

Trees, Water and People/AHDESA, Honduras 2005



the **Ashden Awards**
for sustainable energy

Fuel-efficient stoves for rural and urban households

Summary

TWP and AHDESA, not-for-profit organisations based in the USA and Honduras, have enabled the installation of over 4000 efficient wood-burning stoves for cooking in Honduras. About half have been installed in and around the Honduran capital, Tegucigalpa, where demand for fuelwood has led to severe deforestation in the nearby hills, and also means that wood prices are high. Deforestation exacerbated the destruction which was caused by Hurricane Mitch in 1998. The other half have been installed in rural areas.

About 700,000 households in Honduras (90% of rural households and 50% of urban households) use fuelwood for cooking, and 90% of the wood cut down is used as fuel. Most of them cook over inefficient open wood fires, and often indoors, thus women and young children spend much of their time breathing in smoke. Although the work of TWP originally focused on decreasing fuelwood use in order to reduce deforestation, the need to prevent the damage to health from smoke has become increasingly urgent.

The 'Justa' stove (named after one of the community leaders involved in the design) which was developed in Honduras therefore reduces both wood use and smoke. It is a substantial brick-built stove, incorporating a 'Rocket' elbow for efficient combustion and heat transfer, and a chimney to take smoke out of the kitchen. It has a hotplate which allows it to be used for several pots at a time, or for cooking tortillas. Field studies have shown that the laboratory measurement of 50% fuelwood saving is sometimes increased to 70% in practical use, because users find that they can burn agricultural residues to substitute for wood. A study of indoor air pollution is in progress, with 24-hour measurements of pollutants before and after a Justa stove is installed.

AHDESA work with poor communities to educate about the risks of smoke and deforestation, and to install stoves. Although users do not pay cash, they contribute construction materials and labour. The reduction of wood use and smoke production are immediately apparent, and there is a waiting list of communities who want stoves. TWP and AHDESA have also started a commercialisation programme to design and produce stoves for commercial sale, which will enable more rapid uptake and use in different sectors of the population.

The Ashden judges were impressed by the highly effective partnership between TWP and AHDESA. They have worked closely with communities to develop effective and popular stoves, and their technical installation programmes also provide education about health and the environment. They have also seen the importance of measuring the practical performance of stoves in the field, not just in laboratory tests.

The organisation

Trees Water and People (TWP) is a non-profit organisation based in Colorado, USA. It was founded by Stuart Conway and Richard Fox in 1998, and works to protect the environment and welfare in Central and South America, also USA. Their main focus is on tree planting and the development and dissemination of fuel-efficient cookstoves, with about 1.1 million trees planted and 14,500 stoves installed through their involvement. Within Central and South America, TWP

always work with a local partner, to ensure a continuing presence and an appropriate local approach. In Honduras their partner is the Honduran Association for Development, AHDESA.

AHDESA founded in 1992, is a registered Honduran non-profit organisation that works to help the poor through training, technical assistance, and implementation of projects including appropriate technology, community reforestation, watershed protection, and sustainable agriculture. Ignacio Osorto Nunez is the founder and executive director.

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Technology and use

The stove technologies used by TWP in Honduras are based on the 'Rocket' concept which was developed by the Aprovecho Research Centre in Oregon, USA. The key features of the Rocket are that it provides efficient combustion and efficient heat transfer. It also discourages the use of excess wood and, with a chimney as used in the Justa stove, takes smoke out of the kitchen.

Efficient combustion is achieved by the elbow-shaped combustion chamber, essentially a horizontal pipe which bends round to a vertical pipe, each with a cross sectional area of about 20,000 mm² (200 cm²). The wood sits on a shelf at the bend, so that air is drawn from underneath it and upwards. This air flow provides a high air-to-fuel ratio, thus promoting efficient combustion and reducing the production of carbon monoxide, unburned particles and other products of incomplete combustion, which are damaging to health. The small size of the chamber prevents the use of large pieces of wood, and therefore means that wood is not left burning when cooking has finished. Efficient heat transfer is achieved by forcing the hot combustion gases through a narrow gap under the hotplate or 'plancha'. The chimney which then carries the gases out of the kitchen both enhances air flow and removes about 95% of the combustion gases from the house.

The Justa stove is built into the kitchen by AHDESA technicians, with assistance from the household. It is made on a raised platform, which is normally used for cooking in Honduras. The body of the stove is built from standard masonry bricks, with ceramic bricks used for the combustion chamber. The dimensions of the combustion chamber and the air gap under the plancha are critical, but other dimensions can be more flexible, depending on the space available and the wishes of the user. Pumice or ash is filled round the chamber to minimise heat loss. The hotplate is made from 3 mm thick steel, with a surface of about 0.15 m² (1,500 cm²) and is large enough to fit several pots and also be used to make tortillas. The mild steel chimney leads vertically through the roof of the house.

TWP brought technicians from Aprovecho to work with AHDESA and community leaders on the stove design. One of the leaders, Dona Justa Nunez, was particularly instrumental in providing the designers with an understanding of what would be most appreciated by the users of the stove. In recognition of her contribution, the Justa stove carries her name.

TWP and AHDESA are currently working on three new designs of portable stove, based on the same principles, which can be produced and sold commercially, rather than built into kitchens. This will enable them to reach new sectors of the population and increase the use of improved stoves more rapidly. Five designs, targeted at different markets, are currently nearly ready for production. The Ecofogon, essentially a metal version of the Justa stove and very similar to the Ecostove which was developed in Nicaragua with TWP support. The Ecobarril, a Rocket elbow built into an oil drum with a chimney to take the smoke away. This provides a large, circular hotplate for cooking in outdoor foodstalls and markets. The third commercial stove is the Ecolena, a tiny stove with the Rocket elbow and outer casing made in one piece from ceramic brick. This has been designed to be as cheap and portable as possible, to be accessible for the poorest households and migrant labourers, and is the only model without a chimney. Two larger stoves are the EcoTortillera with a larger plancha for tortilla businesses, and the EcoHorno with an oven.

How users pay

Users construct the platform for building the Justa stove, and provide bricks, sand and one day of labour with the AHDESA technicians. The manufactured components (chimney, plancha and ceramic bricks) are provided by the programme. Overall the contribution of the users represents about 30% of the installed cost of about \$US60..

The new portable stoves will be sold commercially, with the Ecofogon costing US\$92, Ecobarril US\$35, EcoTortillera US\$116, EcoHorno US\$124 and the Ecolena only US\$10. These prices include a warranty period and the costs of follow up visits for the stove with chimneys. Credit

facilities are being set up to enable stove producers and retailers to get businesses going, and also to enable customers to buy the stoves.

Training and support

AHDESA works on the Justa programme with local community groups such as Church groups, many of which are led by women. The group leaders are the key stove promoters, and are crucial for the success of the programme. Each group draws up a list of women who would like stoves, and decides the order of priority - for instance, getting the first stoves to women who cook tortillas for sale and therefore inhale smoke all day, or to the poorest members of the community. AHDESA technicians train the group on stove use, and the environmental benefits of stoves before the programme starts, and also through working alongside the household in the construction of the stove.

Users are trained to clear ash from the chimney every day (there is a door at the base of the chimney to do this) and clean the surface of the plancha every week. However, many clean the whole stove every day. After about two years there may be problems with slight buckling of the plancha, also corrosion in the chimney, and a few users have replaced the plancha. ADHESA are now using planchas with thicker plates in the middle to reduce this problem.

For each installation programme, AHDESA technicians make follow-up visits after one month and six months, to check that all is going well. The good initial design and careful construction mean that very few problems arise. The Justa stove lasts at least 5 years.

TWP and AHDESA will have less control over the manufacture of the portable stoves, when they move to commercial production. They are therefore looking at ways to maintain the brand quality, and protect the brand name. The initial phase of commercialisation will be with a small group of about four producers and 25 vendors, so that quality can be monitored very carefully. It is expected that the metal stoves will last for 5-10 years.

Benefits of the project

Reduced fuelwood use is an immediate and obvious benefit of the Justa stove. Standard tests carried out by Apreovecho suggest that the Justa stove reduces fuelwood consumption by 50%. In some stove programmes, the savings found in real use are not as good as those found in laboratory tests, but in the case of the Justa stove they are better. An extended field survey carried out in Tegucigalpa found that fuelwood use was actually reduced by an average of 70%, because the design of the combustion chamber allowed users to burn some agricultural residues (such as maize cobs and sugar-cane stalks) instead of wood. It is also notable that fewer fuelwood trucks visit the communities which have had stove programmes. This reduction in demand for wood is particularly important around Tegucigalpa, where extensive deforestation because of unsustainable wood use is already apparent. Informal settlements are continuing to grow on the outskirts of the city, putting increasing pressure on supplies.

The damage to health caused by inhaling smoke is well known. Doctors in Honduras have identified 97 distinct health problems which are caused or exacerbated by smoke, including bronchitis, asthma, heart disease, and blocked tear ducts. 20% of children die before they reach the age of five. One woman told the visiting Ashden judge that her doctor had told her that the only way to get rid of her asthma was to get an improved stove. ADHESA have substantial anecdotal evidence of reduced problems after the Justa stove was installed. They are currently carrying out a research programme to monitor both pollution levels and health. This involves making 24-hour measurements of carbon monoxide and particulates in kitchens, before and after a Justa stove is installed, supported by a questionnaire on health. This study will give valuable quantitative data which can be related to known effects of pollutants.

Reduction in the use of unsustainable fuelwood reduces the emission of greenhouse gases, both carbon dioxide and other gases such as methane and hydrocarbons. Field studies of stoves in use

in Tegucigalpa suggest an average saving of about 1.5 tonnes of CO₂ equivalent per year, per stove.

The Justa stove brings financial savings, since most wood in Tegucigalpa is purchased. Avoiding 70% of the daily fuelwood cost of about US50c is a significant benefit, since the typical household income is only about \$US2 per day. Some Justa stove owners may be increasing their earnings through tortilla production: making 600 tortillas per day provides a daily income of about \$US2.50. However the tortilla market in Tegucigalpa is currently saturated, so this is probably not a significant financial benefit.

What tortilla makers really appreciate is that the Justa stove saves them time. The stove lights up and gets hot quickly, and the plancha can accommodate nine or ten tortillas at once, so a skilled cook can reduce the time she spends cooking by 70%. This further reduces smoke exposure as well.

AHDESA leave the outside of the stove as unfinished bricks. It is an indication of how much the Justa stoves are appreciated that most households plaster and paint the outside of the stove, or occasionally finish it with tiles. Many households go further and paint the inside of their house as well - this was pointless in the past when the paint would just become covered in soot. Evidence that the stoves are in demand is the waiting-list of communities kept by AHDESA: these have already listed and prioritised households, and are waiting for a Justa stove programme. In addition, people with electric and LPG stoves are now asking to purchase Justa stoves, because of growing concern about the rising price of commercial energy.

Management, finance and partnerships

The effective partnership between TWP and AHDESA is the foundation of the success of this work. AHDESA is responsible for the day-to-day operation of the programme in Honduras. Half of the AHDESA employees are community leaders who became involved with the stove programme on behalf of their communities, and subsequently joined the staff. There is a strong sense of commitment to the organisation, fostered by good management practice such as regular rotation of technicians between different projects so that they have skills in all aspects and do not have to stay away from home for too long.

TWP initiated the programme, continue to source most of the funding, and maintain contact through regular working visits to Honduras. They also brought the stove experts from Aprovecho to Honduras, in order to ensure best technical design within a locally-acceptable stove.

The main funds to date have come from Rotary International and individual Rotary Clubs, a number of private foundations, and a network of over 5000 individual donors. The US Environmental Protection Agency have supported the programme of air quality monitoring and the commercialisation programme which is in currently in progress.

Use of the Ashden Award

After the success TWP and their partners had had in installing wood-burning stoves, they wanted to expand the scheme further and develop a cheaper portable metal version of the stove. They set a target of selling an additional 1,440 stoves by July 2007, and had already sold over 1,000 by December 2006. TWP and their partners now sell six stove models, rather than the two original models; the prices range from \$10.60 to \$140. The larger models tend to be used in businesses and, surprisingly, the most expensive model is the most popular among the large stoves. The publicity due to winning an Ashden Award has significantly increased the demand for their stoves, almost to the point where they were struggling to build enough, so they have trained four local shops to produce them.

TWP has also been advertising in Honduras via TV, radio and newspaper, and estimates that more than 200,000 people are now aware of the dangers of indoor air pollution and how an efficient stove can be good for their health.

This report is based on information provided to the Ashden Awards judges by Stuart Conway of TWP; findings from a two-day visit by one of the Ashden judges to see the work of TWP and AHDESA in Honduras; and presentations by Stuart Conway at Ashden Awards seminars in London.

Dr Anne Wheldon, Technical Director of the Ashden Awards, March 2006.

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