

Indoor Air Quality Impact on Improved Wood Stove in Ghana



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EWVITA Objective and IAP Study Overview

- *Promoting Clean Energy for Households & Institutional Cooking in Ghana*
- *Aims at improving the health and productivity of Ghanaians by reducing IAP - smoke and particulate levels, in urban and rural households.*
- *IAP Study Method*
- *IAP Findings*





Technology



Charcoal Stove



Ceramic Liner

Metal Casing



Wood Stove



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Promotion of Improved Biomass Cookstoves in Ghana-EWV Approach

- Created 523 sustainable household energy enterprises actively distributing over 68000 units/yr of improved cookstoves for Improved Natural Resource Management in Ghana
- Enhanced private-public partnership in Natural Resource Management.
- Mitigating environmental threat in Ghana by reducing CO2 emissions by around 47,000 tons/yr
- Reducing IAP levels and associated health issues in urban and rural households through the creation of sustainable supply chain for improved biomass cookstoves and awareness of the dangers of IAP
- Household Poverty Reduction through energy cost saving.



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EWV Stoves Partners

Funding:

1. USAID- April
2. The Shell Foundation
3. EPA, USA
4. JPMorgan/ClimateCare
5. Vangaurds

Other Collaborators

- Center for Entrepreneurship in International Health and Development (CEHID), University of California, Berkeley
- Aprovecho Research Center – Oregon
- Columbia University, NYC
- Industrial Research Institute, CSIR-Ghana
- Ministry of Energy – Ghana
- Energy Commission-Ghana
- EPA Ghana
- EPA USA



Strategies and Approaches

GUIDING PRINCIPLES

- Stove must be affordable and an improvement over existing types/designs
- Profitable value chain
- Profitable with a short pay back period for the end user
- Locally available and not dependent on special imported parts or materials

BUSINESS DEVELOPMENT ASSISTANCE

- Product Development Services
- Production Training Services
- Quality Management Services
- Management Advice Services
- Market Access Services

Marketing & Promotion

Branding

- Name “GYAPA” for *Good Fire*
- Catch phrase “Aben da da” for “*already cooked*”



Promotion

- Static & dynamic ads
- Stickers, posters & flyers
- User manuals
- Product demos
- IAP Publicity



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Added-Value Proposition

- 60% wood fuel savings
- 40% charcoal fuel savings
- Better cooking
- User friendly
- Reduced emissions
- Better health
- Preserved environment

Social Marketing with the general public

+

Commercial Marketing with entrepreneurs

=

Sustainable transfer of technology





Monitoring

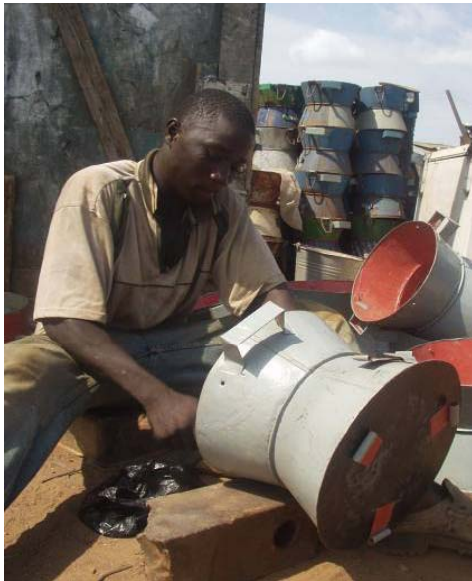
What we monitor and why?

- Product Quality
- IAP Levels (Improve health, livelihood, and quality of life through reduced exposure to air pollution, primarily among women and children, from household energy use)
- Energy Savings through baseline studies and kitchen performance test
- Market performance-effects of promotion sales at production and distribution points
- Utilization levels using contact details to trace sampled buyers
- User satisfaction levels through user surveys

Win-Win

Profitable for producer and consumer

- Return on investment exceeds 100% within one year
- The producer must make a reasonable profit to ensure continued production



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IAP Local Capacity Development

- Capacity building of local agencies in IAP assessment, with technical assistance from Center for Entrepreneurship in International Health and Development CEIHD- University of California, Berkeley

Impact

- 18 experts in sustainable biomass energy for cooking and environmental issues trained.
- Experts drawn from the Gh EPA, CSIR-IIR, Ministry of Energy , REES, KNUST, MoH, and MoFA-WIAD.





Study Methodology

IAP Household Sampling

- Primary objective of study was to measure changes in IAP after adoption of the new Gyapa Rocket Wood Stove
- Kitchen concentrations of PM2.5 and CO (the two pollutants responsible for the bulk of the ill-health with indoor smoke) were monitored
- Screening of households to ensure their suitability for the IAP study
- Baseline measurements were made in 36 households in and around Accra
- 34 of the households used a traditional clay wood stove while the other 2 used three-stone stoves for cooking



Study Methodology

IAP Data Sampling

- The sampling period 24-hour (a 24-hour sample is considered a representative indoor air sampling time due to the typical daily cycle of cooking and household activity pattern).
- PM was measured in each of the households using a UCB-PM monitor equipped with a photoelectric detector(UCP-PM measured and logged PM2.5 concentration every minute of the sample period)
- CO was measured and concentrations logged every minute using HOBO CO logger (Model #11-001, Onset Computer Co...USA)
- Monitors were placed on the walls of the kitchens according to best practices criteria.
- IAP data was collected during “before” and “after” monitoring phases





EWVITA IAP Study Results

- Average kitchen concentration of PM2.5 showed significant 52% reduction after introducing the improved stoves
- Similarly, average 24-hour kitchen CO concentrations measured decreased significantly by 40% after the introduction of the improved Gyapa rocket wood stove
- A post monitoring survey showed that households spending on fuel wood for cooking decreased from GHC 0.25 to GHC 0.17 local currency representing 32% reduction



EWVITA IAP Study Results

Average PM2.5 and CO kitchen concentrations in Ghana for households using traditional clay wood stoves or open fires compared with concentrations after adoption of the Gyapa wood stove.

	T-clay wood stove or open fire	Gyapa wood stove	Percent reduction	t-Test (p-value)
PM2.5: 24-hour average (µg/m³)	650 (490)	320 (240)	52%	0.00
PM2.5: maximum (µg/m³)	42 000 (20 500)	31 300 (18 400)	26%	0.02
PM2.5: highest 15-minute average (µg/m³)	12 500 (9 750)	7 220 (4 790)	42%	0.01
CO: 24-hour Average, HOBO (ppm)	12.3 (9.9)	7.4 (6.1)	40%	0.01
CO: maximum, HOBO (ppm)	124.8 (84.6)	120.7 (125.1)	3.3%	0.86
CO: average, tubes (ppm)	6.8 (5.6)	5.0 (5.0)	27%	0.18

Standard deviations are shown in parentheses.

Particulate Matter Standards

PM Standards			
	Time Period	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	PM _{2.5} ($\mu\text{g}/\text{m}^3$)
United States EPA ^a	Daily	150	65
United States EPA ^a	Annual	50	15
California	Daily	50	Under discussion in 2002
California	Annual	20	12 (Proposed in 2002)
European Union ^b	Daily	50	Not set
European Union ^b	Annual	20	Not set

^a Under revision.

^b To be met in 2010 (to be reviewed in 2003).



Acute (Toxic) Effects of CO

Dose = Ambient Concentration x Length of Exposure

200 ppm for 2-3 hours	Mild headache, fatigue, nausea, dizziness
400 ppm for 1-2 hours	Serious headaches, symptoms intensify
800 ppm for 45 minutes	Nausea, dizziness, convulsions, unconscious within 2 hours
1600 ppm for 20 minutes	Death within one hour
3200 ppm for 5-10 minutes	Death within one hour



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Benefits to Households

Future Plans/Goals

- Market expansion through a Distributor model
- Projected annual sales of 100,000 stoves

Request

- Funding support to expand the project to other parts of Ghana and the West Africa sub region
- Technical assistance

Offers

- Experience sharing
- Institutional collaborations



Thank You



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