TChar Technology for Cookstoves:

Part E-1: Results – Workshop in Nicaragua – 1/2012

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Preamble

Essential introductory and construction information about the TChar technology is presented in Parts A and B, and is not re-presented in this Part E-1 document. See: www.drtlud.com

Introduction

On 11 January 2012, eight Peace Corps Volunteers and four staff from across Nicaragua met with Dr. Paul Anderson at the PROLEÑA workshop in Managua to fabricate and test a newly developed TChar stove. Peace Corps Nicaragua has been working with other types of improved stoves, but this was the Volunteers' first introduction to a TLUD stove. Anderson and Leonardo Mayorga of PROLEÑA first explained the history and theory of the TChar stoves.

Figure 1: Participants at the Peace Corps workshop with some of the TChar TLUD stoves they produced in Nicaragua on 11 January 2012

Volunteers then observed as Dr. Anderson lit several TLUD units, including TChar variations that allow TLUD micro-gasification to be combined with a charcoal stove. Featured was a new TChar unit which he had constructed the day before with the PROLEÑA staff. This model utilizes tabs and matching slots for simplified, manual assembly. After the demonstration the Peace Corps Volunteers fabricated

their own TChar stoves from sheet metal. These stoves were taken by them to different communities in Nicaragua to be tested and introduced to the communities.

This document contains the following sections:

General Comments: The Role of Peace Corps Volunteers in the Development of Improved Stoves
Fabrication: Preparation and Assembly
Logistics: Time, Material, and Costs
Challenges and Opportunities: TLUD technology in a Nicaraguan context.
Conclusion

General Comments: The Role of Peace Corps Volunteers in the Development of Improved Stoves

Peace Corps is dedicated to the development and implementation of sustainable projects that help provide solutions to health-related illnesses, socio-economic inequalities, and environmental issues in over 130 countries around the globe. According to the CIA World Fact Book, in 2010 Nicaragua had a 7.8% unemployment rate and a 46.5% underemployment rate; roughly 48% of the population lives under the poverty line. From an economic and environmental standpoint, the improved stove project headed by Dr. Paul Anderson provides some feasible solutions to the many issues that have caused deforestation in Nicaragua, including an affordable and efficient, resource-conserving alternative to traditional wood-burning stoves. Not only are the stoves easy to construct, but also the skills and tools needed to build them can be easily found within any community of Nicaragua, which further contributes to the project's sustainability.

Along with other projects that Peace Corps Volunteers develop and implement, the technology, skills, and supplies needed are constantly evolving to meet the needs of the community. Therefore, the stove's feasibility in certain communities may be easier than in other communities. For example, the department of Leon has currently put an embargo on chopping wood for fuel, but has not yet provided an alternative. Therefore, in places such as these, the improved stoves with the Top-Lit UpDraft technology are more than a proven commodity; they are a necessity. In other departments of Nicaragua, where wood can be easily found and burned, the "need" for this type of technology is neither economically nor environmentally driven. Furthermore, although the stoves are extremely efficient and clean, (there were virtually no visible fumes evident while the wood was burning), certain cultural aspects may deter use of these stoves. For example, the main staple foods in Nicaragua, beans and rice, take longer to cook than the stove allows for wood to burn in a single batch of fuel. The challenges and opportunities for these stoves in a Nicaraguan context are considered in more detail in a later section.

Fabrication: Preparation and Assembly

NOTE: This document is about an event and is not intended to provide detailed fabrication instructions. Separate documents are being prepared to explain the fabrication in detail with measurements and recent refinements, and will be presented in appropriate Parts of the overall documentation on "TChar Technology for Cookstoves" available at this same website: www.drtlud.com

All tools and materials for the fabrication of the TChar stove were provided by PROLEÑA. PROLEÑA is a Nicaraguan engineering firm whose specific goal is to develop and produce efficient stoves to be marketed throughout Nicaragua. Dr. Paul Anderson, known in the Stovers community as Dr. TLUD, worked with PROLEÑA staff the day before the arrival of Peace Corps volunteers to develop a

TChar model that could be produced in Nicaragua (see Figure 2). For the day of the event, PROLEÑA staff provided the materials for the construction of the gasifiers and assisted volunteers with preparation of the pieces and their assembly.

Figure 2: The TChar unit developed by Dr. Anderson and PROLEÑA staff the day before the workshop, with an extra-tall T-Base.

Figure 3: Two of the five units produced at the TChar workshop. Note that the T-Base was not a charcoal burner. Instead, a regular round base with a circular wall made of galvanized metal was constructed to hold the T-Top and to catch the charcoal. The T-Base height in this Figure is more appropriate than the one in Figure 2.

The various components of the TChar unit (specfically the T-Top) were constructed from one-foot wide strips of galvanized sheet metal (Gauge 26 for convenience of training; different gauges should be used for different pieces.). Using templates seen in Figure 4, the Volunteers traced the component parts onto the sheet metal and then made the necessary cuts using tin snips. PROLEÑA staff assisted with a standard sheet-rolling device to make the inner and outer cylinders.

Figure 4: Peace Corps Volunteers marking the component parts to be cut out of galvanized sheet metal. Note the metal tabs that are on the bottom of the outer cylinder.

The preparation of the pieces for the T-Top was the most labor intensive aspect. A main hole (with fringe tabs) was cut into the center of the horizontal piece in order to insert the inner cylinder (for the fuel, the pyrolysis, and the upward flow of the combustible gases). Smaller slots were made in the horizontal piece in positions to match the tabs cut in the bottom edge of the outside cylinder.

As seen in Figure 5, a rectangular opening about 2 by 2.5 inches for entry of air was made on the side of the outer cylinder near the bottom horizontal piece. A smaller hole, approximately 1 inch in diameter, was made on the horizontal piece between the outer cylinder and inner cylinder to allow primary air flow into an otherwise sealed T-Base.

During assembly (which was quite easy and fast), the tabs and slots fastened the two pieces together. Two tabs and slots are visible in Figure 5. A concentrator lid (with a 3-inch hole) was made from 12 x 12 inch metal with 8 sides folded down. Then handles were attached to the T-Top by means of an electric drill and screws.

Figure 5: Entry for secondary and primary air.

Logistics: Time, Material, and Costs

The total construction of five TChar gasifiers (from flat metal to finished units) took approximately two hours for each pair of Volunteers during their first efforts. Most of the time was spent in the fabrication of the component parts. PROLEÑA has committed to making pre-fabricated kits which could be sold and assembled in communities throughout the country. Trained individuals could then assemble these kits in less than thirty minutes, significantly cutting down on the time and tools needed during the piece-fabrication process. The materials, including one sheet of galvanized metal one foot by five feet, screws, handles and various tools such as hammers, tin snips, and straight-edges, were provided by PROLEÑA. Cost of the raw materials, excluding the tools used, was US$7-8 per TChar gasifier.

Challenges and Opportunities: The TLUD model in a Nicaraguan context.

Challenges: After building and experimenting with the TChar units for a full day, the Volunteers identified **three challenges** of the TLUD gasifier stoves (including TChar units) in a Nicaraguan context. (These challenges are for TLUDs everywhere, and solutions will be shared as they materialize.)

1. Durability of materials (and resultant cost issues): Speculation about the durability of the produced units boiled down to the need for actual testing of the units to see how long the different components would last in typical Nicaraguan conditions. Several Volunteers will be using the stoves and making observations in the coming months. Also, other construction materials should be considered. TLUDs can be fabricated out of a variety of materials. Successful units have been built out of everything from stainless steel to ceramics. The challenge in Nicaragua is finding a suitable material that can both resist high temperatures and be cost effective for customers. As Nicaragua has no steel industry, sheet metals are expensive and difficult to find. Units constructed out of ceramic clay would be more affordable but are much heavier and more fragile. Identifying durable materials out of which to fabricate TLUD units will be necessary in order to ensure the success of TLUD units in Nicaragua.

2. Length of burn: In Nicaragua, beans are a central part of the national diet. Women are accustomed to letting their beans boil over a wood stove for as long as necessary. A daily serving of beans for a family of seven takes from 1 to 1.5 hours to cook. The longest burn recorded on our TChar

prototypes was fifty minutes. Having to re-fill the fuel source at 30 to 50 minute intervals could be inconvenient and needs to be compared with the fire-tending associated with their traditional cooking methods. Because standing-up while cooking is common in Nicaragua, future prototypes should seek to increase the length of burn time per batch by increasing the height of the fuel chamber.

3. Fuels: The third challenge TLUD stoves face in a Nicaraguan context will be in adapting available fuels. Biomass fuel types are abundant throughout Nicaragua. However, using the current TChar prototype, biomass fuels such as coffee and corn husks would require briquetting or pelletizing or the possible addition of small fans to the stoves.

Figure 6: View of 9-inch outer cylinder and 5-inch inner (fuel) cylinder where pyrolysis occurs.

Opportunities: The Volunteers identified **four opportunities** for TLUD stoves in a Nicaraguan context that are also of importance world-wide:

1. Reduction of deforestation: Nicaragua is the Central American country with the largest amount of its original forests intact. Much research on plant and animal species is performed in these forests, which are also very important as a biological corridor linking the rest of Central America. The problem, however, is that the consumption of these forests is proceeding rapidly. By some estimates, the fifty percent of Nicaraguan forests that are still remain will be completely consumed in twenty years. While a majority of this deforestation is caused by agriculture and industrial cutting, a significant portion, especially in certain areas, is due to the need for firewood for cooking.

Managua, for instance, the largest city in Nicaragua, has many poor areas where most families use wood fires. These people have to buy their wood, and the wood itself arrives from farther and farther away, as a gradually larger area around Managua becomes deforested. This process is happening to a lesser extent in the other cities of Nicaragua as well. One great opportunity for the TLUD stoves, then, is to provide families in these cities with stoves which are able to use a fuel that isn't wood. This could both have an economic benefit as well as reduce the pressure on surrounding forests to provide wood for a large city.

2. Improvement of interior air quality: The very low emissions of TLUD stoves can greatly reduce the indoor air pollution (IAP) that is a major health problem of people who still cook with smoky traditional 3-stove fires. In the Western Hemisphere, this problem is greatest in the Central American countries, and can be solved with improved cookstoves like the TChar units.

3. Creation of small businesses and economic benefits to families: The TLUD stove also brings to Nicaragua the opportunity to create small businesses. The fabrication of the stove itself is a business opportunity. The repair and maintenance of the stoves, as well, could provide income to people trained in the care of the stoves. Even more employment is in the potential supply chain of appropriate dry biomass fuels for TLUD stoves. Collecting, processing, transporting, distributing, and selling are all gainful activities with other fuels, and will be with dry biomass fuels, which can also add the employment associated with growing the renewable energy sources. TLUD technology provides the opportunity to turn waste products, such as the husks of rice and coffee, corn cobs, or sawdust into viable fuels.

Although these fuels may need to be slightly processed (for example, made into pellets or briquettes) to serve well in the TLUD stoves, right now they are waste products that rice and coffee plantations often burn or simply dump on the side of the highway.

4. The actual production of charcoal by the stove: Charcoal is a valuable product in Nicaragua. On the Pacific coast charcoal is purchased to grill meat or other foods, while on the Atlantic coast often all of the foods are cooked with charcoal. The process of making this charcoal is extremely wasteful. The fact that TLUD stoves create charcoal offers families a product to sell or use as their own charcoal to cook. The newly-designed TChar stoves for Haiti and Africa allow the charcoal to fall right into a charcoal stove (used as the T-Base) to permit the continuation of cooking. (See Figure 7.) The charcoal also has the added benefit of improving soil quality when mixed with dirt; it is then called biochar and is truly carbon negative for the atmosphere.

Figure 7: A Haitian charcoal stove with a TChar T-Top made from standard hardware store items.

Conclusion

Although TChar stoves are a new technology, and there are still some challenges to be overcome in the Nicaraguan context, the participants of the Peace Corps workshop on 11 January 2012 left feeling optimistic about the opportunity to introduce the new TChar model to communities in Nicaragua. These stoves have the chance to help solve some of Nicaragua's biggest environmental problems, as well as improving the health and economic situations of families. Through innovation and creativity this stove technology can be further developed to provide an effective means of cooking without compromising the cultural norms of Nicaraguan cooking.

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There is also much more to the TChar story, and we are documenting it as fast as we can, while at times simultaneously doing research and development of additional features that become evident nearly every day. This series of documents entitled "TChar Technology for Cookstoves" is currently planned to have five parts that can be updated and have annexes or subsections as needed:

A. Introduction	Defining TChar, basic info, importance, origin
B. Construction	Overview, guidelines, specifics, alternatives, production.
C. Operations	Fuels, fire duration, costs, human factors, planning projects.
D. Further Developments	Variations, enhancements, biochar, and visions.
E. Results and Reports	Documentation of projects and impacts around the world.

All interested parties are urged to contact the authors/editors who will assist them to participate according to their goals and circumstances. Initiative is great, independence is fine, isolation is undesirable. Please communicate.

Authors/Editors of the series of documents: Anderson, Roth and Fairchild

All of the documents are available at www.drtlud.com