Assessing the Impact of Outdoor and Indoor Air Pollution on Community Health in Villages of Punjab

Survey by Doctors For Clean Air and Climate Action (DFCA), an initiative of Lung Care Foundation (LCF)

Introduction

Air pollution is a leading environmental health risk worldwide, contributing to **acute respiratory infections, cardiovascular diseases, and lung disorders**. In Punjab, rural communities experience **dual exposure** to **indoor and outdoor pollution**, worsening health outcomes.

- The **Punjab Air Quality Index (AQI)** frequently exceeds **WHO's safe limits**, with PM2.5 concentrations **2.1 times above recommended levels**.
- The **NFHS-5 (National Family Health Survey)** data indicates that **34% of rural households** still rely on **solid fuels** for cooking, exacerbating **household air pollution (HAP)**.

Survey Rationale & Objectives

Despite increasing awareness about air pollution, **local perceptions, behaviors, and barriers to uptake of cleaner practices remain understudied**. This survey fills that gap by:

- Assessing exposure to air pollution (indoor and outdoor) and its health/economic impact.
- Understanding community perceptions, behaviors, and barriers to adopting cleaner practices.
- Informing DFCA's intervention strategies through evidence-based recommendations.

Objectives of this community survey were to—

- **Primary Objective**: Investigate the impact of outdoor and indoor air pollution on community health and well-being.
- **Secondary Objectives**:
    - Document participants' experiences and perceptions related to air pollution.
    - Identify key local issues and priorities regarding air pollution through community input.

Relevance to Doctors For Clean Air and Climate Action (DFCA)

The survey aligns with **DFCA's mission** to **engage healthcare professionals, policymakers, and communities** to drive **clean air and climate action**. Insights from this study will directly contribute to:

- Communication for clean air policies at the state and local levels.

- Capacity-building initiatives for health professionals and local influencers.
- Community education programs to promote clean energy adoption and pollution reduction strategies.

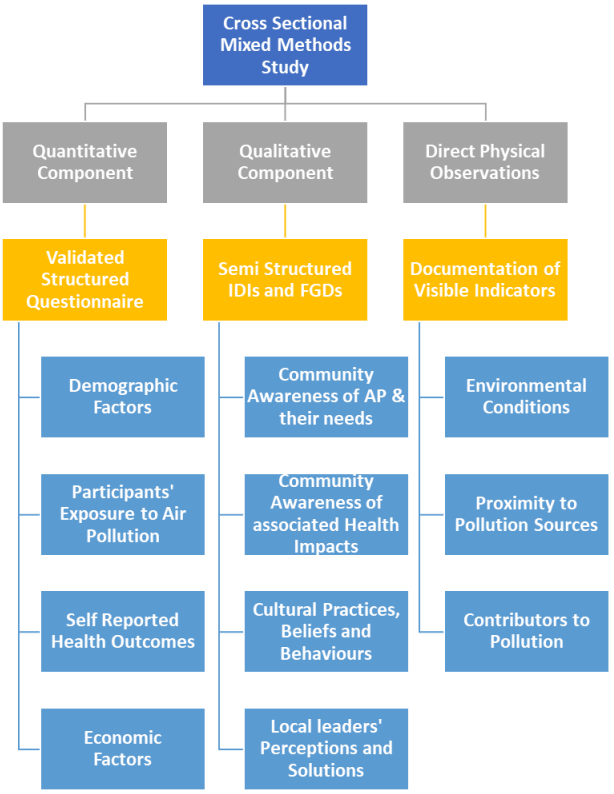


Figure 1: Study Design and Methodology

Methodology

This survey, conducted between **November 2024 and January 2025**, employed a mixed-methods cross-sectional design to assess the multifaceted impacts of air pollution in rural Punjab. It explored community awareness, household behaviors, and the health and economic consequences of both indoor and outdoor air pollution. An effort was made to ensure a balanced representation of men and women among the respondents. Information related to children under five years of age—including health conditions and household practices affecting them—was gathered indirectly through the adult respondent, and no child was directly questioned as part of the study. It also focused on understanding the barriers and enablers influencing community adoption of cleaner practices, behavior change, and condemning polluting activities. Respondents were asked to reflect on their experiences over the **past six months (May/June - November/December 2024)**, allowing for analysis of longer-term patterns in air pollution exposure and its effects.

Study Design

This was a **mixed-methods cross-sectional study** using:

- **Quantitative household surveys** (structured questionnaires).
- **Qualitative in-depth interviews (IDIs)** and **Focus Group Discussions (FGDs)**.
- Observations and Field Notes

Sampling Strategy

A **multistage sampling** approach was used:

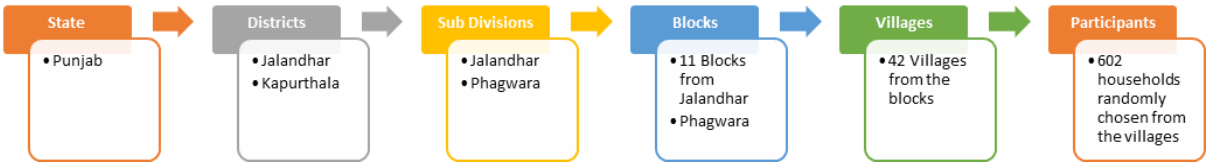


Figure 2: Sampling Strategy

- 602 households were surveyed.
- 4 FGDs and 4 IDIs were conducted.
- **Inclusion Criteria:**
    - Individuals who consented to participate.
    - Individuals above 18 years of age.
    - Individuals who have been residing in the village for more than a year.
    - One respondent per household.
- **Exclusion Criteria:**
    - Individuals who did not consent to participate.
    - Individuals below 18 years of age.
    - Individuals who are tenants, paying guests, or residents for less than a year in the village.
    - More than one respondent from the same household.
- No data was collected from individuals under 18, even with guardian permission.

Figure 3: Population and Participants

Data Collection Tools

- Household surveys (air pollution exposure, health outcomes, economic impacts).
- In-depth interviews of a Sarpanch, ASHA, ANM, CHO and Focus Group Discussions of Primary Caregivers, Sarpanches, Men and ASHA (perceptions, barriers, experiences).
- Direct physical observations (fuel use, ventilation, proximity to pollution sources).

Data Collection

For the data collection, a team of enumerators from Morsel Research & Development Pvt. Ltd. conducted door-to-door surveys in the selected villages. LCF team provided comprehensive training to the surveyor agency's team, covering both the quantitative (structured questionnaires) and qualitative (Focus Group Discussions and In-Depth Interviews) aspects of the data collection. While the surveyor team was responsible for collecting the quantitative data, LCF representatives also accompanied the moderators for the qualitative FGDs and IDIs to ensure alignment and quality.

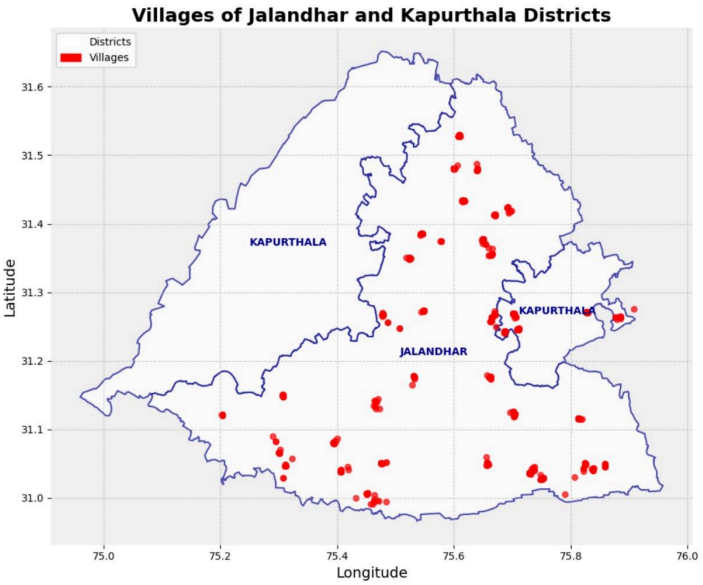
Data Analysis Approach

- **Descriptive statistics**: frequency distributions of variables.
- **Inferential statistics**: Cross tabulations, chi-square tests, correlation analyses, logistic regressions, other statistical tests for associations between variables using MS-Excel, Python, SPSS.
- **Thematic analysis** for **qualitative data**: community narratives, perceptions using NVivo, followed by mapping the findings into the COM-B framework.

Observations

Demographics

A total of **602 households** across **42 villages** in Punjab participated in this survey, covering **3,150 individuals**. The data provides a comprehensive understanding of the surveyed population's composition, including age, gender, marital status, education, income levels, and employment along with the data about variables of interest. These demographic insights help contextualize the community's vulnerabilities to air pollution exposure and its subsequent health and economic impacts.



The table below presents a breakdown of the surveyed population's demographic characteristics.

Characteristics of Respondents	Number	Percentage
Number of Villages	42	
Number of Households	602	
Number of FGDs	4	
Number of IDIs	4	
Number of Individuals within Households	3150	
Mean Age of Respondents	43 years	
Sex of Respondents • Male • Female	 246 356	 41% 59%
Marital Status of Respondents • Married • Never Married • Single (Divorced/Widowed)	 470 92 40	 78% 15% 7%
Education Level • No formal education but can read and write • No formal education and cannot read and write • Primary • Secondary • Higher	 23 100 157 228 94	 5% 16% 26% 38% 15%
Mean number of family members in the household	5	

Mean number of rooms in the household	3	
Vulnerable Population • Children Under 5 years of age • Pregnant Women • Elders above 65 years of age • People with chronic morbidities	 170 63 225 132	
Household Income Range • 0 - ₹20,000 • ₹20,000 - ₹40,000 • ₹40,000 - ₹80,000 • ₹80,000 - ₹1,20,000 *Mean Household Income*	 468 94 35 5 *₹20,058.52*	 78% 15% 6% 1%
Employment • Student • Unemployed • Self-employed • Labourer • Salaried Employee (Government/Private) • Other	 13 185 115 168 50 71	 2% 31% 19% 28% 8% 12%

Table 1: Surveyed Population's Demographic Characteristics

Key Findings

Out of the **3150** individuals surveyed across **602** households through the reflection period of May/June - November/December 2024 -

1. Over **70% of the households** reported use of **biomass** fuels for heating purposes being a critical factor reinforcing indoor air pollution risks.

2. **51.66% of kitchens** lacked **chimneys or exhaust fans,** contributing significantly to respiratory illnesses and eye irritation, particularly affecting women and vulnerable groups like children and the elderly.

3. Nearly **4 in 10 individuals** in these households reported experiencing at least one respiratory or related health issue in the **last six months** due to air pollution. Among those affected, **1 in every 4 individuals** required medical attention or hospitalization, underscoring the widespread burden of air pollution on community health.

4. **34.64% of households** face **Catastrophic Health Expenditure (CHE)**, where healthcare costs exceed a critical income threshold, underscoring the financial burden of out-of-pocket medical expenses. While these expenditures can indicate the financial burden associated with air pollution-related health issues, it's important to note that a direct causal relationship cannot be definitively established due to various other confounding factors.

5. Vulnerable groups are disproportionately affected by air pollution's health impacts: pregnant women are **7.9% more likely** to report health issues, older adults face a **13.6% increased likelihood**, **young children are 7.1% mo**re susceptible, and **individuals with pre-existing health conditions are 20.9% more likely** to experience exacerbated symptoms.

6. **Community awareness remains fragmented**: While **younger individuals** demonstrate greater recognition of air pollution risks, **older populations** often dismiss concerns, citing tradition and economic barriers. Knowledge gaps persist, with many unaware of “invisible” pollutants or long-term health consequences, hindering adoption of cleaner practices.

7. Gender significantly influences air pollution exposure and health risks. Women primarily experience **indoor air pollution** due to traditional practices using firewood and cow dung, leading to chronic respiratory conditions, eye irritation, and skin issues. On the other hand, crop burning, vehicular emissions, and industrial pollutants encountered in agricultural and labor-intensive work expose men more to **outdoor air pollution**.

Qualitative Findings

To better understand the behavioural dynamics influencing community responses to air pollution, the qualitative insights from the survey have been analysed using the **COM-B framework**—which examines the interplay between **Capability**, **Opportunity**, and **Motivation** as drivers of **Behaviour**. This model helps structure the findings by identifying specific enablers and barriers within each domain that affect the adoption of clean air practices and health-seeking behaviours. By mapping the lived experiences, perceptions, and challenges shared during focus group discussions and in-depth interviews onto this framework, the analysis offers actionable direction for designing context-sensitive interventions that can effectively shift behaviours at the community level.

COM-B Component	Sub-Dimension	Insights from the Survey
Capability	*Psychological*	• Limited understanding of air pollution’s long-term effects • Misconceptions: “bad smell = bad air” • Low health literacy in older generations
	Physical	• Inability to afford clean alternatives (e.g., LPG) • Limited skills to implement clean practices (e.g., crop waste composting)
Opportunity	*Physical*	• High LPG costs, limited availability • Lack of alternatives to crop burning

		• Poor infrastructure (ventilation, sewers) • Free testing but indirect health costs persist
	Social	• Cultural norms: traditional cooking & stubble burning • Resistance to change (“always done it this way”) • Mistrust toward health workers • Low collective action (“others must change too”)
Motivation	*Reflective*	• Beliefs: air pollution is seasonal or harmless • Doubts about effectiveness of preventive actions • Financial prioritization over clean practices
	Automatic	• Habitual use of chulhas • Emotional attachment to tradition • Women more motivated by family health, men more dismissive

Table 2: Table with Qualitative Findings Mapped Into COM-B Framework

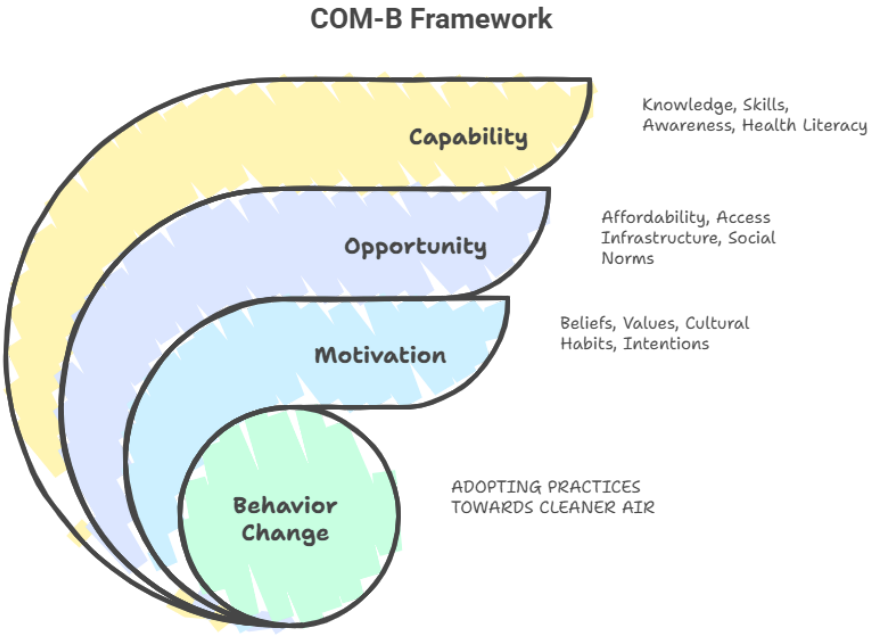


Figure 4: Illustration depicting Qualitative Findings Mapped Into COM-B Framework

Actionable Insights for the Districts

The key findings from the survey provide a robust foundation for designing a wide range of interventions addressing the multifaceted impacts of air pollution—including physical and mental health, behavior change, financial vulnerability, gender disparities, and health equity.

However, given the operational scope and resource bandwidth of DFCA in Punjab, these interventions can be strategically organized into three broad categories:

a. DFCA-Led Actions

Initiatives directly implementable by DFCA leveraging its strengths in awareness, capacity building, research, and doctor-led communication.

1. **Community Awareness and Behaviour Change**
   Conducting targeted awareness sessions for different segments of the rural population to address the health impacts of air pollution, with a strong emphasis on harmful practices such as the use of biomass fuels, open waste burning, and stubble burning. Special focus could be placed on indoor air pollution and its contributing factors, including poor ventilation, mould infestation, and unclean cooking practices. These sessions could also cover preventive strategies for households located near high-risk exposure sources such as highways, industrial zones, brick kilns, and agricultural fields where burning occurs.

2. **Capacity Building of Frontline Health Workers**
   In collaboration with local health leadership, DFCA can facilitate training sessions for frontline health workers, including ASHAs, ANMs, Aanganwadi workers, and Community Health Officers. These sessions could enhance their knowledge on the health impacts and sources of air pollution, mitigation strategies, and effective community communication. The focus would be on building their capacity for early detection, health education, and community-level intervention, particularly for vulnerable groups such as children, pregnant women, and the elderly.

3. **Resource Dissemination and Strategic Communication**
   DFCA can develop and distribute context-specific educational materials such as posters, infographics, toolkits, training modules, and action agendas tailored to the needs of rural health professionals. This will be complemented by a coordinated messaging strategy using both electronic and print media to amplify key messages, raise awareness, debunk prevailing myths, and increase public risk perception across diverse community groups.

4. **Evidence Generation and Applied Research**
   To strengthen the intervention framework and advocacy efforts, DFCA can continue to lead research and evidence-generation activities. This includes community-level surveys, health assessments, and exposure mapping aimed at generating actionable data to inform program development, adapt strategies, and provide a robust evidence base to drive local air quality and health policy reforms.

5. **Doctor-Led Communication**
   Local DFCA leaders will be supported in participating in district and municipal policy dialogues, using evidence from this survey to communicate for targeted reforms. Doctors and public health professionals will be equipped to engage with administrators, quote local

data, and recommend practical measures that align with community needs and administrative feasibility, thereby amplifying the health voice in air quality governance.

b. Policy Recommendations

Evidence-based recommendations that can be presented to local and district authorities to inform structural or regulatory changes.

1. Integration of air pollution exposure and respiratory illness indicators into district health dashboards, public health registers, and routine surveillance systems to enable real-time tracking, informed planning, and early intervention.
2. Inclusion of respiratory risk screening protocols and early treatment guidelines in the standard operating procedures of PHCs, CHCs, and district hospitals to improve the detection and management of pollution-related illnesses.
3. Stricter enforcement of bans on open waste burning and stubble burning, particularly within a 1 km radius of residential areas, schools, and healthcare facilities, to reduce direct exposure among vulnerable populations.
4. Supporting the establishment of decentralized, community-based monitoring systems to report, track, and discourage burning activities, with active involvement from local governance bodies such as Panchayats and ward committees.
5. Promotion of targeted financial protection measures to reduce Catastrophic Health Expenditure (CHE) linked to air pollution, including coverage of pollution-related illnesses (e.g., asthma, COPD) under state health insurance, creation of emergency health funds at the district level, and provision of subsidized or free respiratory care at public health centers.
6. All government-supported rural housing programs, such as PMAY, should mandate the installation of chimneys or exhaust systems, incorporating clean air infrastructure into building codes and housing design guidelines.

c. Collaborative and Partner-Driven Solutions

Resource-intensive or cross-sectoral interventions best implemented in partnership with NGOs, civil society organizations, academic institutions, or local governance bodies.

1. Partner with academic institutions or public health bodies to conduct cohort studies and long-term exposure tracking, particularly for vulnerable groups like women, children, and the elderly.
2. Organize pan-district awareness events, such as Clean Air Fairs, mobile exhibitions, or mega health camps, by pooling resources and networks of multiple NGOs and CSOs.
3. Facilitate inter-generational dialogue sessions to promote cultural transitions from harmful traditional practices (e.g., cow dung use) to cleaner, health-focused alternatives.
4. Undertake research and development to explore alternative crop-residue management methods in collaboration with farmer groups and agriculture-focused CSOs.

5. Provide waste segregation training for sanitation workers and waste-picker cooperatives in partnership with local NGOs and municipal stakeholders.

Conclusion

This survey highlights the profound impact of air pollution on community health, economic well-being, and quality of life in rural Punjab. The findings underscore the urgent need for targeted interventions, including improved household ventilation, clean cooking transitions, strengthened air quality regulations, and enhanced healthcare accessibility. The evidence gathered reinforces that air pollution is not just an environmental issue but a critical public health emergency affecting the most vulnerable—children, the elderly, pregnant women, and individuals with pre-existing conditions.

DFCA remains committed to translating these insights into actionable solutions by strengthening community awareness, communicating for evidence-based policy reforms, and fostering multi-stakeholder collaborations. Addressing air pollution requires a collective effort from policymakers, healthcare professionals, researchers, and communities, and this study serves as a foundation to drive sustainable, long-term improvements in air quality and public health.

By leveraging scientific evidence, community voices, and policy assistance, DFCA will continue working towards its vision of clean air for all, safeguarding both human and planetary health.

Appendices

- Survey Questionnaire - Sheet 1
- Observation Checklist - Sheet 2
- Interview & FGD Guide - Sheet 3 and 4
- Gallery
- Long Format Report