

SUBMITTING AGENCY: WHO – DEPT OF HEALTH IN SUSTAINABLE DEVELOPMENT

TITLE

Modernization of Fuelwood Use in Nicaragua with the EcoStove

ABSTRACT

Less than 5% of fuelwood users (who comprise over 50% of all urban households in the Pacific region of Nicaragua) are aware of improved woodstoves which can reduce both fuel consumption and indoor emissions. To date, dissemination has been restricted to non-governmental organisations (NGOs) and the areas of their projects, and performance (efficiency and emissions) has generally been poor. PROLEÑA has developed a new EcoStove which has *higher efficiency (45% savings in fuelwood)* than the “three-stone” fire, and provides a *smoke-free* indoor environment. The EcoStove is portable and can be mass produced, *facilitating quick dissemination*.

PROLEÑA is pursuing an integrated sustainable dissemination project with a target 8 000 EcoStoves installed by 2002. This project combines assembly, promotion, marketing, finance, and technology transfer for private sector development.

KEY ISSUES ADDRESSED

The key issues addressed by this case study are :

- Energy efficiency, through development of a new woodstove which substantially reduces fuel consumption for domestic cooking.
- Renewable energy, since the widespread use of EcoStoves has the potential to significantly reduce the demand for fuelwood from natural forests, currently being harvested at an unsustainable rate, to a level more closely aligned with sustainable growth of the forests.
- Rural energy, since the most common household fuel used in rural areas of developing countries is fuelwood.
- Technology transfer, through the training of small private sector industries, to produce and disseminate EcoStoves in Nicaragua.

COUNTRY PROFILE

Nicaragua, as with many other less developed tropical countries, is still very reliant on wood for energy needs. In 1997, the Nicaraguan Energy institute (INE) reported that fuelwood accounted for about 47% of the internal gross primary supply of energy, petroleum products 24%, electricity 25% and other biomass residues 3%. Fuelwood consumption is predominantly for household use, with 90% used for home cooking, and 10% for industries including bakeries, lime, brick and charcoal production.

Location

The project is located in the Pacific region of Nicaragua, an area where about 60% of Nicaragua’s 4.5 million people live. This is the most important economic area of the country, with good volcanic soils, and major urban areas including the capital, Managua, but has suffered serious overexploitation of forest resources. The region is also home to the tropical dry forest, a fragile ecosystem, which has been severely overexploited, with 97% of its original cover removed.

Project area profile

According to surveys of 2050 households undertaken in seven of the main cities of the Pacific region of Nicaragua by ESMAP 98¹ and EMOLEP 99², over 50% of households use fuelwood as the primary fuel, followed by LPG and kerosene. These surveys showed that the preference for firewood as a main cooking fuel is due to its availability and usefulness in preparing food quickly. It is also relatively cheap, and can be burned in very simple stoves consisting of just three rocks. Finally, cultural values play a role, in that fuelwood is regarded as traditional, and gives food a better flavour.

¹ ESMAP,98: Energy Sector Management Assistance program, A joint World Bank-UNDP program. In Nicaragua, it evaluated in 1998, the household energy perspective in two main cities: Managua and León.

² EMOLEP,99: Strategy to improve fuelwood supply and its efficient use in the Pacific region of Nicaragua. Prepared by CATIE-PROLEÑA for the CNE.

Wood is also the traditional fuel in rural areas, for three main reasons. First, it doesn't require special stoves; second, access is relatively easy and the cost is low; and third, firewood has become a tradition due to the total absence of other market options and their corresponding stoves.

Nevertheless, those using firewood in urban areas recognize that traditional wood stoves generate a great deal of smoke, which results in a poor indoor environment and affects the family health. This disadvantage and the lack of knowledge about improved woodstoves could explain the tendency to substitute the use of firewood for the use of LPG and/or charcoal, which are cleaner fuels.

The main niche for the shift from fuelwood toward LPG in urban areas is concentrated in the middle class and in the upper lower class. The key reasons for this shift can be defined as:

- cleanliness in comparison to traditional woodstoves (clean indoor air and clean pots);
- reduced operational cost (lower fuel cost per meal cooked); and
- association with improved socio-economic status (quality of life improvement).

Although this trend might continue for the next ten years or more, as pointed out by EMOLEP, there will be some restrictions to a complete transition from fuelwood to LPG in this coming decade. For instance, the fact that fuelwood can be purchased in small amounts every day contrasts with LPG which requires a larger disbursement from the family budget when it is time to refill the cylinder. Low income families (the traditional users of fuelwood), do not have enough saving capacity to accommodate such large financial outlays on household fuels. Important also is the fact that a traditional woodstove requires no financial investment, since it can be made from three stones.

Furthermore, as pointed out in a study by Barnes and Qian (1992) for ESMAP in eleven developing countries, LPG will not replace fuelwood if average per capita income of the family is below 25 dollars per month. The Nicaraguan Ministry of Social Affairs, in its 1998 report on poverty, showed that in the Pacific region, the percentage of the urban population in poverty grew from 28.1% in 1995 to 39.6%, while the rural population in poverty reduced from 70.7% to 67.1%. Also, 84% of the urban poor and 97% of the rural poor use fuelwood for home cooking. On the health side, the report mentions that acute respiratory infections among infants was the second leading cause of deaths (after diarrhea), the risk of which is increased by woodsmoke exposure.

The National Energy Commission's (CNE's) EMOLEP project estimated that by the year 2010, at least 20% of urban households in the Pacific region will continue to use fuelwood. This will be due to saturation of LPG market penetration, limited by various factors such as restricted socio-economic development of Nicaragua, cultural traditions, and even more by other factors such as economic depression, higher international oil prices, serious problems with LPG imports and/or restrictive government policies. Indeed, since EMOLEP's formulation in July 1999, international oil prices have more than doubled, from 12 to over 30 dollars per barrel, and LPG distribution in Nicaragua has gone through many crises, increasing scarcity and prices, and deteriorating consumer confidence.

SUSTAINABLE DEVELOPMENT ISSUES ADDRESSED

The problems facing the fuelwood sector in Nicaragua can be summarized as being very under-developed. First, almost all harvest or production is based on non-sustainable forestry and second, almost all fuelwood consumed is based on low efficiency stoves. In neither case is there any satisfactory regulation, control, incentives or any planning for the supply side. Despite fuelwood being the major energy source and forest product of Nicaragua, and strongly linked to the poor, there is no government agency whose priority concern is the planning and modernization of this sector.

In the case of the household demand side with woodstoves, recent studies done by the CNE within EMOLEP (1999) show that less than 5% of fuelwood users in the Pacific region are aware of improved woodstoves which can reduce fuel consumption as well indoor emissions. However, the same study showed that the overall efficiency of so-called improved woodstoves in the region was very poor (12.1%) and below that of traditional open fires like "three-stones" or U shaped semi-closed fires (14.9%).

The improved woodstove model most widely disseminated in the region is the CETA model, which was first developed in Guatemala by ICAITI³ and later adapted for use in Nicaragua by DINOT⁴. Field surveys of the performance of the CETA stove, which was disseminated by many Nicaraguan NGOs, show that many of these stoves, usually made by local artisans, tend to deviate from the original design, lack of quality control and monitoring, are not properly finished, and use low quality materials. These factors combine with often inappropriate operation, resulting in poor efficiency. However, due to the presence of a chimney, these stoves do generally achieve a significant reduction in indoor emissions of carbon monoxide and particulates, in some cases reaching indoor levels near to those acceptable by the World Health Organization.

Furthermore, EMOLEP pointed out that the reasons for the limited dissemination of improved woodstoves in the Pacific region are the geographical restriction of programmes to areas where NGOs and projects are operating, the lack of widespread commercially available models and/or specialized masons for construction, lack of mass promotion, and lack of financial incentives.

OBJECTIVES

The purpose of this program is to modernize the use of fuelwood as a household fuel, through the introduction of a new improved woodstove called the “EcoStove” (economical and ecological), with the following advantages:

- Significant improvement of fuel efficiency, by reducing fuelwood consumption by an average of 45%
- Significant improvement of indoor air quality (and therefore of health), by dramatically reducing indoor smoke pollution
- Improved women’s working conditions, by allowing multiple cooking tasks simultaneously, keeping pots and pans free of soot, and a compact, portable and better looking stove.

IMPLEMENTATION

PROLEÑA, since 1995, has been pursuing the development of a new woodstove which could address the main concerns about traditional woodstoves, such as high fuel consumption and indoor smoke pollution. From the CETA stove model (an in-line 3 burner stove) which is used in Honduras, PROLEÑA introduced a metal griddle cooking surface which could avoid leakage of smoke indoors. In addition, the griddle or “plancha” allows cooking directly on it, like the “tortillas”, a basic element of the diet of Meso America, as well as cooking with multiple pots, at the same time keeping the pots free from soot. The result was favorable, since Honduran women liked the smoke and soot-free characteristics of the plancha stoves. However, as expected, this stove was not as efficient as the CETA or even the open fire, due to radiation losses from the griddle.

In its efforts to produce a better stove, PROLEÑA with financial support from Trees, Water and People (a US NGO), invited, in the aftermath of hurricane Mitch which hit Honduras and Nicaragua in 1998, a group of volunteers from the APROVECHO Research Center in Oregon, USA. They visited PROLEÑA communities in Honduras and investigated the possibility of using the highly efficient Rocket woodstove to improve efficiency of local woodstoves in Honduras. The Rocket stove is a simple chimney-less wood burning device developed by Dr. Larry Winiarsky in the early 1980’s in the USA. This stove follows a number of principles to achieve increased combustion and improved heat transfer. Unlike high mass stoves that absorb heat from the fire, the Rocket stove body is a low-mass insulated stove that is designed to maximize combustion chamber temperatures, increase combustion, and direct the hot flue gases to the pot. In Nicaragua it uses pumice stone as the low mass insulator. It is designed to burn only the ends of the wood and to limit the amount of particle fuel in the combustion zone. This reduces the rate of oil vapour (smoke) production to a volume that is more easily combusted.

OUTCOME AND IMPACTS

APROVECHO’s team observed that women liked the smoke and soot-free features of the Plancha stove, and decided to combine both stoves, calling it, at first, the “Justa Stove”. The Justa Stove is a combination of the Rocket stove’s fuel-efficient combustion chamber with the user friendly attributes of the Honduran Plancha stove. This new stove, although not as efficient as the single-pot Rocket stove, produced a *higher efficiency* than the three stone fire. Furthermore, it provides a *smoke-free* indoor environment, thereby contributing to improved health, keeps *the pots*

³ ICAITI: Central American Institute for Research in Industrial Technology, based in Guatemala

⁴ DINOT: Department of Research and Technological Approach of the UNI- National Engineering University of Nicaragua.

free of soot, allows for the *cooking of multiple pots* at the same time, *and improves the appearance* and aesthetics of the kitchen.

The Justa Stove utilizes the same principles of the Rocket stove and more:

- totally encloses the fire and its emissions, while not obstructing the combustion dynamics. It maintains approximately the same cross-sectional area for the passage of hot flue gases through the combustion chamber, metal cooking surface, and external chimney.
- promotes heat transfer by forcing the hot flue gases to circulate under all the metal cooking surface, ensuring contact and increased heat transfer by the use of fins attached to it.
- channels all the smoke out through the chimney.

The great impact of the Justa Stove was to overcome the main negative features of traditional woodstoves, such as poor efficiency and indoor air pollution. The Justa Stove reduced fuelwood consumption by an average of 45%, resulting also in no noticeable indoor air pollution. In addition, the Justa Stove retained the good features of the plancha stove, such as multiple pot and food cooking, direct cooking on the plancha, and soot free pots. An additional advantage was the significant improvement in family quality of life (less fuelwood expenditure or collection time) and working conditions for the women (smoke and soot free environment).

However, the Justa Stove was being produced in the same traditional custom-made way, with a brick frame, the construction of which required the hiring of a specialized mason. Woodstove evaluation carried out in Nicaragua under EMOLEP, had concluded that all brick frame woodstoves promoted during the 80's and 90's had suffered from low performance due to poor quality control, and poor dissemination. With this in mind, in early 2000, PROLEÑA/Nicaragua started producing the Justa Stove with a metal frame instead, which resulted in a compact, portable, better looking and more marketable product. Furthermore, it could be mass produced by specialized metalshops or assembly plants, guaranteeing quality and good performance, and above all, a potential for cost-reduction. This new stove was renamed the EcoStove in Nicaragua, due its sound economical and ecological features.

PROGRAM STATUS

In Honduras PROLEÑA and another local NGO called ADHESA, has produced over 400 Justa stoves since 1999. In Nicaragua PROLEÑA has produced over 150 EcoStoves during the year 2000 in a pilot assembly plant, including some models with an oven inserted. However, two factors still hinder limiting the promotion of the EcoStoves: first the cultural barrier of some traditional open fire users, who refuse to accept the new technology; and second, its price of US\$60, which is a prohibitive price for many traditional fuelwood user households. To overcome these barriers to the rapid dissemination of the EcoStove, PROLEÑA is pursuing a project with financing from USAID, aimed at disseminating around 8 000 EcoStoves in the Pacific region of Nicaragua by 2002. The project is currently being implemented and will utilise an integrated strategy:

1. Establish a well equipped assembly plant to consolidate the technology and supply the initial market demand,
2. Promote the new EcoStove among NGOs and development projects with household energy components,
3. Implement a media campaign in radio, newspapers and TV, promoting the new features of the EcoStove and motivating fuelwood consumers for woodstove modernization.
4. Create a network among the main public markets of the region, to distribute the EcoStove commercially.
5. Channel most of the commercialization through microcredit financing agencies, which are very common in the region, and will facilitate sales to poor families.
6. Transfer the technology to 2 or 3 other regional assembly plants, to create a competitive supply market.

In a parallel initiative, PROLEÑA is joining forces with the National Energy Commission of Nicaragua, a government energy planning agency, to rapidly disseminate the technology into small household businesses such as tortilla and food preparation establishments in the Pacific region, and with financial support from the Brazilian Cooperation Agency, to transfer the technology to a Brazilian university, for future dissemination into rural areas of the Minas Gerais state in Brazil.

Furthermore, PROLEÑA/Nicaragua has requested technical assistance from ESMAP, a joint World Bank and UNDP energy assistance program, to help with further development of the EcoStove design, and to evolve the business and

marketing strategies. The assistance will also include technology transfer to Honduras and other neighbouring countries. This request has been approved and it is expected to be implemented by early 2001.

REPLICABILITY

The EcoStove dissemination strategy could be implemented in neighboring countries such Honduras, El Salvador, Guatemala and southern Mexico. Similar cooking habits and socio-cultural conditions in these regions favour the acceptance and dissemination of the EcoStove. Furthermore, it is expected that in parts of South America, such as Brazil and other countries, the EcoStove could also be successfully implemented, given that its technology is more modern than existing improved woodstoves used in that region. In other parts of the world such as Africa and Asia, where fuelwood is also a common household fuel, detailed socio-cultural and logistical evaluations should be done to assess its market potential.

LESSONS LEARNED

The main lessons learned through the process of developing the EcoStove are the following:

1. The fuelwood sector has traditionally been neglected by the government forestry and energy agencies in Honduras, Nicaragua, and in many other countries. Although being the major energy source, forestry product and the energy for the majority of the poor, no government agency is concerned with its planning and modernization, as they are with other energy sources as petroleum and electricity, or other forestry products such as timber, conservation and ecotourism. The role of a dedicated and professional NGO to fulfill this government inaction regarding fuelwood, can produce excellent results, as shown by PROLEÑA in Honduras and in Nicaragua.
2. The role of collaboration between north and south NGOs is important, as occurred in this case amongst PROLEÑA, Trees Water and People, and APROVECHO. A joint effort by all these volunteers and low budget organizations can produce excellent results when work is done with perseverance, clear goals and self-motivation.
3. The role of the internet is significant, since the connection between these 3 NGOs mentioned above, was only possible through a woodstove discussion group which has been underway on in the internet since 1994.
4. Cooking with fuelwood does not have to be a contaminating task. With a simple but well designed appliance, wood cooking can be clean, efficient and practical, making it more desirable and compatible with life in the 21st century. In Nicaragua it has been observed that many wealthy families buy an EcoStove to use for entertaining or barbecuing in their modern houses.
5. The failure of many improved woodstove projects in Latin America in the past is related to the insistence by stove designers and development workers on fuel efficiency to save trees, and self construction technologies. The new EcoStove approach compromises on some of the efficiency in favour of other valuable features such as a smoke and soot free kitchen, and mass produced high quality stoves, and has resulted in a well accepted technology for people from all levels of economic status, and rapid dissemination.



FURTHER INFORMATION

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