



Project: Improved Stove Certification Center

FINAL REPORT

**Evaluation of Improved Efficiency Firewood Stoves in the
Zamorano Certification Center and in Local Communities in
the Yegüare Valley, Honduras**

Zamorano University - Escuela Agrícola Panamericana

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1. INTRODUCTION

The purpose of the final report is to provide comprehensive information about the activities and outcomes of the project, important lessons, and a financial accounting of how the money was spent.

The project was financed by TPW Energy Collaborative and it targeted the installation of a certification center for improved stoves in Zamorano by accomplishing the following objectives:

- Evaluate heating efficiency by type of fuel and pollution production of five of the most commonly used improved stoves, and a normal stove in campus.
- Test the same stoves' efficiency and pollution production within households at Yeguaré Valley.
- Create a certification standard on stove construction materials, to be used for projects and direct sales in Guatemala, El Salvador, Honduras and Nicaragua.

2. ACTIVITIES

In order to achieve the objectives of the project, the following activities per each objective were carried out:

2.1 Evaluate Heating Efficiency by Type of Fuel and Pollution Production

In order to evaluate heating efficiency activities completed included:

Acquisition of measurement equipment and personnel training: As part of the efficiency evaluations Staff from Zamorano traveled to the APROVECHO research center to purchase and to receive training (Photo 1) in the use of Portable Emission Measurement System (PEMS), Indoor Air Pollution Meter (IAP), thermometers, scales, blood pressure measurement cuffs, respiratory capacity meters, pots, pans, and various additional supplies.

Construction of the certification center: A structure was designed with six (6) laboratory kitchens, an open space for stoves without chimneys and a small classroom for training sessions. Each cooking space has identical window and door location to help insure equal ventilation during the comparative evaluations of the different stove models. The structure was built utilizing environmentally friendly "eco-bolques" which are fabricated utilizing local resources and limited industrial construction materials (Photos 2 and 3).

Improved efficiency stove construction: AHDESA was contracted to build the following stove models: Tradicional Justa, Ecofogón, Onil, Inkahuasi, Patsari, Malena. Technicians from the Proyecto Mirador installed the Justa 2X3.

Evaluation of heating efficiency and pollution production: A full-time technician was hired to assist in the project completion including conducting the evaluations. The evaluations included the Water Boiling Test (WBT) and the Controlled Cooking Test (CCT). The general protocol descriptions below are internationally accepted evaluation techniques and were developed by *Bailis et. al.* for the Household Energy and Health Programme, Shell Foundation. <http://www.bioenergylists.org/>

The WBT developed for the Shell HEH program consists of three phases that immediately follow each other. In the first phase, the cold-start high-power test, the tester begins with the stove at room temperature and uses a pre-weighed bundle of wood or other fuel¹ to boil a measured quantity of water in a standard pot. The tester then replaces the boiled water with a fresh pot of cold water to perform the second phase of the test. The second phase, the hot-start high-power test, follows immediately after the first test while stove is still hot. Again, the tester uses a pre-weighed bundle of fuel to boil a measured quantity of water in a standard pot. Repeating the test with a hot stove helps to identify differences in performance between a stove when it is cold and when it is hot. The third phase follows immediately from the second. Here, the tester determines the amount of fuel required to simmer a measured amount of water at just below boiling for 45 minutes. This step simulates the long cooking of legumes or pulses common throughout much of the world (source: Bailis et. al., 2005).

The Controlled Cooking Test (CCT) is designed to assess the performance of the improved stove relative to the common or traditional stoves that the improved model is meant to replace. Stoves are compared as they perform a standard cooking task that is closer to the actual cooking that local people do every day. However, the tests are designed in a way that minimizes the influence of other factors and allows for the test conditions to be reproduced (source: Bailis et. al., 2004). In the case of the Zamorano testing center a rice meal was prepared.

During these tests, fuel wood consumption, emissions and exposure were measured. Additionally, existing protocols were enhanced to help capture the impacts of the stoves performance. This 76 page document, in Spanish, is available on request.

Draft final document. The results of the evaluations were compiled and analyzed. The final 95 page report, in Spanish, is available upon request.

2.2 Test stoves' efficiency and pollution production within households at Yeguaré Valley

Four households in the Yeguaré valley were selected for this phase of the project. Baseline data included the traditional stove design (dimensions, materials, smoke exhaust methods, etc.), the CCT and the Kitchen Performance Tests (KPT – described below), and socioeconomic descriptors were initially collected when these houses were still using the traditional wood burning stoves. Households participating in the project were asked to sign a one year contract allowing Zamorano build the improved efficiency stove, conduct efficiency and emission measurements and guarantee that the household would use the stove, conduct the appropriate maintenance and that they would not remove the stove prior to the end of the study.

Upon completion of the baseline data collection, improved efficiency stoves were installed. Four models, the Justa Tradicional, the Ecofogon, the Oneil and the Justa 2X3 were accepted by households in the local communities whereas the other models (Inkahuasi, Patsari and Malena) were not. After the instillation of the improved efficiency stove the user was trained in the use and maintenance of the particular model. A three week adaptation period was allowed for the user to become familiar to the stove prior to the subsequent evaluations.

Once the users were comfortable with the stoves operation, the CCT and KPT evaluation protocols were implemented. *The Kitchen Performance Test (KPT) (also developed Bailis et. al. for the Household Energy and Health Programme, Shell Foundation) is the principal field-based procedure to demonstrate the effect of stove interventions on household fuel consumption. There are two main goals of the KPT: (1) to assess qualitative aspects of stove performance through household surveys and (2) to compare the impact of improved stove(s) on fuel consumption in the kitchens of real households. To meet these aims, the KPT includes quantitative surveys of fuel consumption and qualitative surveys of stove performance and acceptability. This type of testing, when conducted carefully, is the best way to understand the stove's impact on fuel use and on general household characteristics and behaviors because it occurs in the homes of stove users (source: Bailis et. al., 2006).*

In addition to the standard protocols for the CCT and KPT, emissions and exposure measurements were taken with the PEMS and IAP, respectively.

The results of the evaluations were compiled and analyzed. The final 95 page report, in Spanish, is available upon request.

2.3 Create a certification standard

Based upon the results of the above efforts contact was made with COHCIT (Consejo Hondureño de Ciencia y Tecnología or the Honduran Council of Science and Technology) for the development of a certification standard. Additionally, during international conferences and computer based networking information was collected regarding similar certification standard efforts. Coordination with governmental organizations was complicated during 2009 due to the political instability in Honduras. Therefore Zamorano decided to explore certifying stoves based upon specific designs and reduced consumption and emissions compared to the traditional stove.

The ground work has been established to conduct a National/Regional certification conference in September 2010.

3. IMPACT

3.1 Regional impact:

Zamorano University currently has 1200 students from 18 countries from throughout Latin America. The Improved Stove Certification Center has been integrated into the Learning-by-Doing curriculum for all second year students. Thus, annually over 300 students will be educated in construction and evaluation techniques of improved efficiency wood stoves.

The Zamorano Stove Certification Center is positioned to become the leading regional testing center in Latin America. During the ETHOS 2010 conference staff presented our activities during both the opening events and during one of the plenary sessions. Preliminary contacts were made for conducting efficiency emission evaluations for projects in Guatemala, El Salvador, Nicaragua, and Costa Rica.

Additionally, during the ETHOS 2010 a Spanish speaking Stove Camp at Zamorano was discussed with multiple attendees and was received with great enthusiasm. During the PCIA closing presentation John Mitchell (EPA) eluded to US financial assistance for the event.

Finally, Mini-workshops and/or tours have been conducted for the following organizations: Peace Corps, Honduras, Penn State University, Universidad de Cuenca, Ecuador y AGEAPSE, Proyecto Sabana Yegua Sostenible, República Dominicana, Banco Interamericano de Desarrollo – BID, and Proyecto SUR.

3.2 National/local impact:

We are currently involved with emission monitoring for the Proyecto Mirador in compliance with the Gold Standard Carbon sequestration certification requirements.

Approximately 45% of the Honduran Military bases still use firewood for cooking meals for over 40,000 enlisted personnel. Contacts were made with the Directors of the Armed Forces Institute of Research, Development and Innovation to explore areas of collaboration in the area of improved stove implementation.

The availability of the different models of improved efficiency stoves in one location allows NGO's, governmental projects, donors, or the final end-users to "test drive" a particular model prior to its selection and dispersion.

4. FUTURE GOALS AND PROGRAMS

During the KPT evaluations in the local communities significant variations were identified in terms of fuel type and moisture content. These can greatly impact emissions and efficiency illustrating the importance of conducting a more rigorous evaluation of these variables to estimate actual emissions during stove project implementation. Therefore we propose to do a rigorous evaluation of the impact of fuel moisture content on stove performance and emissions.

Additionally, our initial work identified slight differences in construction methods and materials during the instillation of the stoves during the first year of the project. These variations may significantly influence emissions and efficiency of the stoves. Thus there is the need to evaluate the impacts of these variations and incorporate stove design specifications and material use in the certification standard.

Similarly, the current KPT evaluation protocol prescribes the use of standardized fuel type and moisture content. Because of the huge variability (both species and moisture content) of firewood typically used for daily cooking, the traditional KPT may not accurately reflect actual fuel consumption and emissions of improved stoves installed in the community. To help identify the real world impacts of these stoves we would like to modify the KPT procedure to measure the actual emissions and efficiency during normal cooking activities; that is with the same firewood that is currently being used in the home.

Finally, each stove design appears to be suitable for relatively unique food preparation. For example the eco-fogon seems to be ideal for tortilla and pupusa preparation where the Justa is more appropriate for bean and rice cooking. Therefore, these qualitative aspects should be identified and documented for more appropriate stove model selection by future local and regional projects and NGO's.

Without a doubt the next objective is the dissemination of these experiences to the development community to maximize the impact of these efforts.

5. LESSONS AND OBSTACLES

The implementation of the 2009 phase of the Zamorano Stove Certification Center was extremely interesting. Initially, the economic impact of the global recession impacted the availability of construction materials for the center. Once that was solved, we experienced complications caused by the AH1N1 scare and an almost overwhelming political crisis (military coup) and national instability (the resulting reaction – internationally, regionally and locally – due to the coup). It was... interesting... and very challenging.

However, we successfully completed building the certification center, the instillation of the model stoves in the center and the collection of both fuel wood consumption and emissions of seven models of improved efficiency stoves. Local community participants were selected and base line data collection and instillation of improved stoves in the local communities were completed although three of the stove models were rejected by users for inclusion in the community study. Currently, the accepted models have all successfully accepted and adapted well to the stoves, except one of the households were the users had to abandon the dwelling due to complex internal family conflicts (Oneil model).

In general this experience opened the doors to extremely important opportunities in the 1) improvement in the quality of rural health and life due to the reduction of indoor air pollution and costs of fuelwood collection, 2) reduced environmental impacts due to forest degradation and deforestation caused by the high consumption of traditional fire wood stoves, and 3) a reduction in the atmospheric contamination caused by inefficient fuel combustion.

6. FINANCIAL ACCOUNTING

As can be seen in Table 1 approximately 51% of the grant was utilized in the construction of the Certification center and almost 32% on the acquisition of measurement equipment. About 7% percent was spent on travel for equipment, training and transportation and 7% in the employment of a full time technician.

Table 1: financial summary TPW 2009 grant.

Item	Amount Spent (\$)	Amount available (\$)
Human Resources (Technician for four months)	3,252.17	
Office material	283.49	
Measurement equipment (Portable Emission Measurement System (PEMS), Indoor Air Pollution Meter (IAP), thermometers, scales, blood pressure measurement cuffs, respiratory capacity meters, pots, pans, and various additional supplies)	13,528.12	
Center construction	22,016.06	
Travel cost	2,938.16	
Total spent	42,018.00	
Funds received (15/11/2008)		42,800.00
Available		782.00

Please submit this report to the following people:

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Photo 1: Zamorano Staff training with emissions equipment March 2009.



Photo 2: the Zamorano Stove Certification Center – Fall 2009.



Photo 3: Visit to the Certification Center with Arie Sanders, Kim Kreiling, and Zamorano students. January 18th 2010



Photo 4: Portable Emission Measurement System (PEMS) installed in the Certification Center.



Photo 5: Portable Emission Measurement System (PEMS) with the Justa Traditional stove.



Photo 6: a Peruvian student completing the WBT utilizing the PEMS and IAM systems.



Photo 7: Zamorano students assisting technicians from the Proyecto Mirador in the installation of a Justa 2X3 stove in the house of Doña Delfa Lagos.

Figure 1: Location of participating households, 2009.

