THE “CHULHA” PROJECT
Research Partners: Center for Microfinance, Gram Vikas, Poverty Action Lab

I. PROJECT BACKGROUND

Worldwide more than three billion people continue to depend on solid fuels, including biomass fuels (wood, dung, agricultural residues) and coal, for their energy needs. A disproportionate fraction of these people reside in poor nations. Specifically, it has been estimated that half of the population of developing countries rely on solid fuels, and nearly 95% in extremely poor countries (Biswas and Lucas, 1997).

Cooking and heating with solid fuels on open fires and/or traditional stoves may result in high levels of health-damaging pollutants (including particulates and carbon monoxide). In fact, the use of traditional stoves in poorly ventilated houses may cause particulate pollution levels to be much higher than the commonly accepted guideline values. For example, the US EPA standard for the 24-hour average of PM$_{10}$ is 50 µg/m$^3$. In contrast, Smith (2000) found that mean 24-hour PM$_{10}$ concentration from solid-fuel-using households in India sometimes exceeds 2000 µg/m$^3$.

The high levels of particulate matter emitted by traditional stoves may have large effects on health. According to the World Health Report 2002, indoor air pollution (IAP) is responsible for 3.9% of the global burden of disease. Numerous studies have found associations between IAP and chronic bronchitis, pulmonary disease and lung cancer (WHO, 2000). Further, there is emerging evidence that IAP increases the risk of other negative child and adult health problems, including low birthweight, perinatal mortality, asthma, otitis media (or middle ear infection), tuberculosis, nasopharyngeal cancer, cataracts, blindness, and cardiovascular disease.

In addition to possible negative effects on health, traditional stoves may also impact climate change by accelerating deforestation (Pandey, 2001). The traditional stoves are inefficient in producing energy and, thus, require large quantities of wood to cook even a simple meal.

In response to these global health and environmental problems, improved stove technologies have been developed. In the laboratory, these new technologies have been found to be more fuel-efficient and to emit fewer harmful pollutants. However, much work is still needed to determine their effectiveness under the tough environments often found in developing countries (erratic or high temperatures, unsteady supply of fuel, misinformation regarding stove and fuel use, etc). Moreover even if the stoves reduce IAP levels, there have been few opportunities to reliably measure the effect of “clean stove” on individuals’ well being.

This project will provide new evidence on the effect of these stoves on IAP and affected individuals’ health and economic well-being. Moreover, we will assess whether the improved stoves can lead to reductions in biomass consumption and, therefore, can be used to combat the high rates of deforestation in developing nations.

II. PROJECT DESIGN

Over the course of the next three years, we will work with an Indian non-governmental organization, Gram Vikas, to assess the impact of a “clean stoves” program on IAP, health, economic wellbeing, and fuel consumption. Notably, the analysis will be based on an experiment that randomly assigns clean stoves among the 2,500 households in our sample.

The project will be conducted in Orissa, India and will last for three years, allowing us to test for long run health outcomes. National statistics indicate that Orissa is the poorest state in India, with 40% of the population living below the poverty line. Poverty is significantly worse in the western and southern districts of the state (the setting of our projects), which have a higher proportion of adivasis and dalits (traditionally the two most disadvantaged groups in India).

Gram Vikas has identified 2500 households, across roughly 40 villages, which have agreed to take part in the study. In each village, a lottery will be conducted at the start of the program.
The lottery will randomly divide the households into three groups. The first group will be given a chance to purchase a stove (at a subsidized rate) immediately. A year and a half into the project, the next group will be given an opportunity to buy a stove (at the same subsidized price). The final third will be given the opportunity at the end of the three-year study.

The evaluation team will conduct vigorous monitoring of IAP to determine the magnitude of the pollution reduction that can be attributed to the improved cooking stoves. Since cooking practices and fuel availability change across seasons, monitoring will continuously take place during the course of the three years. In addition to monitoring pollution levels within the kitchen, CO breath analyzers may be used to determine the changes in an individual’s intake of CO as a result of the stoves.

A series of detailed surveys will take place at the start, middle and end of the project. The surveys will include questions on cooking practices, fuel usage, recent health status and health expenditures, and labor supply. A short physical health examination will accompany the survey. This exam will include a spirometry test and the Harvard Step test, which are both designed to gauge respiratory health. As women and children typically have the most exposure to the smoke from cooking stoves, we will pay particular attention to the effect of the stoves on the infant mortality and birth weight, pregnancy complications, and the physical development of children under age 5.

Finally, in addition to the large-scale surveys, a local individual in each village (hired and trained by the evaluation team) will conduct a small monthly health recall and fuel usage survey in all villages. This will make it possible to track differences of the “stove” effect across seasons.

III. CONTRIBUTIONS

This study will make several contributions to the literature on IAP and clean stoves. First, the random assignment of stoves means that the results will be causal, not simply associational. This is a substantive difference with much of the previous literature that is based on observational studies of the health effects of indoor air pollution (Bruce et al., 2000). The shortcoming of observational studies is that individuals who decide to buy an improved stove may do so because they are wealthier or have greater cause for concern about their health. Further, they may also undertake preventive health measures other than the stoves. In this case, the simple comparison of households that do and do not own households will confound the effect of the stoves with these other factors.

Second, the large sample size of 2,500 households will allow for the detection of small changes in health status, economic well-being, and fuel consumption. As a point of comparison, this sample size is roughly 5 times larger than the only other randomized evaluation of clean stoves that we are aware of (Smith-Sivertsen et al (2004). Thus, it may be possible to precisely estimate changes to infant birth weights, one of the biggest predictors of lifetime health status.

Third, this study will expand the list of outcomes beyond those traditionally studied. For example, our survey will assess whether the clean stoves lead to improved economic outcomes (e.g., due to fewer days of work lost to illness). Additionally, we will explore whether the stoves’ introduction causes individuals to alter their behavior in ways that mitigate the stoves’ effect on health outcomes. For example, we will test whether the stoves cause individuals to smoke more or seek less medical care. Evidence on mitigating behaviors will provide a deeper understanding of the stoves’ benefits. Finally, this study will greatly advance knowledge about whether these stoves can reduce the rate of deforestation. An affirmation of this possibility might greatly increase international support for funding “clean stove” programs in the name of preventing global climate change.
IV. RESEARCH PARTNERS

Academic Team/Poverty Action Lab:

- Esther Duflo (MIT): Dr Duflo has worked extensively on randomized policy evaluations in South East Asia and Africa. Most recently, Dr. Duflo spear-headed one of the most ambitious surveys on health undertaken in a developing nation.

- Michael Greenstone (MIT): Dr. Greenstone is one of the leading experts in environmental economics and policy. His work has primarily focused on the effect of U.S. environmental regulations on industrial activity, individuals’ valuations of environmental amenities, and the effects of ambient air pollution on infant and adult mortality rates.

- Rema Hanna (NYU): Ms. Hanna will receive her PhD in economics from MIT in 2005. She is currently a joint appointment in NYU’s Wagner School of Public Service and Economics Department in the fall. Her dissertation work included numerous policy evaluations in both urban and rural India, including a study of corruption in New Delhi and an education project in rural India (joint with Dr. Duflo).

Center for Micro Finance (CMF): CMF is a research organization based in Chennai, India, that studies the impact of different policy choices on the poor. CMF has committed funding for the health survey portion of the study, and has provided the local team to manage day-to-day operations of the project.

Gram Vikas (GV): Gram Vikas is a rural development organization who, since 1979, has worked with the poor marginalized communities of Orissa. Gram Vikas is a registered NGO under the Societies Registration Act of 1960 and currently serves a population of more than 28,000 households across 400 villages in Orissa. Gram Vikas will be responsible for installing improved stoves and for their continued maintenance.

Gram Vikas’s housing and environmental work have received international recognition (including the World Habitat Award 2003 for the Rural Health and Environment Programme awarded by the Building and Social Housing Foundation, UK; Most Innovative Project Award 2001 from the Global Development Network of the World Bank for the Rural Health and Environment Programme). More information about Gram Vikas is available at: http://www.gramvikas.org/.
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