

Envirofit Cookstoves for Liberia (ECL)

SUSTAINABLE VISION

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INTRODUCTION

ASU Sustainability Team SJedi seeks a NCIIA Sustainable Visions Grant in order to introduce Envirofit Intl's clean cookstoves into Liberia and sub-Saharan Africa. SJedi seeks to mimic the success of Envirofit's G3300 series cookstoves that were recently introduced in India and where "over the next five years these 60K cookstoves will keep over 400,000 tons of CO₂ and over 85,000 kg of black carbon from entering the atmosphere, while garnering savings of over 900 million rupees (\$18M USD) for some of India's lowest-income consumers."

The NCIIA Sustainable Vision Grant will allow SJedi to introduce new technology into rural communities **(1) decreasing indoor air quality dangers and improving health, (2) decreasing deforestation by requiring women to collect less wood for cooking and heating, (3) decreasing the invisible costs women and children face in cooking and preparation labor, and (4) reducing rural poverty by participating in Envirofit's carbon emission reduction revenue sharing scheme.**

The Technology

The G-3300 Single Cookstove Design was developed using advanced Computational Fluid Dynamics, heat transfer modeling, and robust emissions and durability testing to optimize the geometry and materials of the stove. The result is a patent-pending design that makes the stoves clean burning, efficient, light-weight, and affordable; while also strong and durable.



Envirofit partner Colorado State University's Engines & Energy Conversion Lab (EECL) provides Envirofit with state of the art R & D, engineering and rigorous emissions & durability testing. The EECL's test facility represents the most advanced cookstove emissions testing laboratory in the world, using Fourier Transform Infrared Spectrometry, emissions analyzers and gravimetric particulate measurements to analyze particulate measurements and gas emissions, including CO, CO₂, NO_x, and excess O₂. All testing is done per United States Environmental Protection Agency (US EPA) approved Title 40 emissions measurement methods. Accelerated durability testing at the EECL has validated a 5-year life (minimum) for the G-3300 combustion chamber.

Envirofit cookstoves are engineered not only to be high-quality, but also affordable for emerging market consumers, costing the equivalent of one to three weeks wages. However, based on fuel savings alone, the stoves pay for themselves in less than six months. In addition by partnering with reputable microfinance groups, Envirofit has enabled some of the lowest-income customers in the world the opportunity to purchase stoves and improve their lives.

Two innovations allow SJedi to bring these cookstoves to Liberia. The first is the fact that Envirofit offers a five-year warranty on the G-series cookstoves—the longest-duration warranty ever offered on cookstoves sold to emerging market customers. The warranty provides the risk mitigation or insurance against failure that allows rural customers to know that their investment is long term and worthwhile.

The second innovation is that the manufacture, delivery (to country distributor), and warranty of the cookstove is subsidized by a Shell Foundation Grant which allows Envirofit to partner with local entities to distribute the cookstove throughout Africa at an affordable rate. This subsidy allows Envirofit to sell the cookstove to SJedi for \$5 USD, provide the 5-year warranty, and provide partner communities a carbon emission reduction (CER) revenue sharing scheme.

Indoor Air Quality

Cooking fires across Africa are projected to release about seven billion tons of carbon in the form of greenhouse gases to the environment by 2050, and about six percent of the total expected greenhouse gases come from Africa. More than 1.6 million people, primarily women and children, die prematurely each year from respiratory diseases caused by the pollution from such fires. Scientists estimate that smoke from wood fires used for cooking will cause 10 million premature deaths among women and children by 2030 in Africa.

According to World Health Organization, nearly half the world's populations – nearly 3 billion people – cook their daily meals indoors using traditional fire and stoves, burning biomass fuels like wood and crop waste. These traditional cooking methods are inefficient, waste fuel and are deadly, converting the burning biomass into toxic substances. The resulting Indoor Air Pollution (IAP) kills 1.6 million people every year, more than 85 percent of which are women and children under five. In addition, recent research has revealed that the soot from developing world cooking fires is second only to CO₂ in affecting global warming. As such, government agencies and global leaders have been promoting improved cookstoves as a potential stop-gap solution to slow global warming effects.

Deforestation

SJedi's strategy is to focus on the tropical rainforests of the Upper Guinea Biodiversity region of western sub-Saharan Africa. This region extends from Guinea to Togo and is one of 35 such critical areas for global biodiversity conservation (Mittermeier, 1999). Forests in this region have been reduced to an estimated 14.3% of their original extent with Liberia maintaining 43% -- approximately 4.52 million hectares -- of what remains in two large blocks of forest including evergreen lowland forests in the southeast and the semi-deciduous mountain forests in the northwest. Despite its exceptional importance for biodiversity conservation, only 4% of Liberia's forests are contained in two protected areas: Sapo National Park (180,000 ha) and the Nimba Nature Reserve (13,500 ha). Therefore, Liberia is the "heart of the hotspot" – critical to successful conservation in the region, and in need of immediate conservation action.

Envirofit stoves are clean-burning and incredibly efficient, reducing cooking time by at least half and reducing smoke and toxic emissions by up to 80 percent. It also decreases the time it takes to boil and purify water while also using up to 60 percent less fuel than traditional stoves. These benefits significantly improve the lives of customers in the developing world, while having a net positive impact on the global environment.

Gender Equity

Liberian cuisine works nicely with solar cookers and Integrated Cook Stoves (ICS) since it is mostly slow cook style meals, with very little deep fried food dishes which require a high heat. Thus, an integrated cooking system where food is slowly cooked in a solar cooker or integrated cook stove (ICS), then kept warm in a hay basket, works nicely with the Liberian cooking system. Clean water is also an issue and an efficient cookstove will allow families to quickly and efficiently purify their water.

In Monrovia, families cook three times daily, breakfast, lunch and dinner. In the rural areas, meals are usually cooked twice daily, breakfast and dinner, since the men usually find their own food near their worksite or on the farm. Rural families cook three times during the rainy season since there is less farm work during this period.

In the dry season, women spend about 1hr 30mins on milling, grinding, de-hulling (rice, palm oil, palm butter, etc), 5hrs on domestic activities (getting water, wood, meals preparation), 8hrs on agricultural work on household collective and private fields or home garden (difficult to differentiate between the two in the villages), 1hr Training in reading and writing (night school in Duayee for instance), 30mins Livestock care or animal husbandry, 2hrs rest and leisure, 1hr petty trade (C. Dormah 2009). Therefore, women and often their female children helpers face a tremendous invisible cost spent collecting wood and preparing meals. An ICS could help alleviate some of these invisible costs.

Rural Poverty Alleviation

SJedi's ECL addresses rural poverty alleviation by relieving some of the gender inequity that exist by decreasing some invisible costs associated with time spent collecting wood, cooking, and improving IAQ. The program also empowers women by granting them a micro-loan to afford the cookstove and requested accessories. The cookstove's efficiency provides more time for women to spend in trade and once their additional loan is paid off, they can apply for additional loans for their local business interests, increasing family income and gaining household prestige.

Women in rural Liberia cook, do the household chores, nurture the children, tend the family garden, and also participate in family and communal agriculture. One of the benefits of the cookstove program is that it qualifies the participants to qualify for Envirofit's carbon emission reduction revenue scheme which promises additional revenue to rural families for participation in the program.

As a case study, one Liberian village, Duayee has approximately 4,000 pop. and 260 homes. Around 10-15 people sleep in the home each night. Each home collects about 150-200 lbs of dry wood each day or every other day for cooking, cleaning, and heating (stack lasts for about 2 days).

Normally each household cooks 2 times per day, breakfast & dinner (depending on rainy or dry season). Some cook lunch for their school kids so 3 times daily. Patrick Horka, from South Pole Carbon estimates the carbon emissions for this one village based on cooking alone like this:

The emission reduction would be the difference between the CO₂ potential of the wood currently collected during one year (based on C-content in the wood) and the “production” emission of plant oil. Such projects need quite extensive monitoring and are only worth on large scale. Roughly calculated I assume around 3’000 tCO₂/yr (50% C-content in the wood, 40% Project emissions and leakage).

According to Aprovecho Research Center near Eugene, Oregon, “different methods agree that stoves [Integrated Cook Stoves—ICS] saves about 40% of fuelwood without the pot skirt. If the skirt is used, this figure increases to about 50%. The stove also reduces particulate emissions by 50 to 70%, and carbon monoxide emissions by 50 to 60%.

The absolute saving of wood depends on how frequently the stove is used, and for what purposes. For example, in the Aprovecho’s Indian study, families without improved stoves used an estimated 1.8 tonnes/year fuelwood to cook two meals per day using a three-stone fire. The stove saved 40% of wood use, approximately 0.73 tonnes per year per family. Converting fuelwood savings into greenhouse gas savings depends significantly on the sustainability of the wood source, and also on which emissions are included in the calculation. ARC studies suggest that, if CO₂ and all the other Kyoto greenhouse gases are included, then the savings are between 1 and 2 tonnes/year CO₂ (equivalent) per stove.”

Envirofit will subsidize the carbon development costs required to register the program and the necessary documentation. In exchange, SJedi and community managers will track, verify, and quantify carbon emission reductions in their communities as a result of the cookstove program. SJedi’s assumption is that once carbon is monetized, Envirofit would be paid back first for the costs, delivery subsidy, and carbon developer management costs, after which, carbon offset revenues would be split 50%-50%.

HISTORY AND CONTEXT

The Environmental Cookstoves for Liberia project (ECL) is part of a broader community initiative called the Sustainable Village Initiative (SVI). The SVI is a community-based participatory rural appraisal program that engages rural communities in land-use planning, resource mapping, and ecosystem conservation and management that was developed by SJedi with partners in Liberia over the past 18 months. Currently, SJedi and partners Tufeia are working with communities within the Gbehyi Chiefdom and Tappita.

The Gbehyi Chiefdom consists of a total of 13 towns and villages. Gbehyi is governed by a Paramount Chief who is democratically elected by the people and represents the entire chiefdom. According to a 2007 survey completed by the Adventist Development and Relief Agency International (ADRA), there were 2,317 people living in 248 houses in the primary village of Duayee, while the estimated population of the entire thirteen villages, which comprise the Gbehyi Chiefdom, was approximately 13,000. The Gbehyi Chiefdom was chosen as an implementation site due to the prevalence of poverty, disease, malnutrition and lack of basic services necessary for survival and sustainability.

The Tappita Community has the larger town of Tappita with nine satellite villages and a total population of approx 15,000. SJedi and Tufeia have been working with these two communities for approximately 18 months, conducting community mapping using GPS and remote sensing, designing land-use planning maps and spatially locating future areas for fish

farming, bamboo and jatropha plantations, and selecting community members to be future managers and health aides.

In May 2008, SJedi conducted community workshops using solar cookers and a simple rocket-stove provided by Solar Cookers International and the program was very popular. Unfortunately, there was no continued funding to provide micro-loans for families to purchase the solar cookers or rocket-stoves.

THE TEAM

SJedi's current clean cookstove development & strategy team consists of School of Sustainability MA grad student Peter Gbelia, Professor Mark Henderson of Global Resolve, Rev. Caleb Dormah, Executive Director of the Tufeia Foundation and youth activity coordinator for the northern region of Ganta, and Betty Broh, Tufeia's Community Organizer for Women's Associations. We share a passion for the health and wellbeing of developing populations and are excited about the positive health, environmental, and economic possibilities these cookstoves will bring to the region. Together we have the institutional capacity to implement an innovative business model.

Principle Investigator & SJedi Advisor- Mark Henderson is Professor of Engineering at Arizona State University Polytechnic Campus. He co-founded GlobalResolve (<http://globalresolve.asu.edu>), an ASU multi-disciplinary, multi-country design experience that is currently working in villages in Liberia and Ghana and whose goal is the development of sustainable village-owned ventures for economic development. GlobalResolve partners with in-country universities, NGOs and villages to develop solutions to existing problems in water, energy and health. Current projects include smokeless fuel and stoves, water purification and electric lighting and refrigeration from charcoal or other fuels.

CO-Principle Investigator & Pres. SJedi: Peter Gbelia is a graduate student in the School of Sustainability's (SOS) MA program and a proud graduate of the US Air Force Academy, class of 1993. Currently, he is a C-17 Pilot with the 313th AS, AFRC, and also flies commercially as a 737 First Officer (FO) for Alaska Airlines. Peter is a LEED Accredited (Leadership in Energy and Environmental Design), and also HERS Certified (Home Energy Rater System). In addition to his accreditations, he founded the Empowerment Society International (ESI) with the goal of introducing Sustainable Development to the war torn regions of Africa. It is his true belief and goal that sustainability is essential to the growth and survival of these devastated regions.

Local Implementer: Reverend Caleb Dormah received a MS in Math from the University of Liberia in 1985. Reverend Dormah also attended the Liberia Baptist Theological Seminary and holds a bachelor's degree in Religious Education. He has worked with children and youth for the past 21 years. In 2003, the United Methodist Church at the Liberia Annual Conference asked Rev. Dormah to expand his ministry to include displaced members of the community in Ganta Nimba County. Community building is now the focus of his work.

Local Implementer: Betty Broh. Betty is Tufeia's lead community organizer for women's associations and working committees. She is also the project coordinator for Monrovia NGO

NAWOCOL (National Association Women's Council Liberia). Previous experience includes Chairwoman of the New Tappita Women (2006-pres); Social Worker (2007-2009); Registrar Tappita Hospital (2003-2006); chairperson for Saclepea Displaced Women (1997-2003); Co-Chairperson Benwah Refugee Women (1994-1997); Graduated HS 1988.

PROPOSED BUSINESS MODEL

Envirofit is proving its expertise in engineering high-volume centralized manufacturing, global supply chain management, market research and sales channel networks in developing world markets. SJedi will leverage their proven business model and modify it for Liberia.

SJedi & Tufeia will establish an office in Monrovia to coordinate the sale and distribution of the products and serve as the processing center for any warranty claims, repairs, and replacements. Tufeia will purchase a small truck to service our partner communities. In the future, the railroad from the Iron Ore mines in Nimba County, to the port city of Buchanan will be repaired to provide a quick and inexpensive means of shipping to the interior and other countries such as Guinea, Ivory Coast, Burkina Faso, Niger, Mali, etc. once expansion of the program occurs.

SJedi's strategy is to take full advantage of a partnership with Envirofit and its funders by allowing Envirofit to subsidize the cost of the stove and delivery costs in order to receive the product at the very lowest price, i.e. \$5 USD. Envirofit will also subsidize the carbon development costs required to register the program and the necessary documentation. In exchange, SJedi will track, verify, and quantify carbon emission reduction in country as a result of the cookstove program.

SJedi plans that once carbon is monetized, Envirofit would be paid back first for the costs, delivery subsidy, and carbon developer management costs, after which, carbon offset revenues would be split 50%-50%. In the rural areas, the stove will sell for \$10, with the goal of signing up entire communities at once and providing micro-financing.

In rural areas, individual family units, tribes, clans, and villages primarily engage in agriculture and trade of commodity goods. With proper financing terms, they will be able to pay off the micro-loan in short order, and studies have shown that repayment of micro-loans occurs at rates higher than 85%.

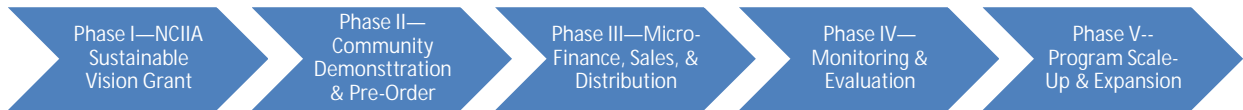
In our two pilot communities, Gbehyi and Tappita, there are approximately 2,800 households that will be our market. With micro-financing, we estimate that we will initially get 2000, pre-orders. SJedi will also assume that every rural household will need micro-financing to purchase the cookstove at the price of \$10 USD, thus SJedi will require \$10,000 for the micro-loans, and \$10,000 to purchase the cookstoves from Envirofit at the subsidized rate. SJedi will assume an 85% loan payback and a 6 month payback timetable. Other start-up costs include office rental and equipment in Monrovia, a truck to transport and service the products as well as engage in community outreach, a small computer and GPS to engage in community mapping, and an annual internet fee to facilitate communication and supply and delivery sequencing. Profit from cookstove sales will go back into the SJedi Trust to provide additional micro-loans for cookstoves & accessories.

WORKPLAN & OUTCOMES

The ECL will have an immediate and significant impact. SJedi & Tufeia will hold workshops organized by community women’s associations to demonstrate the cookstove’s benefits as well as informational sessions on the dangers of poor indoor air quality. Our team will engage the entire community with resource mapping exercises, assigning K-12 classrooms the task of leading the map making exercises and identifying locations of cookstove owners, providing educational experience and aiding in tracking cookstove households. This data will later be transferred to GIS generated maps and database with the help of the University of Liberia Geography faculty and student participants.

NCIIA SVG funding will be used to establish the Monrovia office and create the supply chain with Envirofit. Tufeia staff will engage community women’s association to demonstrate the cookstove’s capabilities and establish pre-orders. Families that cannot afford the stove outright will apply for a micro-loan covered by the NCIIA grant. Once enough families have pre-ordered the products, Envirofit will ship to Liberia and Tufeia will deliver to the communities. SJedi and Tufeia will establish community carbon emission baselines through participatory rural assessment methodology. Tufeia and staff will establish community members from the women’s association to evaluate & monitor the program and continually surveying the women on their satisfaction with the product and to determine if the objectives of the program are being met.

Once the micro-loan is paid, those funds become available to provide loans to additional communities as well as applications for community based micro-business. Tufeia continually expands its community outreach and hosts a one hour radio show from the Ylamba Communication Network, a radio station in Saclepea (accessible to our project communities), where they talk about sustainability issues and environmental education and can market the benefits of the cookstove as well as IAP training in order to open up new community markets.



Woek Plan (SJedi & Tufeia) + Community	Q1’10	Q2’10	Q3’10	Q4’10	Q1’11	Q2’11	Yr. 2+
Phase I—NCIIA Sustainable Visions Grant	→						
Phase II—Community Demonstration & Pre-Order	→						
Phase III—Micro-Finance, Sales & Distribution		→					
Phase IV—Monitoring & Evaluation			→				
Phase IV—Scale-Up & Expansion*					→		
*If Pilot Proven, Scaling Plan (Multiple concurrent sites possible)							

EVALUATION AND SUSTAINABILITY PLAN

The rural communities in Liberia are endowed with an abundance of natural resources and a great many opportunities for entrepreneurship when coupled with micro-finance initiatives.

SJedi’s ECL will evaluate its success based on our stated objectives. If proven, this pilot project will be scaled-up and expanded to more local communities and regionally into adjacent countries.

This project will have immediate and positive impact. 10-15 people per household will be served by the product. Our initial target is 2,000 households benefitting 20,000-30,000 men, women, children, and babies living in poverty. It’s anticipated that 2-3 hours of wood collection per household will be saved. 1-2 hours of cook time will be saved. The women, little girls, and babies often attached by a cloth to the cooker’s back, will immediately benefit from the absence of cooking smoke. These families of 10-15 will immediately benefit from time savings providing the opportunity to engage in other revenue generating activities. The forests will immediately see less wood-harvesting pressures and these communities will benefit, after application approval, from the reduction in their emissions in the form of CER revenue.

<u>Project Goal</u>	<u>Definition of Success</u>	<u>Success Metrics</u>	<u>Assessment Methods</u>
PRA ⁴	Max Community Participation. Productive workshops/demo, Identify microloan candidates. Right price & interest on loans	Community buy in and product approval; Microloan payback times	Resource & wealth mapping by K-12 students. GIS database. Microloan payment collection by community mgr.
Decrease indoor air quality dangers and improve health	Envirofit Cookstoves in selected homes. Less IAQ illness reported	Stoves delivered and women like the product and are using product	SJedi & Tufeia interview survey, text data to UoL/LISGIS ⁵ partners to log in GIS database
Decrease deforestation	Less wood required for cooking, heating, water purification, etc	Less wood collected. Decreased cooking & heating times	Community women mgt. associations’ measure before & after. Text data to UoL database
Decrease invisible costs preparation labor	Women feel empowered, have more time for other activities, recognition	Time spent cooking, cooking-prep, wood collection is less	SJedi & Tufeia interview survey, observation. Data added to database for analysis
Reduce rural poverty by participating in Envirofit’s carbon emission reduction revenue sharing scheme.	Project is successfully registered for future CER revenue and show carbon savings, qualifying community for CER credits	Revenue Generated go toward community institutional capacity: education, health services, infrastructure	Baselines created at beginning of project. Community women mgt assoc. monitor data & text to UoL/LISGIS database showing reductions for analysis

Additionally, this pilot program focuses on rural communities in Africa that use biomass as their primary form of cooking fuel. However, Envirofit Intl will offer a charcoal based product in early Q1’10. When that occurs, SJedi and Tufeia will have the infrastructure and micro-financing arm in place to offer cookstove products to the urban centers and reach an exponentially greater urban population, further decreasing the pressure on the environment to provide the fuel for cooking and heating.

⁴ PRA: Participatory Rural Appraisal

⁵ University of Liberia (UoL) & the Liberia Institute of Statistics and Geo-Information Services (LISGIS). Remote sensing lab will be established at the UoL to help facilitate the research. UoL Geography Dept. students & faculty will collaborate with the expertise provided by LISGIS professionals.