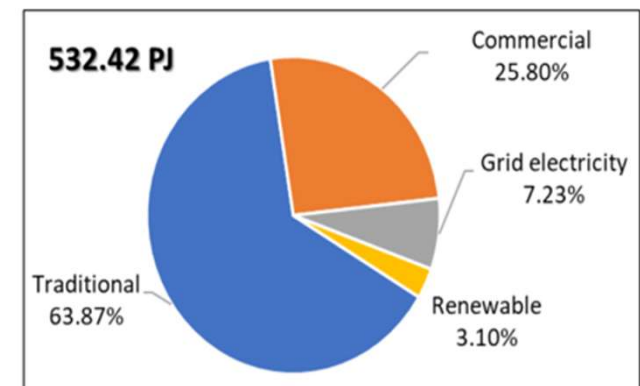


Fig.2: Energy consumption for FY 2079/80 by fuel type (WECS,2024)

# Objective

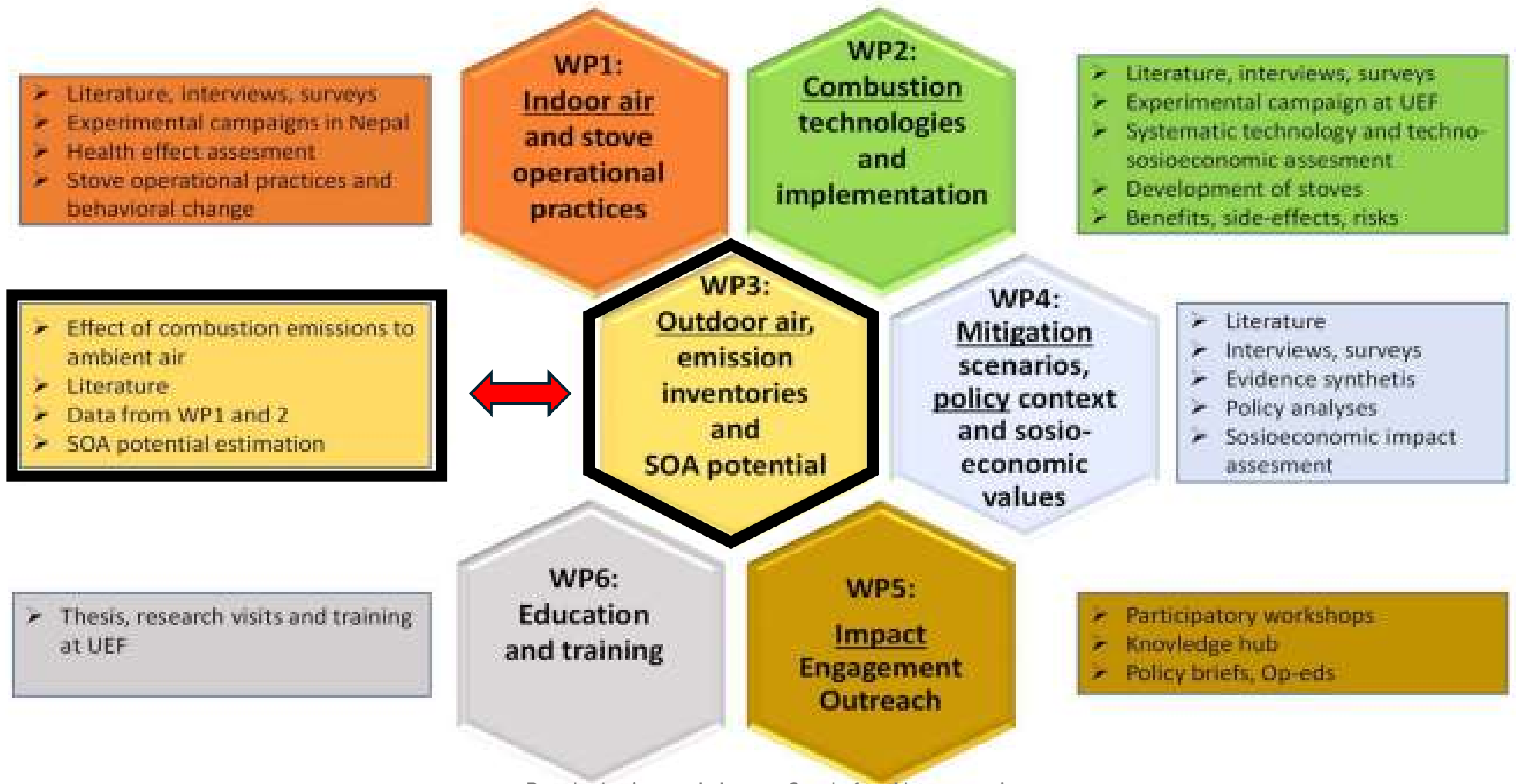
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- To find out the most effective, techno-economic, and socially acceptable measures to reduce RBC emissions from Nepalese rural houses and thus, lower the exposure of indoor air pollutants to women and children.



*Photo: Enna Mool, CDES, TU*

# WORKING PLAN AND THE ROLE



# *Research implementation: methods and activities*

## *Meetings*

- Total of Meetings: 12 Online and 4 in-person (3 in Nepal and 1 in Finland)
- Kickoff meeting On- line: 20.11.2023



4/15/2026

Result sharing workshop on Smokefree Homes-project  
overview

# *First Inception Workshop 2024*

- 17 October 2024
- Hotel Himalaya, Lalitpur, Nepal
- Total Participants: 44 (11 F & 33 M)
- Affiliations: Academic institutions, Governmental institutions, NGO/INGO, Private Sector



4/15/2026

Result sharing workshop on Smokefree Homes-project  
overview

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# *Research implementation: methods and activities*

## **First Field Monitoring: CHITWAN**

20th - 29th October 2024

- Ratnanagar Municipality
- Kalika Municipality
- Rapti Municipality
- Khairahani Municipality



*Photo: Charan Bhattarai/CDES*

# Second Field Monitoring: RASUWA & KAVRE 1-17<sup>th</sup> March, 2025

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*Photo: Balkrishna & Enna, CDES, TU*

# Measurement campaign at the UEF

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- The experiments focused on SOA, particulate and gaseous emissions, and indoor air quality
- Experiments were performed using four different stoves and five different wood species



## *Risks and risk mitigation measures*

- Permit restrictions prevented the import of firewood from Nepal. To address this, a similar wood species was successfully sourced from Pakistan.
- a delay occurred in sample analysis: some OC/EC and PAH samples will only be analyzed in 2026 due to malfunctions in the analytical equipment.
- Additional measurements will be performed in Chitwan in April 2026.

## *Research implementation: personnel, researcher mobility, visits, conferences*

- **Develop2 program:**
- At the **opening seminar**, principal investigator of the project, Jarkko Tissari, gave a presentation about the project and Professor Sunil Prasad Lohani (KU) participated remotely in the panel discussion organized at the seminar.
- **Develop2 Annual Seminar, Dec 11, 2022:**
- - Professor Sunil Prasad Lohani (KU) and Professor Rejina Maskey (TU) gave presentations



# researcher mobility

Result sharing workshop on Smokefree Homes-project overview



# Researcher mobility, visits



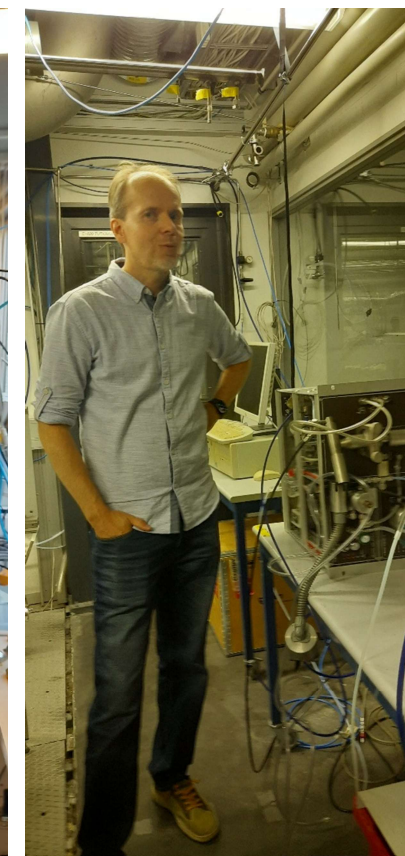
4/15/2026

Result sharing workshop on Smokefree Homes-project overview



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# Visit to Different Laboratories-UEF



4/15/2026

Result sharing workshop on Smokefree Homes-projekt overview

# Seminar at UEF



4/15/2026

Result sharing workshop on Smokefree Homes-project  
overview

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# *Results reporting: academic publications and degrees*

## **Paper, published:**

Sunil Prasad Lohani, Rosy Pradhan Shrestha, Mandip Shrestha, Henna Rinta-Kiikka, Jarkko Tissari, 2025, Rethinking clean cooking solutions: Assessing the impact of subsidy and distribution modality on improved cook stove programs in Nepal, Energy Research & Social Science, Volume 123, 104027, ISSN 2214-6296, <https://doi.org/10.1016/j.erss.2025.104027>.

## **Papers, submitted:**

Narayan Babu Dhital, Juho Louhisalmi, Henna Rinta-Kiikka, Sampsa Väätäinen, Jani Leskinen, Olli Sippula, Jarkko Tissari (2026) Effect of an electrostatic precipitator on particle mass, composition, and number size distributions in residential wood combustion emissions. Submitted to Fuel 24.12.2025.

Sunil Prasad Lohani, Smika Sharma, Henna Rinta-Kiikka, Marko Hyttinen, Rejina Maskey Byanju, Jarkko Tissari, Marc Jeuland (2026). Navigating the Clean Cooking Transition in Nepal: Strategic Insights from SWOT and PESTEL Analyses. Submitted to World Development 13.1.2026.

# *Results reporting: academic publications and degrees*

## **Papers ready for submission:**

Poushan Shrestha, Sarvesh Pandey, Smika Sharma, Rejina Maskey Banjyu, Henna Rinta-Kiikka, Marko Hyttinen, Jarkko Tissari, Sunil Prasad Lohani (2026).

Unlocking Clean Cooking Transition: How Behavior and Finance Shape Adoption Pathways. Manuscript.

Charan Bhattarai, Rejina Maskey Byanju, Bhupendra Das, Balkrishna Poudel, Enna Mool, Ramesh Sapkota, Jarkko Tissari, Henna Rinta-Kiikka, Marko Hyttinen, Narayan Dhital, Indira Parajuli, Sunil Lohani

(2026) Household Cooking Stoves and Indoor Air Quality in Bagmati Province, Nepal. Manuscript

**Several papers are under preparation.**

# Degrees

Post Doctoral Degree: Narayen Babu Dhital, PhD



Charan Bhattarai (TU) successfully defended his Master's thesis in September 2025. The thesis, titled "Household cooking practices and indoor air quality in Bagmati Province, Nepal" was based on measurements done in Nepal.

Balkrishna Poudel (TU) has submitted his Master's thesis, titled "Ruralhousehold biomass combustion emissions in Nepal: an inventory across three ecological regions" was also based on measurements done in Nepal. The defense is expected to be in spring 2026.

Markus Palmumaa (UEF) is preparing his Master's thesis related to SOA formation, based on data from the 2025 measurement campaign at UEF. The thesis is expected to be completed in 2026.



# Strengthening Research Capacity through Seminars



## Strengthening Research Capacity through Seminars – Part 1

Online via Teams  
 November 10<sup>th</sup> 2025  
 13-15 (UTC+5.45) / 9.15-11.15 (UTC+2)

Register <https://forms.office.com/e/D1yWQQPPag> no later than November 9<sup>th</sup>

### Speakers



**Tommi Forsberg (SYKE)**  
National air pollutant emission inventory and reporting system in Finland



**Dr. Marko Hyttinen (UEF)**  
Analytical methods and instruments to measure indoor air pollutants, analysis, QA/QC, data interpretation

This event is part of SmokeFreeHomes Nepal project, aiming to support scientific collaboration and knowledge exchange. We warmly welcome researchers, students, and professionals to join. Participation is free of charge.

## Strengthening Research Capacity through Seminars – Part 2

Online via Teams  
 February 18<sup>th</sup> 2026  
 13-15 (UTC+5.45) / 9.15-11.15 (UTC+2)

Register <https://forms.office.com/e/D1yWQQPPag> no later than February 17<sup>th</sup>

### Speakers



**Dr. Otto Hänninen (THL)**  
Health effects of indoor and outdoor air pollution



**Dr. Henri Hakkarainen (UEF)**  
Inhalation Toxicology: Leveraging In Vitro Models to Reveal the Toxic Compounds in the Air We Breathe

This event is part of SmokeFreeHomes Nepal project (funded by Ministry for Foreign Affairs of Finland), aiming to support scientific collaboration and knowledge exchange. We warmly welcome researchers, students, and professionals to join. Participation is free of charge.



# THANK YOU



<https://uefconnect.uef.fi/en/technological-and-socio-economic-solutions-to-reduce-indoor-air-pollution-in-nepal/>

<https://sites.uef.fi/fine/front-page/main-on-going-research/technological-and-socio-economic-solutions-to-reduce-indoor-air-pollution-in-nepal-smokefreehomes-nepal/>

