The Hearth Kills
More than the Sword

Kirk R. Smith
Professor of Global Environmental Health
University of California Berkeley

Driving Change Shaping Lives
Gender in the Developing World
Radcliffe Institute for Advanced Study, March 3-4, 2011
Toxic Tsunami threatening US women’s health

By OUR CORRESPONDENT

Evidence indicates that a wave of toxic material will soon be affecting US women. As many as half of all households to be exposed to hazards from new technology far exceeding safety standards. Thousands likely to die.

Prosecutors Seek Trial for Berlusconi

Prosecutors filed a request on Wednesday to try Prime Minister Silvio Berlusconi of Italy on criminal charges related to prostitution and abuse of office.
It will wash across the countryside exposing half of US women to a toxic soup containing

- Dozens of poisonous organic chemicals known to be mutagens, immune system suppressants, severe irritants, blood poisons, inflammation agents, central nervous system depressants, cilia toxins, endocrine disrupters, or neurotoxins.
- Several other chemicals firmly established as human carcinogens.
- Other toxic inorganic chemicals known to cause asphyxiation, stillbirth, infant death, heart disease, and severe acute and chronic lung disease.
The Toxic Tsunami

• It will be the result of a process that pours this toxic soup directly into half of all US homes every day; all year; every year.
• Only when women are present.
• It will expose the women to toxic levels much higher those of people living on top of toxic waste dumps, working in most heavy industries, or residing in the dirtiest cities
• These toxic levels will be tens or hundreds of times the levels set by international and national organizations to protect health
Why would it happen?

• Because a technology will be widely promoted that takes perfectly safe natural material and converts 10% of it to toxins in the course of functioning. Sometimes as much as 20%

• The efficiency of the process is extremely low, leading to little human benefit per unit toxin created as well as waste of the natural resource.

• Instead of carefully disposing of this toxic material in safe places, this industry will spread the toxic soup by air right into neighborhoods where people live.

• All this, in spite of there being well-known alternative technologies available producing very little toxin.
What might be the health consequences if this happens?

• Thousands of women would have their breath taken from them as their lung function is slowly eaten away by exposure to the toxins.
• Thus, at tragically young ages they will become unable to breathe normally or do common tasks.
• Alarmingly, once a woman is affected, there is no known medical therapy to reverse the process.
• More than 500 per week, 25 thousand per year, would soon start to die prematurely because their lungs would finally give out.
Anything else?

• There are strong indications that the burden on women would include many other diseases, including
  – Significant exacerbation of heart disease, the most important cause of death in women
  – Increases in cancer, including lung and perhaps cervical
  – Damage to the eyesight of tens of thousands of women every year
  – A significant increase in tuberculosis, one of the most important and intransigent of the re-emerging infectious diseases
What should the response be?

In fact, nothing will happen – no one will notice

• Full time coverage on CNN and all other news outlets as the disaster unfolds?
• A major effort coordinated by the National Guard to protect the country?
• Emergency legislation in Congress to provide funds for cleaner technologies?
• New laws and regulations to make sure it never happens again?
Environment

Toxic Tsunami threatening US women’s health
By OUR CORRESPONDENT
Evidence indicates that a wave of toxic material will soon be affecting US women. As many as half of all households to be exposed to hazards from new technology far exceeding safety standards. Thousands likely to die.

OPINION

EGYPT
Editorial: The West must press Egypt’s vice president to get serious about reform.
Friedman: The events of Tahrir Square are the wave of the future.

WHAT’S POPULAR NOW

- Brian Jacques, Writer of Redwall Series, Dies at 71
- Forgive Me, Father, for I Have Linked
- Dovd: Forgive Me, for I Have Linked
- Comments
- Bittman: Is ‘Eat Real Food’ Unthinkable?
- Op-Ed: A Friendship of Values, Not Convenience
- Room for Debate: Why Can’t Americans Save?
Everything stated about the Toxic Tsunami is true, as best we know, except for three aspects:

1. It is already happening
2. Not half of US women, but half of women in the rest of the world
3. No industry is responsible... but poverty and complacency

A sin of omission, not commission

But still killing 1.6 million women and children
Household pollution from burning simple solid fuels like wood

A sin of omission, not commission

But still killing 1.6 million women and children
Households Using Solid Cooking Fuels

For 2005, CRA-10 preliminary
Woodsmoke is natural – how can it hurt you?

Or, since wood is mainly just carbon, hydrogen, and oxygen, doesn’t it just change to $\text{CO}_2$ and $\text{H}_2\text{O}$ when it is combined with oxygen (burned)?

Reason: the combustion efficiency is far less than 100%
Toxic Pollutants in Biomass Fuel Smoke from Simple (poor) Combustion

- Small particles, CO, NO₂
- Hydrocarbons
  - 25+ saturated hydrocarbons such as *n-hexane*
  - 40+ unsaturated hydrocarbons such as *1,3 butadiene*
  - 28+ mono-aromatics such as *benzene & styrene*
  - 20+ polycyclic aromatics such as *benzo(α)pyrene*
- Oxygenated organics
  - 20+ aldehydes including *formaldehyde & acrolein*
  - 25+ alcohols and acids such as *methanol*
  - 33+ phenols such as *catechol & cresol*
  - Many quinones such as *hydroquinone*
  - Semi-quinone-type and other radicals
- Chlorinated organics such as *methylene chloride and dioxin*

Health-Damaging Air Pollutants From Typical Woodfired Cookstove in India.

- **Carbon Monoxide**: 150 mg/m³
- **Particles**: 3.3 mg/m³
- **Benzene**: 0.8 mg/m³
- **1,3-Butadiene**: 0.15 mg/m³
- **Formaldehyde**: 0.7 mg/m³

Wood: 1.0 kg Per Hour in 15 ACH 40 m³ kitchen

Typical Health-based Standards

- **Carbon Monoxide**: 10 mg/m³
- **Particles**: 0.1 mg/m³
- **Benzene**: 0.002 mg/m³
- **1,3-Butadiene**: 0.1 mg/m³
- **Formaldehyde**: 0.0003 mg/m³

Typical Indoor Concentrations

**IARC Group 1 Carcinogens** - Best single indicator
First person in human history to have her exposure measured doing the oldest task in human history

Kheda District, Gujarat, 1981

How much ill-health?
Household Air Pollution Comparative Risk Assessment, 2011
Preliminary Estimates for India

Estimated 24-h PM$_{2.5}$ for solid-fuel-using households

~400 ug/m$^3$ mean
EPA standard = 15ug/m$^3$
WHO AQG = 10 ug/3
Diseases for which we had epidemiological studies available around 2001

ALRI/Pneumonia

Chronic obstructive lung disease

Lung cancer from coal only

Three outcomes qualified with sufficient evidence to be included in the World Health Organization’s Comparative Risk Assessment of 2004
Global Burden of Disease from Top 10 Risk Factors
plus selected other risk factors

Underweight
Unsafe sex
Blood pressure
Tobacco
Alcohol
Unsafe water/sanitation
Child cluster vaccination*
Cholesterol
Lack of Malaria control*
Indoor smoke from solid fuels

Overweight
Occupational hazards (5 kinds)
Road traffic accidents*
Physical inactivity
Lead (Pb) pollution
Urban outdoor air pollution
Climate change

WHO data

Percent of All DALYs in 2000

1.6 million premature deaths/year

1.6 million premature deaths/year
Diseases for which we have epidemiological studies - 2011

ALRI/Pneumonia
(meningitis)

Low birth weight

Stillbirth

Cognitive Impairment?

Asthma?

Birth defects?

Chronic obstructive lung disease

Cancer
(lung, NP, cervical, aero-digestive)

Blindness
(cataracts, opacity)

Tuberculosis?

Heart disease*
Blood pressure
ST-segment
*Interpolated

Burns, health and safety impacts of fuel gathering?
Meta-analysis for Studies of Household Air Pollution and COPD in Women

- Random effects model was used to account for significant heterogeneity between studies  \( X^2=150.329, \ df=29 \ (p=0.000) \)
- Overall effect measure for all studies, OR=2.140 (1.777, 2.577)
Risk of COPD: Vented vs. unvented coal stoves

Xuan Wei County, China, retrospective cohort, 1976-1992, 20,453 subjects, 81% added chimneys

Cataracts

• Major burden of disease in developing countries
• In South Asia, 2.8% of total DALYs in 2005
• Half that of ischaemic heart disease
• Roughly same as TB or stroke
• Greater than COPD or maternal conditions
• Women suffer 40% more than men
HAP and cataract: biological plausibility

- Cataracts have several known risk factors: UV, diabetes, tobacco smoke
- Napthalene, a prevalent product of incomplete biomass combustion, is a reactive oxidative species (ROS) causing oxidative stress & damage to the eye
- Cataract outcomes have been shown in rabbits and cows with prolonged exposure or under high doses
- Recent study in Nepal shows exposure-response with biomass smoke exposure and lens opacity, a preclinical indicator of cataracts.
### Summary of 7 (of 9 total) studies

**Studies adjusted for smoking (random effects)**

<table>
<thead>
<tr>
<th>Study (year)</th>
<th>ES (95% CI)</th>
<th>Weight</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saha (2005)</td>
<td>2.41 (0.906, .42)</td>
<td>10.23</td>
<td></td>
</tr>
<tr>
<td>Pokhrel (2004)</td>
<td>1.90 (0.99, 3.62)</td>
<td>14.93</td>
<td></td>
</tr>
<tr>
<td>Sreenivas (a) (1999)</td>
<td>0.37 (0.02, 6.69)</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Sreenivas (b) (1999)</td>
<td>1.82 (1.14, 2.92)</td>
<td>17.91</td>
<td></td>
</tr>
<tr>
<td>Ughade (1998)</td>
<td>4.14 (2.69, 6.37)</td>
<td>18.58</td>
<td></td>
</tr>
<tr>
<td>Badrinath (1996)</td>
<td>4.90 (2.83, 8.49)</td>
<td>16.57</td>
<td></td>
</tr>
<tr>
<td>Mohan (1989)</td>
<td>1.62 (1.14, 2.30)</td>
<td>19.86</td>
<td></td>
</tr>
<tr>
<td><strong>Overall (I-squared = 71.3%, p = 0.002)</strong></td>
<td><strong>2.45 (1.61, 3.73)</strong></td>
<td><strong>100.00</strong></td>
<td></td>
</tr>
</tbody>
</table>

*NOTE: Weights are from random effects analysis*
Pathways Relating Household Smoke Exposures and Low Birth Weight

Indoor Cooking Smoke

- Particulate Matter
- Carbon Monoxide
- Reduced O2 Content of Maternal Blood
  \(\rightarrow\) Reduced O2 Delivery to Placenta
  \(\rightarrow\) Maternal Lung Disease
  \(\rightarrow\) Impaired Fetal Growth
  \(\rightarrow\) Reduced O2 Transport Across Placental and Fetal Uptake
  \(\rightarrow\) Preterm Delivery
  \(\rightarrow\) Low Birth Weight

- Reduced O2 Delivery to Placenta
  \(\rightarrow\) Reduced Nutrient Intake
  \(\rightarrow\) Maternal Lung Disease
  \(\rightarrow\) Impaired Fetal Growth
  \(\rightarrow\) Reduced O2 Transport Across Placental and Fetal Uptake
  \(\rightarrow\) Preterm Delivery
  \(\rightarrow\) Low Birth Weight

Child and Adult Ill-health
Pooled birth weight difference (low minus high exposure): Adjusted estimates

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Lower Exposure</th>
<th>Higher Exposure</th>
<th>Mean Difference</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Total</td>
<td>Mean</td>
</tr>
<tr>
<td>Boy 2002</td>
<td>2,835</td>
<td>533</td>
<td>357</td>
<td>2,772</td>
</tr>
<tr>
<td>Mishra 2004</td>
<td>3,271</td>
<td>1,448</td>
<td>766</td>
<td>3,096</td>
</tr>
<tr>
<td>Siddiqui 2008</td>
<td>2,812</td>
<td>404</td>
<td>80</td>
<td>2,730</td>
</tr>
<tr>
<td>Thompson 2005</td>
<td>2,805</td>
<td>579</td>
<td>366</td>
<td>2,723</td>
</tr>
<tr>
<td>Tielsch 2009</td>
<td>2,819</td>
<td>453</td>
<td>646</td>
<td>2,715</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>2215</td>
<td></td>
<td></td>
<td>11740</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2 = 2.85$, df = 4 ($P = 0.58$); $I^2 = 0$

Test for overall effect: $Z = 6.74$ ($P < 0.00001$)

All estimates: +96.6g (68.5, 124.7)

Excluding self-reports +93.1g (64.6, 121.6)
Global Burden of Disease Database
and Comparative Risk Assessment

Being completely updated
For 2011 release

For household air pollution:
New exposure assessment modeling
New outcome estimates based on meta-analyses
ALRI, COPD, Lung Cancer
Low birth weight, cataracts, cardiovascular
Perfect Storm for Health Impacts

- Highly polluting activity
- Half of world households
- Several times a day
- Just when people are present
- Most vulnerable (women and young children) most likely to be there
In other words, the Intake Fraction is extremely large

IF is the fraction of material emitted that is actually breathed in by someone
Food for a Week, Germany

© 2005 PETER MENZEL PHOTOGRAPHY
Food for a Week, Darfur Refugees, Chad
Joan’s Question

• Men have been standing around the kitchen watching women cook since the control of fire – a million years ago.

• But my husband is the first one to make career out of it.

• Why is that?

• A number of reasons, but among them is that these are the people at the bottom of the pyramid in economic and political power: poor, rural, and female.
Who are we?

ENERGIA's goal is to contribute to the empowerment of women - both rural and urban - through a specific focus on energy.

ENERGIA is the international network on gender and sustainable energy, founded in 1995. We work in Africa and Asia through and with our regional and national gender and energy networks. We work from the contention that projects, programmes and policies that explicitly address gender and energy issues will result in better outcomes, in terms of the sustainability of energy services as well as the human development opportunities available to women and men.

Read more

News

Factsheet Gender, Energy Technology and Climate Change

Friday, 26 November 2010

This factsheet, jointly produced by the Women’s Environment and Development Organization (WEDO) and ENERGIA - the International Network on Gender and Sustainable Energy, highlights
Question for the Conference

• Cooking is probably the most prevalent gender-specific but non-biologically determined task today and perhaps in human history
• Do solutions such as improved stoves, therefore, need to be gender sensitive?
• **Affirmative:** The hearth is central to women’s social and cultural identities and any change must consider them to work
• **Negative:** A better stove need be no more gender-specific than a refrigerator, light bulb, bicycle, or cell phone – just a matter of good design and marketing.
Many thanks

Publications and presentations available at my website:  http://ehs.sph.berkeley.edu/krsmith/
Or just Google “Kirk R. Smith”