

Fuel briquettes as a sustainable economic alternative to deforestation in the Lake Malawi eco-region

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Lake Malawi National Park (LMNP), designated in 1986 by UNESCO as a World Heritage Site, is seriously threatened by deforestation. In Malawi over 90% of the population uses wood for domestic energy consumption [1] and wood provides for approximately 80% of Malawi's energy needs [2]. The trade in firewood in all regions has accelerated deforestation throughout the country [3] and one of the recommendations of the LMNP's Management Plan [4] was to promote appropriate technology that would be sustainable, economic and also compatible with the rural culture [5]. Thus, World Wildlife Fund (WWF), commissioned a study into the production, sale and use of fuel briquettes made from organic waste material.

The 2001 study took place in Chembe village, the most populated village in Malawi (circa 10,000) and situated adjacent to LMNP (see www.sustdev.org for map). Approximately 3–5 tons of firewood (from LMNP) were being used daily – based on the consumption of 800 families, and women were having to walk ever greater distances (average 2–3 km) for the collection of firewood. After consultation with the Chembe Trust, a team of six women (Figure 1) was established to develop a series of experiments in briquette-making.

Saving Malawi's forests

Earlier studies of fuel briquettes utilisation noted the reluctance of Malawians to relinquish their traditional wood and charcoal fuels. Since women gather the fuel and cook the family meal our study paid special attention to their needs and habits (Figure 2).

The major constraint in adopting alternative fuels is to convince villagers that the use of apparently 'no cost' wood was not sustainable. Henceforth, this technology would need to be promoted and popularised within the cultural construct of the local rural communities – living within and adjacent to LMNP.

Deforestation is threatening much of the Lake Malawi Watershed Eco-region as a growing population depends upon its finite forest resources. Environmental degradation has been estimated to cost Malawi about 243 million US dollars annually, or 12% of its GDP [5]. Therefore, with support from WWF, we attempted to find an alternative fuel source for cooking (Figure 3), using the abundant local waste vegetation – namely grass, cornstalks and deciduous tree leaves.

The project's objectives were to:

- convert organic biomass in LMNP into solid fuel briquettes



Figure 1. Chembe Village women's briquette team

- produce a uniform product that could be easily transported and stored
- improve the combustion efficiency of the traditional method of using wood and briquettes in an open fire by developing a simple, inexpensive stove
- design a low-cost lever system for compressing the biomass into briquettes
- encourage the villagers to utilise waste grass and corn stalks, and not to burn their fields or bush areas
- encourage the development of briquettes within the traditional working techniques and seasonal timetables of women
- carry out a survey of the community and determine acceptable purchase and sale prices of briquettes and their small-business potential
- determine methods for minimising the costs of making briquettes

The fuel briquette-making process

Fuel briquettes can be made from most organic materials such as sawdust, coconut and groundnut shells, grass, leaves, animal dung, waste paper and



Figure 2. Women carrying fuel wood from Lake Malawi National Park



Figure 3. Traditional cooking with wood fuel

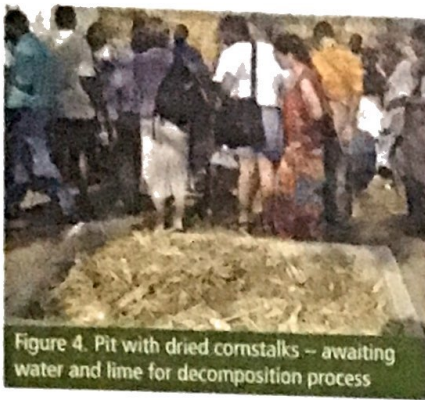


Figure 4. Pit with dried cornstalks – awaiting water and lime for decomposition process

cornhusks (Figure 4).

These waste materials are compressed into a high-density form that can easily be transported and substituted for conventional fuel such as charcoal and firewood. The collected material is softened into a pulpy mass by the process known as retting (Figure 5).

Between 6–21 days later, it was lifted out of the pits, rinsed and pounded with a pestle in the traditional African wooden mortar used to grind corn (Figure 6).

We developed a simple, inexpensive lever press for compressing the waste into a metal cylindrical mould, using a long wooden pole (See www.sustdev.org for diagram).

Wet briquettes were removed from the cylindrical mould and placed onto a wire rack, which was traditionally used for drying fish. They were left to dry for 2–7 days.

Design of stoves and cooking efficiency

A simple cement stove was designed, using a plastic bucket and the briquette-making cylinder as a mould, allowing the central cylindrical hollow of the stove to fit two briquettes, which would cook the family meal (Figure 7).

The average burning time for a



Figure 5. Retting pits – wooden lids lined with plastic retain moisture and keep out vermin

briquette was approximately 8 min. for each 100 grams of dry weight material in the briquette (Figure 8).

Table 1 gives the gross energy (calories/g) that was determined from averaging three runs (runs were within 50 calories). Samples were compared on a dry matter basis.

Our experimental data indicate that the dried briquettes have energy value, per gram, equal to or greater than the collected wood.

Detailed surveys of local families in Chembe Village

Portable cement stoves and briquettes were given to 48 families for use during a two-week period. We requested information on their consumption of firewood; how they obtained it, their

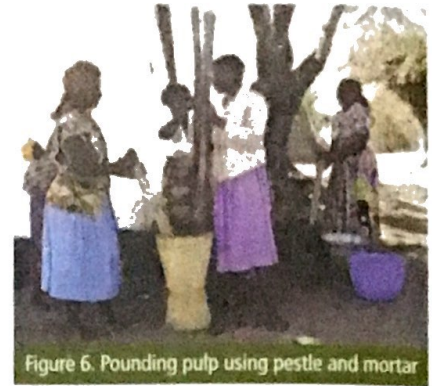


Figure 6. Pounding pulp using pestle and mortar

opinion on briquettes and stove, as well as the price they would pay for and sell such briquettes. Not surprisingly, our survey revealed a statistical difference in the manner by which families of different livelihoods obtained wood. Almost 60% of the salaried families bought wood, whereas, for those farming or fishing families, all but one collected wood (See www.sustdev.org for table).

Forty-four families stated that they were interested in utilising briquettes instead of wood. An initial price of 3K (US \$0.05) would allow for the majority of families to both buy briquettes, as well as produce and sell them (Figure 9).

The average family thought they would use approximately 12 briquettes a day.

TABLE 1. ENERGY IN ORGANIC WASTE BRIQUETTES			
Waste material	Gross calories/g	Water content %	Calories/g dry
50% waste paper and 50% corn	3732	7.96	4055
Cotton	3918	6.66	4198
Corn stalks	3566	7.12	3840
Leaves	2891	6.79	3102
Cattle dung	2208	5.39	2334



Figure 7. Cooking with fuel briquettes on a cement stove

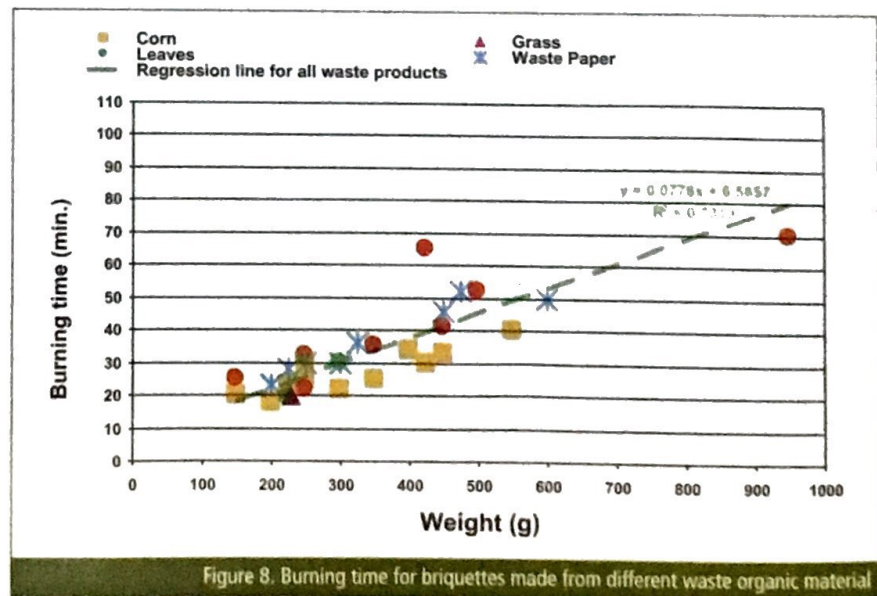


Figure 8. Burning time for briquettes made from different waste organic material

Conclusion

To replace firewood consumption completely, approximately 10,000 briquettes would be required daily. Given that an average worker can produce 100 briquettes a day, employment could be created for 100 individuals earning 200–300 K daily. A single worker could earn in one month what the average annual per capita expenditure has been in a year [7]. Therefore, a single woman, with five children, making briquettes during 50% of her time, could easily support her family for the entire year.

The production of briquettes and stoves would create new job opportunities, generating income for single women who head households; reduce time spent collecting fuel; reduce accidents from open fires, and create a safer cooking environment; reduce law-enforcement conflicts; reduce disturbance to wildlife and allow natural processes to develop within LMNP forests; reduce deforestation, reduce soil erosion, siltation and pollution of Lake Malawi due to excessive soil runoff; enhance tourism by lessening environmental degradation, both on land and in the lake and thereby increasing job opportunities in this economic sector; and reduce smoke in the local environment from bush fires and CO₂ production into the atmosphere.

The data from this study are encouraging. Undoubtedly, a significant proportion of the village could convert to this ecologically sustainable fuel source. Small micro enterprise loans and support from donor agencies (to

establish retting pits, provide seed money for stoves, simple lever presses and moulds for the briquettes) would be helpful in establishing small family businesses. At a price of 3 K (\$0.05), over half of the population would purchase briquettes and there would be a large pool of possible producers.

Theoretically, the briquettes made from organic waste and burned in the cement stoves are both more energy-efficient, cheaper and ultimately easier to obtain than the alternative wood fuel source in LMNP

The experiments in briquette-making demonstrated that its calorific value and market value compared favourably with wood fuel [8]. In addition, the raw materials were close to hand and the production technology of briquettes was relatively simple and inexpensive. The handicapped and elderly members of the community would benefit from a cheaper source of fuel.

However, questions were raised, such as the seasonality of production. This could not conflict with the planting and harvesting of corn. In addition, collection of raw materials would have to be made during the dry season. Production would be less efficient during the rainy season. Traditionally, women fetch wood for fuel either alone or in groups. While this was time-consuming, the fuel-gathering excursion could be a relaxing break from family pressures. Should the Chembe Trust, on

a larger scale, organise briquette-production or should there be a series of smaller production units operated by individual families?

The question of cost and running a briquette-making business also raised gender issues. Hitherto, Malawi custom dictated that the wife had to turn over her income to her husband – who may or may not spend it wisely. Single women with dependents would not have such a constraint and would be more likely to be motivated to run a business than their married sisters.

Theoretically, the briquettes made from organic waste and burned in the cement stoves are both more energy-efficient, cheaper and ultimately easier to obtain than the alternative wood fuel source in LMNP. Nevertheless, our briquette-making experiment was only a pilot project. Undoubtedly, further research would be needed to gather more accurate information about the viability of briquette production as well as, most importantly, its cultural acceptance. Poverty has played a significant role in environmental degradation [9]. Any attempts to improve the standard of living of the villagers living within LMNP, in a sustainable, environmentally sound manner, should be welcomed. A major economic benefit to the community could be ecotourism – if the unique, natural beauty of LMNP were to be maintained. At the same time, educating the population on ways to create and use these briquettes could make an important contribution towards the protection of natural resources in the Lake Malawi Watershed Ecoregion.

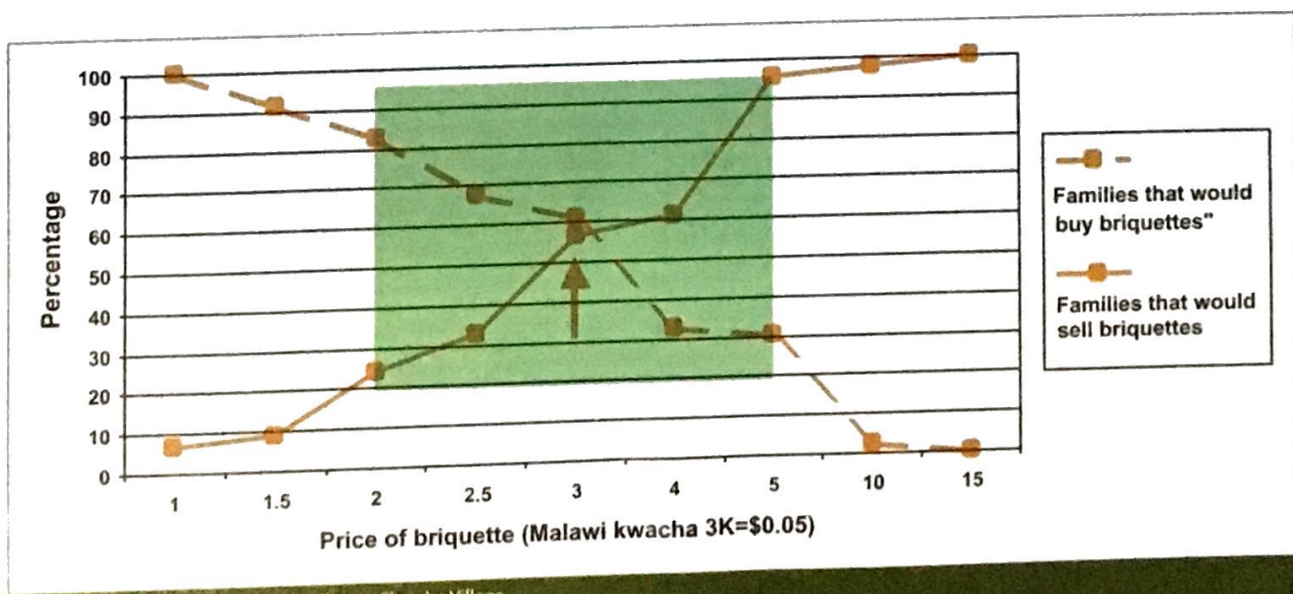


Figure 9. Pricing of briquettes by families in Chembe Village. The arrow signifies that 3 K would be a good price for initial marketing of briquettes

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Dr. Kenneth McKaye has dedicated 25 years to studying the fishes of Lake Malawi, while working with the local populace for the conservation of this important natural resource. He initiated the movement to name LMNP as a UNESCO World Heritage Site in the early 1980's and his data were successfully presented by WWF to justify the World Heritage designation for LMNP.

Mr. Joseph Mponda began working with the Lake Malawi Fisheries Research Project in 1979 as a Scuba diver. He is now a well recognised artist and educator and is Project Manager of the WWF Chembe Village Conservation and Economic Development Project.

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