# THE DEVELOPMENT, PLANNING AND DISSEMINATION OF WOOD/CHARCOAL UTILISING COOKING DEVICES

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## ABSTRACT

To ensure meaningful fuelwood conservation, the rural people must be persuaded to abandon the use of fuel-inefficient open hearths which are widely used in the rural areas. The development and diffusion of a fuel efficient woodstove in rural areas is described. The aim of the strategy is not only to familiarise the rural people with a new and beneficial technology but to satisfy national objectives of a. fuelwood/environmental conservation; b. alleviation of felt hardships; and c. employment generation.

## DEVELOPMENT OF EFFICIENT COOKING DEVICES

The first and important use of wood in rural (communal) areas is as a source of energy for cooking. The traditional open fire has many disadvantages:

1. fire hazards
2. smoke in the home during cooking
3. constant attention of fire during cooking
4. uncontrolled draughts that increase wood consumption
5. cooking at ground level that gives rise to unhygienic cooking conditions.

A rural survey to assess needs in 1980, revealed that rural people were facing acute hardships through fuelwood shortages. Wood collection had increased to well over 10 man-hours per week and household incomes were being diverted to the purchase of fuelwood.

Following the survey, recommendations were presented defining the type of cooking device desired to alleviate hardships. The Department therefore researched into a reasonably priced woodstove that could meet the stated desires for safety, durability and multiple cooking.

### Design features of the stove

The stove consisted of a metal chimney; a metal grate; a metal damper (for control of draughts through the chimney); a cast iron hot plate (or a hole for a hot water utensil); and a body constructed of fired brick.

### Choice of brick over metal

Although an earlier survey had shown that metal stoves (mbauras) were fuel-efficient, the brick stoves were seen to have these advantages over metal stoves:-

i. Cheap to construct in rural areas.

ii. Retain heat for longer periods of time than metal stoves.

iii. Bulky but static and therefore safe to use even by children.

The Department of Energy Development therefore improved on a series of Herl-Chulas (Hyderabad 1956) by incorporating a grate, chimney, damper and baffles into the body of the stove for test purposes. Six designs were compared for efficiency of heat utilisation and fuel saving as described below (Seke Woodstove Project, 1982).

**Determination of heat efficiency**

The time and fuel required to evaporate 1 litre of water and the amount of fuel used to bring water to boiling point were recorded. The calorific values of fuel used and moisture content of wood were determined. The efficiency was calculated from the calorific values of heat utilised and calorific value of fuel burnt. The mean of four estimates obtained for each stove was taken as the average efficiency. The equation for determining efficiency is

$$\text{Efficiency of design} = \frac{\text{useful heat used to boil water}}{\text{heat supplied by fuel}}$$

That is, is specific heat capacity of water times amount of water in vessel times temperature rises plus latent heat of steam times quantity of water boiled off divided by calorific value of fuel times quantity of fuel used.

The results are as follows:

| Stove design | | | Efficiency (%) |
|---|---|---|---|
| Stove 1 | - | a brick stove (2 pot holes) | 5 |
| Stove 2 | - | a brick stove (3 pot holes) | 18 |
| Stove 3 | - | modified Nepal Chula (Khatmandu, 1980) | 20 |
| Stove 4 | - | modified smokeless stove (Ghana) | - |
| Stove 5 | - | modified Herl-Chula (3 pot holes) | 33 |
| Stove 6 | - | modified Junagadh Chula (Research Action Institute Lucknow 1967) (2 pot holes) | 19 |

## Conclusion

Stove 5 had the highest heat utilisation efficiency (33%) and achieved a 30% fuel saving.

## Charcoal stove

Although a brick stove was selected for the rural areas, a metal charcoal stove has been designed for use in urban areas. This stove, 'Manyekera', has two pot holes and an air pump to assist the ignition of charcoal. The stove was developed by a private company in Zimbabwe and is marketed through some retail outlets. The efficiency of the stove is 45% but its use at this stage is limited because charcoal is not used widely for cooking in Zimbabwe.

The stove will, however, form part of the charcoal programme initiated by the Energy Department. The programme aims to promote the sale of commercially produced charcoal to urban and peri-urban households as a drive to discourage the use of wood by this sector.

## EFFICIENCY OF OBJECTIVE ACHIEVEMENT BY ENERGY CONSERVATION PROJECTS

Efficiency of objective achievement of a project, that is, the extent to which a project converts available scarce resources into objectives or goals, has to be undertaken during the planning of energy projects. These objectives can be divided into either sectoral or national goals, because these distinct parties attach different weights to each of the stated objectives. A project should therefore be implemented as a compromise of the objectives of all sub-systems (rural communities, local authorities and the national government).

## Resources as part of the objective achievement of projects

Resource analysis is important since the resources available will control the type and level of activities and hence goals that might be achieved. Resources include

i. finance

ii. manpower

iii. physical site specific resources (land, water, animal waste, etc.)

iv. implementation capacity (which is an aggregation of all resources that are consumed by the project including the degree of cooperation between various interested parties).

In the field of development or conservation of energy, several projects (biogas, solar devices, afforestation, woodstoves etc) can compete for the available resources. Therefore a ranking order of projects based on relative efficiency of objective achievement is essential. The initial step therefore is to determine goal achievement by a project thus:

Achievement of objective by project using a specific resource(s) = $\frac{\text{Consumption of resource(s)}}{\text{objective(s)}} = A$

Relative efficiency of objective achievement by project = $\frac{A}{A \max}$

where A max is the highest value of A for all given projects.

Objectives can be: i. self-sufficiency in energy (sectoral and national goals); employment generation (sectoral and national); hot water at specified times (sectoral) etc. The ranking of projects is only possible after the calculation of relative efficiency of objective achievement for each project.

Cost/benefit analysis

Efficiency of objective achievement can also be measured by undertaking a cost/benefit analysis of each project. In this analysis, it is not useful to use market prices as other costs, for example, use of foreign currency in a project has an economic cost to the nation. Therefore costs of projects, where necessary should be estimated at shadow prices ie scarcity value of components of a projects.

Benefits are usually more difficult to quantitate unless income generation accrues from a project. Social benefits on the other hand can be measured indirectly as gains in other directions.

The present net value of a project arises from the determination of net benefits over a stipulated period period of time, ie

$$\frac{\text{Net Benefits}}{\text{time}} = \frac{\text{Benefits - Costs}}{\text{time}}$$

A project with a high net present value and a high relative efficiency of objective achievement will therefore be the most attractive option. When costs of a project outweight benefits, this project is said to be economically inefficient.

**SELECTION OF PROJECTS THAT CONSERVE WOOD**

The objective of the Zimbabwean government is to ensure energy conservation particularly of wood. Various strategies to achieve this objective have been attempted and these are:

a. development of new and renewable energy systems,

b. rural afforestation,

c. conservation of wood via the use of wood stoves,

d. conservation of wood via use of charcoal.

In the area of direct wood conservation, the projects c and d compete for the same scarce resources - manpower, wood and finance. However, as outlined below they do not make equal claims on these resources.

**Finance**

Because the charcoal project depends on the design and marketing of a metal charcoal stove it is a more expensive option than the wood stove programme which depends on owner-built stoves made out of local materials such as brick, sand and scrap metal.

**Wood**

Although both projects have a claim on wood, charcoal production is inefficient (25%) use of wood.

**Manpower**

The charcoal project requires a higher level of demand for manpower for example with marketing skills.

The relative efficiency of objective achievement demands that projects consume scarce resources at a low rate or that they do not place great claims on resources. This would indicate that the woodstove project has a higher objective achievement than the charcoal project.

Thus, although both projects are required for the national objective of wood conservation, the woodstove project has been given a higher priority.

The development of energy systems destined for the rural areas has to take cognisance of the fact that rural areas are economically poor and that adoption of technologies is dependent on the costs of the technologies.

Technologies that require large inputs of initial capital investment are destined to be unacceptable by the rural people. Cost reduction via local production of components may reduce the claim on finance and thus aid adoption.

If a technology, by its nature, has a high claim on a site specific resource, the option to exploit this technology has to be weighed against other competing technologies. In other words, the choice for this technology or project or strategy has to be justified by either cost/benefit or resource analyses. If resources are scarce, implementation capacity of the executing agency becomes low and objective achievement is low.

The woodstove programme in Zimbabwe has therefore been revised to include local production of stove components by local labour to not only reduce the claim on finance available, but to reduce the claim on skilled labour. The establishment of local production units (energy centres) has been incorporated into the woodstove programme.

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