

SeaChar Estufa Finca Project

Project Summary

Now in its second year, a group of volunteers from SeaChar (Seattle Biochar Working Group) have completed a pilot project working with organic coffee growers in the Santos region of Costa Rica to provide micro-gasifier cookstoves to migrant coffee pickers to reduce exposure of women and children to smoke from open cooking fires and to produce biochar. Organic coffee farmers are already familiar with biochar, having used it in their compost formulations for the past 10 years. The project has a large number of partners including the National University of Costa Rica (UNA) and APORTES, a women's cooperative that is manufacturing the stoves. A follow up visit in January 2011 showed that user acceptance of the stoves is high. Savings in fuel and cooking time were validated. The next phase of the project will work with a growers cooperative (APPTA) further south in the Talamanca region of Costa Rica to bring stoves to an indigenous population. Each stove can produce about 10 to 30kg of biochar a month. While this amount of biochar is not enough to supply the farms, it is useful and effective in vegetable gardens and seedling nurseries. SeaChar and its partners see this project as opening the door to further efforts throughout Central America that will develop biomass gasifier energy technologies at many scales that can help mitigate and adapt to climate change and energy shortages by providing heat for cooking and crop drying while expanding the supply of biochar for use in vegetable horticulture, commodity crops such as coffee, cacao and banana, forestry and other agriculture.



Photos: Old cookstove with blocked chimney fills the house with smoke. A house before and after installation of Estufa Finca

Project History and Need

The Estufa Finca (Farm Stove) project began in 2009 when Arturo Segura, owner of the Sol Colibrí coffee farm, on a marketing mission to Seattle, encountered SeaChar founder Art Donnelly promoting biochar and his biochar producing gasifier cookstove technology at an organic harvest fair. In this convergence of people and ideas, Art saw possibilities for implementation of his simple and elegant technology and Arturo saw a solution to a problem: Every year, in the Santos region of Costa Rica, approximately 10,000 migrant workers and their families come from Nicaragua and Panama to pick coffee. They live in tin-roof shacks, generally without electricity or running water, cooking over open wood fires—a notorious source of upper respiratory health problems and driver of habitat destruction

from overharvesting wood. Arturo is a member of La Alianza – an organic coffee growers cooperative, and he invited Art to bring his stoves to Costa Rica to help improve living conditions for the families that he and other members of the cooperative employ during the coffee picking season.

Arturo is concerned for the health of his workers, but he is also worried about the impact of climate change on his coffee farm. He and other coffee farmers have noticed chaotic and unpredictable changes in temperature (wider fluctuations in heat and cold) and precipitation (droughts that have required coffee farmers to install irrigation, floods that bring landslides destroying farm terraces and equipment). Erratic precipitation has had a huge impact on coffee production, altering the usual flowering and ripening schedules and interfering with the practice of terrace drying coffee beans in the sun. Many growers must now use drying sheds fueled by vast quantities of unsustainable wood or gallons of expensive diesel. Arturo realized that it is possible to take the basic wood gasification technology of the Estufa Finca stove and scale it up to a size that would provide heat for crop drying.



Pictures: With climate change bringing unpredictable rains, solar drying on terraces is no longer reliable. Heavy rains generate massive landslides. Arturo Segura lost an \$11,000 coffee processing facility to landslides last year.

Also, Arturo and other farmers are eager to obtain more biochar for their farms. Used for thousands of years in the Americas as a soil amendment, over the past several decades charcoal has once again become popular in Central America. It was introduced to organic farmers by Japanese agronomists as a component in the fermented fertilizer known as bokashi compost. Italian perma-culture instructors promoted bokashi in Costa Rica as an effective alternative to chemical pesticides. But the problem, Arturo pointed out, was that the farmers were forced to buy the charcoal from traditional charcoal makers.

Using inefficient and polluting traditional pit-charcoal making techniques, these producers were helping to strip Costa Rica's hills of trees.

Organic farmers are already engaged in practices that can help with climate change mitigation and adaptation as well as other environmental problems like farm chemical leaching and pollution of waterways. Adding carbon to soil as compost and biochar can help control leaching of nutrients and regulate soil moisture during drought. There is also evidence that biochar helps with pest management. Unfortunately, organic coffee farms are still a very small minority of coffee producers in the region and they do not have adequate financial incentives to use biochar. If it can be demonstrated that biochar makes a big contribution to the success of organic coffee farms, this may encourage the spread of biochar and organic practices to other farms. SeaChar's mission is to bring positive tools for carbon negative living.



Photos: Biochar on Sol Colibrí farm. Arturo composts biochar with bokashi ferment and uses it to grow vegetables as well as coffee.

Art Donnelly explains that this set of problems and the opportunity of obtaining more biochar made the SeaChar Estufa Finca project “an easy sell” in Costa Rica. By May of 2010, SeaChar had a proven stove design and a donated shop space in the Santos region of Costa Rica for the manufacture of stoves. Working with money raised by SeaChar, a generous donation from Sol Colibrí Coffee and a \$2,000 grant from the Bloomington-Normal Illinois chapter of Rotary International, a local women's cooperative, APORTES, was outfitted with the tools and materials to build their first 20 stoves. SeaChar spent two weeks training the women to build stoves and to teach stove building workshops for community and volunteer groups. Noted TLUD stove designer Dr. Paul Anderson, Rotarian and Board member of the Biomass Energy Foundation, joined Art Donnelly in this process.

During the current 2010-2011 harvest season, SeaChar is helping APORTES produce 100 stoves to distribute to 650 indigenous Ngöbe coffee pickers from Panama. With support from the Canadian Fund for Local Initiatives, Seattle International Foundation, Plant-It 2020, Rotary International and Groundwork Opportunities, SeaChar is collaborating with the National University of Costa Rica, the International Biochar Initiative and numerous dedicated volunteers, to support a complete program of stove distribution, monitoring and evaluation. As of March 7, 2011, 56 stoves have been installed. These

are complete installations that include a brick cook top structure and pot support. Installation also includes training cooks to operate the stoves.

In December and January of 2010-2011, SeaChar worked with academic researchers from the University of Washington and the UNA-IRET program (National University of Costa Rica migrant worker program) to carryout monitoring and controlled-cooking tests with 32 families using the Estufa Finca cookstoves. Results show 40% or higher gains in fuel efficiency, reduced cooking time for the most commonly cooked meals and high levels of customer satisfaction. Partnering with researchers from UNA-IRET, SeaChar will continue to track these installations, while planning for the remaining 44 stoves in the coming year. SeaChar laid the groundwork for the current season's success by working last year to modify the stove design so it could be made with locally available materials and tools, while establishing a workshop space, acquiring tools and training the women of APORTES to manufacture the stoves. The women of APORTES are unemployed middle class Costa Rican women who now have part-time jobs manufacturing the Estufa Finca. They are very excited about expanding their business to provide stoves for needy families in Costa Rica.





Photos, clockwise from top left: Women of APORTES in their workshop with helpers; woman using her new stove; researcher from UNA-INET interviews cookstove user; stove installation in daily use: “We are heartened to see the obvious signs of daily use at most of the households. We are told repeatedly: ‘it cooks faster, makes less smoke and uses less wood’”

The technology – stove design

The Estufa Finca is micro-gasifier stove based on the principle of Top Lit UpDraft gasification (TLUD). The process of combustion of solid biomass fuels includes several different stages including pyrolysis (heating in the absence of air that releases gasses), combustion of the gasses by combining with air, and finally, gasification and combustion of the remaining charcoal. A gasifier stove differs from common biomass combustion as found in an open fire or a rocket stove, by separating these stages in space and time. In common combustion they are mixed which reduces efficiency and increases pollution. In a gasifier stove, the gas is first separated from the solid fuel and then burned. A good gasifier stove provides the right amount of air to burn the gas completely. Depending on the design, a gasifier can either burn the char (the solid left after the gas is liberated) or it can conserve the char by excluding oxygen or quenching the char with water. The Estufa Finca can be operated in either a char-burning mode - complete gasification, or in a char-conserving mode. In the latter case, it can be referred to as a pyrolytic cookstove because it stops short of the stage of char gasification and combustion.

The Estufa Finca consists of a 5 gallon combustion chamber made from a bucket that is surrounded by a shroud formed of galvanized roofing. Air is preheated in the annular space between the bucket and shroud and directed to the top of the combustion chamber to burn the gas. The stove is big enough to use a wide variety of biomass materials and it is very powerful. The stove has good control of both “primary air” used to control the heating phase and “secondary air” used to burn the gas. The Estufa Finca was tested for emissions of carbon monoxide (CO) and particulate matter (PM) in October 2010 at Aprovecho – a leading stove test facility in Oregon. Aprovecho found that the emissions of the Estufa Finca are “extremely low.” In the standard Water Boiling Test, the stove met the benchmarks for CO, reducing CO by 83% in comparison to an open fire and “easily exceeded the PM benchmark, producing an average of 573 mg of PM (one third of the benchmark)” or a 91% reduction in PM in comparison to open fires.

It is important to realize that the Estufa Finca metal combustion unit is just a portion of the overall cooking system. All of the stove installations have included a cook top structure and a setting made of bricks. The cook top structure and setting is robust and is expected to last for many years. The combustion unit is expected to last for at least a year (one unit has been in continuous use for over a year now) and hopefully longer. It is possible to extend the stove lifespan by replacing inexpensive parts that may wear out first, like the bottom grate.



Photos: a newly installed Estufa Finca. Visual instructions help train users more effectively.

Meeting the need for clean cookstoves in the Talamanca

Encouraged by the success of the pilot project in the Santos region, SeaChar and APORTES are now looking to expand. In July of 2010 the APORTES women's group and the US non-profit Education Without Borders, working with teen volunteers from Oakland, California, traveled to the Talamanca region in the southeast corner of Costa Rica to hold a one-day Estufa Finca stove building workshop in the indigenous Bribri community of Watsi to build 10 SeaChar Estufa Finca stoves.

The women were trained in stove use and educated about the benefits of the biochar in their gardens. The ten participating households consisted of members of APPTA, the local organic cacao growers co-op. In September of 2010 the board of APPTA asked SeaChar to help them provide all 1200 members of the co-op with an Estufa Finca stove. APPTA also asked for SeaChar's assistance in developing larger scale biochar producing technology and testing the potential of biochar to help cacao farmers with climate change adaptation. After much planning with the current and future partners, SeaChar has designed a two-year project to meet this exciting challenge. This Estufa Finca-Talamanca Project collaboration will give SeaChar the opportunity to evaluate the effectiveness of this new paradigm in carbon negative energy production among a settled population.

Phase 1 of the Estufa Finca-Talamanca Project will be a one-year pilot project (2011-2012) with the Bribri and Cabécar indigenous population in the Talamanca region. This will consist of a 100-stove implementation process supported by a rigorous testing, monitoring and customer satisfaction survey program. Testing will rely on protocols developed by the Gold Standard and USAID. This first year project phase will focus on determining the unique needs, solutions and implementation strategies needed to achieve goal for the Estufa Finca-Talamanca Project Phase 2, of placing a stove in the home of each of the additional 1100 farmer members of APPTA. The women of APORTES in the Santos region will manufacture the 100 stoves needed for Phase1 of the Estufa Finca-Talamanca Project. This will allow SeaChar to begin its implementation work while we develop the capacity of a Talamanca area women's stove building co-op and conduct our initial stove promoter training. SeaChar will provide business-planning, manufacturing training, and marketing tools for local women's groups to produce stoves from locally sourced materials. The experience developed by the women of APORTES will be used to begin the training of the new women's stove building and marketing co-op in the Talamanca region.

Furthering opportunities to develop sustainable businesses and jobs in building and marketing stoves is critical to long-term success. Learning about this technology from other women will give the new partners a positive model for success. As in the Santos region, SeaChar will bring service learning volunteers from around the world to work with local partners in building and implementing these clean burning stoves.

Phase 2 of the Estufa Finca-Talamanca Project will produce 1100 stoves and will be accompanied by continued development of partnerships in the private sector, universities, NGOs and governmental agencies in order to create the social and economic conditions that will sustain this important development effort. One key new partnership that is progressing quickly is an agreement to work with MyClimate.org to develop the project in the Talamanca to meet the Gold Standard for the voluntary market in carbon offsets. Adding this financial component will hopefully provide a long term sustainable funding source for the project.

Scaling up to adapt to climate change with biochar

When SeaChar first brought the Estufa Finca gasifier stove to the Santos region of Costa Rica, one of the first questions that coffee farmers asked was: can you make this bigger? Farmers and the surrounding communities can benefit from an applied technology that uses agricultural/forestry biomass waste as a fuel. SeaChar successfully tested a broad range of fuels including corn, sugar cane, coffee, coconut, cacao and blackberry crop wastes. The use of sustainable fuels, in combination with 40 percent gains in fuel efficiency, will reduce pressure on forest resources. Waste organic materials provide clean energy and a marketable commodity, valuable as a soil amendment, which sequesters carbon that would otherwise be released into the atmosphere.

At this time protocols are being developed to allow the soil sequestration of durable, fixed carbon to be traded as carbon credits. The offsetting abilities of these stoves already qualify this project for income from Carbon credits. Working with My Climate.Org, a respected carbon credit project developer, SeaChar has already begun the process of developing its project to meet the very rigorous Carbon Offset Gold Standard criteria. SeaChar technology can not only save the user money and time spent gathering fuels, but also provide the stove users and farmers with another means of generating income.

SeaChar is working with its partners, including the local coffee and cacao co-ops, Earth Watch, CATIE (the Center for Tropical Agriculture) and with support from several educational institutions, to plan community gardens and commodity crop test-plots in both its Santos and Talamanca project regions. The biochar produced by the stoves will be used in community demonstration gardens. SeaChar's own biochar test plot project, located in Seattle, is providing valuable experience in how to maximize the potential of biochar for urban food production. The USDA, Washington State University, the University of Washington and the Landscape and Horticulture Department at South Seattle Community College are supporting SeaChar to conduct practical citizen science. SeaChar will be providing its partners with training in and technology development of larger scale TLUD style gasifier technology: SeaChar is already successfully prototyping the appropriate scale technology needed for making the larger amounts of biochar required by commercial agriculture. This larger scale technology could, for instance, offset

the use of almost \$10,000 in diesel fuel, which our partners at APPTA used for drying cacao beans in 2009 or the thousands of hectares of hardwood now used to dry coffee in the Santos region.

The stoves distributed so far are each capable of producing 10 to 30 kg of biochar a month, but the migrant coffee pickers will not produce biochar without an incentive. Arturo Segura is incentivizing his coffee pickers by paying for the biochar they produce for use in his organic fertilizer. He pays them \$5 for a 10 kg sack – a few dollars less than what he pays the commercial charcoal producers. This amount of biochar is not sufficient for his coffee farm, but it is enough to make a difference in his vegetable garden.

The next phase of the Estufa Finca project will look at different ways to incentivize the stove users to save the biochar. In the Talamanca, the APPTA members will establish demonstration gardens to show how the biochar can improve crops. The people in this region are indigenous, not migrants. Hopefully, once they see the value of the biochar in agriculture that will be enough motivation to save the biochar and not burn it up for cooking.

TWO YEAR PROJECT SCOPE:

- Partner with local groups in the Santos region to continue developing a women owned stove building workshop and volunteer training center
- Continue and expand on work with the UNA-IRET program and the Coffee community to scale up delivery of stoves to the picker population.
- Introduce, demonstrate and share affordable, appropriate-scaled biochar/clean energy producing technology for the farmers and processors
- Product development to continually improve Estufa Finca for new users in new settings
- Establish a coffee related biochar test plot
- Expand testing and implementation of the stove and biochar technology to the Talamanca region, beginning with a 100 pilot project
- Develop the local (APPTA, the local women's group) and Institutional partnership network to sustain a 1200 stove, two-year project in the Talamanca region
- Establish a cacao related biochar test plot in the Talamanca region
- Establish a volunteer and intern program for both the Santos and Talamanca regions
- Establish a biochar/stove volunteer training program in the US
- Expand regional Central America production, marketing and training program

Project Team

- Art Donnelly, Project Director [art.donnelly@seachar.org]
- Arturo Segura, Project Manager - Central America [arturo@solcolibri.com]
- Anita Hornby, Operations Officer [info@seachar.org]

Partners

- SeaChar.Org - Project management and technology development
- Sol Colibrí Organic Coffee - Project management and education outreach
- APORTES women's group - Stove manufacturing and training
- Earth Watch
- APPTA – Cacao Co-operative

- ACOMUITA Indigenous Co-op
- UNA - Universidad Nacional Costa Rica - Technical assistance, testing and monitoring
- SALTRA - Technical assistance

Donors

- Canada Fund for Local Initiatives
- Seattle International Foundation
- Groundwork Opportunities
- Sol Colibrí Organic Coffee
- Rotary International
- Plant-it 2020
- Individual donors

Contact and Reference Information

- Visit our website: www.seachar.org
- Visit our Facebook page: www.facebook.com/SeaChar
- View Mas Que Café Video: www.youtube.com/watch?v=eGIVh-zMWgY
- Background on climate change impact on coffee production in Costa Rica: [Seattle Times: Climate change takes toll on coffee growers, drinkers too](#)

Budget and Fundraising Plan

| SeaChar Estufa Finca Project Budget | | |
|--|--------------|--------------|
| | Year 1 | Year 2 |
| Women's Business Development and Training | \$ 16,000.00 | \$ 16,000.00 |
| Production and Installation of stoves (110 in year 1 and 1100 in year 2) | \$ 10,000.00 | \$ 88,000.00 |
| Facilities Development | \$ 36,000.00 | \$ 12,000.00 |
| Community Training, Outreach and Marketing | \$ 21,000.00 | \$ 42,000.00 |
| BioChar Technology and Test Plot (X2) | \$ 9,000.00 | \$ 12,000.00 |
| Local and Institutional Partnership Development | \$ 16,000.00 | \$ 16,000.00 |
| Volunteer Training and Management | \$ 6,000.00 | \$ 8,000.00 |
| Monitoring, Testing and Evaluation | \$ 15,000.00 | \$ 6,000.00 |
| Project Assessment and Planning | \$ 3,000.00 | \$ 2,000.00 |
| Project Documentation | \$ 4,000.00 | \$ 4,000.00 |

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|-----------------------------------|----------------------|----------------------|
| Administrative and Indirect costs | \$ 10,000.00 | \$ 14,000.00 |
| Staff Travel | \$ 4,000.00 | \$ 5,000.00 |
| TOTALS | \$ 150,000.00 | \$ 225,000.00 |

| Two Year Fundraising Plan for SeaChar Estufa Finca Project | | | |
|--|-----------|---|-----------|
| Year 1 | | Year 2 | |
| National Geographic | 60,000 | National Geographic | 60,000 |
| NW Coffee Festival | 30,000 | NW Coffee Festival | 50,000 |
| Rotary International | 6,000 | Service Learning Workshops(100 attendees) | 2,000 |
| Service Learning workshops (100 attendees) | 2,000 | Big Give UK | 20,000 |
| Groundwork Opportunities | 2,500 | Groundwork Opportunities | 5,000 |
| Planet 2020 | 3,000 | Global Alliance for Clean Cook Stoves | 10,000 |
| Biomass Energy Foundation | 600 | Seattle International Foundation | 15,000 |
| Individuals | 5,500 | Elemental Impact | 15,000 |
| Fundraisers, events, sales (anticipated) | 4,500 | Canadian Fund for Local Initiatives | 30,000 |
| Artist Project Earth | 30,000 | Planet 2020 | 5,000 |
| Seattle International Foundation | 15,000 | Biomass Energy Foundation | 600 |
| Total | \$159,100 | Rotary International | 20,000 |
| | | Individuals | 8,000 |
| | | Fundraisers, events, sales (anticipated) | 4,000 |
| | | Stove sale profits | 22,000 |
| | | Total | \$244,600 |