MITIGATION OF GLOBAL AND REGIONAL CLIMATE CHANGE

PROJECT SURYA

Buying the Planet Time by Reducing Black Carbon, Methane and Ozone

PROJECT SURYA
Mitigation of Global and Regional Climate Change

Buying the planet time by reducing black carbon, methane and ozone

Nithya Ramanathan[1], I H Rehman[2], A. Kar[2], N. Bhatt[3], and V Ramanathan[3]
Submitted to UNEP Black Carbon Newsletter

Project Surya aims to mitigate the regional and global impacts of anthropogenic climate change by immediately and demonstrably reducing atmospheric concentrations of black carbon, methane, and ozone. Together, black carbon (BC), methane, and ozone are responsible for 30% to 50% of the human effects on global warming. However, unlike CO_2 which lasts over a hundred years once released, these pollutants are short lived.

Their effects on the atmospheric warming and glacier retreat will disappear within months (BC and ozone) to decades (methane) of reducing emissions, thus buying the planet much needed time to find solutions to mitigating the effects of CO_2. Ultimately Surya's aim is to steer the three billion people who depend on polluting solid biofuels towards cleaner, locally available renewable energy sources.

Photo Credit: Adam Ferguson; NY Times, 4/16/09

Additionally, the major co-benefits of reducing these air pollutants will include immediate improvements in public health, agricultural productivity, and economic development for the rural populations in developing nations. Bringing together climate scientists, epidemiologists, computer scientists, energy technologists, economists and rural economic development experts, Project Surya takes an integrated approach to addressing four of the most pressing challenges facing Asia today: economic development, air pollution, climate change, and public health.

SCOPE OF PROBLEM

While reduction in CO_2 emissions has been at the forefront of many efforts to reduce global warming, the impact of reducing CO_2 emissions will not be seen for decades due to its long lifetime in the atmosphere. Recently, attention has expanded to BC, methane and ozone which may contribute as much as CO_2 to global warming. BC alone may be responsible for as much as 50% of the alarming retreat of the arctic sea ice and the Hindu Kush-Himalayan-Tibetan glaciers. Yet, because these pollutants have shorter lifetimes, any reduction in their emissions will be realized immediately.

Smoke clouds captured by NASA satellite

COOKING WITH SOLID BIOFUELS: ENVIRONMENTAL IMPACTS

Photo Credit: Adam Ferguson; NY Times, 4/16/09

Surya's first focus is on the polluting solid biofuels (firewood, dung, crop residues) that roughly 650 million rural Indians are forced to burn for cooking, lighting, home heating, and small industry due to economic conditions. A mass of scientific evidence suggests that biofuel burning contributes up to two thirds of BC and carbon monoxide (a precursor to ozone) emissions in South Asia.

In addition to their regional climate effects which threaten the water and the food security of Asia, biofuels are also known to have significant public health consequences: inhalation of indoor air pollution from biomass-fueled fires and kerosene-fueled lamps lead to more than 400,000 deaths annually among rural women and children in India alone. Finally, the time required to gather biofuels is significant, forcing women and children to forgo other activities including school.

SOLUTIONS

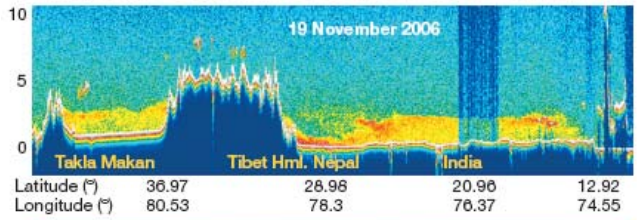
In its first phase, Project Surya will target three regions in rural India: one region in the Himalayas, one region in the Indo-Gangetic plains, and one region in South India for deployment. The Indo-Gangetic plains (IGP), extending eastwards from Pakistan, across India to Bangladesh, inhabited by 600 million, is the major source region for black carbon, CO_2 and other pollutants. Since it provides the southern boundary of the Hindu Kush-Himalayan (HKH) region, IGP is one of the major pollution sources for the effects of black carbon on the fast retreat of the HKH glaciers. Surya will provide sustainable, effective, incentive-based plans to enable five to ten thousand households in each region to switch to cleaner-burning technologies such as solar lamps, biogas plants, efficient stove technologies, and solar cookers.

A steady flow of snow melt runs down from Mt. Everest

Unprecedented Data Collection

What distinguishes Project Surya from numerous other cleaner-cooking projects is its scope and evaluation. Surya's multi-disciplinary team will undertake the most comprehensive and rigorous scientific evaluation to date on the efficacy of reducing biomass-fueled cooking on climate warming, air pollution, and health.

Surya's study methodology is unique because it aims to collect high quality, reliable data at every level: from the individual household, to the village, to the regional impacts of the project intervention. Household data will be collected via cutting-edge sensor technologies and analytics installed in mobile phones distributed to participating households. These mobile phones will measure individual reductions in exposure to pollutants as well as adherence to the intervention in a distributed and scalable fashion that improves on traditional data collection technologies. Instrumented towers installed in each region will collect climate-related metrics at the village level including concentrations of BC, carbon monoxide, and ozone, and will measure the resulting change in the solar heating of the air and the ground. Finally, these data will be combined with the most advanced data from A-Train NASA satellite (http://aura.gsfc.nasa.gov/instruments/omi.html) to measure the regional heating effects and probable cooling effect of other particles emitted when solid biofuels are burned.



CALIPSO data for BC surrounding Himalayas

Documentation of the Impacts of Intervention

The evaluation of black carbon effects on heating will take two years. During year one, background data will be collected without intervention. Deployment of new technologies will commence at the end of year one. Conceptually, Surya will create a BC hole in the intervention region within weeks of introducing the energy-efficient technologies. In order to separate the 'signal' from contamination smoke from surrounding regions, the control village and the surrounding villages will be monitored using satellite instruments. The height of the BC cloud (shown above), absorption of sunlight by the cloud, ozone, nitrogen dioxide and sulfur dioxide, will be used in conjunction with meso scale models to quantify the transport of smoke and air pollutants from areas outside the region of intervention. The analyzed data will be used as input to regional climate models to estimate the reduction in the global warming potential of soot.

Locally Relevant Goals and Capacity Building

At the local level Surya targets cooking with solid biomass fuels to reduce black carbon, primarily because reduction in smoke from cooking is expected to have major co-benefits like improved health of women and children due to reduced exposure to indoor air pollution. At the regional level Surya will mitigate the retreat of the glaciers and snow packs of the Hindu Kush-Himalayan region.

Phillips stove in Surya village
Photo: Douglas Varchol

BP Oorja stove

Envirofit stove

The specific aims of the project are:

- Document the impact of using kerosene lamps for lighting applications and using mud stoves with locally available unprocessed biomass for cooking applications (Business as Usual-BAU scenario) on local environment (outdoor and indoor air quality in terms of soot, particulate matter, carbon monoxide and carbon dioxide emissions) of a sample population as the study baseline.
- Replace above mentioned polluting lighting and cooking technologies by disseminating clean technologies like solar lanterns and energy efficient improved cooking (and processed fuel) technology to a sample population and ensure sustained voluntary usage.
- Document the impact of using solar lanterns for lighting applications and energy efficient improved cookers (and processed fuel) for cooking applications to undertake a comparative assessment of local the environment

A primary aim of Surya is to introduce these cleaner technologies in ways that are locally relevant, appropriate and ultimately sustainable through increasing participation of local populations. These efforts will include *a priori* and ongoing community surveys in order to select feasible cleaner-burning methods that take into account local customs, dietary needs and locally available fuel sources. We are working directly with three different manufacturers (Phillips, British Petroleum, and EnviroFit; stoves are shown in the images above) to select energy-efficient and BC-free (or nearly BC-free) stoves for general use. In addition, Surya will provide ongoing training in the use, maintenance and repair of the new stoves and mobile phones. Project Surya will develop a strong, locally accessible, network of entrepreneurs for cooking technology service, repair, fuel supply, and stove marketing. It will also employ an adaptive technology dissemination plan in which there will be routine exchange of information between the users (i.e. the women who cook with the stoves) and the companies and cook-stove researchers. The stoves will be modified in response to user feedback.

Project Surya additionally builds research and development capacity in the target region by locating a majority of the implementation, research, analysis, and technology development in India. Indian institutions, such as The Energy Research Institute in New

Delhi, Sri Ramachandra University in Chennai, Jawaharlal Nehru University, Center for Development Finance, and the Indian Institute of Technology in Delhi will lead the implementation effort. Collaboration and knowledge transfer will involve leading institutions in the United States, including Scripps Institution of Oceanography at UC San Diego, UC Los Angeles, and UC Berkeley and in the European Union nations.

Pilot Phase Has Started

In order to field-test our approach of stove deployment and data collection, we have embarked on a pilot phase to replace traditional mud stoves with cleaner cooking technologies in 500 households. The research focus will be on testing the implementation methodology, and on identifying suitable technology which will conveniently and economically fulfill the lighting and cooking needs of the project population from the existing battery of commercially available technologies. The pilot project is being executed in Khairatpur village in IGP, located at the coordinates 26.47N; 81.65E, in the Sultanpur District of Uttar Pradesh state of India. The experience and data gathered during this pilot phase will be used to conduct the first field phase with five to ten thousand households in the three regions.

Scaling Up

A sustainable financial model is currently being developed to improve the adoption rate of the new technologies. This model will include the creation of a cap and trade program where villagers who adopt the energy-efficient stoves can sell carbon credits. Surya's accurate, reproducible climate data will quantify the equivalent CO_2 emissions saved by reductions in emissions of BC, methane and ozone. This data will then be used to secure carbon credits for the villagers. It is our expectation that the monetary returns to the villages and the villagers through these credits will be an important motivating factor.

Surya aims to make its approach to climate mitigation a governmental policy, through UNEP's policy wing. Building on success in the first phase, the goal will be to scale up Project Surya to all of India, China and other regions of the world where biomass-fueled cooking is prevalent. The Surya concept has been enthusiastically received by UNEP, SIDA, EU-India joint initiative, and the World Bank. Surya has also received widespread media coverage including a front page article in the New York Times and an article in Scientific American which lists Surya among the top 10 climate experiments. The pilot phase is being funded by 150,000 USD from UNEP and 50,000 USD from private donors.

[1]University of California at Los Angeles
[2]The Energy Resources Institute, New Delhi
[3]The American Heart Association
[4]Scripps Institution of Oceanography, University of California at San Diego

SURYA PROJECT OFFICE
Center for Clouds, Chemistry and Climate (C4)
Scripps Institution of Oceanography
UC San Diego
9500 Gilman Drive, # 0221
La Jolla, California 92093-0221

Contact: V. Ramanathan
vramanathan@ucsd.edu
http://www-ramanathan.ucsd.edu/ProjectSurya.html
+1 858-534-8815