Final Progress Report
2007 Award
Report submitted 090121

Project Title: **The Role of Small-scale Energy Use in Local Air Pollution Patterns in Accra, Ghana**

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1. Project abstract:

The aim of the proposed research is to understand the effects of urban biomass use on local air pollution patterns, especially in relation to neighborhood socioeconomic and spatial characteristics. To achieve this, we leveraged an ongoing project on air pollution exposure in Accra, Ghana, and conducted detailed and high-quality measurement of energy supply and energy use and within-neighborhood variation of air pollution, and collected samples to analyze the composition of neighborhood particle pollution in selected low-, middle-, and high-income neighborhoods. We are using these data to map and quantify domestic and small-scale commercial energy supply and use, and their contributions to neighborhood air pollution. In addition to scientific results, the project helped with graduate and undergraduate student training at Harvard and University of Ghana. We also plan to use the results of this research as the basis for working with Ghanaian scholars and practitioners who specialize in energy policy, environmental regulation, and community development to advance policy analysis and evaluation regarding urban development, energy, and air pollution in Accra.

In addition, briefly describe:

1) How the project has advanced research promoting sustainable development in the developing world:

Sub-Saharan Africa is the world's fastest urbanizing region, with many urban residents, especially in low-income neighborhoods, continuing to use biomass fuels. A better understanding of the role of biomass sources, versus transportation and industrial ones, in air pollution could lead to policy and programmatic interventions that are more effective and, as importantly, more equitable. This research became, to our knowledge, the first-ever analysis of neighborhood patterns of air pollution sources and levels in sub-Saharan Africa.

2) The project's intellectual merit:

This project, including the component funded by the CID Sustainability Science Program, constitutes one of the largest and most detailed primary data collection efforts on air pollution levels and sources in a developing country city. As a result, the research will greatly inform our understanding of one of the most important environmental health issues in developing country cities, with emphasis on between and within neighborhood variation.

3) How the project has contributed to solving a practical problem of sustainable development:

See No. 1 above. The findings of the project will have direct relevance to interventions and policies for air pollution control in developing country cities.

4) Any developing world component, including field work, engaging a co-investigator or practitioner from the developing world, the development of institutional links with an academic or practitioner/ applications/ problem-solving oriented institution in the developing world:

The field work component of the funded research was entirely based in Accra, Ghana, with active participation from faculty and graduate students from the University of Ghana. The manuscripts from the project are co-authored with University of Ghana faculty and graduate student researchers. The main collaborating partners at the University of Ghana were the Department of Geography and Resource Development and the Environmental Science Program.

5) The engagement of a student or research fellow in the project and whether the project has provided any opportunities for a thesis or masters student exercise:

The project has engaged one graduate student (Kathie Dionisio), two junior research fellows (Ari Friedman and Michael Rooney), and one undergraduate student (Heather Carmichael) from Harvard, and three graduate students (one PhD and two MPhil) (Allison Hughes, Raphael Arku, and Audrey Quaye) from the University of Ghana. All but one of these students worked on activities related to the SSP-funded component. All are co-authors of in-preparation manuscripts and all are using the data for their doctoral, masters and senior theses at Harvard. One Ghanaian student (Raphael Arku) is currently enrolled in a Harvard-affiliated MSC program (The Cyprus International Institute for Environment and Health) and another at Harvard on a one-year fellowship.

6) Any funds leveraged as a result of this project:

The SSP-funded project has added a pollution source component to an NSF-funded project. Given that field research has just been completed, we will apply for additional external funding only after data analysis is more advanced, likely in late 2009.

7) Reports, papers, publications or presentations building on this support (please list full citations here and attach copies or URL's if possible):

The two manuscripts below are in preparation

Dionisio KL, Rooney MS, Arku RE, Friedman AB, Hughes AF, Vallarino J, Carmichael H, Agyei-Mensah S, Spengler JD, Ezzati M (2009) "Within-neighborhood variation of particle pollution in developing country cities: mobile monitoring and GIS analysis in four neighborhoods in Accra" in-preparation.

Dionisio KL, Arku RE, Hughes AF, Vallarino J, Carmichael H, Friedman AB, Agyei-Mensah S, Spengler JD, Ezzati M (2009) "Particle pollution in Accra neighborhoods: spatial and socioeconomic patterns" in-preparation

The preliminary findings were also presented in the following presentations

"Neighborhood air pollution in Accra: levels, variations, and sources" The 20th Annual Conference of the International Society for Environmental Epidemiology (ISEE), Pasadena, California

"Integrating poverty and inequality in measurement of environmental risks" The National Science Foundation Human and Social Dynamics grantees meeting, Arlington, Virginia

8) Discussion of any significant deviations from the proposed work plan:

Our data collection was affected by an unexpected rise in the frequency of electricity outages in Accra (12-hour outage in every 48 hours) and hence has been on a slower schedule than planned. But the proposed work was completed by summer 2008 by hiring additional field workers.