Burning Issues: Implementing Pilot Stove Programmes, a Guide for Eastern Africa

by Stephen Joseph and Philip Hassrick

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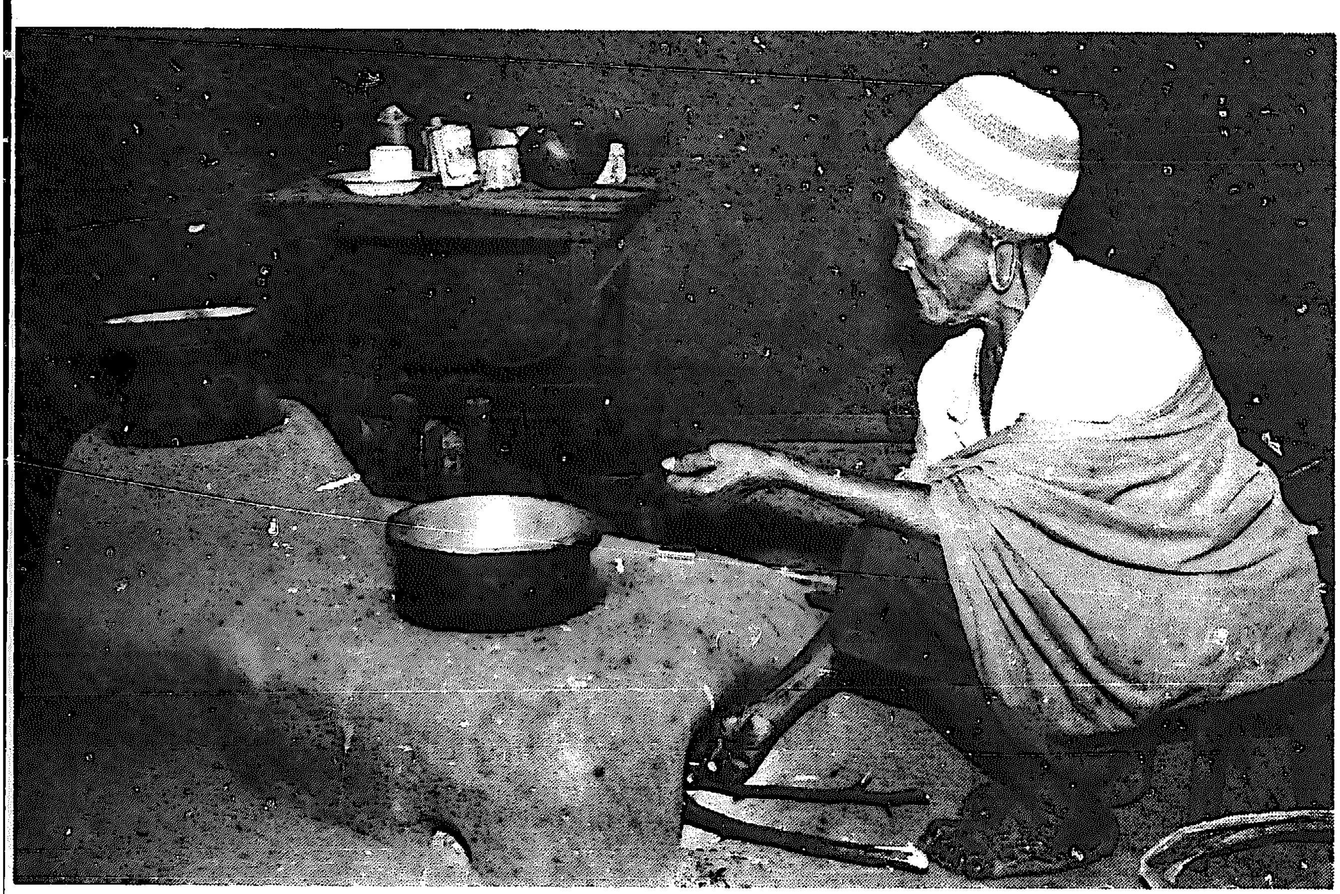
A Guide for Eastern Africa

Stephen Joseph and Philip Hassrick



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INTRODUCTION

Over the past three years the Technology Support Section of UNICEF's Eastern Africa Regional Office (EARO) has been working with UNICEF country programmes and governments to develop stoves that are suitable for the local economic, social and cultural environment. UNICEF had been able to provide numerous reports on how to design and test stoves, but does not have detailed information on how to plan, manage and implement pilot projects. The principle objective of this publication is to guide project directions through the planning process. It is also hoped it will be useful for administrators in other development agencies which have an involvement in energy and women's development. It is based on the experience of the UNICEF projects in Kenya and Ethiopia, the projects in Kenya, Gambia, Tanzania, Sri Lanka, Nepal and Indonesia who have been collaborating with the Intermediate Technology Development Group (ITDG), the work of CILSS in the Sahelian countries, and the projects in Lesotho, Senegal, and Kenya that have been assisted by Aprovecho.

The book principally addresses those people working in Eastern Africa. Where possible, examples are given from the Eastern Africa region, and then, as necessary, the book draws on material and experiences from other projects in Western Africa, Asia, and Latin America. Hypothetical case studies are used to help planners formulate their own plan and structure appropriate to their own situation. They are used when relevant case studies are not available. Considerable emphasis has been placed on describing how improved charcoal stoves can be introduced into urban areas since widespread use of charcoal is common throughout the Eastern Africa region. Much of the information presented is applicable (with modification) to other regions and it is hoped that the publication will be of use to a wider audience.

Subject areas of stove design, construction, and testing are well covered in the current literature, and selected references are provided. In this book, planning, needs assessment, matching technology to needs, and monitoring and evaluation are covered in much more depth.

The book has been split into four sections. The first sets the context and explores the potential benefits from, and constraints encountered in, implementing a project. The second section covers planning and implementation, and the third section explores the different types of assessment undertaken during the project. The final section outlines how the transition is made from a pilot project to larger scale replication. Each section is intended to be self-contained, so there is some repetition.

In describing the implementation, we have outlined three strategies that can be used. To help planners, an example of each of these is resourced and scheduled. Personnel selection, training and follow up is covered in depth, and establishing effective communication (both within and external to the project) are discussed.

In separating assessment from implementation, we are trying to emphasize three points. Assessment of needs and acceptability, demand, and impact is the main aim of a pilot project. Assessment is an ongoing process that takes place throughout the project: i.e. needs assessment does not stop when design work begins. Assessment is also one of the main tools used for effective management.

The final section details the steps that may be necessary before replication of the technologies occurs on a much wider scale. This includes making the case to governments, donors, commercial enterprises, and non-governmental organizations to support/implement the programmes/ projects, and planning for these programmes.

Technology push versus technology pull

Within a society, there will be differing individual needs (both physical and non-physical) and national needs, and different priorities given by different people and groups of people to these needs. In respect to fuel and hygiene, the national need may differ from many individual needs. It is quite probable that the need at a national level to introduce stoves is greater than at the individual level. To create an effective demand for the stove, the policy makers have the option of creating a need at an individual level by either changing energy pricing structures, subsidizing the stove or supporting a large scale promotion campaign. (This is known as technology push.)

Alternatively, the needs of individuals can be assessed and given priority. For example, if they have a low priority for fuel saving or improved kitchen environment, but a high priority for a greater water supply, then a stove is not provided; i.e. stoves are not always a high priority for individuals and thus they may not want to purchase or participate in the project.

Objectives of a project are determined by national needs or individual needs or a combination of the two. Objectives will in turn primarily determine the method of introduction.

It is often easy to create a demand by advertising, but to create an effective demand (i.e.

people acquiring) is much more difficult. Recent work by Freeman and others indicate that innovations are more likely to be quickly disseminated if there is a 'pull', if people see net positive benefit and desire the technology.

Technology pull requires a very different approach to the generation of technologies. The users must first of all perceive that, for example, deforestation, smoke in the kitchen and hygiene are crucial factors in their survival. They must be able to decide whether putting resources into this programme will have greater returns than into an alternative programme.

The type of technology developed and its method of testing will be partly decided by users and/or organizations representing users. The method of manufacture will be developed with local artisans, small business entrepreneurs or with selected members of the community who may want to be trained as stove artisans. The community is involved in the assessment work and helps develop the promotion of the training programme. This type of development is much more applicable to rural areas than urban.

In urban areas advertizing can be used to create an effective demand. People can be induced or pushed to purchase the stove (if it does perform better than the existing model and is not priced outside the financial capability of most of the potential users).

SECTION 1: THE CONTEXT

1.1 THE NEED

Studies by the Beijer Institute (1982) and Digernes (1981) have highlighted the problem for many people in Eastern Africa in the collection or purchase of fuel. This has been particularly acute for people living in urban areas. Land around cities and towns has been denuded of trees for use as a domestic fuel. The loss of tree cover is leading to deforestation (FRIDA 1980). The need for urgent action has now been recognized and numerous programmes have been started in the East Africa region, either to increase the supply of fuel or to increase the conversion efficiency of kilns, furnaces and stoves. The potential effect of alterations in stove efficiency on domestic energy consumption as well as rates of deforestation has been emphasized frequently, while other writers have highlighted the potential benefits to women of improved stoves.

Before implementing a stove project it is important to understand clearly the potential benefits for both the nation as a whole, as well as for communities and individuals. Once these benefits are understood it is necessary to realize the constraints, and costs, that may prevent these benefits being realized. Once the benefits and costs are clearly understood it is easier to set realistic project objectives and to design projects that can meet these objectives.

1. Potential benefits that accrue to the individual

Tests in controlled burning and the boiling of water undertaken by Yameogo (1983) and at Kenyatta University (Kapiyo 1983) have indicated that stoves have the potential to reduce fuel consumption by up to 40%. A field survey carried out by KENGO in 1983 has indicated that improved charcoal stoves are reducing the average consumption by 30-40%. In areas where fuel is purchased this can lead to savings of income of up to 12% (Kanti and Koech 1982). Considerable time collecting fuel could also be saved. In a survey in Sri Lanka (Howes et al, 1983) it was also apparent that users perceived considerable savings in cooking time; this was seen as a real benefit as they could reallocate this time to other activities. Kapiyo (1983) has suggested that new stoves can reduce the number of accidental burns to children, both from fire itself and scalding from boiling liquids. The kitchen environment can be improved by reducing or eliminating the level of pollutants, and this in turn may lead to a decrease in eye and lung disease. Improved stoves can also make it easier to burn low quality fuels, while some women have reported (Kapiyo 1983) that properly designed stoves have reduced the physical effort involved in tending the fire and stirring the food.

2. Potential benefits that accrue to the community

Involving local organizations (especially women's groups) in the design and dissemination process can both lead to the creation of employment locally and the generation of confidence to carry out further domestic technology programmes. (This certainly has been seen by the authors in the Karai stove project in Kenya.) The development of a new product can stimulate dying artisan industries (especially pottery industries whose traditional market, cooking pots, is being eroded by aluminium pots). In some cases there may be a need for a new small business to clean and repair stoves.

3. Potential benefits that accrue to the nation

Stove programmes can provide the stimulus for the planting of trees. The effect of planting trees is of course only seen over a relatively long period of time, while the impact on a family that adopts a superior new stove can be immediate. If their fuel consumption and cooking is positively affected it is probable that ordinary people will be more willing to invest time and money to plant trees for firewood. In addition, if consumption of charcoal can be greatly reduced in urban areas then the massive deforestation that has been observed could be reduced.

Fig. 1

1.2 CONSTRAINTS

We have already said that very few stove projects have been successfully implemented: there are many factors that affect the impact of stove projects, and the following are among the most important.

1. THE KITCHEN SYSTEM IS COMPLEX AND IS DIFFICULT TO CHANGE

The types of kitchens that exist in any society are extremely varied. The kitchen is the centre of household activities. It is a place not only for cooking and eating but where sometimes people sleep and events concerning both the family and community are discussed (Kizerbo, 1980). Grains, water and fuel can be stored in the kitchen, and the kitchen may be the centre of worship. In some societies men are excluded from the kitchen, in some women cook communally (Von Bulow, 1983). Some societies have two or three kitchens, some being an integral part of the house and others being separate. Some kitchens are made from long-lasting non-combustible materials and others are made from bamboo/wood and thatch. Some kitchens are outside, some are spacious and others are extremely small. Some are well ventilated and others have only a small door to allow smoke to exit. The decision to build a new kitchen, or to alter the external and internal design can rest with either or both males and females in the family (Von Bulow, 1983). The number and type of utensils and layout of a kitchen can be an indicator of a family's wealth or status. All these factors will affect the type of stove that will be acceptable and are explored in depth in Sec. 3.3.

2. THE EXISTING RANGE OF HEARTHS AND STOVES FULFIL MANY FUNCTIONS: IT IS THEREFORE DIFFICULT TO DESIGN STOVES THAT HAVE A SUPERIOR PERFORMANCE AND ARE ACCEPTABLE TO USERS

It is extremely important to understand and acknowledge both the strengths and weaknesses of existing hearths when designing new stoves. In Africa the most common stoves are the open fire place, made from stones, and the metal charcoal stove.

The open fireplace is an extremely flexible, simple, long-lasting, portable cooking device. The primary functions are cooking food, heating water, lighting, and in some places space heating. Fires also keep annoying insects away from the living area, dry crops and provide heat for both humans and animals. The fireplace will accommodate a large range of pot sizes and will burn a wide range and sizes of fuels. Again, the fire can be the centre of social discourse or worship (Gill, 1983).

The performance of open fires is, however, quite variable (Joseph et al, 1980). To use an open fire efficiently it is necessary to keep away all draughts and to control the fire carefully so that burning only takes place under the pot. It is often difficult to sustain a fire when wet wood or agricultural residues are used.

Many households have more than one fireplace and some have an open fire as well as a charcoal stove. This charcoal stove can also be used for burning small pieces of wood.

The charcoal stove is common in urban cooking. This is relatively cheap, portable, easy to use and provides heat. But heat lost from the metal walls around the area where charcoal is burning leads to poor combustion, carbon monoxide formation, and low rates of heat transfer to the pot.

3. THE STOVE DESIGN IS EXTREMELY DIFFICULT AND COMPLEX TO CREATE, UNDERSTAND OR CONSTRUCT

To develop new stoves or modify existing stoves requires inputs from trained stove designers, skilled artisans, social scientists, extension personnel, production and marketing experts and, most importantly, users. Innovations and modifications (of the design introduced in training) by craftspeople are inevitable, but short-term training is rarely, if ever, adequate to give artisans the background to do this effectively. The dimensional modification of even a few centimetres in the interior of a stove can markedly diminish its performance.

Programmes that have tried to introduce a stove developed in another area, without having carried out modification and testing, have not been successful.

4. THE DEVELOPMENT AND DISSEMINATION OF A STOVE DESIGN IS A PROCESS REQUIRING CONSIDERABLE RESOURCES

Developing a stove requires a carefully planned and well-managed project. The essential first step is to carry out a needs assessment/market survey to determine if stoves are required and what the criteria are that users expect the stoves to meet. (Stoves are not necessarily the answer!)

It is essential to know what materials are available for the construction and how the stove could be manufactured. Design criteria must be developed and the range of stoves should be built and tested in the laboratory. If these stoves meet performance and user criteria it is then necessary to field test a range of prototypes. This will involve establishing a small extension programme in a number of selected areas where the local population and development organizations see a need for improved stoves, or wish to gain experience in implementing rural technology programmes. The necessary extension personnel will need to be hired and trained to organize production, as well as training of recipients in use and maintenance of the stove. A number of different extension strategies may be used to determine which is the most effective method of disseminating information and in construction, marketing, and installation of stoves.

Monitoring of the programme will have to be organized so that designs can be modified if they have serious deficiencies. At the end of the field test programme it will be necessary to establish whether the stoves have been acceptable, what modifications they may need, what the demand for the stoves is, and how dissemination could proceed. Thus proper planning and management is essential.

5. DISSEMINATION STRATEGIES HAVE NOT TAKEN INTO ACCOUNT THE DIFFERENT ECONOMICS OF RURAL AND URBAN AREAS

Rural populations are scattered, and stoves can be difficult to market. In many places, people buy neither stoves or fuel; sometimes the cost is in terms of labour, but improved stoves usually cost money, and surplus income is not often available. Also many rural stoves that have been built are very heavy and/or not portable. These stoves require considerable time and skill to build, do not fulfil many of the same functions as the open fire and thus have often proved unacceptable. It has also been difficult to train stove builders in clay stove craftsmanship

In Eastern Africa, urban stoves should offer the best chance for dissemination, for there is a concentrated market and people already buy stoves and fuel (Manibog, 1982). Improved charcoal stoves usually pay for themselves in reduction of home fuel costs without demanding a change in the user's procedure, except for having to add fuel less often. However, difficulties may arise from having to train traditional stovemakers to use other materials, or assemble components, or bring clay and metal workers together. Clay workers must be trained to fire clay stoves properly, otherwise the 'improved' stoves may not last long. There is very little organized marketing of stoves, and even when promotion creates a demand, the stoves may not be easily available to the consumers.

6. GOVERNMENT POLICY ON THE PRICING AND AVAILABILITY OF ENERGY SUPPLIES INFLUENCES THE DEMAND FOR AND THE EFFORT REQUIRED TO DISSEMINATE STOVES.

Government policy on pricing and availability of energy supplies (both solid and liquid) will influence the prices of fuels, the choice of fuels available and the proportions of urban dwellers using each fuel type. It will have an impact in both urban and rural areas. For example Von Bulow (1983) notes that the banning of charcoal and the switching to woodfuel in the urban areas in the Gambia had an impact on the amount of fuel available and its cost to urban dwellers, and also possibly led to some commercialization of woodfuel in rural areas. If non-renewable fuels become scarce and if improved stoves that are clean and easy to use are available, then it is possible that a significant section of the urban community will switch to wood, and thus national fuelwood consumption may increase. This will save foreign exchange and necessitate fuelwood plantations or the equivalent. Government policy on pricing and import quotas on steel and concrete may have a considerable effect on the choice of stove construction material, and therefore the durability and price of the final product. The type of assistance (e.g. credit and training) provided to different types of local industry will influence who produces the stoves and what type of technology is used to produce the stoves. Also, if workers in the informal sector are harassed by local government and if their livelihood and workplaces are insecure, they may not wish to participate in developing and producing a new product. Government policy and priorities on rural/community development and bio-energy, may therefore determine the level of commitment and assistance given to government and non-government programmes. For example, in Nepal the Government and Monarchy are committed to reafforestation and community forestry, and thus the stove programme has been provided with much greater resources and assistance than in many other countries; as a result the time taken to develop and field test stoves has been significantly shorter than in other countries.

SECTION 2 PLANNING AND IMPLEMENTATION

Planning a project involves determining objectives, the strategy that will be used to meet these objectives within a specified time, allocating resources to match the strategy, formulating a detailed work schedule, and developing a management structure that allows effective communication between various participants in the project and the wider public.

2.1 OBJECTIVES

The objectives of a pilot stove project can be:

a) to determine if a stove project is the most suitable intervention to improve fuel availability, health and hygiene in the kitchen, etc;

b) to determine the range of stoves required in a given area;

c) to develop and assess the acceptability of new stoves;

d) to determine how acceptable, improved stoves can be effectively placed in large numbers of households;

e) to assess the potential impact of widespread introduction of large numbers of stoves, the costs and benefits and to whom they accrue;

f) to improve the organizational and technical ability of the research group to undertake other such projects;

g) to introduce a certain number of stoves into a certain area.

Organizations will have different priorities for these different objectives. It is essential at the outset to rank these objectives. Ranking objectives helps in allocating resources, scheduling and determining the strategy for project implementation and institutional assessment. For example, an institution may primarily undertake a pilot stove project to build up its research and development capability. The project may then have limited scope and the results from final assessment may not provide sufficient information to determine impact and demand. Alternatively, another institution may be more concerned with developing strategies for dissemination and will allocate less time to technology development. The process of assessment carried out during the project's planning and implementation phase may indicate a need to change objectives. It will be necessary for the project to be flexible enough to accommodate unanticipated but logical changes.

The possible benefits accruing to the individual, the community, and the nation from the widespread introduction of stoves have been mentioned in the previous chapter. These benefits can be classified as:

a) Social welfare (including health, pride in the kitchen or local environment, increase in self-esteem, and increase in co-operative development);
b) Socio-economic (including reduced labour or fuel cost, decrease in soil erosion, and increased employment);
c) Institutional/organizational (including the local community's ability to design and implement technology-based projects).

Assessment of the impact of the project and the development of design criteria is extremely difficult if the project does not explicitly state what priority is given to these different benefits. Assessment of these different types of objectives will require different techniques. Social benefits are difficult to quantify and are often only observed over a long period of time. For example, community or health authorities may only notice an improvement in health after ten years.

Socio-economic benefits can be more easily quantifiable and therefore easier to assess. They are often given higher priority by donors than either social welfare or institutional benefits. This may affect the priority given by the implementing institution. The few assessment studies carried out in Africa indicate that users often do not consider socio-economic benefits more important than social welfare (Kapiyo, et al, 1983).

Institutional/organizational benefits are very difficult to quantify and are usually ignored by donors and implementing institutions. Improving local community organizations is (or is becoming) a priority in many African countries, both at the grassroots level as well as national level. They should not be discounted.

INSTITUTIONS SHOULD PLAN FOR LONG TERM BENEFITS RATHER THAN SHORT TERM RESULTS

2.2 PROJECT STRATEGIES

The strategy used will depend on the objectives of the project, the resources available, and the philosophy of the implementing organization.

In outlining the strategies used to date, it has been necessary to condense experience and present three 'model' strategies (Joseph, 1983 a and b). These are classified as 'Action', 'Action Research', and 'Systems'. No one organization has followed these strategies precisely. Experience has indicated that strategies will be altered or completely changed during the implemresult of monitoring, or could occur as resources to the project increase or decrease (Imboden, 1978).

The strategies used by non-governmental organizations (NGOs), who normally have limited resources, are usually different from those of governmental or research organizations. NGOs usually follow an action or action research strategy. Governmental institutions usually follow an action research or systems strategy.

ACTION STRATEGY: Rural Areas

Model

The implementing organization contacts, or is contacted by, a local organization who wishes to undertake a stove programme. An agreement is made between the community and the stove project team as to how collaboration is to work. A rapid appraisal of needs and resources is undertaken. Based on results of this appraisal, a number of stoves are chosen which meet local needs and resources. These stoves have been designed for other areas and should have undergone extensive field and laboratory testing.

The implementing organization then arranges for either artisans or members of the community to participate in the training. The people who participate, the training method, and the syllabus will depend on the types of stoves being introduced. This is discussed in detail in Section 2.6.

The implementing organization then provides assistance for the local community to promote and introduce the stoves. The local community decides what assistance is required. The techniques for dissemination (within the pilot project) are also determined by the community. Agreement will be reached on how and when follow up monitoring and assessment is to be undertaken.

ACTION STRATEGY: a rural case study

In 1978 extension workers from the Ministry of Agriculture introduced a woodstove in the rural Karai Location 40 km from Nairobi, Kenya. The stove was built of stones and mud, reinforced with metal bars, and had a metal chimney. It could have two or three potholes, and an optional water heater at the base of the chimney. Members of a women's group in Karai were taught to build it.

Only a small number of stoves were built until UNICEF brought to the attention of the community the possible benefits of improved stoves. Working with a local committee managing a water tank project, UNICEF assisted in developing and funding a stove project proposal and in training community members in stove construction. Later, two other designs, a two pot Lorena and Tunga Lowon (a chimneyless model) were introduced and UNICEF provided training courses for the artisans to learn to build the simpler stoves.

People in the community who desire a stove ask for one from the committee. The committee, which comprises representatives from each of the five sub-locations within Karai, determines who gets a stove, what price they pay, and is responsible for keeping the artisans busy.

With the assistance of the household, an artisan with a women's group will construct a stove, and the household, if it is able, pays 100 Ksh to the artisan and 50 Ksh to the committee. The 50 Ksh pays for the stove pipe and helps to subsidize stoves for the poorest people, who pay little or nothing. The committee members are not paid for committee work.

By mid-1983, an estimated 1,000 stoves

had been built. No field tests have been done on the stoves, but it is probable that the stoves do reduce smoke in the house but are not more fuel-efficient than a three stone fire, as many of the details of good stove design are missing. Some homes switched from buying charcoal to buying wood for their stove, and they say that they now spend up to two thirds less on fuel. There is obvious pride in the stoves, and the artisans are assured of work and income. The social organization, and mutual community support that has developed is the success of the project. The committee's chairman says that the secret of success is '... devotion. Commit yourself seriously (Childers, 1983).

IT IS EXTREMELY IMPORTANT THAT THE COMMUNITY PARTICIPATES IN THE EVALUATION, AND THAT THE RESULTS OF THE STUDY ARE NOT PUBLISHED UNTIL A REPRESENTATIVE OF THE COMMUNITY HAS APPROVED THE DOCUMENT.

It is also advisable that the members of the stove project make social visits to members of the committee to gain informal feed-back. The stove project can also offer to carry out refresher training programmes or to introduce new models (once the laboratory test phase has been completed). In some cases the community may request that a member of the stove team stays for an extended period in the village.

There are certain advantages and disadvantages in this approach. First, the community can be wholly integrated and essentially runs the project. The resources required by the stove implementors are small, but the quality and quantity of information that they receive can be variable.

But if a trusting relationship is developed between the stove project team and the committee organizing the project, and if the committee has the trust and is representative of the community, then a great deal of accurate information will flow between all parties. If for example the committee feels threatened by the failure of stoves to meet users' needs, then they may not pass this information on to the stove project. If outside donors are involved, the committee may feel that some of the information may need to be censored. Little quantitative information is gained until the evaluation is undertaken. The pace at which the community works is often much slower than if the researchers were organizing the distribution of the stoves. In Kenya it took nearly five years before 1,000 stoves were built in one location.

Replication can also be a problem if stove enterprises have not been established. The community may shift priorities to another project and the team originally building stoves can move on to another project.

It would appear from existing action strategy projects that the principal benefit from this strategy is the building of community organization for self-development and kitchen environment.

ACTION STRATEGY: Urban Areas

Model

A similar strategy can be used by non-governmental organizations working in urban areas. They would be trained to implement the programme and to establish workshops to build either improved charcoal or wood-burning stoves. (Methods of training are covered in Section 2.6.)

Alternatively the stove project may decide to use a 'market strategy'. A number of artisans or small businesses are trained to build the new stove. They are then provided with assistance to establish and market the stove - for example, by advertising, by involving politicians in promotion, introducing subsidies, etc.

The stove project then monitors the output and the quality of output of the production unit, and how fast other artisans or enterprises start to build and sell the stoves. Distributors of the stoves are visited to find out if and why people return the stoves or come back to complain. Because people are often reluctant to give their addresses and participate in follow up, very little information is obtained on why people are buying the stove or how the stove deteriorates. Intervention to improve the product will only occur after market resistance has been established, since continuous monitoring is not taking place.

ACTION RESEARCH STRATEGY: Urban and Rural Model

This strategy is, to date, the most common method used by organizations implementing pilot projects in both rural and urban areas.

Model objectives are usually not ranked before the project begins. The ranking is developed as the needs of the people are more clearly identified after monitoring. The initial research phase (i.e. assessing needs, undertaking laboratory testing) is usually short, requiring few resources.

A single rural community, or a number of households in an urban area, is found which is willing to participate in the initial pilot phase. A single design is introduced, and after feedback from the participants the stoves are redesigned and then undergo laboratory tests and improvements before large scale testing takes place.

Often different extension strategies are tried in different areas. In one district the project may work with artisans who try to sell the stove in local markets or through local hardware shops. In another district a different stove may be built by local artisans, by extension workers, or by a group of members from a women's group. Alternatively people may be given a choice either to purchase a portable stove, or have a mud and pottery stove installed in the house, or to participate in the construction of a mud stove. In urban areas different types of production units may be established, for example, one run by an NGO or training school, one in an artisan's small workshop, or in a large-scale factory. Stoves could then be marketed through different outlets.

This larger programme is monitored and as a result further research is undertaken. After fixed intervals of time the programme is evaluated and a decision is taken either to carry out further field trials or to proceed to the dissemination phase in each areas. Since different extension strategies have to be used and evaluated it will be possible to determine which strategies are most appropriate for different areas to meet the overall objectives of the programme.

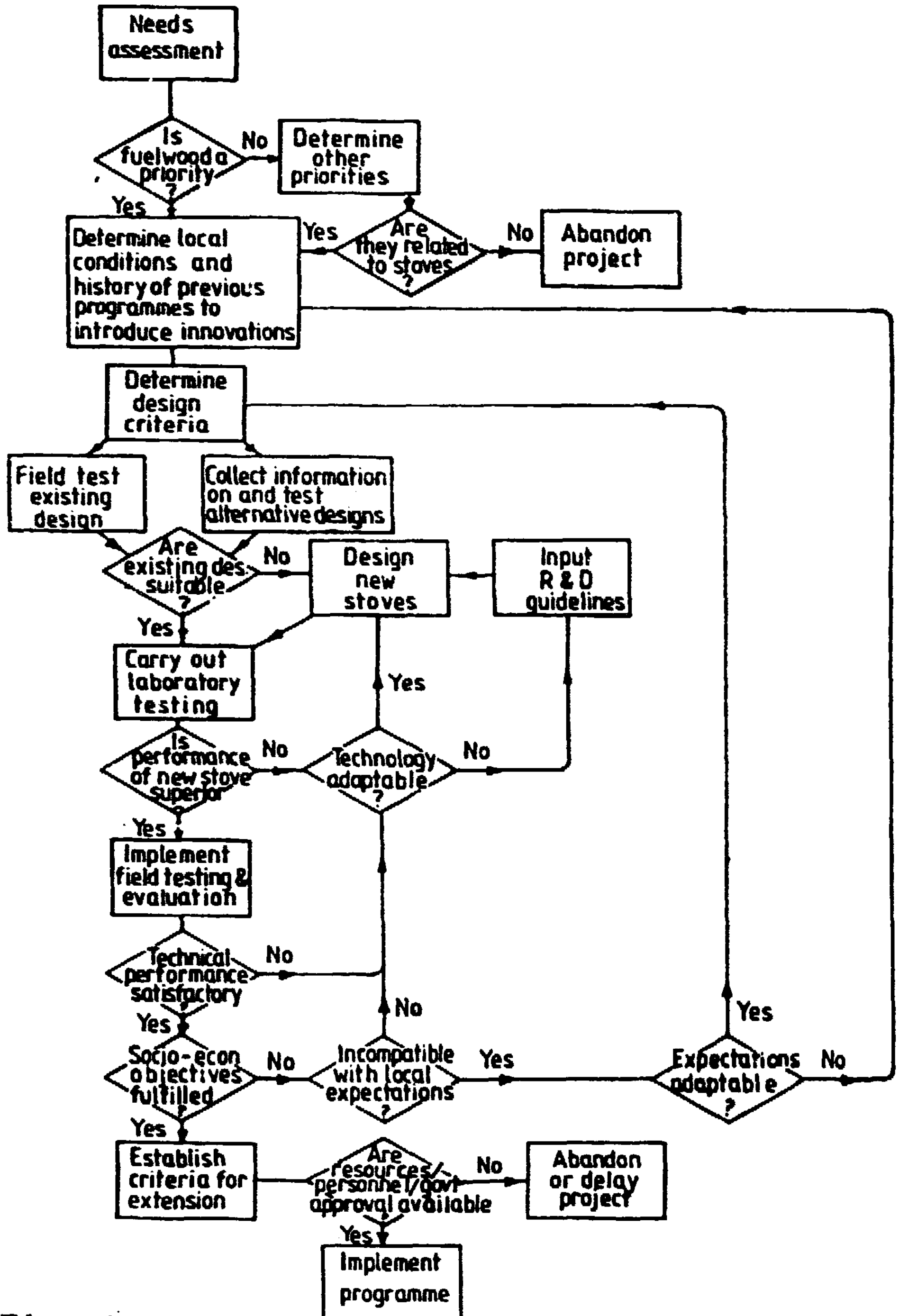


Fig. 2

Action research strategy (Reproduced, by permission of the Food and Agriculture Organization of the United Nations, from 'A Preliminary Evaluation of the Impact of Wood Burning Stoves Programmes'.)

Action research appears to be a suitable strategy when little is known about the technology, or if the needs of the people are difficult to specify clearly, or if resources are limited. A selected group of users is actively involved in the development process, and there is constant interaction between users, extension workers, builders and researchers. The strategy appears to be most appropriate for Appropriate Technology institutions, having few resources, and for other non-governmental organizations. However, progress can be slow, especially if staff do not receive comprehensive training before the project starts. It appears to take 3-5 years to arrive at designs and extension strategies that will lead to widespread dissemination of the product. At some stage sufficient funds must be acquired to undertake major research and extension projects.

Action research has the benefit of basing the research locally and targeting the programme for specific groups, and thus it may be possible to improve a local community's or producer's capacity to innovate. Action research allows for a great deal of flexibility in how the action and the research are implemented. However, there is a danger that research is not structured enough to allow adequate answers to such important questions as 'why do people adopt or not adopt a stove?', and 'what is the most cost-effective way to introduce a stove?'.

LESOTHO STOVE PROJECT: an action research case study

The Lesotho stove project is a component in larger renewable energy project funded by USAID and implemented by the Ministry of Co-operatives and Rural Development. Assistance is provided by Associates in Rural Development. The objectives of the project are to help the rural poor meet their energy needs by providing technologies which are socially, technologically and economically acceptable, and to build up the local institutional and manufacturing capability to meet these needs (Burrill, 1982).

Initial survey work was carried out in 198 to identify needs and how these could best be met. Based on this survey the original programme (as laid out in the project document) was modified to meet more adequately the people's expressed needs, and a test centre was established at one location. A range of stoves was designed to meet the range of cooling and heating needs of the local population. These included fired mud and stone stoves and portable metal stoves. These stoves were tested by the stove team, and either modifications were made to improve their performance, or, if the performance could not be improved, the designs were abandoned. Women attending the clinic (situated next to the test centre) were asked to use the stove and comment on its performance. As a result of these comments the designs were changed. The two models that appeared most acceptable to users were thoroughly tested.

During this testing period a number of exten sion strategies were devised for the production and distribution of the stoves for field testing. Training programmes were also prepared to teach artisans how to build the metal stoves, and extension workers and users how to build the stone stove. These training programmes have been implemented and stoves are now being placed in houses. The effectiveness of the training programmes and stove acceptability are being monitored by the core stove team.

SYSTEMS STRATEGY: Urban and Rural

Model

In this strategy considerable resources are allocated to research at the beginning of the project. Before stoves are field tested, research is carried out to assess needs and resources, develop design criteria, and establish areas for potential field trials. Potential demand for a stove is established in each of the areas that have been studied and a decision made whether a stove programme could improve access to fuel, health, etc. If a positive decision is reached, a research programme is established to develop stoves that meet these criteria. This involves design and testing of stoves and stove materials, development and economic assessment of 'production', promotion, and distribution options, development of a monitoring and evaluation programme, and of a training programme for producers, extension workers and installers.

A structured field programme is then established in areas that have been surveyed. A single extension strategy is used and a number of different types of stove are introduced. During this phase, performance and acceptability are monitored to enable researchers to improve the designs. After a six to twelve month period, a final evaluation will help to determine what designs should be promoted. Once the designs have been fixed, different extension strategies can be implemented and evaluated in other areas (see Section 3.5.). This should determine whether and where large scale projects can succeed, how they should be implemented, the costs and benefits, and the policy measures necessary to reduce domestic fuel demand or increase the supply.

At the time of writing such a study has not been implemented in Eastern Africa. The example given is based on work now being carried out in the Gambia. This type of strategy is feasible if a large research and extension organization is implementing the pilot project. One major drawback is that there may be minimal participation of users in many of the research phase components. Community confidence may not be increased.

RESEARCH DESIGN SYSTEMS APPROACH:
a hypothetical case study

An area where there are three different ecological zones (desert, savannah, and semi-tropical forest) is chosen for study. Four villages and one urban centre willing to participate in each of these three zones are chosen. Detailed needs assessment, resource, and socio-economic studies are undertaken. During this time, laboratory facilities are established and work commences on materials testing. As data from the survey is analysed, designs are developed and tested, using locally available materials and built with assistance of local entrepreneurs. From analysis of survey results, a decision is made as to where the pilot project will be implemented. Let us assume that one urban centre and two villages in each of the savannah, forest, and desert areas are selected. A range of designs suitable for the three different areas are developed and fully tested in the laboratory. An extension strategy is developed to introduce the stoves in the different villages. For this project, a team is established for the urban areas and for the rural areas, consisting of team leader/promoter, trainer, artisan, and monitor. In rural areas, the team establishes a demonstration centre and individuals and groups are invited to come and use the stoves. Those who are interested in receiving the stove are given assistance either to purchase or construct the stove. In return, they allow monitoring of acceptability and performance. In urban areas, the households are approached at random, and asked if they will use a new stove for a one month trial period. They will then either give the stove back or pay a small (subsidized) price for its purchase. In return, they will also allow monitoring to occur. Based on monitoring, programme design changes are made and people will be offered either a new stove or to have their stove altered. After twelve months, designs seem acceptable and are proven to be fuel-efficient. Evaluation of the first phase of the project is now undertaken. Based on this evaluation, new extension strategies are developed. These include providing a merchant with stoves to sell at the local fair or market, establishing a small production unit to sell the stoves through hardware stores in urban areas, and training a local women's group to build stoves in their village. Assistance to these ventures is provided by the two stove teams. Monitoring is carried out for six months and final evaluation takes place. Sufficient information is obtained to mark out costs and benefits of the different dissemination strategies and recommendations are now made as to how the project can enter the 'replication phase'.

2.3 PROJECT ORGANIZATION

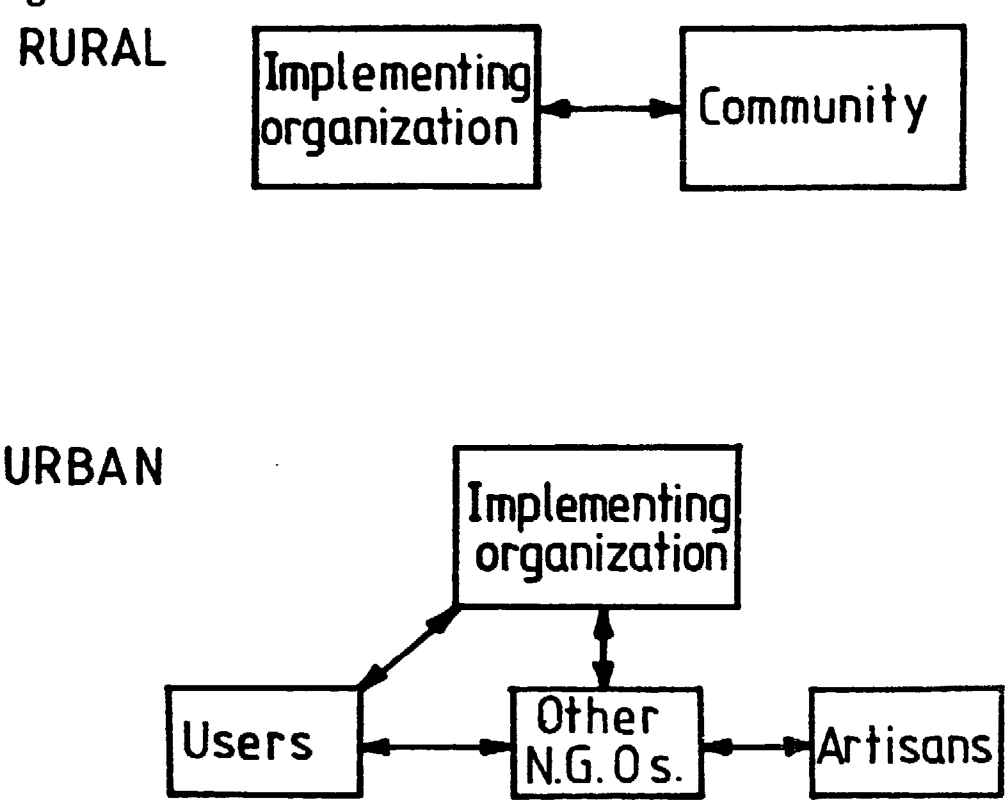
STRUCTURE

The project can be organized in many different ways. The management structure developed will depend on the objectives of project, the type, size and resources of organization implementing the project and the strategy taken to implement the pilot field programme. Examples of different structures relevant to each strategy are given below, although each organization will have to develop its own structure applicable to local circumstances.

<u>Action Strategy</u>

The implementing organization consists of a project manager, a stove designer and senior extension worker/social scientist. They will usually be employed by a NGO. In rural areas the stove team work directly with the community organizations. In urban areas they will work with NGOs or artisans/entrepreneurs. The project team will have help from or access to local universities and works closely with other extension organizations and government departments involved in assisting small business or training.

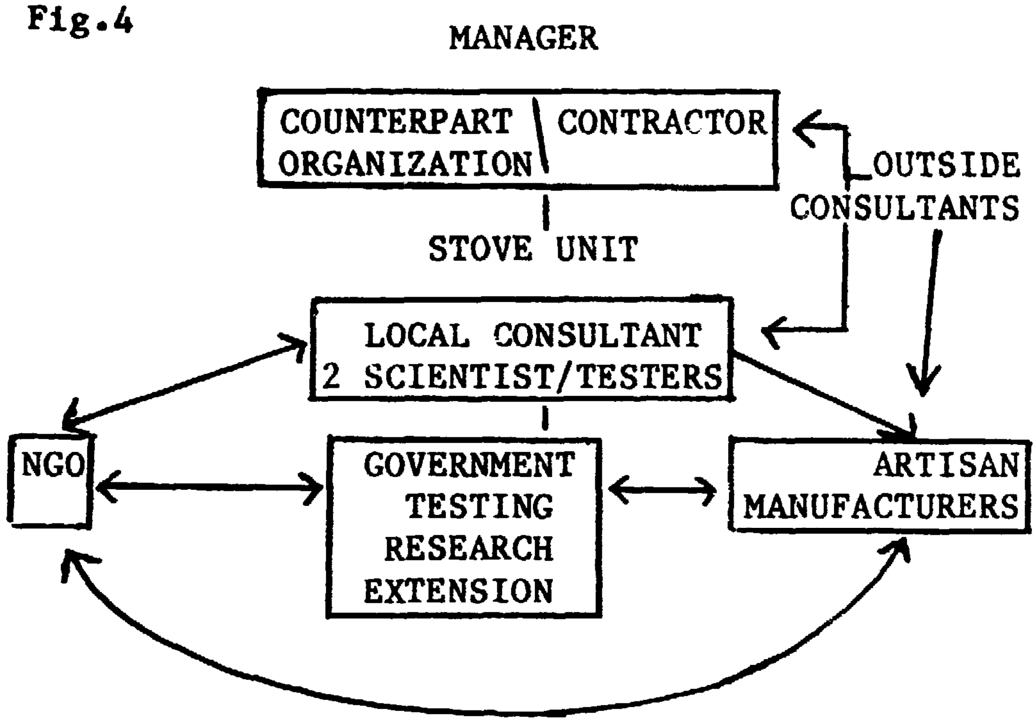
Fig. 3



Action research strategy

In Eastern Africa to date most of the action research programmes have been executed by a consultancy firm who have been contracted by the donor. This firm works with a local counterpart organization either from a part of a Government Ministry or an NGO. The contractor hires in outside consultants and local consultants to implement various parts of the project. At the same time the counterparts are trained to take over the project when the contractor leaves. Research is carried out at a university or by the government research team. A stove unit is formed, consisting of a social scientist and scientist testers. They work closely with artisans and manufacturing industries (especially in the urban areas). Field work is carried out by NGOs and government extension organizations. The structure presented below is taken from the Ministry of Energy/Kenya programme.

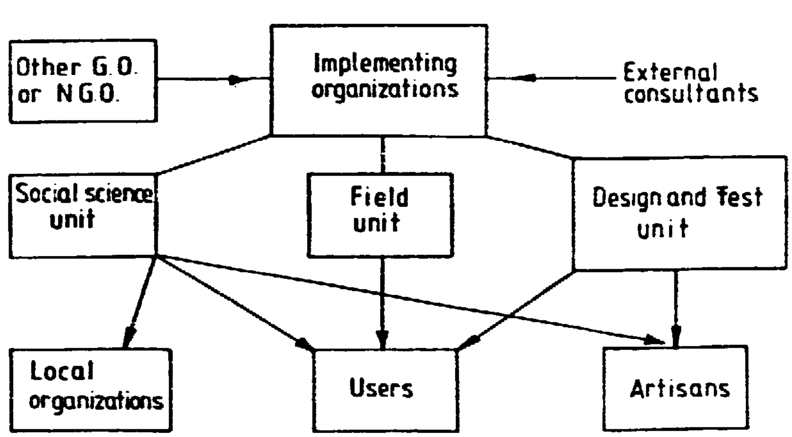
Fig.4



Systems strategy

This project will be carried out by a government department usually working in conjunction with a research establishment. The project will probably have external funding and a number of experts will usually be seconded to the project. The project will have a unit involved in social science research, in stove development and testing, and in implementing the field project. The project may have assistance from a promotion/information and training unit from the same government department and from other government departments and NGOs. The stove unit may have an engineer, artisans and testers. The social science unit may have graduate social scientists and senior extension personnel with social science training. In the field a number of extension units will be established who will either work with community organizations/artisans rural areas or with households/entrepreneurs/artisans in the urban areas. These units will have a manager, builders and trainers/monitors. External consultants will be brought in for all phases of the project. This type of structure is being used by the Gambian project and is described more fully in Joseph and Loose 1983.

Fig. 5



INTERNAL AND EXTERNAL COMMUNICATION IN THE PROJECT

The task of both managing a project and obtaining external support will be greatly assisted if effective communication systems are developed. It will be extremely important for all members of the team to have an understanding of each other's role, and specific tasks. Information must be frequently exchanged between team members and mechanisms be established both to discuss and to act on suggestions from the field. Meetings are not the only effective way of spreading information and encouraging collective decision making. Internal newsletters that detail project activities, amusing stories and details of births etc can not only be useful to disseminate information but will build up team morale. Wall charts can also be used to detail activities. If external consultants are used it will be necessary to spend considerable time assisting them in communicating with the staff and potential users.

CONSULTANTS WILL BE EFFECTIVE IF THE PROJECT TEAM EXPENDS CONSIDERABLE RESOURCES WORKING WITH THEM.

If the project has sufficient resources, members of the team should prepare information sheets, pictures and talks to use when discussing their project. As the results of the project are analysed it is useful to summarize these either on flip charts or wall posters. Models of the different stoves can be useful when giving talks. Arrangements can be made with local radio and newspapers to inform the public of the progress of the project.

In a number of African countries a National Woodstove Group has been formed. These groups meet regularly to exchange information and to discuss relevant issues related to stove design and dissemination. A national newsletter (at exhibitions and demonstrations) can also stimulate interest. If possible a member of the project team should liaise closely with national energy planners. These people could be given unpublished data to help in their own endeavours.

2.4 SITE SELECTION

One of the most important early tasks for the project is to develop criteria for site selection. Sites must be chosen for the inital needs assessment study and then for the pilot projects.

For the needs assessment study it will be important to survey in different ecological zones and amongst different ethnic groups. (Since the project is often trying to assess where the need is greatest and/or where demand is the highest.) This is covered in more detail in Section 3.1. In choosing areas for field trials, ideally a random or a stratified clustered sample would be taken from the areas where the needs assessment has been carried out (Casley and Wry, 1981). However, there are many factors that may influence the selection of the site of field trials. These include the project objectives, strategy used, the resources, ease of access/communication, need, previous contact of village with the organization introducing technologies, and availability of marketing producers and outlets, or extension organizations.

It will be necessary to draw up a list of criteria to select villages (or households for urban areas). There will be conflict between desirable criteria. It will, for example, be important to select villages where there is willingness to participate in the project, but it is also possible that these villages will not have the greatest need. It will be necessary to determine the trade-off between choosing a representative sample from the project area and the other criteria (i.e. ease of access) representative of the area. A list of possible selection criteria are given in Table 2.1

Table 2.1 Criteria for Site Selection

a) Availability of fuel
b) Incidence eye/lung disease
c) Socio-economic status
d) Location (ecological zone)
e) Accessibility
f) Innovativeness
g) Success/contact with other AT projects
h) Started or requested stove/improved kitchen work
i) Existing community/women's development programme

2.5 PHASING AND RESOURCE ALLOCATION

PLANNING

For the purpose of planning, the project can be divided into six activities:

1) Planning Project
2) Needs assessment/resource survey
3) Stove design and testing activities
4) Field test and monitoring programme
5) Implementing evaluation studies
6) Planning for dissemination

These activities can be further broken down. An example of how this was carried out for a project using a systems strategy is provided in appendix 2.1. Having detailed the activities, it is now possible to allocate resources. This will involve determining the number of people, their qualifications, the equipment, facilities, transport, back-up services and time needed to carry out a certain activity. Specific resource allocations will depend on project area and size, availability of skilled people, experience of the organization in implementing a similar type of project and effect that seasons have on transport, etc.

Also provided in Appendix 2.1 is a Guide to the minimum time (in person weeks) that will be required to undertake an activity. Each activity should be allocated a specific time to produce a certain output. This will allow monitoring of the programme to be effectively undertaken. Having allocated resources, it will be necessary to schedule the programme.

It will also be necessary to allow a certain degree of flexibility in this scheduling since there are so many unknowns. It will be inevitable that certain activities will take longer than planned, and thus it will be necessary both to reschedule and to shift resources between different activities. Since stove development is not a linear process, it will be necessary to determine what activities can occur simultaneously, what activities must be completed before other activities can occur, and what is the cost of delaying the start or extending the duration of certain activities. Seasonal duties of the participants (i.e. planting, harvesting) should not be forgotten.

It is not advisable to use complex scheduling procedures such as critical path analysis. Bar charts (see Appendix 2.2) are more than adequate.

DEFINING TASKS

In most small projects to date the tasks that people undertake have evolved as the project was implemented. There is a high degree of integration in the team. Members of the team will often interchange roles as and when necessary. Larger projects involving more staff and inter-organizational co-ordination have specified the tasks undertaken by different members of the team. In past projects, the manager has initially not only undertaken the tasks normally attributed to such a position (e.g. planning, reporting, personnel selection, organizing training, communication etc) but has also been involved in assessment studies, stove design and testing and implementation of the field project. She or he has worked very closely with stove designers, testers and senior extension personnel. As the projects grew in size so the manager has had to revert to a more traditional role.

When trained social scientists have been attached to projects, they have been involved in developing assessment methodologies, training field staff implementing the field studies, analyzing results and writing reports. In the last few years they have worked closely with designers to develop more socially and culturally accepted designs. Site selection will be made by the social scientists in collaboration with the rest of the team. They will also spend considerable time with users discussing problems with technology and method of introduction.

The engineering staff will be involved in both laboratory and field work. They should work with social scientists when they carry out needs assessment, match needs to technology, and undertake evaluation studies. They will also work closely with local artisans and extension workers (who would be installing or building the stoves). They will be involved in developing and implementing training programmes.

The success of the field programme will depend on the skill of the senior extension workers (stove promoters). They will manage the programme, promote the programme locally, provide liaison between engineers and users, carry out routine monitoring, assist social science engineering teams in their field work and assist in training programmes. Both senior extension workers and stove installers/builders should be local to the area. Possible job descriptions for the different staff are provided in Appendix 2.3. These are only a guide, and will need modification.

2.6 TRAINING AND FOLLOW UP

COURSE DESIGN

Recent review of stove projects have emphasized the need for effective training and follow up if the pilot project is to determine if the stoves introduced are acceptable (Joseph, 1983a; Foley, 1983; Prasad, 1982). The pilot project will proceed more quickly if any inexperienced members of the core team receive training. Training at the beginning of a project can help form the core team into a more integrated effective unit. Poor training of either field workers or stove builders will lead to stoves that are inaccurately constructed and/or installed. In many cases, these stoves use significantly more fuel than existing hearths. Inadequate training of field staff can also result in poor communication with users, insufficient monitoring of stoves, and lack of feedback to designers.

It will be necessary to have both formal and informal training thoughout the project. This training will involve imparting new manual skills as well as intellectual skills. There is no formula as to how training is implemented but experience from stove programmes in Africa and Asia has provided guidelines as to what should be included in training courses. The specific material presented will depend on the aim of the training, the philosophy of the implementing organization, the qualifications and experience of the trainees and trainers and the resources available and the method of stove construction developed for the particular project. Training will be carried out by people (mainly artisans) who have been taught through an apprenticeship system. This system has emphasis on instruction through repetitive hands-on experience, under the watchful eye of a skilled master, who will not allow the apprentice to make mistakes or unsuccessful innovations that will risk their reputation and livelihood. Steps are learned one at a time; the student masters the simplest task, acquiring a feel for the material, before more delicate work is taken on. During the apprenticeship, the student also learns how to manage the enterprise and how she or he will train apprentices. The training received will depend on the skill of the craftsman, and the quality of the products of the trainee will depend on the quality produced by the craftsman.

It is important during implementation that senior staff work through problems and tasks with the field and laboratory staff as they undertake their work. The time for formal training will be considerably reduced if informal training is properly resourced and implemented.

Alternatives to long apprenticeship have (relatively) recently come about. Many different books have been written and many methods developed to train people 'how to carry out an activity' (ATB, no date). These methods condense the information in a systematic and clear way. 'Showing People How, a management skills guide' (ATB, no date) suggests this approach:

Training is divided into three processes: preparation, instruction, and checking. Preparation involves focusing on results, planning logical learning stages, and deciding the key points to put across.

Instruction is characterized by the manner of the teacher, who should show interest and confidence, treat the learner as a mature individual, and encourage questions and discussion. In introducing each stage, required results should be established, and then how to achieve them explained. In showing how, clear demonstrations should be given at each stage with key points emphasized, great care being taken to hold the learner's attention. Several things can be done to help people learn, such as plenty of practice time structured in, telling the learner of progress at each stage, careful spotting of errors, and helping the learner to correct them.

At the end of instruction, the teacher should check to see if the learner can perform the task to the required standard. Regular job follow up should see that she or he continues to perform the task to required standards.

a) Core Team

The core project workers' skills can be divided into two categories: technical and social science.

The technical team may require training in:

1) Stove design and laboratory testing.
2) Methods of construction and materials testing.
3) Training artisans and entrepreneurs.

The social scientists may require training in:

1) Field survey techniques. This would cover needs assessment, performance measurement, monitoring and evaluation.
2) Methods of production and marketing of stoves.
3) Matching technology to needs and resources.
4) Training techniques, and how to work with field extension workers.

b) <u>Extension Workers</u>

Two distinct categories of extension workers are involved in the project: stove promoters and installer/builders.

Stove promoters are usually senior extension personnel. Their responsibilities are outlined in Appendix 2.3. Their training should emphasize:

1) Managing the field programme/staff.
2) Methods of assessing needs of different groups in the community.
3) Assisting designers to match department technology to the local needs.
4) Understanding how a new stove works and its advantages and disadvantages compared with the existing stove.
5) Monitoring the acceptability and performance of an improved stove, and monitoring the quality of production.
6) Promoting the stoves.
7) Training users how to repair and use the stove.

Initial training should be over a three to four week period, with one or two weeks of the course spent in the field. Follow up should take place three months afterwards.

Other extension workers are stove installer/-builders. They are usually members of the village where the stoves are to be built and installed. The task of an installer/builder depends upon which materials are being used: metal, metal/ceramic, mud, mud/ceramic, etc. Some installers may also be the local health or community development workers. Training for installer/builders should emphasize:

1) Understanding how a new stove works, its advantages and disadvantages.
2) How to build and/or install a stove correctly.
3) Training users how to use, maintain, and repair a stove.

Initial training for installer/builders can take two to three weeks, and will involve follow up training after three months.

Attempting to train people to build stoves who are not already artisans (either potters, masons, brickmakers, metal smiths etc) will be difficult and is not recommended, because they are not accustomed to the strengths and limitations of the materials, nor the importance of careful measurement. It is these skills that require a certain length of time for experience to establish.

During the training and follow up, be aware of how precisely artisans are measuring, and work with them to develop ways to assure correct dimensions when they are on their own. Clear drawings of the stoves, with dimensions given, and/or templates may be helpful.

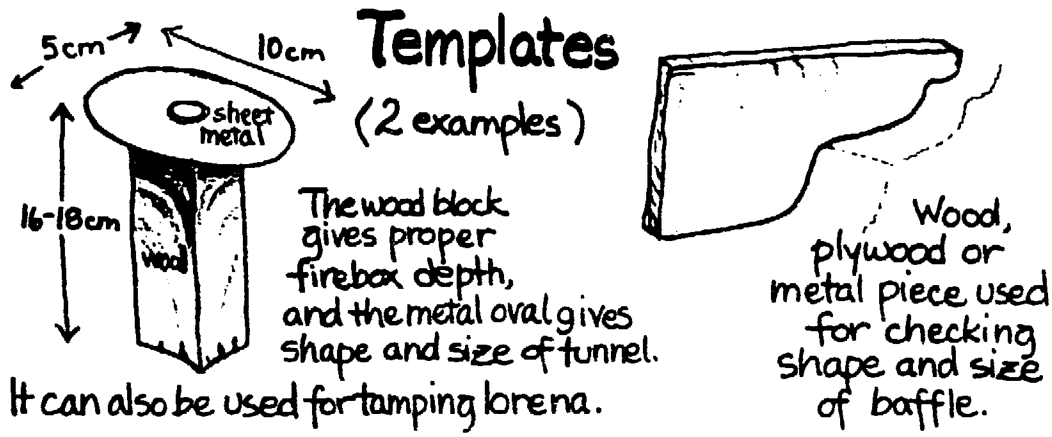


Fig. 6

The use of moulds or templates in the production process increases the confidence of the trainee and uniformity of the stoves, and decreases the time required to train the builders and to construct the stoves.

Also during the training and follow up it is essential to be aware of abilities and tendencies for innovation. It is this ability to innovate that will evolve stove designs most suited to the needs and aesthetics of the users, and innovative artisans tend to enjoy and take more pride in their work. What goes hand in hand with innovation in stove design is a responsibility for the effects of the changes, and this requires a fairly sophisticated understanding of some complex principles of combustion, heat transfer, and materials properties. One does not need an academic background in physics, but it requires experience, and usually a knowledgeable person, to point out each of these principles which can be demonstrated by changes in stove design or manipulation of an open fire. The principles are perceivable in a kitchen environment using only ears, eyes, and the ability to feel heat with the hands (Childers, 1983).

The training material presented to people involved in mud stove projects will be different from those for metal stove projects. Training material will be different if you are training artisans to build a specific stove design from training artisan/extension workers how to design or choose a stove to suit a particular household.

> TRAINING A PERSON TO BUILD A STOVE IS A LONG, REPETITIVE PROCESS. STOVE BUILDING IS A HIGHLY SKILLED PROFESSION, INVOLVING COMPLEX ENGINEERING PRINCIPLES. ALL EFFORTS OF DESIGN DEVELOPMENT AND PROMOTION WILL BE WASTED IF ARTISANS ARE NOT FULLY TRAINED AND GIVEN SUBSEQUENT ASSISTANCE AS REQUIRED.

During the course of the field project it may be necessary to train:

c) Users

1) To build a stove (if they use mud).
2) To install a stove (if mud and ceramic are used).
3) To clean their stove (if a cleaning service is not provided by a builder or extension worker).
4) To repair their stove (if it is not provided).
5) To operate a stove.

If they are willing to perform tests it will be necessary to train them how to do this.

In training users to build their own stove, they can learn by working with trained people on several other stoves built in other homes first. If they have helped making three stoves, they will be more capable of leading the design and construction of their own. Instruction of repair and maintenance should also be carried out in the home. Moulds and templates should be used by owners to ensure accurate construction.

FOLLOW UP

Follow up should occur within the first three months after the training. Part of training follow up utilizes information collected in monitoring. Note how many stoves have been built, how closely stoves follow correct dimensions, the quality of materials and assembly/construction, and the owner's understanding of, and reaction to, the stove. This information provides clues to what was successful about the previous training and work that has been done since by laboratory and field workers toward achieving the goals of the project.

Follow up is an important time for managers, the core team, and the extension workers to talk. What problems have each encountered? And what successes? What information is sketchy and would be helped by more training? What can be done to improve communication between workers? Strategies may need to be adjusted in the light of what is learned from this and the monitoring.

More than likely, a refresher course for the builder/installers will be needed after three months. The level of confidence and craftsmanship of the artisans will have levelled off, and working together in another short training session will enhance these. Some artisans may have developed innovations to the design and procedural short cuts; their effects on the stove's performance can be checked and the techniques shared with other artisans. Monitoring may determine that the stove designs need to be altered, and so artisans will need this up-dated information.

It is possible that some artisans, after three months, will have developed enough skill and confidence to train more artisans.

2.7 PROMOTION AND MARKETING

Within a pilot project it may be necessary to promote the stoves in the project area as well as to test-market the stove.

There are many ways to promote programmes. These have been outlined in detail in Gern et al, 1982. The methods used to date include: community meetings, demonstration at fairs and agricultural shows, broadcasts on radio and articles in the paper, puppet shows, films and posters. Very little test-marketing has been tried. This could involve establishing a stall in a market place. A person would be employed to demonstrate the stove, and food would be offered as an inducement to get people to examine the stove. The cost of purchasing the stove could be subsidized and a money back guarantee be given. Leading business people/entertainers/politicians could be used to help sell the stove. A travelling stove marketing show could be established. This show could visit both government and private sector work places as well as fairs etc.

In Kenya, successful market demonstrations have been held with the Ministry of Energy's pottery-lined charcoal jiko. Side by side with the traditional jiko, the two stoves simultaneously cook the same size pot of beans. The women watching determine when to open and close the doors, add fuel, and add water to the beans. The stoves start out with equivalent piles of charcoal and it becomes readily apparent that less charcoal is added to the improved jiko.

It is important to have stoves available for sale at the time of inciting interest by offering such obvious proof of a good product. 'What good does this do us?' people ask if you have no stoves for sale (Childers, personal communication, 1983).

Appendix 2.1

NEEDS ASSESSMENT AND RESOURCE SURVEY

Activities	Personnel resources	Equipment resources	Expected minimum time (Person weeks)
1. Review available data and studies	Project social scientist	Nil	4 weeks
2. Initial field visits to decide size of survey	Project social scientist Project Manager Related organisations Field staff	Transport	2 weeks
3. Develop and adapt survey methodology	Project social scientist Field staff	Transport	2 weekd
4. Develop questionnaire/observation sheets	Project social scientist	Copier/duplicating machine	5 days
5. Select and train field staff	Project social scientist Field staff trainees	Transport	3 weeks depending on education and level experience
6. Testing/modifying questionnaire observation sheets	Project social scientist (interpreter)	Transport	2 weeks
7. Implementing Study	Social scientist Field staff	Transport	Dependent on survey size approximately 4 households per researcher per day
8. Analysing results and developing design criteria	Project social scientist Project Manager Data analyst Project engineer	Computer time	4 weeks

STOVE DESIGN AND TESTING PHASE

Activity	Personnal resources	Material resources	Minimum time requirement
1. Drawing up designs	Project social scientist Project engineer	Workshop/office facility Drawing material	2-3 weeks
2. Building prototypes	Project engineer Stove builders	Workshop Clay Punches Knives Metal Sand Chisel Shovel Shears Fibre Vice Hammer Trowel Anvil	2-6 weeks Depend on materials or if designs are new or adapted
3. Boiling tests to optimize designs for thermal efficiency, ease	Project engineer Technical staff	Fuel Moisture Content Thermometers Water meter Scales Timing Pots Data sheets Tongs device	1-2 months
Materials Testing		Small kiln clay Electrical cement Thermocouples	9 months
4. Compare design Performance with existing stoves - redesign if results are poor. Boiling water test	Project engineer social scientist Technical staff	sáme as activity No. 3	2-3 weeks
5. Cooking tests by users to determine performance and acceptability	Project engineer Technical staff	same as activity No. 3	5 days
6. Optimise design for ease of manufacture Choose materials	Project engineer Technical staff Stove builders	same as activity No. 2 2-3 weeks	
7. Kitchen performance tests in the field	Social scientist Field staff	Scales Thermometers Tongs Data sheets Timing device	1 month Depend on size of sample

FIELD TEST AND MONITORING PHASE

Activity	Personnel Resources	Material Resources	
1. Designing a field test programme	Project social scientist	Transport to visit study areas Need/resource assessment material	5-7 days
2. Selecting a sample	Project social scientist (interpreter)	Same as No. 1	7-14 days
3. Developing a monitoring system	Project scientist	NIL	1-2 days
4. Training builders	Project engineer Skilled artisans	Workshop facility materials dependent on type of stove being disseminated Tools	14 days
5. Training field staff	Project social scientist/ designer Project engineer Field staff trainees - number depends on size of sample	Developing training materials Questionnaire/observation sheets Diaries for field staff Measuring equipment Read charts or books Transport to site	7-14 days developing training materials 14-21 days monitoring over a period of 3-6 months
6. Distribution	Social scientist Stove builders (depends if stoves are built on site) Field staff	Transport Materials and tools if stoves built on site Record books	Depends on type of stove distributed Nil time metal stove 1/2 day liner stove 1/2 day mud stove
and Promotion of stoves	Graphic Artist Media Resource people	Posters Radio spots User leaflets etc.	On-going from time of distribution
7. Monitoring meetings	Project social scientist Project engineer Field staff	Questionnaire/ observation sheet results Diaries Charts/Record books	1-2 days per month
8. Monitoring/	Project social scientist Field staff	Same as no. 7	2-3 visits to each household per week
9. Retraining builders/field staff if new or adapted Designs are introduced	Same as No. 4,5	Same as No. 4,5	Dependent upon degree of change 1-5 days

EVALUATION STUDY (FOR PHASE 1 AND 2)

Activities	Personnel resources	Material/resources	Expected minimum time (person weeks)
1. Analyze monitoring Data	Social science section	Computer	1 - 2 weeks
2. Develop methodology	Social science section		2 weeks
3. Develop and test survey	Social science section and field staff	Transport Translators	2 - 4 weeks
4. Determine sample survey	Social science section		1 week
5. Determine sample for kitchen performance test	Social scientist Engineer		1 week
6. Implement survey Case studies Observations Tests	Social science section	Transport Translators	8 - 20 weeks
7. Analyze results	Engineer Social science section		3 - 6 weeks
8. Write report for phase Modify designs Develop new extension methods	Senior social scientist Engineer		3 - 6 weeks

PLANNING FOR DISSEMINATION

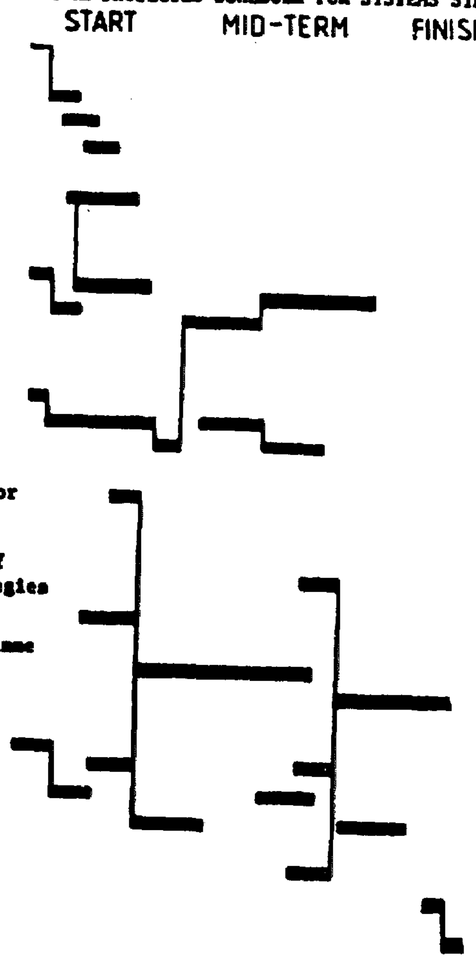
Activities	Personnel resources	Material/resources	Expected minimum time (person weeks)
1. Determine best strategies for dissemination from evaluation study	Project manager Planner Socio economist/anthro		2 weeks
2. Hold seminars: policy donors extension org entrepreneurs	Project man/soc scien Project man/soc scien Des/proj man/soc scien Des/proj man/soc scien	Publications Lecturing aids Seminar facilities	4 weeks
3. Plan: develop overall strategy resources required training required promotion	Project Manager Planner		2 - 4 weeks
4. Write project proposal	Project manager		2 weeks
5. Seek funds Seek collaborating institutions, personnel, entrepreneurs	Project manager	Transport	4 - 8 weeks
6. Prepare publications (academic and for media)	Journalist/social scientist Project manager Artist	Photographs Drawings	12 weeks
7. Promote the stove	Public relations/ Journalist	Transport	4 weeks

Appendix 2.2

SYSTEMS STRATEGY

ACTIVITY

OVERALL PROJECTED SCHEDULE FOR SYSTEMS STRATEGY



1. Design of Project
2. Needs Assessment
   - Area 1
   - Area 2
   - Area 3
3. Analysis of Results, Developing Design Criteria and Production Techniques
4. Stove Design
   - Set-up Laboratory
   - Manufacture New Stoves
   - Redesign work as a result of field data
5. Stove Testing
   - Develop Test Procedures
   - Laboratory Tests
   - Kitchen Performance Tests
6. Selection
   - Phase 1 Field Test Sites for Determining Stove Acceptability
   - Phase 2 Determine Effect of Different Extension Strategies
7. Develop Monitoring System
8. Implementing Field Test Programme
   - Phase 1
   - Phase 2
9. Training
   - a) Core Staff
   - b) Field Staff
   - c) Manufacturers
   - d) Users
10. Evaluation
    - Phase 1
    - Phase 2
11. Planning Dissemination Phase

Appendix 2.3: Job Descriptions

MANAGER

1. Project planning.
2. Locate and negotiate project sites with government and communities.
3. Allocate financial resources and obtain material resources.
4. Recruit staff.
5. Specify and order project equipment.
6. Phase and monitor project activities.
7. Define and monitor staff activities.
8. Develop operational procedures.
9 Provide motivation to teams.
10. Communicate with government and related agencies.
11. Prepare periodic reports.
12. Ensure that financial administration is carried out.
13. Control against budget.
14. Maintain inter-organization co-ordination.

SOCIAL SCIENTIST

1. Review available social data on kitchens.
2. Design and carry out need/resource surveys.
3. Train field staff in survey techniques.
4. Analyze survey results.
5. Design and assist in the implementation.
6. Train field staff in monitoring techniques.
7. Monitor field tests.
8. Carry out project evaluation.
9. Assist engineers to make stove designs more socially and culturally acceptable.
10. Site selection.

ENGINEER

1. Assess existing stoves and materials in laboratory and field.
2. Design and produce improved stoves.
3. Train stove builders.
4. Optimize new designs and material through laboratory tests.
5. Design and implement a stove production system.
6. Redesign stove if necessary.
7. Monitor the quality from production unit.
8. Carry out field testing of new stoves.

SENIOR EXTENSION WORKER

1. Manage field programme.
2. Help assess needs and match technology to needs.
3. Monitor extension workers' performance.
4. Supervize monitoring of production units.
5. Organize and participate in training courses for builders, extension workers and users.
6. Promotion of project in villages.
7. Monitoring field project.
8. Communication with core teams.
9. Assist in evaluation.

STOVE INSTALLER/BUILDER

1. Assist user to choose the type and site of stove.
2. Build/install stove.
3. Train users to operate, clean and repair.
4. Modify poorly built stoves.
5. Assist in monitoring the project.

SECTION 3 ASSESSMENT

3.1 NEEDS ASSESSMENT AND RESOURCE SURVEY

This section will outline in detail:

1. The types of information required;
2. the method of collection and collaboration of results;
3. how the information collected will help determine the objectives and strategy of the project.

TYPES OF INFORMATION REQUIRED

a. Information should be collected at the area or village level where the stoves are to be introduced

During the survey information should be collected on key aspects of the ecological and socio-economic environment, as well as the community and government organizations. A detailed list of variables which may be applicable is provided in Appendix 3.1.

Information on the environment will give indications on the rate and effect of deforestation. It will indicate which group is enduring the greatest burden in the collection and purchase of fuel, and where the greatest demand for a new stove will be.

Socio-economic information in an area profile will also suggest the potential size of the market, and whether agro- or community forestry projects may have a greater impact than stove projects. It will help determine how status relates to allocation of time, and the effort/ cash that people may be willing to invest in a stove. Patterns of social decision-making will influence how the stoves are introduced into the area, as will the social structure and the nature and effectiveness of the community organizations. People's previous experience with technology programmes, especially in rural areas, will determine their willingness to participate.

b. Information should be collected at the household level

Household information includes patterns of supply and consumption of fuel, functions and characteristics of the fireplace, methods of cooking and types of food. The types of pots and utensils used in the kitchen, kitchen economics and layout, and user needs are also factors to be examined. Appendix 3.2 outlines Household Information.

The information on home fuel and acquisition will further help to determine people's needs and the possible demand for a new stove. It will also indicate whether people are more interested in, or would be better served by, improved cookpots, pot lids, a new kitchen, or a wood drying rack. The stove could be part of a programme of kitchen improvements.

c. Information should be collected on resources

Before implementing a stove project, it is essential to determine the availability of different types of materials, the skill level of local artisans and industries, and the production and marketing mechanisms available to them. A resource survey is outlined in Appendix 3.3.

Stoves can be made from either cast or sheet metal (welded or riveted), cement, fired clay (brick or pottery), mud (clay, sand, and/or fibre combinations), or stone. The material and the manufacturing process used will depend on such factors as:

1. whether the stove is to be built by the user, artisans, small- or large-scale industry;
2. whether or not it is to be portable;
3. the target retail price of the stove (this can be affected by subsidies);
4. the present supply and demand for the material;
5. the quality of material available (i.e. its ability to withstand forming methods and thermal stress);
6. the production target.

If artisans or industry are to be used, the choice of material will be affected by such factors as:

1. the tools, machines and organization of the production process to be utilized;
2. the potential impact on these factors of introducing a new technology;
3. the possibility of either introducing new production techniques to those already in use by artisans, or the establishment of new work places employing existing or newly trained artisans.

CARRYING OUT THE NEEDS ASSESSMENT STUDY

In carrying out a large-scale survey, the research team should consist of a social scientist, an engineer, and field staff (see Appendix 2.3). Recent experience in Kenya, Nigeria and the Gambia has shown that information can be most effectively obtained if fuelwood gatherers, sellers and artisans are closely involved in the research process (Von Burlow 1983, Morgan 1983, and Kinyanjui 1982). Women's groups can be involved in the collection of data, as can local community development officers or other extension agencies. Potential manufacturers can be contacted (and possibly paid) to help assess their ability to manufacture the stoves. Local community research groups can be formed, trained and paid to carry out the research. General socio-economic information, census data and information about the distribution and quality of clay may be available from government departments or local universities. Getting information from artisans (unless they can see a clear benefit) can be extremely difficult, as they can often be suspicious of such enquiries. Useful information, however, can be obtained when engineers actually work with artisans to produce stoves.

It will be very difficult to interview more than a few entrepreneurs, because of the time involved in developing a trusting relationship. It has been found that observation and informal chats in the areas where entrepreneurs work can often yield as much useful information as a detailed survey. However, prices and availability of materials can be determined by interviewing a random selection of merchants (it is easier to start the survey in areas where they are concentrated).

The main tool for collecting information will be the questionnaire or observation sheet. This will be filled in either by field workers or local research groups. Information on fuel consumption can be obtained by direct measurement, and by questionnaires. The specific techniques are outlined in the next section. Sample survey sheets are provided in Appendix 3.4. Before undertaking the main survey, it is useful to pre-test sampling procedures, questionnaires, and interview schedules in a pilot survey.

The problem of sampling for the kitchen

survey is extremely complex. Experience indicates that in most villages there appears to be a wide range of kitchen systems and a wide range of fuel consumption patterns. It is sometimes possible to determine, from a previous social survey or from the pilot kitchen systems survey, groups that have similar consumption patterns of cooking habits. Random samples can be taken from these groups. Most researchers, however, have opted to use either ethnic or geographical differences to choose a limited number of villages in any particular region. Thus it is necessary to visit as wide a range of villages as possible in the pilot survey, or to provide enough time to extend the area of the survey if different systems (that were not found in the pilot survey) are observed. Within any village a random sample is chosen, or as has happened in a few surveys, most of the households are interviewed.

CASE STUDY

The kitchen systems survey carried out in the Gambia is typical of the small number of surveys that have been undertaken. This was a national survey that was to be carried out in the urban as well as the rural areas. It was implemented by the Department of Community Development and was funded by the Danish government. A social anthropologist was employed to lead the survey team. She reported directly to the stove programme director (who was also head of the planning unit) and was assisted by two members of the planning unit. In the urban areas a team of six interviewers was set up, consisting of four community development assistants (males), and two homecraft assistants (HCA). The men mainly carried out the fuel wood survey while the HCAs mainly interviewed the women in each of the households. In the rural areas the interviews were carried out by the local CDAs and HDAs. The consultant would visit the village at the start, and during the course of the interviewing, mainly to collect completed forms and to fill in any gaps missing in the previous collected sheets. The consultant also carried out detailed group discussions with members of women's clubs, using the planning officer as the translator. All the computation was carried out by the planning unit and the analysis was carried out by both the planning unit and the consultant. In her report the consultant had the following comments:

"To make use of the locally posted staff has obviously a lot of advantages. The assistants are familiar with the village area in question and are thus able to give a lot of general information on the place. Further, it has been essential to the project that the interviewers were well known and mostly highly respected by the villagers facilitating the work of the whole team." (Ref 9.) All the interviewers received a short course on how to interview people and how to fill out the forms. However, the consultant noted that the quality of the completed forms and the degree to which people picked a random sample was very variable. This she partly attributed to the short length of the training course. However, these problems were partly overcome by frequent checking of the forms and visits to the village.

Intensive interviewing of key informants will provide in depth information on patterns of consumption and production of fuelwood, allocation of time to kitchen activities and user needs. Shah (1982) found that this information is best obtained if visits to collect fuelwood are made with women and children.

To help determine user criteria for a new stove and, if possible, the demand, it may be necessary to demonstrate the use of different types of stoves, or to show pictures of them. However, women may not want to participate in a pilot programme if the stoves they see are unacceptable. Alternatively, they may see designs that they like and be unwilling to try an improved version that is still to be developed in the laboratory.

3.2 TECHNOLOGY ASSESSMENT

Upon initiating a pilot stove project, it will be necessary to:

a. assess the range of functions the existing hearths and stoves perform;
b. assess the suitability of the local materials for stove construction, and develop improved materials;
c. compare the performance of the new stoves with the existing hearths/stoves.

PERFORMANCE IS A MEASURE OF FUEL CONSUMPTION, COOKING TIME, EASE OF IGNITION AND OPERATION, SAFETY, AND DURABILITY.

In this section the characteristic features of different types of stoves will be examined, as well as an assessment of stove materials.

RANGE OF FUNCTIONS OF TRADITIONAL STOVES.

Rural: the open fire

Most common is the 3-stone fireplace, although sometimes the stones are ridged clay mounds. Some places have instead metal triangles with legs, or iron bars held by four clay mounds (Gill 1982) to support the post, or three legs on a cast iron pot. Sometimes the fire is sunken (Kapiyo 1982) and various other ways of shielding the fire and/or pot with mud have been developed in many traditions.

The open fire can:

- burn wood, dung, agricultural waste;
- provide light;
- accommodate different pot sizes and types of pots.

Also such a fire can be:

- portable;
- of little or no cost;
- used to dry wood stored overhead or alongside;
- used to preserve grain stored overhead with its smoke.

Finally,

- its heat output is easily variable and pots can be positioned around the fire to keep food warm;
- its smoke keeps away mosquitoes;
- most fires can cook many pots;
- and it is often a social or ritual focus.

Urban: Metal Charcoal Stoves

Small portable combustion devices for cooking are often made from scrap metals. They contain a grate for fuels that require it and are often found in rural homes (that can afford it) as a supplementary cooker. It is known as the Jiko in East Africa and the Fourneau Malgache in West Africa.

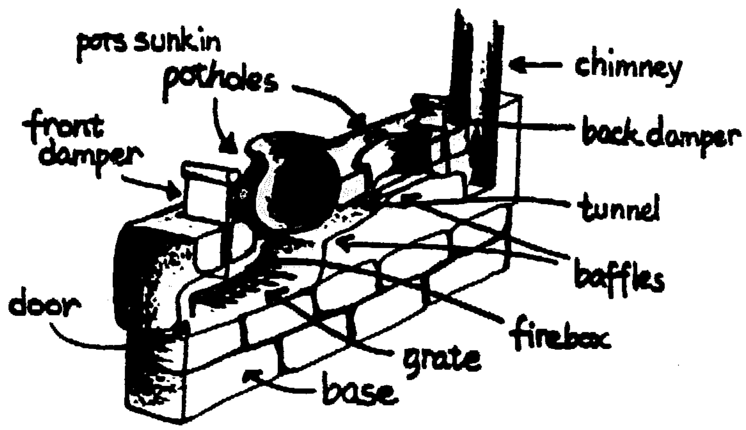
Some of these stoves were introduced only this century, but are widespread and ingrained enough in the cooking practices to warrant the status of tradition.

Characteristics: urns charcoal, maize cobs, coconut shell, wood, dung, briquettes;
portable: can be lit outside and brought inside when smoke has subsided (often done by children);
can be placed in different parts of the kitchen for safety or convenience;
requires less attention re-fuelling and controlling temperature than woodstoves;
provides warmth;
easily repaired or replaced (both inexpensive and higher quality are available);
can roast food.

Other stoves have been developed to burn specific fuels, such as sawdust, and many adapted for special purposes such as brewing beer, which requires a large volume to simmer for long periods of time.

DESIGN FEATURES OF NEW STOVES

To assess the suitability of a new stove or the functions and performance of an existing stove, it is helpful that a classification system be devised and utilized during assessment.



CUTAWAY VIEW INTO A COMPLEX 2-POT STOVE

Fig. 7.

Stoves and fireplaces come in many shapes and sizes. A range of materials and methods is used to make these stoves. Some stoves are purchased from artisans and some are made by members of the family. Some are fixed, some are portable. Stoves can have chimneys and grates in the fire box; others are little more than shields. Stoves and fireplaces can accommodate up to five pots of different sizes; some can only accommodate one pot. Some stoves have special devices (dampers) to control the flow of air - these can be placed at the entrance to the stove, between the pot-holes, or in the chimney. Some stoves have baffles to help increase heat transferred to the pot. Some stoves are specially designed to burn one fuel, others burn a range of fuels.

Two features that significantly affect the cost, acceptability, performance and method of dissemination of stoves are the number and type of pot seats used and whether or not a chimney is used. Key characteristics of stoves on the basis of these two variables are described below.

Single Pot Stoves

a) Single Pot Chimneyless Stoves are known as shielded fires (de Lepeliere 1981).

i) Burning woody fuels

Shielded fires can either accommodate one size of pot or a range of pot sizes. They can be portable or fixed. A shield is placed around the pot to both direct hot gases up the pot sides and prevent heat escaping from the pot. Fuel savings are greatest on stoves that take one size of pot that sits right into the stove. It has been found that the fuel savings are largest when a grate is used. To reduce smoke it is necessary to determine accurately the number and position of air holes in and above the grate. Using a

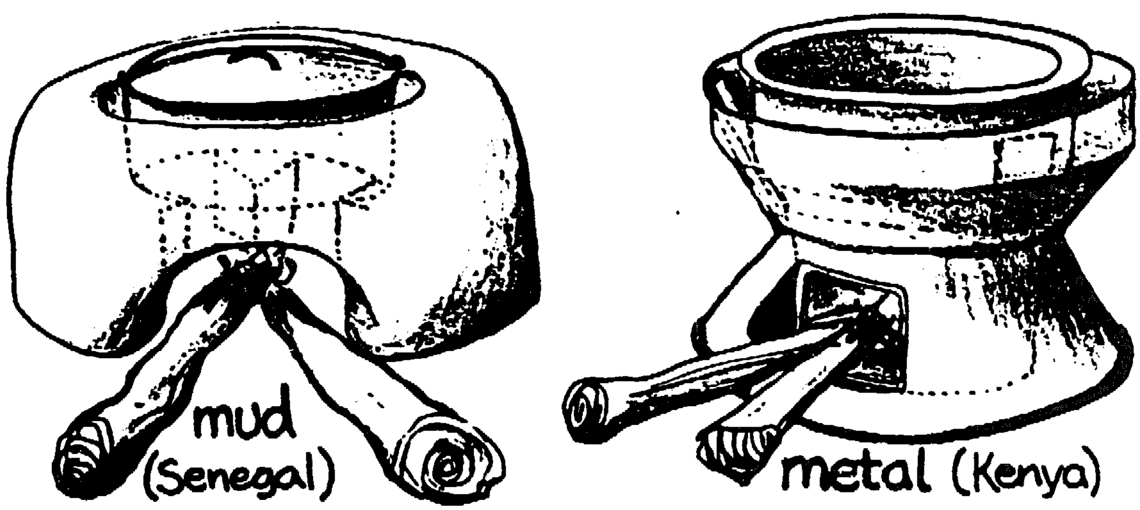


Fig. 8

grate reduces the amount of charcoal produced during cooking. It should be noted that the charcoal is often required for ironing and grilling or is used in the stove to simmer the food slowly. Thus stoves with grates may not be acceptable to some people. The performance of the stove does not seem to vary significantly if the distance between the pot and the shield and the grate and the pot is varied by 1 or 2 centimetres. These stoves can be used as ovens by placing an insulated lid on the top, and shutting the door. Stoves that accommodate a range of pot sizes can also fry as well as stew. The stoves can be constructed to provide light and allow the users to see the fire.

Simple mud or stone shielded fires can easily be made by the users, whereas metal or pottery must be made by artisans. Metal shields are made either by artisans or in small workshops. All these stoves are by far the cheapest to produce and appear to be more easily disseminated in large numbers in the African context (Madon, 1982; Thomas et al, 1983; Yameogo et al 1983). However, they are not smoke free (although often combustion is improved) and the portable stoves must be fixed if they are to be stable. Supporting pots that sit right into the stove is difficult, and it is necessary to have some type of fixture that wedges the pot in place for vigorous stirring. Single pot stoves are more appropriate when one dish is cooked at a time. If two or more dishes are to be cooked simultaneously it is necessary for the family to purchase two stoves. Metal stoves that are uninsulated can give considerable warmth to the room, where insulated stoves do not.

Shielded fires are most suitable when:

- people cook outside or in well ventilated kitchens
- more than one cooking area is used regularly;
- one dish is cooked;
- heating is required;
- mass dissemination/fuel conservation is the prime objective.

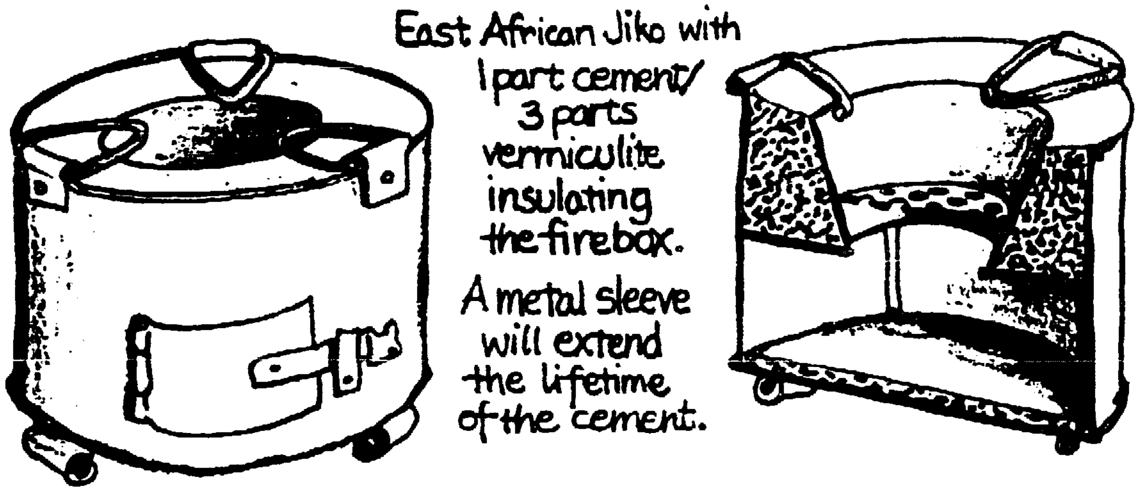


Fig. 9.

ii) Burning charcoal

Stoves that burn charcoal can be upgraded by placing either a metal, clay liner or cement and vermiculite liner inside. The pots can either be sunk inside the stove or sit on top of the stove. Sinking the pot inside the stove increases the fuel efficiency, but decreases the flexibility and ease of operation of the stove. Stoves that are insulated with clay, mud and cement and vermiculite do not radiate as much heat as those with only metal walls. However, a field survey of the Umeme stove carried out by the authors indicates that the heat retained by the stove with mud between the walls helps decrease fuel consumption for long periods of cooking. In Kenya, despite the fact that improvements on existing metal charcoal stoves double the cost, the payback period for a user (in terms of reduced expenditure) can be as little as two months.

b) Single Pot Chimney Stoves

These stoves usually accommodate one pot that is sunk into the stove. The pots usually have a diameter greater than 30 cm and thus are used by institutions and very large families (Micuta, 1983). If the pot is not sunk into the stove, the fuel consumption and time to cook will be similar to a well tended open fire, that is shielded from the wind. The performance is similar to a shielded fire. However, they can accommodate much larger pots. These stoves can be portable or fixed depending on the material used and whether the chimney is fixed into the building. The stoves are very stable and if they are made with an insulating material are safe to use. The stoves must use a grate so that a range of fuels can be burnt. Careful control of the primary and secondary air can be achieved. These stoves can boil or fry (but only in the pot provided) and it is possible to bake inside the firebox.

Fig. 10

A long flame path is created by resting the pot on a semi-circle of bricks. The flame travels across the bottom, toward the front, and around the sides of the pot before reaching the chimney.

These stoves must be made by skilled artisans, as it is important that the internal sizes and position of the baffles be accurate. They will be considerably more expensive to produce than a shielded fire. These stoves take at least twelve hours to build.

If a chimney is to be installed in a house it will be necessary to have a trained person provide this service (chimneys are covered in detail in Joseph 1983c and Micuta 1981). The maintenance requirements are higher than those for the shielded fire especially if a chimney is used. It is probable that the performance of this stove will be more susceptible to poor construction and maintenance than the shielded fire.

They provide little light and if insulated provide little warmth.

Single pot chimney stoves are appropriate when:

- only one pot cooking is performed and the pots used are large;
- it is a priority to remove smoke;
- enterprises can be established or artisans trained to produce the stoves;
- a regular maintenance service can be established or sufficient resources are available to train owners;
- light and heating are not requirements.

Two-Pot Stoves

These stoves can be made from all types of materials, but experience has indicated that metal should be used in conjunction with other materials and not used alone.

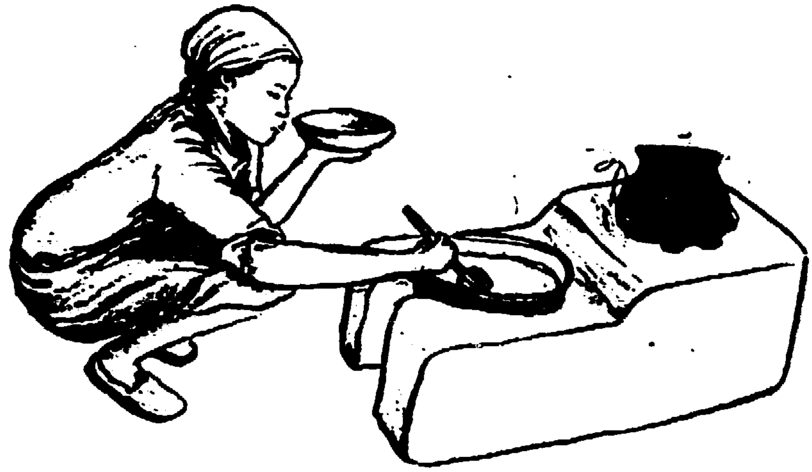


Fig. 11

a) Two pot chimneyless stoves

At present all stoves that have proven acceptable have pot seats that take a range of pot sizes. The two pots are usually sunk into the stove and the exhaust gas flows around them.

The stoves can be fixed. They are carved or moulded in situ (usually from mud) or pottery components are acquired, placed in the desired position, and surrounded by mud. Portable ceramic stoves of this design have proven popular in Indonesia (Kaufman 1983). These stoves do not need a grate but require a number of secondary air holes in the firebox. It is extremely important to construct these stoves accurately if optimum performance is required. The fuel consumption of these stoves is higher than the single pot stoves (where the pot sits inside the stove) (Yameogo 1983). If only one pot is used on a two-pot stove, then the performance of the stove is similar to or less than the well tended open fire. These stoves can provide light and heat by building the stove with an open front, which does not significantly lower the performance. Because of better combustion and the rear exit passage, the smoke is often reduced and released away from the user. It can also be used to dry wood and crops, keep out mosquitoes, and provide some indirect room heat.

These stoves can be made from mud or from fired clay inserts surrounded by mud. If made of mud these stoves can be manufactured both by skilled artisans or well trained groups drawn from the local community. A skilled potter can make 100 insert sets per month using a pottery wheel or about 200-300 using moulds. Alternatively a small ceramics industry can turn out the stoves using either moulds or simple presses.

The mud stoves need frequent cleaning and repairing, and the pottery stoves frequent cleaning, if the performance is to be maintained. Two-pot stoves can produce significant amounts of carbon monoxide and therefore should not be used in a closed room.

These stoves are usually more expensive and take longer to build than the single pot chimneyless stove because they are much more complex.

Two-pot chimneyless mud stoves are most suitable when:

- people want to cook two dishes at once;
- smoke reduction is of some importance but where its use is also of importance;
- users have a tradition of regular repair and cleaning of stoves;
- alternative more long lasting materials are not available;
- resources are available to:
  - train and support artisans to build and regularly service the stove (and where people are willing to pay for their service
  - train users to clean and make minor repairs.

Two-pot chimneyless pottery stoves are most suitable when:

- mass dissemination/time savings/fuelwood savings are the principal objectives;

- pottery producers are highly skilled and available;
- people have the money to purchase (or subsidy is available);
- owners can be trained or encouraged to clean their stove.

Fig.12

Two Pot Chimney Stoves

There are a large number of stoves that have been designed using this basic configuration. Pots, of a fixed size, can be sunk into the stove. The stove can be designed to take a range of pot sizes that sit on top, but the performance of this stove is considerably lower than the stove where pots are sunk into the stove, and than that of the two-pot chimneyless stoves. The stove can be transportable if made of metal, mud and metal (see the Pogbi Stove illustrated at the end of this section), cement sections or ceramics and the chimney is less than two metres high (although a donkey cart is usually required to move the Pogbi stove). The largest segment, the stove body, weighs 200 lbs. Some of these stove models use a grate. It would appear that Pogbi type stoves have a higher performance, but they are more expensive and more difficult to maintain (cleaning the chimney is not easy). The amount of air entering the stove is often controlled either by a door at the front or by using a damper placed between the chimney and second pot seat. These dampers are usually made of mild steel sheet and are often lost or corrode very quickly. They are rarely effective. Baffles are usually placed under the second pot to increase the amount of heat transferred to the second pot.

The size of the internal flues and the distance between the baffle and the second pot will depend on the height of the chimney and the type of fuel, its size and moisture content. If the stove is not made accurately to a predetermined size the performance will be significantly lowered.

The stoves can boil, fry, and possibly bake in the firebox. The models where the pot sits closer to the top of the stove can be opened at the front to provide light. If the stove is made of metal and not thickly insulated, it can provide heat.

Depending on the material, these stoves can be made by artisans or in small industries. The stoves can be made by groups involved in community development (if they are well trained). The time taken to build these stoves depends on the material used and the height of the chimney (and whether it is fixed into the house). A portable metal stove can be built in 2-4 hours; a pottery insert stove can be built and installed in 8 hours; and a mud stove in 8-20 hours.

Both pot holes must be covered while in use difficult to make and use the chimneyless stove. Insulated stoves will provide little heat. These stoves must be well maintained and cleaned if they are to give significant savings in fuel.

Two-pot chimney stoves are suitable when:

- two dishes are to be cooked simultaneously;
- smoke must be removed from the room;
- skilled artisans or small enterprises can manufacture and possibly install the stove;
- resources are available to train users or establish an enterprise to repair and maintain the stove;
- light and heating are not required.

Other design features that can be incorporated into a stove include raising the stove off the ground, ovens, and special racks for drying.

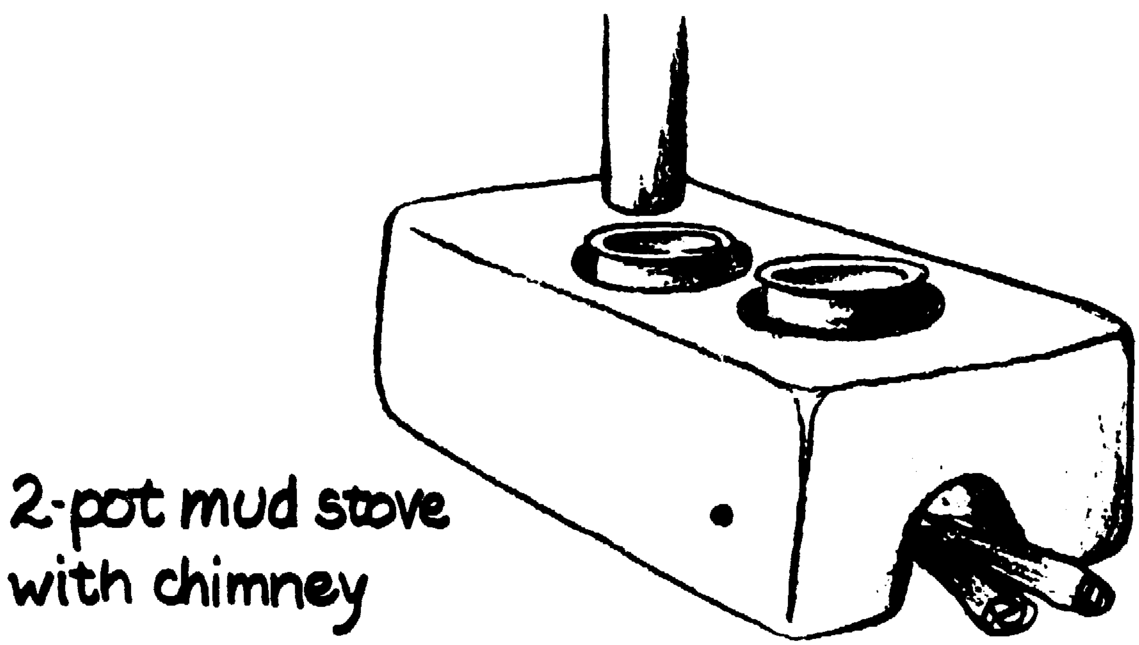


Fig. 13 .

MATERIALS

The overriding feature of a stove which affects the cost, method of construction, the durability and, to some extent, the performance (and the change in performance as the stove ages), is the material or materials used to build the stove. The change in performance as the stove wears (and how this is affected by repair) is given in the first of the following charts. The effect of stove lifetime on the numbers of stoves distributed is given in the charts underneath (as calculated by K K Prasad, 1982).

The main materials that have been used in urban areas to manufacture stoves are steel, fired clay and cement. In rural areas the main materials have been stone, mud and fired clay.

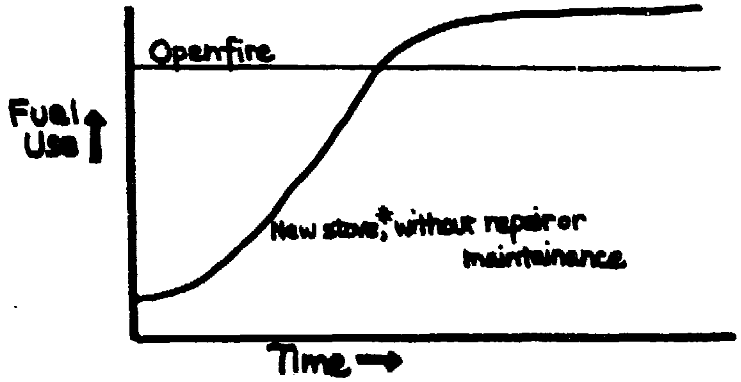
THE MOST ACCEPTABLE STOVES HAVE COMBINED THE BEST QUALITIES OF TWO OR MORE MATERIALS IN THE DESIGN.

The important aspects of choosing and working with each material are presented below.

Metal

Many of the urban wood and charcoal burning stoves in Eastern Africa are made from metal. The main supply of metal is scrap, the thicker gauges (1.5mm thick) are obtained from oil drums and the thinner from 'tin' boxes. The lifetime of a thicker gauge stove (in constant use) is 18 to 24 months. The thinner gauges have a much shorter lifetime.

Grates are normally made from thicker material than the stove body, and have a lifetime of six to nine months. In Sudan strip steel from packing cases (a very strong steel) is woven to provide a much more long-lasting grate (see Fig. 16).



*Actual curve depends on type of stove. Repairs will also significantly alter the curve. Based on information gained in Indonesia by ITDG.

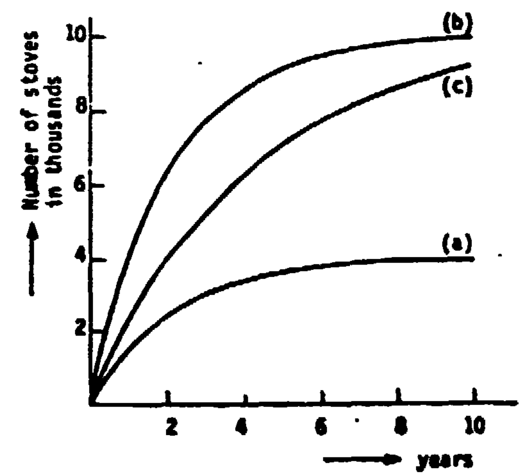


Fig.14 Operating stove population growth with time for a long-life stove design

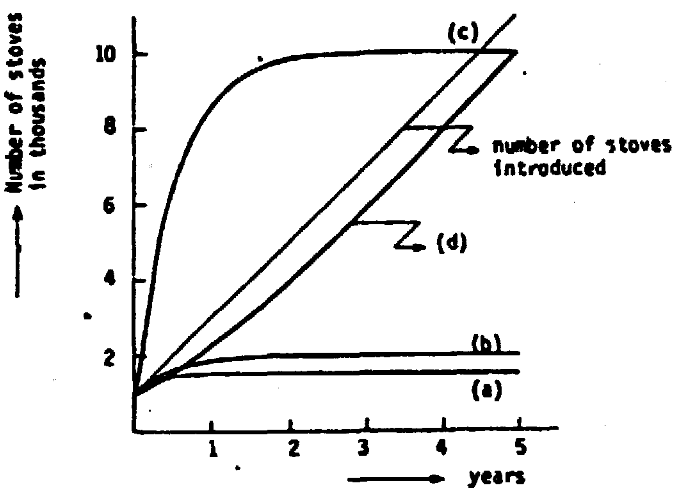
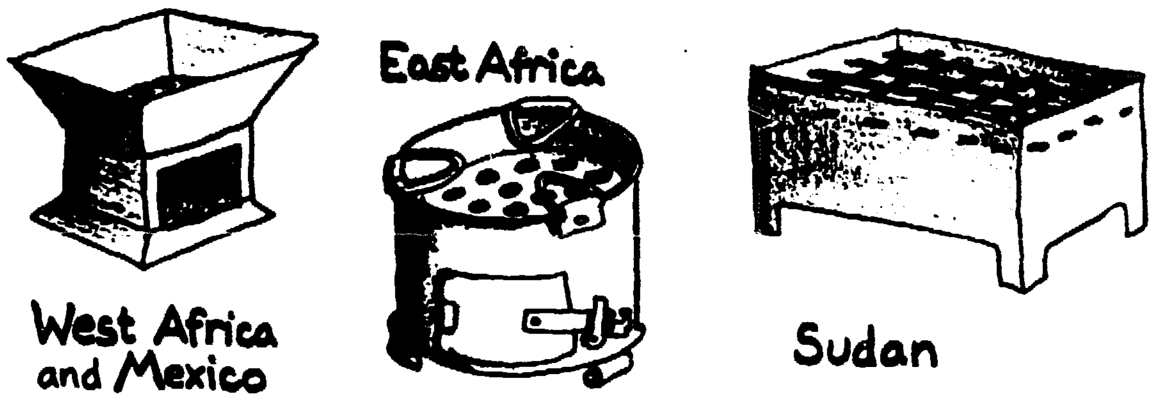


Fig.15 Operating stove population growth for a short-life stove design

Fig. 16

TRADITIONAL CHARCOAL STOVES



Stoves can be made from imported sheet steel at high prices (and probably with a shorter lifetime than those made from oil drum steel). The availability and cost of both imported and scrap steel depends on the level of manufacturing activity and government policy on importing materials. In Kenya, for example, the price of scrap and imported metal doubled in 1982-3.

Metal has the advantage of being easily shaped. Stoves can be produced in large numbers by the existing artisans working in the informal sector or by small or large engineering workshops. Experience in Kenya has indicated that stoves can be produced in the informal sector much more cheaply than in the formal sector. The investment required to produce a new stove is minimal and the time rquired to train skilled artisans to produce a new product can be less than one week. These people can make three to five stoves in a day. However, artisans will often take short cuts and therefore not build the stove to the required degree of accuracy, thus tending to lower the performance of the stove.

Marketing a new product is a much more risky affair for the artisan than for a small industry, which has existing outlets. On the other hand, industry, small or large, may have to find considerable capital to retool or expand. The labour costs will often be greater and the actual market for the product may be smaller than for the artisans. The output from a small industry can be as high as fifteen stoves per day per person. Artisans operate in the rural sector whereas small engineering shops do not exist in many rural areas (and considerable effort is required to develop such industries). However, if small engineering enterprises are established, they may create employment and help produce other useful products.

Metal now has the advantage of providing area heat, though many children burn themselves on its hot surfaces. By adding an inner layer of fired clay (as in the Kenyan Ministry of Energy's stove), or by placing mud between two metal walls (as in UNICEF's Umeme stove), the same amount of heat will enter the room, but over a longer period of time, but will be much safer and more fuel-efficient. The techniques can be used for both charcoal and wood burning stoves, but may double or triple the cost. The addition of fired clay increases the complexity of the production process, but also extends considerably the lifetime of the metal cladding.

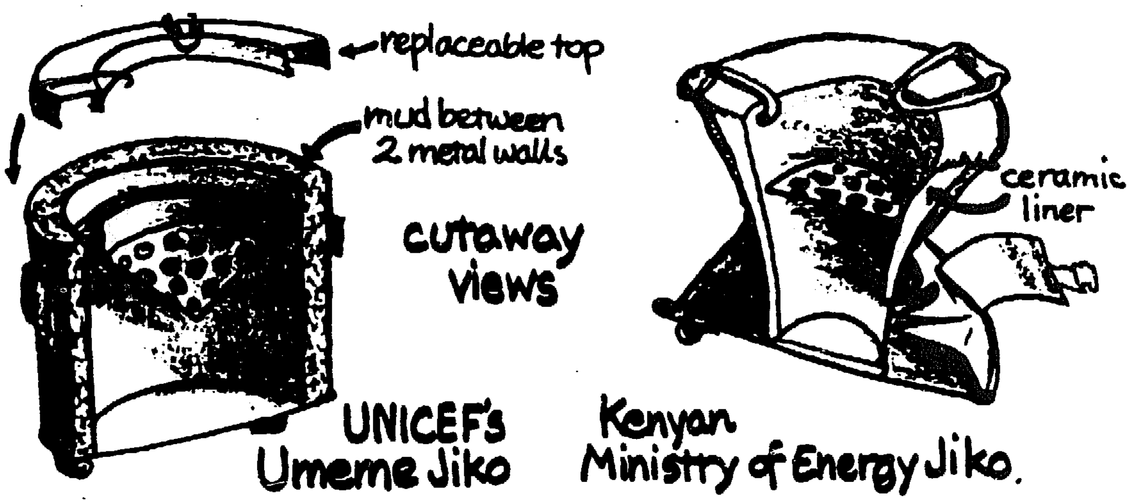


Fig. 17

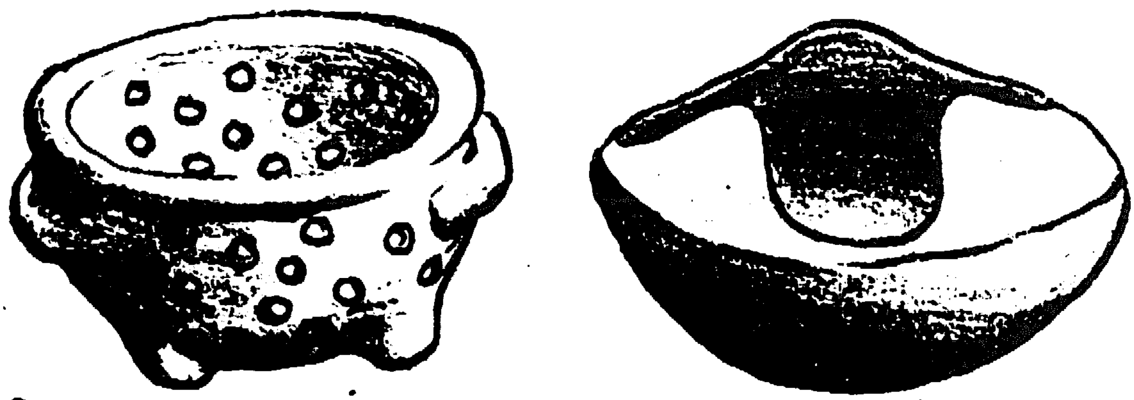
Metal stoves can easily be lined with cement mixed with vermiculite or diatomite, or with soapstone or meerschaum (available in Somalia). This can be done by artisans or by semi-skilled workers who have received a short training course. The lining of charcoal stoves and wood burning single-pot shielded fires is relatively simple, but two-pot wood or charcoal stoves present greater problems. Repairs can be easily carried out by local artisans.

Pottery

Africa has a long tradition of producing fired clay ('pottery') pots, but there are few pottery stoves being produced. In most of Africa there are only a few areas where high quality clay is available for the manufacture of pottery stoves.

CLAY THAT IS SUITABLE FOR PRODUCING FIRED COOKING AND WATER POTS MAY NEED ADDITIONS TO PRODUCE LONG-LASTING POTTERY STOVES.

It is necessary to test the clay (see materials testing, Sec. 3.4). It may be necessary to mix clay from different deposits together, or to include additives such as sand, crushed fired clay, rice husk ash, soapstone, mica, dung or charcoal, in order to produce a satisfactory mixture. The mixture should be easy to form, should not shrink too quickly when wet, and should withstand repeated heating and cooling, and impact loads, when fired.



Senegal Kenya coast

Traditional Pottery Charcoal Stoves

Fig. 13

Pottery stoves are easily mass produced in moulds or on a wheel, and are usually less expensive than metal stoves. They can be portable or fixed. The length of life depends on the quality of the clay, its preparation, the firing temperature, and the stove design. Pottery can be made by artisans, working part time at their homes, or in small ceramic industries. The cost of production in rural areas is much lower than in urban, but transportation of the stoves over long distances is often expensive and difficult.

In Kenya the pottery liners for charcoal jikos are often made by a separate pottery company, and the assembly is done in the informal sector. Alternatively, a pottery company has sometimes hired and managed skilled artisans to do the work on site. Experience has shown that it is much more difficult to train itinerant or part-time potters to make high quality stoves than it is to train metal-working artisans. Often these potters cannot produce stoves all the year round because of lack of fuel or the need to be involved in agricultural activity.

The extension costs of a pottery stove project can be greater than that of a metal stove project. (This applies especially to wood stoves.)

Either potters or extension workers may be required to install the stove, especially if the stove has a chimney. There has only been limited experience of people working with small pottery industries in Upper Volta (Baldwin, 1982) and Kenya, but it would appear that these enterprises can expand to produce a quality product at a lower cost than metal stoves. Training required to upgrade skills is minimal, but frequent follow up is necessary. Investment is usually required to upgrade the artisan or small industry's facility to produce a cost-effective high quality product. This could include improved kilns, clay-working machinery, moulds, or extra drying and working space.

Pottery stoves must be carefully designed so that concentrations of stress do not build up, in order to give a long lifetime (for more information see Joseph, 1983). It is desirable not to rest pots on pottery stoves, and this can be done by encasing the stove in mud or in the case of shielded fires to place an iron frame inside the stove. The lifetime of a pottery stove encased in mud can be from 18 months to 4 years depending on the quality of the clay and the care taken in preparing the mix.

Pottery stoves can easily be repaired with mud, or a mixture of mud, ash and cement, if they were originally encased in mud. A mixture of 2 parts clay : 1 part cement : 1 part rice or millet husk ash, or a mixture of 1 part cement : 3 parts vermiculite can be used to repair portable stoves. The lifetime of pottery charcoal stoves is probably increased if a mixture of cement and ash is used on the internal surface.

Mud

In Africa, most of the wood stoves that have been introduced into rural areas have been made from mud (a mixture of sand and clay). Although mud is widely available and very cheap, it often does not withstand constant heating and cooling for long periods of time. Unless the clay is of high quality, and the walls are very thick, the fire-box will crumble when wood is continually struck against the sides, and cracks can occur adjoining pot-holes, and between wall and pot-hole, if heavy pots are continually dropped or placed heavily on the stove.

Mud stoves can be produced by artisans, extension workers, and by users. Quality tends to vary considerably with the skill and training of the builders. Stoves can be carved from a single block of mud (Fig. 19), made from ropes of clay/fibre (Fig. 20), or moulded (Fig. 21).
A great deal of training and follow up is required if people are to carve mud stoves accurately. The stove can be produced in the home, or at a workshop, and then transported to the household. Small businesses making mud stoves have been established in Guatemala (Caceres, 1983), Senegal, and Kenya. The investment cost is low

and production can be intermittent.

'Methods of Manufacture of Mud Stoves'.

Fig. 19 Lorena (sand/clay) is compressed by layers into a solid block, and then carved with knives and spoons.

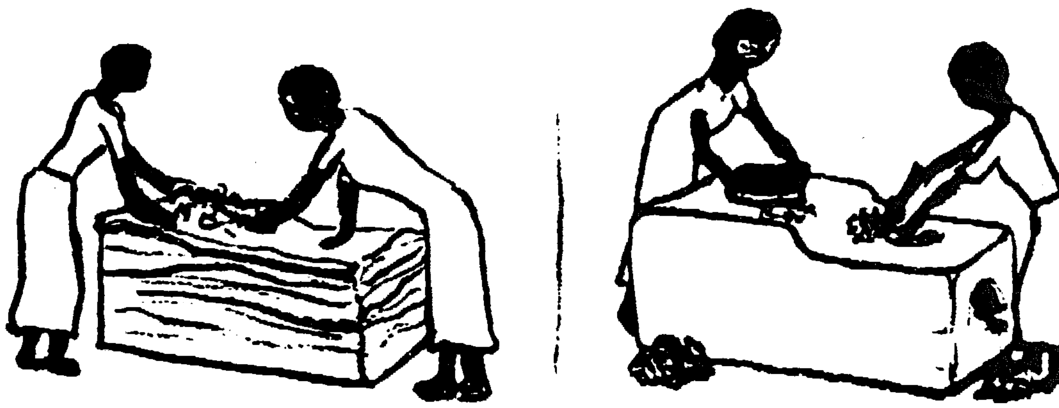


Fig. 20 'Ropes' of 50% clay/50% long fibres (either hay or raw sisal) are prepared, then interlocked and beaten into place around pots resting on three stones or bricks.

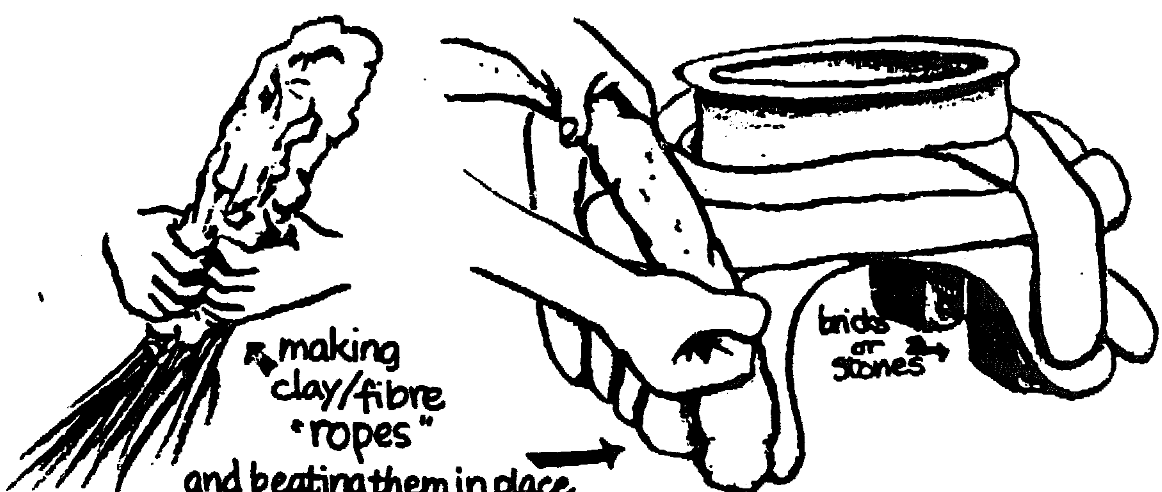
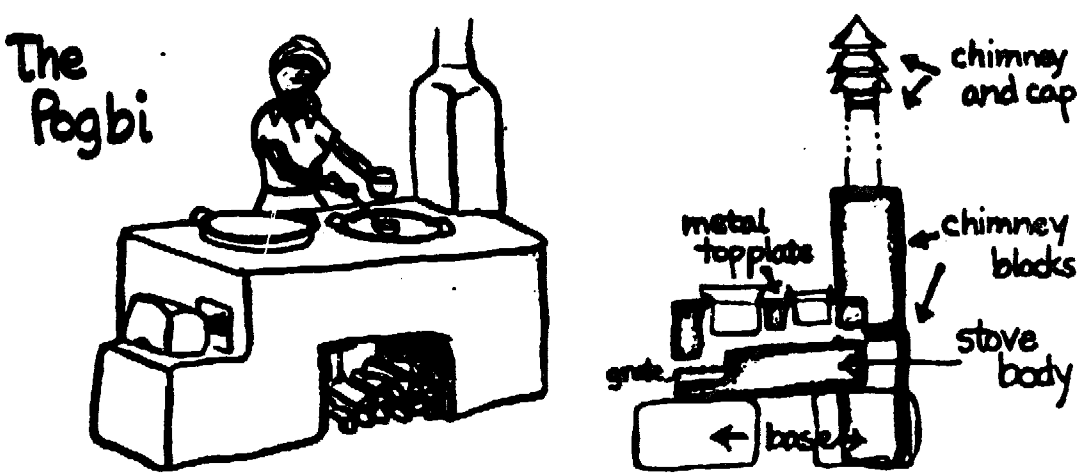


Fig. 21 Moulded stoves are (more often) accurately made, and can be transported if they have a significant fibre content.

Fig. 22 The Pogbi is made in a workshop by pounding clay/hay 'ropes' into wooden moulds. When dry, the body and chimney parts are transported and installed.



One person can produce a moulded stove in half a day, and a two pot-hole carved stove in one or two days. The total time taken depends on whether a chimney is installed and how much time is spent collecting and preparing the material. A great deal of experimental work is often necessary to develop long-lasting mixes. Until recently mixes were developed by trial and error, but work at Kenyatta University College and at ITDG (UK) is starting to indicate how to speed up this process. Experience has indicated that termite mound is the best clay to make mud mixes. Clay should be crushed and sieved before use. It should be mixed with dung, ash and husks (the exact proportions must be found by experiment), mixed with water until damp, and allowed to stand before building. Some stove builders recommend mixing grass and crushed pottery with the clay although initial tests indicate that weak spots in the firebox are areas where grass has burnt away. The addition of fibres gives tensile strength to the block, reducing tendencies to crack. The properties of mud are possibly improved by the addition of 25% cement. A mixture of 2 parts mud : 1 part cement : 1 part rice husks, has been used to make bread ovens in Fiji (Petersham, 1982).

The lifetime of a mud stove can be as low as three months or as high as four years. Durability is considerably enhanced if the stove is constantly repaired. The extension cost of training and follow-up are considerably greater for a mud stove programme than for pottery or metal stoves.

Other Materials

Cement

West African cement stoves often have a lifetime of less than 18 months, are expensive, and difficult to repair. However, the lifetime of this stove could be increased by additions of vermiculite or diatomite to the cement that is being subjected to heat. Cement stoves can be moulded in one piece or made in sections and can be made in the home by artisans or in a workshop. A man can make one to three woodburning stoves a day, depending on size, etc. The capital investment is relatively small.

Cement is quite good as a coating for mud stoves, making the surface impervious to water spills and strengthening against abrasion where pots are inserted into the stove.

Brick

Brick stoves have an extremely long lifetime - up to 20 years if good quality building bricks are used. The stove must be made in the household and usually takes at least one day to complete. To ensure proper construction these stove builders must be given extensive training and be provided with templates to fix the internal dimensions of a stove. The template can be made of metal, clay/fibre, banco or cement. Mortar between the bricks needs to be repaired occasionally.

Stone

Stoves can be formed from stone slabs or carved from soapstone, siltstone, or basalt. These are lifetime. Meerschaum stoves are made in Somalia and siltstone and basalt stoves are common in Indonesia and have now been developed in Lesotho (ARD 1982). Stones can be joined together with cement/clay/husk mixtures to make a stove.

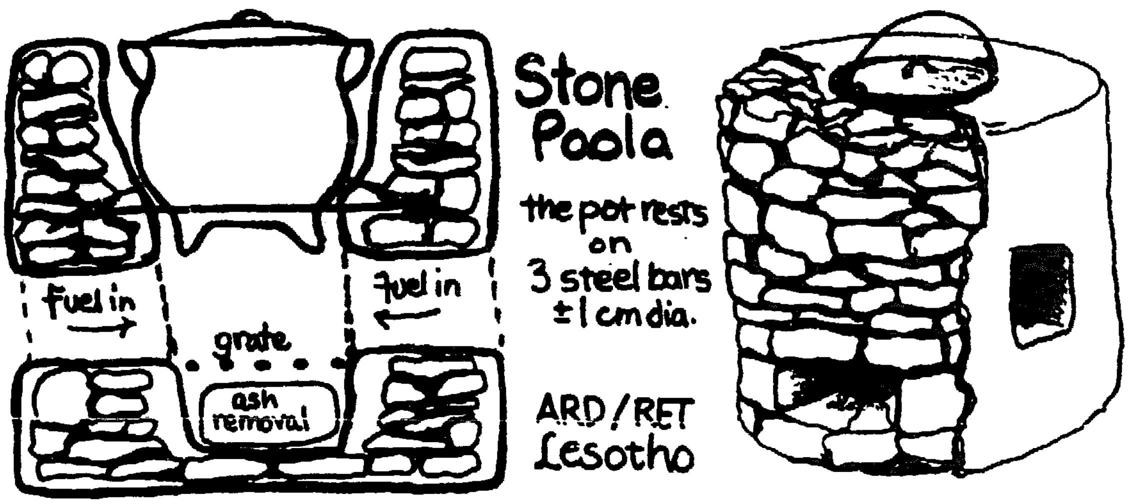


Fig.23

3.3 MATCHING TECHNOLOGY TO NEEDS AND RESOURCES

Having obtained the necessary information from the survey, and understanding the characteristics of different types of stoves, it is now essential to develop design criteria for stoves, and methods of promotion, manufacture, and distribution to meet the local needs and resources. This is presented here as a series of questions and possible answers.

1. What are user and implementing organization criteria for a stove?

NEEDS	POSSIBLE TECHNOLOGICAL
1. Smokeless kitchens	1. °Build a chimney stove °Build exhaust vent or fireplace chimney

	°Increase ventilation in house °Optimize firebox for efficient combustion
2. Use of smoke	2. °No chimney or short chimney °Build drying rack overhead
3. Safety	3. °Build stove too high off the ground for young children °Insert pots into the stove °Fully enclose firebox °Insulate stove °Use stable high-mass stove
4. Ease of maintenance	4. °Do not use chimney, or use a very short chimney that does not go through roof °Use pottery or cement and vermiculite inserts °Avoid more than two pot seats
5. Ease of operation a) in cooking	5. °Interchangeable pots °Easily reached pots for stirring °Build stove high or low, for sitting or standing, as desired
b) wood does not have to be chopped	°Build stove on ground (no base) or with ample support in front of door for long sticks of wood

c) fire needs little tending	°No grate
d) will ignite quickly	°Use grate
e) will ignite wet wood	°Use grate
f) able to raise and lower output of fire easily	°Use dampers or door °Use long sticks of wood
6. a) Cooks faster	6. °Cook two pots at one time °Pot inserted into the stove °Pot lids (thick wood or metal) °Increase fire output or heat transfer
b) First and second pot come to boil at the same time	°Alter baffle dimensions and position
7. Save fuel	7. °Sink pots into stove °Use single pot-shielded fire (multiple pot stoves have not been proven to save fuel in practice)
MOST IMPORTANT	°Well designed °Accurate construction °Proper maintenance
8. Occasional baking	8. °Build firebox large enough to accommodate pans
9. Low cost	9. °Use locally available skills and resources °Minimal cost of transport

	°Develop method of mass production of the stove, or mass dissemination of skills
10. Provides light	10. °Open up the front of the stove °Put many holes in the firebox (this will lower cooking efficiency) °Subsidize alternative liquid fuel for lamps
11. Charcoal for ironing or other use	11. °No grate
12. Provides space heat	12. °Use metal or thin-walled ceramics °Use high mass chimney stove with long tunnel °Lower draught into the kitchen
13. Similar lifetime as three stones	13. °Use high quality refractory cement °Use cement (1 part) and vermiculite (3 parts) °Use cast-iron steel plate °Use dressed stones °Keep design simple
14. Aesthetically pleasing	14. °Use high quality materials °designer or artist °Apply paint, diatomite, whitewash, varnish or tiles to final product

	°Apply patterns to outside
15. Can be made by local group	15. °Mud or rock must be used as main material °Some parts purchased and encased in mud °Cement can be used, especially if a trained mason is part of the group
16. Creates employment	16. °Establish a stove-building enterprise °Ceramic and/or metal stove made by artisans °Establish a repair and maintenance enterprise
17. Able to be produced in large numbers within a five year period (say 100,000 per year)	17. °Made from metal or pottery or a combination °Portable °If mud, requires a large extension service using moulds

It is possible that priority given to some criteria by users will be different to those of the implementing organizations (e.g. the implementers may want the stove to save wood primarily, whereas the users might want to save cooking time). Criteria may be conflicting (e.g. a stove that eliminates smoke will not be as easy to maintain). It is essential to resolve as many of these conflicts as possible before developing and testing stoves. Dialogue with users is the best method. Some of these conflicts will be resolved when other constraints on the designs are detailed. There is still scope for imaginative design to meet conflicting criteria.

2. **How do you adapt the design to fit the physical space available?**

One way is to list the following:

- area occupied by existing stove (if it is to remain);
- area occupied by kitchen furniture;
- area required for preparation/consumption of food;
- area occupied/required for other items/activities.

Subtract the total of the above areas from the total floor area of the kitchen. This will then determine the maximum size of the stove, and possible position. Repeat this calculation for the range of kitchen sizes noted.

Another way is simply to place the pots on the floor where the stove is likely to be, taking account of where the air enters the room and arm movements in food preparation. Lines can then be drawn on the floor (for massive mud stoves).

Stoves are often tables in Guatemala, the large counter space being utilized for serving and sometimes eating (Aprovecho, 1980). Alternatively, the stove may need to be portable if the space is used for sleeping at night.

3. **How does the height of ceiling, type of roofing, degree of ventilation and prevailing wind affect design and position of the stove?**

1. 1.5 metre high chimneys can be placed inside if the roof or the ceiling is 3.5 metres above the floor and if the roofs are made of an inflammable material. If the height of the ceiling is less than 3.5 metres it is necessary to take the chimney directly through the wall or roof. If the roof is

flammable it is necessary to insulate the chimney when it passes through the roof. It is also necessary to have the chimney exit at least 1 metre away from the thatch. If a room is well ventilated it is possible not to use a chimney (a stove that operates properly does not produce smoke except when the fire is first lit).

It is possible to build a cowling to remove the smoke outside the room, in cases of portable or chimneyless stoves. A cowling may be built through the roof or into a window if the material surrounding it is non-flammable and if the cowling does not take away necessary light. Avoid placing the chimney close to an outside wall, especially if the wind hits this wall for a substantial proportion of the time.

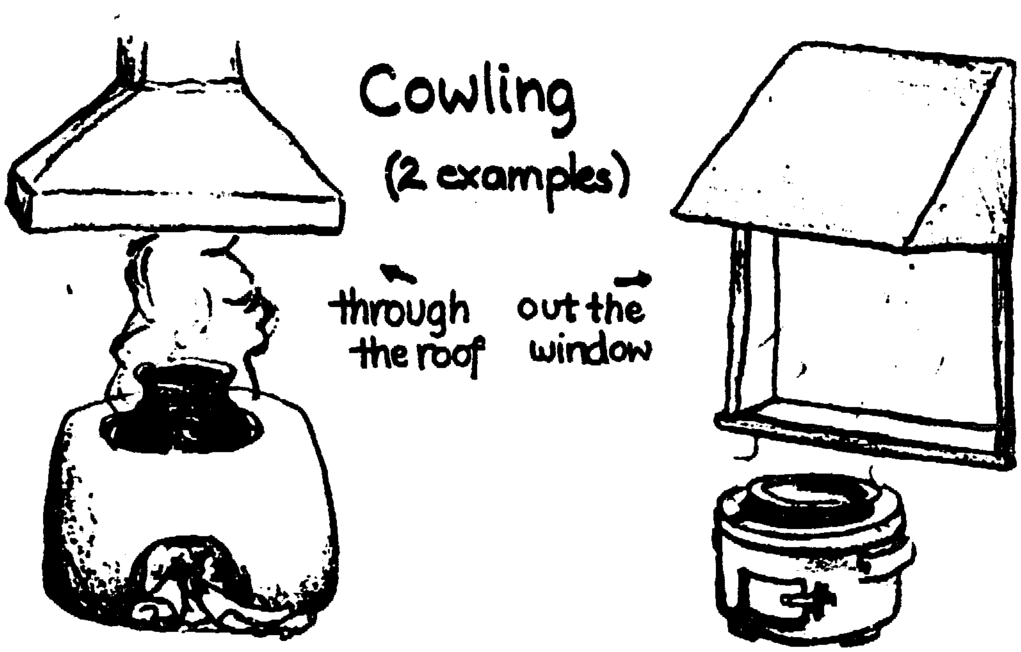


Fig. 24

4. What are implications on the design and the impact of the stove if people have more than one cooking place? or more than one stove?
   - Design a portable stove
   - Design stoves that fulfil the same functions as the existing stoves
   - Be content, (if users are), that the stove can only fulfil some of their needs of fire and that the traditional stove will be used for some cooking and heating functions
   - Considerable wood savings will not be seen if a single fixed stove is used.

5. How does the type, number of, and size of pots reguarly used affect the design?
   - It is important that pot seats can accommodate all or at least the most frequently used pots.

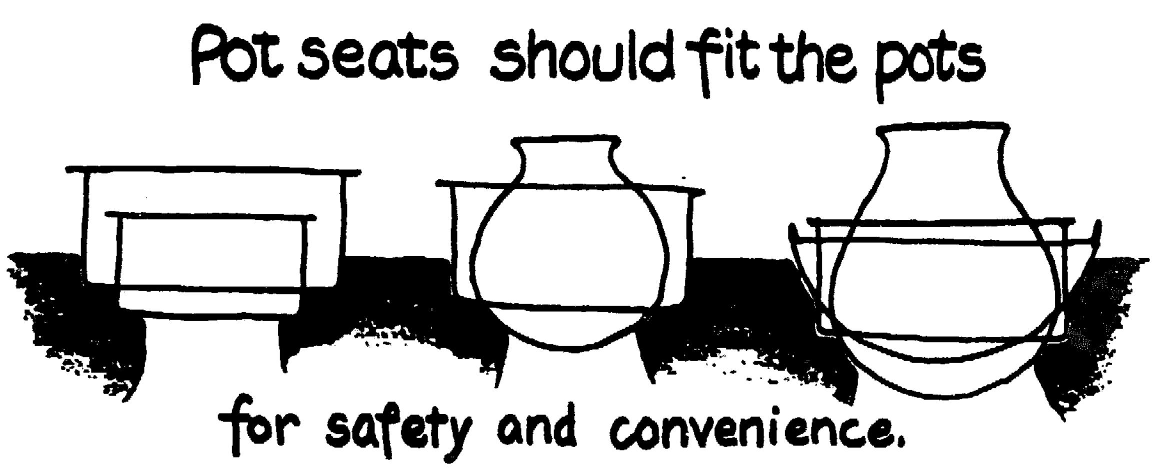


Fig.25

- It is preferable to mould the pot seat to the contours of the pot (Evans and Boutette 1981). This will provide extra stability when cooking. It is important that the bottom of the pot does not hit the baffle.

- If people only use one or two pot sizes it is possible to build a very simple shielded fire or a single chimney stove that has two fireboxes. The pots would sit inside the stove.
- If people use small pots for brewing tea and large pots for cooking, it will be necessary either to make some type of ring or heavy wire screen on which to sit the small pot, or to provide a small stove for brewing teas. It is extremely important to determine whether people would restrict the range of pot sizes used if a stove with fixed pothole sizes were to be introduced (e.g. Pobgi Section 3.2). Pots of tea have to be modified or new pots purchased when 2-holed fixed pot size stoves are introduced.
- Suspend the pot (like a tea kettle) above a bed of charcoal.

6. **What is the significance of different pot sizes for the installation of an insert stove or the construction of a mud stove?**
   - It is important for the builders and installers to get the women to bring out all their pots and identify the use (and frequency of use) of each one. The distance between the 2 pot holes should be large enough to accommodate the two largest pots placed side by side.
   - It will then be necessary to determine the distance between pot seats and chimney, the inner and outer diameter of the pot seats, and the slope that will enable most of the pots to sit safely on the stove.
   - If large pots are used frequently to prepare beer or cattle feed it may be necessary to design a special stove (that is cheap but fuel efficient).

7. What are the implications of the diversity of existing stoves (and their different social and cultural significances) for the introduction of improved stoves?

- It is essential for the promoters to spend considerable effort to get households to explain all the functions of the old stoves. It will then be necessary to understand what functions the new stove can perform (and what are its advantages). It may also be necessary to determine if the household will still use their old stove for ritual, light, or other cooking purposes.
- People who buy a stove may be more willing to purchase a new stove if the lifetime and cost are similar to the old stove. If people do not purchase their present stove they will have to be convinced that the benefits of the new stove outweigh the cost (in either money or labour).
- It is much harder to train people to repair and maintain new stoves if they have not had to do this before. Introducing mud stoves to people who have never used mud before is also extremely difficult.
- It will be necessary to monitor closely the response to the same stove by different ethnic groups living in the same village.
- Since women usually make and use the traditional stove/fireplaces it will be very beneficial to involve them in the choice and/ or installation of the stove.
- If the replacement stove has to be purchased (and the men make the decision on spending) they will need to be involved in the decision to adopt the stove and shown how it would benefit them (especially if they don't collect wood).

8. What are the implications for the design of the stove if people burn a range of fuels?

- It is extremely difficult to design a stove to burn all types of fuel efficiently. Residues and very wet fuel require more air to burn properly. It is normal to introduce secondary air to help these fuels to burn properly. It may be necessary to provide drying space near the stove for wet fuel (especially when a chimney is used).
- Soft wood (e.g. pine) and most residues produce more soot and tar than hard woods (e.g. acacia). Therefore chimneys must be cleaned more often and extra care must be taken not to allow the tar to catch alight in the chimney.
- Some fuels (e.g. rice straw and husks) produce a lot of ash and charcoal. This ash can block the passageway between the fire box and the second pot seat. This will lower the draught and affect the performance. It is necessary to raise the connecting tunnel above the bottom of the fire box or instruct users to keep the passageways clean.
- Little heat will get to the second pot hole when fuel that burns with a short flame is used. This could affect speed of cooking of the second pot of food. It may be advisable to use a design where both pots are positioned over the fire box or use a single pot stove.
- It is very important to make the door wide enough when large pieces of wood are used.
- If people use short pieces of wood then a door could be used to help attain more efficient burning (this assumes that people will not want to observe and tend the fire).

9. How is the resource base related to the design and manufacture of stoves?

- The information on material and artisanal resources needs should be processed before method of manufacture, cost per unit, and the regional investment required to meet the potential demand can be determined. The following process needs to be carried out.
- Determine the relative costs/kg of each of the potentially available stove materials. Estimate their transport costs (in labour or money), and the likely availability in each area where stoves are to be introduced. If mud is to be used, check that users/builders are willing to collect and prepare the material. Note the variation in quality of the material. For example, the strength of cement can depend on its age, method of storage (e.g. was it in a dry place?), type of packing (e.g. plastic lined bags provide a longer shelf life), and the point of origin. Choose materials that are readily available, whose supply does not fluctuate. There should be sufficient quantities to meet the potential demand for the forseeable future.
- It is then important to determine what combination of materials might meet the lifetime criteria of both users and designers. With the combination of materials chosen, can an attractive stove be designed?
- Determine whether the local artisans have the skills to produce the stove. Try to estimate the potential output of stoves from these artisans, using their existing technology. Examine ways of upgrading their production techniques. When carrying out this exercise determine the investment input required to achieve a certain output.

Determine the labour requirement for the new technologies and whether some artisans would be displaced or have their status downgraded (for example, women may become less important in the new production process). Determine whether the artisans have to be organized to meet quality standards and production outputs, and the mechanisms required for carrying this out. It should then be possible to devise a programme to establish viable production units.

3.4 TESTING

Many books and articles have been written on the testing of stoves. In this section we will outline the type of tests carried out and the reasons for carrying out the tests. The reader is referred (VITA 1982b, Joseph et al 1980, Depeleire 1981) for further details of testing.

LABORATORY TESTING

NOTE: ALL DESIGNS SHOULD BE TESTED IN THE LABORATORY BEFORE THEY ARE FIELD-TESTED

Laboratory testing has been carried out in universities, government testing laboratories and in NGO centres. An area approximately ten metres by six metres is required; part of this area should be enclosed and part should be open, and the open spaces should be well protected from winds. Basic equipment for thorough laboratory testing (scales, watch, thermometers, oven) will cost around US$1,000-$2,000 (in Africa). It is useful to have access to metal, wood-working (for making templates and moulds) and pottery facilities. A section should be set aside for materials testing. Considerable time and effort is saved if a programmable calculator or a cheap micro-computer is used to store and analyse the results. Procedures and good methodology are more important and more useful than expensive equipment.

Water Boiling Tests

Water boiling tests:

- Provide quick indication of the relative performance between stoves;
- allow the distribution of heat to the pot, stove, wall and removed by the flue gases to be calculated and thus enables the design to be improved;
- provide a clear indication if a minor modification to a stove has significantly improved its performance;
- enable designers to determine if the type, size, and moisture content of wood, residues or charcoal, size and type of pots and prevailing wind conditions (both above and in the house) affect the performance of the stove;
- provide an indication of how difficult it is to ignite the stove and how often it needs to be attended;
- determine the minimum and maximum heat output of the stove (a stove which has a large difference in minimum and maximum power output often is easier to use and more fuel-efficient);
- determine the comparative level of emissions of CO, unburnt hydrocarbons and soot between two stoves (with proper monitoring equipment).

A series of water boiling tests should first be carried out on the existing range of stoves to provide a base line from which other stoves are evaluated. These fireplaces and stoves should be tested using different wood/charcoal residues/pot, etc. Stoves are built and tested (under standard controlled conditions), and those stoves, whose performance are equal to or better than the existing stoves, are selected for further development work. Universities or large government laboratories can carry out more sophisticated tests which measure heat flows and levels of pollution.

Once designers are satisfied that they have the optimum performance under controlled conditions it will then be necessary to determine how the performance varies when different types of wood, charcoal, pots etc are used. A final assessment can then be made and then cooking tests are carried out on the most promising stove.

Controlled Cooking Tests

The primary objectives of controlled cooking tests are:

- to compare the fuel consumed and the time spent in cooking a meal on different stoves; and
- to determine whether a stove can effectively cook the range of meals normally prepared in the area where it is to be introduced.

The controlled cooking test may also be used:

- to compare different cooking practices on the same stove;
- to give a cook the opportunity to learn how to use the stove; and
- to follow the Water Boiling Test in subjecting a stove to more realistic, but controlled, conditions.

Cooking tests can and should be carried out by both laboratory staff and potential users. They are time-consuming and require careful planning and implementation if the results are to be useful. Cooking tests should be based on information gained in the survey.

FIELD TESTING

The main aim of field testing can be to measure the performance of the stove in the household or to determine patterns of supply and consumption of fuel. These latter fuelwood surveys are outside the scope of this book and the reader is referred to Brokensha et al (1983) for further information.

The main aims of the field testing of stoves are to:

- study the impact of a new stove on overall household energy use;
- determine the relative performance under field conditions of different stoves;
- help determine why particular stoves are used or not used;
- help determine whether builders and field workers are constructing stoves accurately;
- help field workers and users to understand why it is important to build stoves accurately and maintain and use them well, and to show them how to do this;
- determine if innovations developed by users and field workers improve the performance, ease of use or cleanliness of the stove;
- help focus laboratory research towards solving problems encountered in the field;
- determine how the kitchen performance of a stove changes over time.

The kitchen performance test has been recommended as the most appropriate test to meet these aims (VITA 1982b). This would involve the active co-operation of households over a period of one to two weeks. Wood consumption is measured each day for a week before the stove has been introduced. This test is then repeated after the stove has been introduced for a certain period of time (not less than six months). Seasonal variations in fuel cooking patterns must be avoided for accurate comparisons.

This test may not always be appropriate if people are unwilling to participate. Instead a water boiling test can be carried out in the kitchen, using pots and wood brought from the laboratory. The performance measured is compared with the performance measured in the laboratory. Boiling water tests are also carried out on existing stoves (both in households that have the new stove but have retained the old stove, and in households that do not have the new stove) to establish an average performance figure. People are asked if the stove has saved fuel and to estimate the percentage saved. For example, in Indonesia a series of ten tests were carried out on the existing stores. The results were averaged to give a base line efficiency or specific consumption figure. Exactly the same test was carried out on 10 different new stoves. The difference between the average performance of the old stoves and the new stove was noted. The user was then asked if the stove is saving fuel. A 90% the tests and people's answers (i.e., if people noted that they were saving wood, the tests also showed that the stove was more fuel efficient). (Shanahan, 1982.)

In evaluating the performance of new charcoal stoves in urban areas of Kenya, Kengo/Ministry of Energy used questionnaires. A sample of 450 households who purchase their charcoal was selected. They were divided into three socio-economic groups (to determine if this had an effect on consumption) and 50 of the households were chosen at random, to be surveyed in depth. People were asked how much charcoal they purchased just before the stoves were introduced, and two to three months after it had bee. placed in the household (Kapiyo and Kinyanjui, 1983). Initial analysis of the data indicates that a significant difference between consumption before and after the stove was introduced was observed. Adding a control group would assist in determing if the change in consumption was due to the introduction of the stove or some other external factor (e.g., an increase in the price of charcoal).

MATERIALS TESTING

The principle objectives of materials testing are to:

- determine if the mechanical, thermal, and chemical properties of a material make it suitable for construction of a stove;
- determine the possible lifetime of a material under different conditions found in stoves;
- determine if modifications to a material have increased the lifetime of stoves;
- help establish guidelines for more effective development of stove materials;
- establish quality control at site of manufacture or independent testing sites.

Materials testing can be carried out by scientists and engineers in well equipped laboratories, by artisans, by manufacturers and by extension workers. Until recently, materials testing has not been a major component in stove programmes. Laboratory work has been carried out by Kenyatta University College, and by ITDG and CILSS/VITA in Upper Volta. Methods of roughly assessing quality of mud have been devised by Aprovecho and simple methods of assessing thermal shock performance of pottery are used by RECAST in Nepal.

What information is needed?

When testing a material in the laboratory, we want to find out:

- if the material can bear the weight of the pot and the impact of dropping the pot on it, wood hitting the inner walls, or the stove being dropped;
- if the material will crack when it is heated up suddenly;
- what will be the decrease in strength of the material as it is heated and cooled every day? How long will it take before the material will break?
- what is the effect on its lifetime of repairing the stove?
- where will cracks start, and how will the material finally fall apart?
- how (and if) we can improve the properties of a material in the field.

We want to have a method of judging the quality of the material before it is fabricated and the quality of material after the stove is made. For example, the properties of metal will change after it has been beaten or formed (if the material is badly folded). The quality of wet clay or mud is different to that of dry and fired clay or mud. The durability of a clay/mud stove will also depend on how well the material is worked in the wet state, and how well it is formed or moulded. The lifetime of fired clay will be reduced if stones and air holes are present.

What type of test can be carried out?

A test programme involves collecting a range of samples of clay, sand, and additives from the area where stoves are to be introduced. The physical properties of clay (whether used as the basis of mud or pottery stoves) should first be determined. This will involve determining particle size distribution, and amount of silt and organic material in the deposit. For mud mixes, three types of tests should be carried out. The first test will determine the resistance to thermal stress of the material. The second test determines the change in thermal stress resistance as the stove is repeatedly heated and cooled. The third test determines the compressive or bending strength of the material. The procedures used to carry out these tests are complex and are beyond the scope of this book.

The main test for pottery is the thermal shock test. This involves finding the impact or bending strength of the material before and after it has been heated (to the stove's operating temperature) and cooled a certain number of times (Chaplin, 1982). For cement, the same tests as carried out on mud samples can be performed. Durability testing can easily be carried out. Personnel can be hired to operate the stove every day to determine the rate of deterioration of stoves of any material. Different repair and maintenance schedules can be carried out on different stoves to determine the effect on lifetime. Careful notes are made detailing when and how the stove starts deteriorating. To determine the resistance to impact, a heavy weight can be continuously lifted and then dropped into a pot. It may also be useful actually to hit the stove with a weight from a certain height to determine if it can withstand a given impact.

Materials tests in the field will mainly involve observation. Some simple tests for mud can also be carried out (Evans et al, 1981) that involve making a ball or sausage of clay and determining its physical strength and whether it will shatter when placed in a fire. These tests are not always reliable and better tests are yet to be devised.

3.5 MONITORING AND EVALUATION

Both monitoring and evaluation include information collection, analysis and action. The difference is that monitoring involves continuous assessment and that evaluation is periodic and involves comparison and judgement at a more general level. Results from the monitoring exercise are used to make small adjustments in the designs and programme strategy, whereas evaluation results will often lead to more major changes in either strategy or design.

There is a great deal of overlap in the information collected for both activities, and in a review of studies undertaken so far, it is difficult to determine if the information collected is for evaluation or is essentially a monitoring exercise; this section will try to elucidate the important differences.

MONITORING

Information is needed that falls into three categories: (a) the stove itself, reflecting design and craftsmanship; (b) the user's relationship to the stove; and (c) the effects of the extension strategy.

The Stove

Monitoring will help determine:

- if stoves have been built accurately and the construction materials have been formulated and repaired properly;
- if the stove has been installed correctly;

- the durability of the stove;
- the degree of maintenance and repair required on the stove;
- changes in fuelwood consumption and/or cooking times.

During the monitoring it will be necessary for the field staff actually to measure the dimensions of the stoves, either at their site of manufacture, or in the house. These should be compared with the design dimensions specified in the laboratory reports. In the house, it is essential to note whether the stove can accommodate the range of pots that the family regularly uses and whether these pots hit the baffle under the second pot-seat. Careful attention should be given to assessing whether the chimney has been installed correctly. It is important to determine whether the passageways are blocked with ash, soot or stones. Careful note should also be taken of cracks in firebox, front or rear arches, baffle and chimney pipes. For charcoal stoves it will be important to determine where stress is the greatest.

Frequent visits should be made to artisans both to assess the quality of the product, the time taken to produce the product, the reject rate and any innovations that they may have developed. Questions should be asked on how the designers could improve the ease of manufacture or how the training could be improved. If people have been contracted to sell the stoves it would be useful if some record could be kept of who bought the stove and why. It may also be possible to follow up with a visit to some of these people.

The User's Relationship to the Stove

Monitoring will help determine:

- if users know how to operate and maintain the stove correctly;
- innovations developed by the users;
- features of the stove that are unacceptable to users and why some users have stopped using the stove;
- the cooking functions that the stove is, or is not, being used for, and the user's reasons for such usage patterns;
- the degree of maintenance that the user is willing to do;
- changes noted by users in fuelwood consumption, cooking times, or kitchen cleanliness;
- how the users are transmitting information about the innovation.

Monitoring can be carried out by field workers, senior extension staff, by social science units and designers. Very simple sheets can be designed for the field workers (see Appendix 3.6), or more complex questionnaires and observation sheets can be developed and used by senior professional staff. Users and non-users, participants and non-participants in the programme can be interviewed as a group, or individually. Community meetings can be called to discuss the progress of the programme.

IT IS EXTREMELY IMPORTANT THAT DATA BE COLLECTED CONTINUALLY DURING THE PILOT PROJECT AND FREQUENTLY ANALYSED BY SENIOR STAFF

Regular meetings should be held between senior staff and the field workers. During these sessions a detailed chart or book should be maintained indicating number and types of stoves that have been introduced in each village, the number of times the field workers have visited each house and inspected the stove, and the state of the stove. Field workers should be encouraged to keep a diary of activities, and the comments users and non-users have made. These would then be presented at the meetings.

A similar type of chart should be maintained by the production unit. Information placed on this chart could include number of stoves produced, number of people and the time required to produce a given number of stoves, number of stoves broken or inaccurately produced, and any changes made in the production process. Appendix 3.6 is an example of a monitoring questionnaire. The users should be questioned to determine how often they use the stove and what types of food are cooked. A check on the frequency of use can be made if it is observed that the old stove has been used or if the new stove is still warm.

Users should be asked both open-ended and closed questions on what they like or dislike about the stove. They should also be asked what changes have been made and the monitor should make a detailed sketch of the changes. During casual conversation or through direct questions, it may be possible to determine why the user decided to participate in the programme and whether members of the family have discussed the merits/demerits of the stove with neighbours or relatives. It may also be an opportunity to discuss if patterns of fuel consumption or cooking have changed as a result of the stove.

Remember that people are very polite, and have a tendency to tell you what they think you want to hear. Check all answers against careful observations.

The effects of the Extension and Dissemination Strategy

Monitoring will help determine:

- successes and weaknesses in the training programme(s);
- the degree of interaction between extension workers and users;
- whether or not the promotion campaign is being effective.

The effectiveness of the local extension workers and promotion and training material can be judged indirectly by assessing how much information the users have absorbed on proper use and maintenance of the stove and by the number of people who have heard about the new stoves. Direct questions put both to users and non-users, such as, 'how many times has the extension worker visited you?', or, 'how often has there been a demonstration or meeting about the new stoves?', will indicate how diligent the extension worker has been. Discreet and direct observation of the methods used by the extension workers will assist in improving training methods.

3.5.2 EVALUATION

It is necessary to undertake evaluation of stove projects at two levels. Firstly, the evaluators should assess whether a programme has reached its objectives, the factors that have constrained the programme, the ways in which programme implementation could be improved, why people have accepted or rejected the innovation, and whether an alternative innovation, or set of policies, could have achieved the same programme objectives. Secondly, the evaluators assess the programme objectives by asking more fundamental questions about the costs and benefits to individuals, the community and the nation, of implementing the programme. The results of both types of evaluation can be used for policy formulation (McCormack, 1983).

The terms of reference can be defined by the funding agency and/or government, the project manager, and/or by a group representing the users. A study by Imboden in 1977 on project evaluation recommended that the needs of the managers should first and foremost define what is required. The results of the evaluation of the pilot project will be used to determine whether the pilot project should be extended (to improve the technology or method of dissemination).

3.5.2.1 When Evaluation is Carried Out

There are a number of factors that need to be considered before a time is set to carry out evaluation.

Many evaluations are carried out just prior to the end of the funding period, or the time allocated by an implementing organization to complete the project. This is often required to obtain further funds. Some aid organizations insist on a 'mid-term' evaluation. The more enlightened projects use evaluations as a management tool and thus it is initiated when the project leaders feel that a critical appraisal would help improve implementation.

However, it is not feasible to undertake evaluation before a certain number of acceptable designs (at least 300) have been used in households for at least four months. For example, during the monitoring of the field trials it may be observed that the stoves are not being used and that people want a different type of design. The field programme will have to stop while new designs are developed and tested.

CAREFUL MONITORING OF A PROGRAMME IS ESSENTIAL IF EVALUATION IS TO BE EFFECTIVE. THE MORE INFORMATION COLLECTED DURING THE MONITORING, THE EASIER THE EVALUATION WILL BE.

Who Carries Out the Evaluation

Experience has indicated that evaluation is best carried out by both members of the project and external personnel with expertise in evaluation of domestic technology programmes. If such a team is formed it is essential to define clearly what the objectives are and who is to be reported to, what are the tasks of individuals in the team and how conflict will be resolved if different members of the team draw different conclusions from the available data.

IT IS IMPORTANT THAT A DRAFT OF THE STUDY BE MADE AVAILABLE TO THE PROJECT DIRECTORS BEFORE EXTERNAL EVALUATORS LEAVE.

The number of people involved in the evaluation will depend on the resources allocated to this particular task. A trained social scientist, an engineer and at least three field staff are usually required if more than 1,000 stoves have been distributed.

3.5.2.2 What Information is Necessary?

The following can form the contents list of the evaluation report.

a) Base-line Data

It will be important to ascertain if the socio-economic resource and fuel data collected in the assessment study needs upgrading or extending. It may be decided to survey villages where stoves have not been introduced, to help determine if information from the promotion programme is spreading, and if there has been a measurable impact in the villages where stoves have been introduced (i.e. the next section on methodology explains why this is desirable).

b) Performance Data

It will be necessary to carry out kitchen performance tests to help determine how fuel consumption has changed over the period of time that the stove has been in use. It will also be necessary to determine if patterns of preparation of food, cooking, use of the stove and time spent in the kitchen has changed.

A final assessment of the durability of the stove should be undertaken. With the data collected during monitoring it will be possible to determine rates of decay (and how this is affected by repair and frequency of use).

It may also be necessary to determine if the stove is producing less smoke or carbon monoxide than the previous fireplace, and whether there is less pollution in the kitchen than when the previous stove was in use.

c) Impact on Health

Information on the number of visits to the dispensary (and nature of visit) or on times that members of a household had coughs, chest or eye infection or dysentery may provide indications on the health impact of the stove. But to measure accurately the impact on health of a new stove requires a large sample (of users and non-users) and the study must be carried over a much longer period of time (at least two years).

d) Rates of Usage/Acceptability

Much of this information needs to be obtained from the monitoring programme. Rates of usage and acceptability will be determined by both technical, economic, social, cultural and extension factors. These factors are detailed in Appendix 3.7.

e) Rates of Adoption

At least four conditions must be satisfied before a person will adopt a new design of stove: (1) they must be aware of its existence and of the functions which it performs; (2) they must be able to obtain access to it; (3) they must regard it as superior both to existing stoves, and to other alternative stoves of which they are aware; and (4) they must regard it as more desirable than other goods or services which could be acquired with the same resources.

There are many reasons why a stove is adopted and why some groups take up stoves more quickly than others. A detailed discussion is beyond the scope of this book. The reader is referred to Bina Agrawal (1980). Adoption and Usage/Acceptability are closely related and thus Appendix 3.7 can be used to help draw up the necessary questionnaire to determine likely reasons for, and rates of, adoption.

3.5.2.3 Choosing a Sample

If results are to be interpreted easily, it is important to have a large number of stoves placed in each village before evaluation is carried out. (At least half the population should be covered.) In urban areas it is important to concentrate the evaluation in a few selected areas. At least 300 stoves should have been placed in households six months before the evaluation study, and at least 200 homes visited in the study.

Depending on the objectives of the study (see next section) it may be necessary to look also at an equally large group of people who have not received a stove. If the kitchen performance of the stove is to be measured it may be necessary to take a selected sample from the larger survey. A few families may be asked to allow an evaluator to spend considerable time living with or near them to observe the impact of the new stove (before and after its installation). This case study approach can help clarify the findings from a larger survey. However, it is unlikely that the families observed will represent all the range of groups taking part in the survey, and care should be taken when analyzing the results.

Research Designs

The actual research design will depend on the objectives of the evaluation study and how the pilot programme has been established. If the main objective is to determine why a stove is acceptable/not acceptable, the research design can be fairly simple.

The main dependent variable that will be measured is frequency of stove use (e.g. all the time/for some cooking operation/not at all). This can be correlated with socio-economic status/access to fuel/cost of fuel/type of stove/ degree of repair and maintenance, and performance characteristics of kitchen system. Acceptability can also be partly determined from the user's perception of the costs and benefits of owning a stove (e.g. if respondents only note one good feature about the new stove and three bad features it is obvious that the stove is not really acceptable). A simple survey sheet design to provide this information is given in Appendix 3.8.

TO DETERMINE WHY PEOPLE HAVE/HAVE NOT ADOPTED A STOVE AND WHAT HAS BEEN THE IMPACT OF INTRODUCING A STOVE IS A MUCH MORE COMPLEX TASK.

Modern research methods dictate that it will be necessary to establish control areas or villages if results are to be statistically significant. These areas will not be given or sold a stove before the evaluation, although it is often advisable to promise to provide a stove after the evaluation has been completed. The control should be as similar to the project village as possible (geographically, ecologically, socially and economically). The control and the project areas will be assessed in detail before and after the stoves are introduced. If different extension strategies are to be assessed it may be necessary to extend the size of the pilot project area. This will add considerably to the time taken and resources required to implement the project. Large questionnaires will need to be developed and tested and computer facilities provided to analyse the results. A team of at least five enumerators would have to be trained and their work closely supervised. It will be necessary to carry out sophisticated tests on the level of pollution in the kitchen, as well as fuelwood consumption.

Many researchers have severely criticized this approach. Not only is it expensive and time-consuming, but it is difficult to evaluate the social and institutional impact on the participants. Establishing effective control groups is extremely difficult. Change may be occurring in one area due to other non-stove activities, and the reasons for this change could be different between village and regions (Cronbach, 1980).

Attempts have been made to develop methods of determining social and cultural and organizational impact by involving people actively in the evaluation process. Information from this intersubjective approach can also be used to help determine acceptability and rates of adoption.

In needs assessment we have already outlined one method of data collection using participatory groups. Feuerstein (1982) and Oakley have outlined in detail the methods used in participatory evaluation. For example, field workers, participants and builders are asked by the professional evaluator, either to keep diaries, to write brief project reports on a regular basis, or are continually interviewed. (This is especially where literacy rates are low.) Meetings are called at regular intervals to discuss problems, identify solutions, and make plans for the future. A basis of trust is established so that people will be honest in the self-evaluations. The following methods could be employed to collect data:

- Group profile or survey: in order to establish what the situation is as the social development work begins. Such a profile would probably illustrate the kinds of characteristics already outlined and would serve as the basis for determining the extent and nature of future change.
- Collection of quantifiable data: where appropriate, such data can provide an important dimension to changes which have taken place. Such data might include: number of group meetings and participants, numbers involved in particular activities and basic figures on any economic activities undertaken.
- Continual descriptive accounts and observations on each project group: this would based on the five areas of indicators, of

each group. In this method agents would be encouraged to write freely and subjectively with less concern for structured comment or formalized reporting. The emphasis would be on the agent recording the changes as he or she sees them. The record would then be subject to periodic interpretation.

- The minutes or other forms of recording of agents' meetings: such meetings are used to reflect upon the results of work to date and often contain useful information which can assist the monitoring exercise.

The time spent on these reports should not be more than 3-9 hours per month (Oakley, 1982).

Evaluation of the change in patterns of communication are made both by a professional evaluator and the group. To carry out this evaluation it is necessary to identify criteria against which project progress can be measured. These criteria can be developed with participants and field workers. A list that was developed by a Mexican project is provided in Appendix 3.9.

Having developed criteria it is important to identify indicators which can be used to help illustrate the changes taking place. These indicators are used by field workers and users to monitor their own work and attitude to the stove and the project.

Indicators could include:

- greater participation of village in the construction or installation of stoves
- greater attendance at community meetings to discuss not only stove programmes but other matters;
- changes in Group Behaviour: nature of meetings, confusion/order, use of language, abilities to rationalize and explain, nature of participation

- nature of intervention: changes in the relationship of the agent to the group as a result of the group assuming responsibility for its own development, i.e.
  - direct
  - indirect
  - withdrawal;
- relationship with other groups: nature of the relationship with either group; joint action and evidence of inter-group enterprises and organizations.

The above five indicators could, therefore, constitute the means by which social development might be observed and objectively evaluated. These indicators provide a framework which can help structure agents' observations of the groups' development and also assist them in assessing the impact of their social development work. The order of their presentation does not indicate any order of importance.

Interpretation will have to assess the information in terms of this initial situation and suggest the changes which are taking place. The original analysis of the group's situation will have resulted in a number of objectives for the social development work. The interpretation, therefore, will be in terms of these specific objectives.

Appendix 3.1 Area profile of region or village where stoves are to be introduced

a) Environment

What are the:

- Position of community compared to towns, other villages, road, mountains, open land, forests?
- Altitude?
- Rainfall patterns?
- Seasonal variations in climatic condition?
- Time of year assessment is conducted?
- Types of land use (arable fields, grazing land, homestead, waste land, forests, plantations); and some estimate of the amount of land in each category?
- Population and density and how it compares with other areas?

b) Socio-economic

- What are the different types of employment of the community members, and where do they work? (This includes agriculture, industry and petty commodity trading.)

- Does employment vary throughout the year?
- What are the conditions of land ownership and of access to the different community members?
- In the purchase and sale of food, goods and services, is the community integrated into the regional market system?
- What is the level of education?
- What is the status of women and their role in decision making?
- What are the types of transportation available?

c) <u>Community structure</u>

- What are the different groups in the community and how do they interact with each other (different languages and jobs and little interaction, landlord/tenant, high caste/low caste, large landowners/small landowners, followers of different political parties, all participants in village communal system, etc)?
- Who are the influential groups and people in the village and what role do they play in the village politics, economy, introduction and promotion of new ideas, etc?
- What local government officials work in the community and what are their functions?
- What community groups exist and what are their functions?
- What non-governmental outside organizations have contact with the community and what do they do?

d) <u>Assessment of extension and local community development organizations</u>

- What innovations the organizations or institutions have tried to introduce;
- Why people have adopted or rejected the innovation;

- What are the characteristics of the people who initially adopted the innovation?
- Did other groups adopt the innovation at a later stage, and why?
- Is there a two-way flow of information between extension worker and adopter (e.g. do the adopters feed back information on problems they are encountering with the innovation? Has the extension worker established a trusting relationship with adopters? How often does the extension worker meet adopters, and where?)
- Do the extension workers pass on this information to their supervisor and to the resource people?
- Do the resource people react to this information by providing ways of solving the problems?
- Do the supervisors assist the extension workers to overcome the problems they are encountering?
- Does the extension worker communicate with all sections of the community, not just the wealthier groups or their own immediate family and friends?
- Are there cultural norms that prevent the free flow of information or is it structural (e.g. promotion depends on presenting an optimistic picture of success)?
- Who receives training and how is it carried out?
- Does the sex of the extension worker determine who she or he talks to in a family? (Joseph et al, 1981)

Appendix 3.2 Household information

a) Patterns of fuel collection/purchase

- Where is the fuel acquired? How much is collected, how much bought?
- Who collects? How often do they go, how long does a trip take?
- How much fuel is brought each time, per week, per month?
- What kind of fuel is used and what are the preferred species?
- Does it vary during the year: type, moisture, size?
- Is fuel stored? Do they split it?

b) Characteristics and functions of the fireplace

- Where is the fireplace - raised platform, floor, inside, outside?
- What is the kitchen like: entrance, size, ventilation, lighting, storage?
- What is the fireplace made of?
- Where does the smoke go?
- Why do they have this type of fireplace?
- Who built it?
- How old is it?
- Who repairs and cleans its?
- How much does it cost?
- How long does it take to build?
- If they had the money or time, would they change the fireplace, the kitchen? What do they like/dislike about it?
- Are there any rites associated with the stove's construction or use?
- Where does the lighting come from?
- What are the functions of the fireplace: cooking meals, what kind, when, how many pots, how much food and how is it prepared?

Boiling water, when?
Room heat, when?
Light, when?

- How is the fire started?
- Is it restarted during the day, or does it smoulder all day?
- Who tends the fire or cooks food? Do men or children also tend at different times?
- Are there special occasions when the fireplace is used differently?

c) Pots and utensils

- What types of pots are used for the main dish, side dishes?
- Are special pots used for tea, boiling water, frying, roasting?
- Measure and draw pictures of the different pots.

d) Kitchen economics

- The cost of food/day or month.
- The cost of fuel/day or month.
- The cost of traditional fireplaces or stoves and pots.
- The cost of a kitchen building.
- The cost of existing kitchen improvements.
- The income of the household.
- The minimum/average daily wage.

e) Kitchen layout

- What is the shape and dimensions of the kitchen?
- What materials are used to construct the walls and ceiling?
- How many kitchens are there, and where are they located?
- What are the functions performed by the kitchen - cooking, sleeping, socializing, storing, crop processing?

- Who makes the decision to build a new kitchen?

f) Needs

- Whether fuelwood collection is considered a burden to the family or, as has been noted by Hoskins (1979), whether women enjoy the opportunity it gives to socialize.
  If it is considered a burden, is it one of the most urgent of basic needs that they would like to improve upon (or are water, health, extra income or social status more important?)
- What are the design criteria of potential adopters for a new stove?
  Should the new stove:
  (i) cook faster?
  (ii) save fuel?
  (iii) dry crops, wood or kitchen-ware that has been washed?
  (iv) smoke fish?
  (v) bake?
  (vi) warm the house?
  (vii) provide light?
  (viii) provide a platform on which to prepare food?
  (ix) be off the ground?
  (x) be attractive?
  (xi) be portable, or be fixed?
- Is there a requirement for more than one stove in a household?
- Would the potential adopter(s) be willing to purchase or build their own stove, or would they allow an artisan to build or install a stove in their kitchen? It would also be useful to get an indication of what price and time the user would spend to acquire this new stove (Joseph et al 1981).

Appendix 3.3: Resource Survey

a) Resource materials

(i) What is availability and quality and cost of:
- clay?
- sand?
- metal?
- cement?
- clay additives: vermiculite, diatomite, mica and soapstone?

(ii) Who owns the deposits/supply?

(iii) How easy are they to mine or process? To transport?

b) Manufacturers

Local artisans and small manufacturing enterprises will need to be studied.

(i) What are the techniques used in the production process (e.g. pottery wheels, kilns, metal-bending machines?)

(ii) What is the social organization of the production process (i.e. how is supply, production and marketing organized?)

(iii) The social relations of production (the relationship between labour and capital).

(iv) The nature of the relationship between artisans, company directors, material suppliers and retailers.

(v) The investment and working capital, income and/or profit margin; the output per person, the capacity utilization of the equipment and the availability of further investment capital.

(vi) The constraints hindering the expansion of the enterprise.

Appendix 3.4: Cooking Survey Questionnaire*

1) Background

Name of village:

Household size:

_____ Adults _____ Children (under 16)

Number of people for whom food is cooked (average) _____ Adults _____ Children

Who does the cooking: How often:

£1 _____ _____

£2 _____ _____

£3 _____ _____

Type of meal usually cooked:

Morning _______________ Time _____

Afternoon _______________ Time _____

Evening _______________ Time _____

Cooking process for each item cooked:

1. _______________
2. _______________
3. _______________
4. _______________

2) Cooking

Are there customs centered around use or placement of the stove or place of cooking? Yes/No. If Yes, describe, _______________

*This survey was designed by André Longmire (Peace Corps, Mali)

Do they cook inside or outside? ___________
State number of months in each:
inside: _______ outside: _______
In the cold season do they cook inside to keep warm? Yes/No
If they cook mostly inside now and if an indoor stove released smoke outside, would they mind cooking inside most of the time? Yes/No
If the stove is inside, does it have a chimney? Yes/No
If the stove is inside without a chimney, does the smoke serve any useful purpose?
Yes/No; if yes, what? _________________

____

Comments: _________________________________

____

3) Stoves

Describe stoves below, listing them by frequency of use.

Stove No 1 (used most often)
Type: Three stone/2 hole without flue/2 hole with flue
Other (specify) _________________
Age of Stove:
Location: inside/outside/under a shelter
Other ___________________________________
Months of use _____
Frequency of use: daily/3 to 5 times a week/
1 or 2 times a week/other _______
Which meals are prepared on it:

____

Types of pots most frequently used (metal, clay, etc) ________________________________
Which pot sizes fit this stove best:

____

Who built the stove? _________________
How much would it cost now? __________

What are the materials used in its construction?

____

How long would it last? ______________

How is it maintained? ______________

____

<u>Stove No 2</u> (used next most frequently)

(Repeat as in Stove No. 1)

What functions do the stove(s) serve besides cooking? ______________

4) <u>Fuel</u>

What is the most common fuel source: ______

other: ______

When wood is used as fuel, what is the approximate length _____; diameter _____

Type of wood preferred £1 _____

£2 _____

£3 _____

Reasons: ______________

____

Does the household often buy wood? <u>Yes/No</u>

If Yes,

Is wood bought all year? <u>Yes/No</u>(specify)

____

What is the range of prices paid?

Dry season _____ to _____ per _________

Rainy season _____ to _____ per _________

Other times _____ to _____ per _________

How much does it cost now per week?

_________ at a price of _________

If No, (i.e. family rarely buys wood)

Do they use wood from their own trees? <u>Yes/No</u>

Do they gather wood? <u>Yes/No</u>

If they gather wood, who gathers (specify relationship to head of household)

____

How often? ______________

Roughly how much is gathered during each trip?

____

How long does it take for each trip? ______
Do they store their wood dry? ______
If yes, how long? ______________

5) Local materials and technology (a)
Are there locally made stoves, ovens or other cooking devices? Yes/No
If Yes, describe how they are used and how often; how they are made and by whom?

____
____
____

Are there masons in the area? _____
Do the people use bricks, cement, etc for masonry construction? ______________

____

What do the local people use for mortar for their granaries and house? ____________
Traditionally what is the best mortar? Describe:

____
____
____

Is there someone in the village who makes pottery? Yes/No. If yes, describe the type of pottery; how it is made; what materials are used.

____
____
____

Are there stone-cutters in the area? Yes/No
What is the local process for drying vegetables and fish? ____________________

____
____

(a) This part of questionnaire need only be asked of a few families in any village.

Appendix 3.5

MATERIAL	ADDITIVES	MANUFACTURING METHODS	ADVANTAGES	DISADVANTAGES
MUD lorena 75-80% sand, 20-15% clay	fresh dung ash	mould or free-form, built in place	abundant resources, easy to carve and repair. few simple tools, runs cool, stable, safe.	cracks occur without fibres, if fibre is added, difficult to carve. uncertain lifetime. not portable. quality control difficult. can't mass produce
clay/fibre 50% clay 50% hay or sisal long strands	bullrush fibres husks	mould in pieces, then transport and install. OR mould or free-form in place	light and strong enough to transport less clay processing and easier than lorena to prepare.	where large fibres burn out in the firebox, weak spots occur. slow production.
adobe or banco clay, sand, chopped fibre	brick dust (instead of sand)	transportable blocks mould free-form	blocks can be made and transported, and are often already available. less time and labour quality more consistent. masonry skills easily transferred.	quality control difficult without moulds or templates.
POTTERY thermal stress-resistant clays, fired to 900C	coarse sand black ash of rice or millet husks dung	by hand or machine mould, coil, with slab, templates wheel	mass production existing apprenticeship and marketing portable retains strength after cracking if encased in mud or sealed w/cement in metal cladding	may not have suitable clay open kilns usually underfire. if underfired, crumbles. if overfired, cracks easily. fragile: susceptible to breakage and cracking

MATERIAL	MANUFACTURING METHODS	ADVANTAGES	DISADVANTAGES
FIRED BRICK fired ceramic building brick, plus mortar (mud or cement) high quality firebrick may be used.	stoves built in place, with brick walls and mud in centre, or bricks as body of stove. top plate of metal or clay/fibre. bricks may be pot supports in mud stoves.	low-fired (lightweight) bricks are fair insulators, dense firebrick is thermal storage. long lifetime.	unsuitable as toplate.
CEMENT usually cement and sand. mixture of 2 parts clay, 1 husks, 1 part cement is more resistant to thermal stress.	concrete blocks built in place in mould can be coating for mud stove (cement, sand, short sisal fibres)	available and cheap in some places. stove surface resistant to water damage and abrasion.	cement degrades at the same temperature in which wood combusts efficiently.
METAL new: sheet steel recycled: oil drums or large tins.	formed with hammers, then riveted or welded. casting (expensive)	portable quality is usually more consistent. existing marketing and apprenticeship system scrap metal abundant in some urban areas. process can be speeded with machines. easily repaired or replaced.	hot to touch while operating.

Source: Prasad (1982) and Childers

Appendix 3.6: Monitoring Questionnaire, Sri Lanka 1982

1. Village
2. Date
3. Observer
4. Household's name

   Number of people: adults
   children
   small children
5. Stove type
6. Traditional stove - have
   - do not have
7. Age of stove, when built
8. Builder - Stove project staff
   Sarvodaya worker
   Neighbour
   Owner
9. Cleaning and Repairing

   Cleanliness - outside
   inside

   External cracks: repaired
   Firebox tunnel cracks repaired
   Door cracks repaired
   Erosion repaired
10. Stove warm or cold
11. Use of stove

    Cooking all meals and tea
    Cooking most meals and tea
    Cooking meals only
    Cooking some meals and tea
    Cooking few meals or tea
    No use
12. User acceptance

    - totally satisfied
    satisfied with minor problems
    dissatisfied

13. Measurements
    Door - high
           wide
    Air vents - number
                how big
    Height - front
             back
    Firebox - high
              wide

Comments:

Appendix 3.7: Rates of usage and acceptability

Technical factors include:

- ability to burn range of fuel types, size, moisture content, etc
- ability to use range of pots
- ability to prepare all types of meals and smoke/dry crops or roof
- ability to provide heat
- provision of sufficient charcoal for other uses
- length of time to repair or clean
- saving fuel, reducing time to cook or smoke levels, and improving cleanliness and safety in the kitchen
- quality of manufacture and installation
- increase/decrease lifetime of pots due to breakage
- acceptability of structural alterations in the kitchen.

Economic, social and cultural factors include:

- cost of repair
- disruption or enhancement of social activities in the kitchen
- position/portability of the stove
- aesthetic/cultural acceptability to other influential members of the household and/or community
- installation by a person from another ethnic group
- priest attributing illness/death to the installation of the stove
- household was chosen for political/social reasons and does not perceive fuel/smoke/safety/cooking time as a problem
- status inversion: stove is for the poor, not me
- dependence on outsiders instead of household self-reliance

Extension factors include whether the field workers adequately:

- emphasize how to use and maintain the stove
- inform the household of the costs and benefits of having a new stove
- assess the needs of the household and help them to make a choice that suits their requirements
- carry out sufficient back up
- or does the fact that they belong to a different group (race, tribe, church, etc) affect their interaction with users?

Appendix 3.8 Evaluation Survey

Small Farm Family Programme
Agricultural Development Bank
Nepal and UNICEF
(K Basnet, May 1983)

HOUSEHOLD CHARACTERISTICS

1. District ______________________________

2. Panchayat ______________________________

3. Household name ____________________ S. No ____
   Surveyor ______________________________
   Date (Roman) __________/_______/1983
   Main cook's name ______________________

4. New stove type:
   1 Insert   2 Double wall
   3 Modified Magan Chulo

5. Months installed ______________________

6. Floor installed:
   1 Ground   2 1st floor
   3 2nd floor   4 3rd floor

7. Installer ______________________________

8. Ethnic group/caste (see code) __________

9. Regular number of household members ____

10. Number less than 10 years old __________

11. Previous traditional mud stove type 1
There was no traditional mud stove 0

---

12. Present use of traditional mud stove:
Removed 0
Still have but not used 1
Have and used 2

---

13. Traditional Tripod stove type 2

---

14. Present use of traditional Tripod stove
Removed 0
Still have but not used 1

---

15. Stove temperature: warm 0 cold 1

---

16. New stove use: (see code)

---

17. Old stove use: (see code)

Condition of new stove

---

18. Firebox: 0 not cracked/1 cracked/2 broken

---

19. Front arch: 0 not cracked/1 cracked/2 broken

---

20. Baffle: 0 not cracked/1 cracked/2 broken

---

21. Chimney: 0 not cracked/1 cracked/2 broken

---

22. Repaired: 0 not required 1 not repaired
2 partially 3 completely

---

23. Inside chimney: 0 clean/1 soot accumulated
2 ash accumulated
3 both ash and soot accumulated

---

24. Is there ash in firebox or back connecting pipe   0 No   1 Yes

---

25. Number of times chimney cleaned ________

Stove installation

---

26. Measurements: 0 Within tolerance limits
    1 Slightly exceeds limits
    2 Greatly exceeds limits

---

27. Chimney installation 0 Good
    1 Minor problems   2 Major problems (note separately)

---

28. Pot hole spacing: 0 Good   1 Bad

---

29. Stove and chimney location 0 Good   1 Bad

---

30. Frequently used pots fit holes:
    0 Good   1 Fair   2 Poor

Users perceptions and fuel use/fuel use per week

---

31. Estimated percentage fuelwood saving ___

---

32. Amount of fuelwood used before new stove ___

---

33. Amount of fuelwood used at present _____kg

---

34. Present price of fuelwood per kg _______

---

35. Average amount purchased ______________

---

36. Straw/agricultural residue used before ___kg

---

37. Straw/agricultural residue used at present ______kg

38. Dung burnt before ____________________

39. Dung burnt at present ________________

40. Meal cooking time: 0 Decreased
1 same 2 increased

41. Comparative convenience :
0 better 1 same/mixed 2 worse

42. Reduction in smoke: 0 like 1 mixed opinion
2 dislike

43. How did you know about the new stove:
1. Neighbours
2. Promotor/installer
3. Village leader
4. Saw demonstration model
5. Extension booklet
6. Poster
7. Other extension agent
8. Other (specify)

44. Would you be willing to purchase replacement stove or part of stove 0 Yes
1 Yes if cheap 2 No

Interviewer to answer:

45. Promotion and extension effectiveness

46. Estimated economic status
1 High 2 Average 3 Low

Stove use codes

New stove use

1. Heating and cooking all things
2. Cooking all things except wine/alcohol
3. Cooking all things except cattle feeding
4. All meals and tea/tiffin
5. All meals only
6. All meals and tea/tiffin only
7. Some meals only
8. Any other limited use only (specify)
9. Not used

Old stove use

1. No old stove
2. Have old stove but not used
3. Used sometimes only (specify)
4. Only for wine/alcohol
5. Only for wine/alcohol and cattle's feeding
6. Some meals and tea/tiffin and cattle's feeding
7. Almost all cooking, cattle's feeding, etc
8. All cooking, cattle's feeding, etc

Appendix 3.9: List of Criteria to Judge Social Development

Characteristics of group members before process of social development:

- Individualism: reflected in predominance of private property, little interest in community projects, low participation in decision-making.

- Lack of critical analysis of their situation; inability to identify the causes of structural problems and work out solutions to them.
- Economic, social and political dependence on the exploitation by landowners.
- Lack of confidence in their own ability to change the situation
- Absence of organizations which effectively represent their group interest.
- Lack of co-operation.
- Ignorance, suspicion and isolation. People afraid to talk/discuss and become involved.

Characteristics of groups after a period of social development

- Internal cohesion.
- Sense of solidarity.
- Critical consciousness/critical faculty.
- Active and critical participation.
- Reduced dependence, increased self-confidence.
- Self-management, self-sufficiency, group autonomy.
- Collective resources/capital reserves.
- Project management capability.
- Democratization of power, collective responsibility.
- Articulation with other institutions controlled by villagers.
- Involvement in the creation of other similar groups.
- Ability to deal with government officials.

- Articulation with other institutions controlled by villagers.
- Involvement in the creation of other similar groups.
- Ability to deal with government officials.

SECTION 4 PLANNING FOR DISSEMINATION

At the end of the pilot programme a great deal of data will have been collected. In many instances the funding of a larger programme will not be guaranteed and the likelihood of NGOs taking up the project, or commercial organizations manufacturing and marketing the stove without further assistance is not assured. Thus it will often be necessary to convince government and donors that a national stove programme will have positive benefits for the nation as well as individual households. To stimulate manufacture in the informal and formal sector it will be necessary to create demand for the product.

4.1 STIMULATING INTEREST AND SUPPORT

Different groups of people will have to be approached differently. It may be necessary to gain credibility from the academic community, government policy makers and planners, commercial sector donors, as well as the public.

Gaining credibility with the former two groups will involve detailed analysis of data and preparation of reports and scholarly articles. Planners will often require some form of structured socio-economic analysis such as cost-benefit or social impact analysis. Financial analysis and determination of potential demand may be necessary to convince large commercial enterprises or banks that considerable investment in developing a mass production capability will return a profit. Academics and planners will often be interested in learning of the problems encountered in implementing the pilot project, specific designs that have been accepted and the extension methods that have been successful. Academics may wish to see how the lessons from this programme can help improve the body of theory on planning and implementing induced rural change.

Donors and the general public are often mainly interested in learning of the practical results of the pilot project. Specific information on what types of and how many stoves have been introduced and accepted, the (observable) benefits from the introduction of the stoves, where and how the stoves can be acquired, must all be clearly presented.

The resources required to 'make a case' can be considerable. Experience has indicated that the resources required are considerably reduced if an effective communication network has been established and utilized during the implementation of the pilot project (Section 2). Towards the end of the pilot project it may be useful to organize a meeting to present preliminary findings, and to start to plan with both commercial, government, and non-governmental organizations how the project can progress. NGOs may themselves form an association specifically related to energy. This group could be one of the principle organizers of such a meeting. Alternatively, a National Science Council may provide a more suitable vehicle for dissemination of results and co-ordination for all further activities.

EXPERIENCE INDICATES THAT PLANNING FOR DISSEMINATION MUST START WELL BEFORE THE PILOT PROJECT IS TO BE COMPLETED AND SHOULD INVOLVE AS WIDE A CROSS SECTION OF GROUPS/PEOPLE INVOLVED IN TECHNICAL CHANGE AS POSSIBLE.

Publications are an extremely important part of the preliminary preparation. Long academic works may take a year to prepare, whereas short concise publications can be prepared by journalists in two to three months. More informative stove publications (see Kaufman 1982 and Kinyanjui et al 1983) have either given concise details on how to manufacture, use and maintain the stoves, or have given a brief history of the evaluation of both the technology and its method of introducion.

Short articles should be prepared for both national and international press. These articles should also try to detail constraints as well as achievements in such a way that both stimulates interest in supporting further work but also that indicates a level of realization of the problems that still have to be overcome.

It is also useful to review and revise all the training materials that have been developed during the pilot project. If appropriate, training manuals can be developed. These manuals would be used by the project team to train project staff from other organizations to implement projects, or to train artisans or extension workers to build stoves. Courses may also be designed for entrepreneurs and promotion materials may be prepared to help market the stove. Training and promotion material may be prepared for distribution to extension workers to help them train users and promote the programme in their district. Preparation of such training and promotion materials are likely to be a further inducement for other groups to participate in the dissemination. They will see that the project is not only research- but also action-oriented and can provide the necessary back up if they run into problems.

4.2 PROGRAMME PLANNING

Many of the issues raised, and the planning requirements outlined in Section 2 for the pilot project will also apply for a larger dissemination programme. Since this programme is at a much larger scale, the planning will not only be more complex but the strategies used and the organizational requirements will be different. It is only in the last year that a few pilot projects have been completed and have entered into 'a replication phase'. Thus it is difficult to give precise guidelines based on experience. It is possible, however, to present a list of questions that should be asked when developing a programme, and to provide general guidelines based on the experience of other technology-based programmes. A comprehensive discussion of planning and management issues is covered in books by Chambers (1974) and Imboden (1981).

4.2.1 The Context

The first questions that must be answered are 'where do we concentrate our efforts?' and 'who is the target group?' The World Bank (Manibog, 1982), in a review of stove programmes, has felt that dissemination programmes should probably start in urban areas (if halting deforestation is the primary objective). Evidence from fuelwood surveys in Africa (in particular Beier Institute 1981, Digernes, 1980, and Von Bulow, 1983) would indicate that decreasing consumption of charcoal and wood in urban areas would have a major impact on the rate at which trees are cut down around urban areas. Surveys also indicate (Kanti and Koech 1980) that the urban poor can spend more on purchase of fuel than food (up to 30% of a family's income). However, the vast majority of people still live in rural areas and do not have access to the services that most urban people have. In some Eastern African countries there exists an active network of trading between urban and rural areas. Kinyanjui, (personal communication) has pointed out that merchants in rural areas will come to Nairobi and order a large number of charcoal stoves to be sold in rural areas. (However, it is not clear what socio-economic groups purchase these stoves.) It thus may be possible to reach both urban and rural users if programmes are urban based.

Rural programmes can be based in:

- pastoral and ranching areas
- areas where there is irrigation farming
- large farm or estate areas
- marginal lands/hill farming
- intensive peasant small holdings
- organized settlement/frontier areas
- labour reserves
- tenancy and refugee farming areas

Each area has its particular domestic energy/kitchen environment needs and problems of establishing dissemination programmes. (A detailed discussion of these problems is provided by Moris, 1981, p. 27.) Programmes in areas where the population is not stable (refugee and pastoralists) appear to be difficult to implement (Cawley, 1982). In particular, fixed stoves are often abandoned after a few months' use. Local builders/artisans and extensi n workers often leave their district to participate in ceremonies, searching for work, etc. Marginal lands/hill farming and labour resrve areas are often economically and socially depressed and if successful social and economic development programmes are not already underway, it may be extremely difficult to implement a large-scale stove programme in a short period of time (though this is not to say that effort should not be expended to implement a programme). In intensively farmed land, extension services are usually well developed; successful co-operatives and small businesses have often been established and there is a large artisanal population. Fuel is sometimes purchased and people have surplus cash. Often there exists high quality clay deposits (especially around non-saline river areas). The transport network is well etablished and thus materials can be brought in relatively cheaply. Although programmes are easy to implement the needs may not be as great as other areas.

4.2.2 Who will implement the dissemination programme?

The organization that managed the pilot project may not necesarily be the best organization to implement a larger programme. Thus, the first questions that must be answered are:

1. Can the organization that ran the pilot project run the larger programme, either in its present form or by altering its structure and increasing its resources?

2. Can another organization, given training and injection of new personnel, run the programme?

It is important to ascertain what type of interventions (and how they will be implemented) could be used to improve the capability of an organization to undertake a large programme. Interventions could include: training for different levels of staff; rationalization; restructuring the organization; improvement in planning capability; decentralizing decision making; giving the organization an autonomous status, and increasing its resources. The reader is referred to Moris (1981, p. 10/11) and George F. Grant (1979) for further detailed discussion.

Interventions are usually very difficult to implement in a short period of time. They must often be broad ranging, as changing the knowledge base, role or status of a few individuals may not necessarily alter the structure of the organization or its effectiveness.

4.3 APPROACH

The approach used will depend on both the location, the type of organization(s) implementing the programme, the degree of government and multilateral agency involvement (and their philosophy related to technical innovation), and the type of funding provided (and the conditions attached to the funding).

Three different approaches can be distinguished: 'Penetration' or the 'Top-Down Approach; commercialization or 'Outside-In' Approach; or the 'Bottom Up' Approach (Moris 1981).

'Top Down' Approach

The 'Top Down' Approach involves a high degree of centralized planning and administration. The planning will often be carried out within an economic and planning ministry. Usually funds are obtained from an international lending agency which requires detailed programme planning and reporting. Planners rely on information obtained in the pilot project to select organizations to implement the programme. A detailed blue-print is then drawn up that these organizations must follow. For example it may be decided that the Ministry of Forestry will disseminate stoves through its existing extension network. The necessary resources to meet these outputs will be calculated, a schedule of anticipated implementation activities will be set, and operational units will then be established.

For this approach to work it is necessary that there be: (a) a clear specification of goals in advance of design; (b) a fully adequate organizational blueprint which anticipates all eventual needs; (c) firm control over field units which can supply high quality monitoring information; (d) project staff which can realize targeted outputs on schedule; (e) a stable environment where the ancillary linkages are already operative. If these conditions are not operative then success is unlikely (Lele 1981). Chambers (in Leonard 1973) indicates that this approach has more chance of success if field units are given more autonomy and if goals/targets can have a degree of flexibility.

Commercialization Approach

This approach centres on creating conditions for innovation and sale of products through the economy. Key entrepreneurs are contacted and helped to establish stove enterprises. The Government assists in stimulating demand by providing subsidies, promoting the product through media and through its other campaigns, extension activities and establishing outlets through co-operatives, health clinics or tree nurseries. The Government may also contact multinational firms and persuade them as a national service to help produce and market the product.

'Bottom Up' Approach

This relies on stimulating communities to undertake or foster projects locally. The stove as such is not the focus of the programme but a tool to help break the dependency on outside agencies.

The implementing agency acts as facilitator helping communities decide if they want a stove and how stoves are to be produced and maintained.

Many organizations will draw up a contract with villages so that tasks that are undertaken by the two parties are well defined. This type of approach has worked in Nepal (Pelink 1983) and CEMAT (Caceres 1981).

Comparison of Dissemination Approaches

Moris (1981, p. 94) and Lipton (1977) have clearly shown that there are advantages and disadvantages in implementing any of these three types of strategies.

The 'top-down' approach can lead to a proliferation of bureaucratic structures and the displacement of local organizational capacity. It can create greater dependency and dislocate social structures without trying to counteract the negative effect of introducing a technology. It assumes that people are already in a monetary economy and discounts local knowledge (leading to mismatch of technology to locale). Over reliance on the commercialization approach can have similar consequences. Mass production can dislocate local craft production leading to unemployment and greater differences in socio-economic levels within society. Moving production away from villages can create further dependency and the loss of incentive to develop small-scale industry. Subsidies may not benefit the intended target groups but assist a few entrepreneurs and companies to increase their monopoly. The 'Bottom Up' Approach, although the current vogue in development planning, has its own set of problems. For mass dissemination of a technology, in a short period of time, considerable resources must be put into extension, to train local artisans and people to provide follow up.

These paraprofessionals and artisans often lose interest if they cannot develop the practical skills in time allocated for extension in a particular community. Allowing communities to define their own priorities can lead to a proliferation of projects, without guarantee that sufficient resources are available to service them properly.

Successful programmes usually require that these differing strategies are incorporated into the plan. This requires a great deal of innovative thinking but is not impossible. It will be necessary to convince the staff that the different ideologies behind these strategies are not incompatible and must be seen with a national development perspective. Experience from other programmes (Imboden 1977) has indicated that it will be necessary to consider carefully how current political and policy thought and direction will affect both the potential impact of, and the method and area of implementing the project. Within any government and programme there will be groups of people who have a particular approach to implementation/replication. It may be necessary to spend considerable resources convincing these people that the strategy or strategies which will be used are the most appropriate. Once a strategy has been agreed senior staff should be chosen who will be committed to this approach. If possible the senior team should determine how the organization should be structured, what outsider national organizations need to participate, how communication will be developed between field staff and headquarters, how local organizations and knowledge will be incorporated into the project, what will be the methods of monitoring the project, and what type of staff training will be required and how will it be implemented. Careful consideration will have to be given to financing the project and the level of contribution from government, commercial enterprises, donors and end-users.

4.4 FUNDING AND PROGRAMME DEVELOPMENT

FUNDING

Programme planning will be strongly influenced by the requirements of the funders. Many stoves programmes and projects have been initiated when a funding agency has approached an organization with a specific proposal. This agency will have certain conditions that must be met before finance is provided. Alternatively carefully prepared proposals will need to be submitted to donors for their consideration. Finance will be necessary to undertake the planning and preparation phase. This may either come from pilot project funds or from interim Government/NGO or donor funds. Careful consideration needs to be given throughout to the role of consultants in the management of development planning, and in programme design and implementation.

PROGRAMME DEVELOPMENT

Many publications have been written on programme development and it is not the intention in this guide to summarize the findings to date. However, we feel that a checklist of questions may be useful to help planners and managers develop programmes that are appropriate to their locale.

Appendix 4.1: Checklist of Questions

Politics/policy

1. Is the government behind the project?
2. How difficult is it to change political attitudes?
3. Are the principal economic planners and donors supportive of the project? Why/why not?
4. Will overt executive support assist the project? How can it be obtained?
5. Will the project have to locate in areas of key politicians?

Strategies

1. Will different strategies be necessary to implement the programme in different areas?
2. Will it be possible to persuade staff/policy makers that it will be necessary to utilize different strategies?
3. How can the lessons learnt from other similar programmes be applied to developing a strategy(ies) for this programme?

Organization

1. Is it possible for one organization to implement?
2. Can a non-hierarchical structure be established so that chains of command can be short?
3. Can a single agency manage to acquire the necessary external inputs?
4. Can a programme be built into local administration's structure and use existing local resources?
5. Is there a history of co-operation which influences the possible choice of organizations?

6. Can responsibility and resources be placed with local extension resources?
7. What resources are available for monitoring, data collection and analysis, staff training and public relations? Is it sufficient to achieve the programme objectives?
8. What organizational procedures can be developed to allow effective communication between centre and field activities? How can this information be used to help alter objectives and approach?
9. How is co-ordination/communication with other agencies to be managed?
10. What type of back-up will these organizations require?
11. Can the project be integrated into other programmes (forestry, health)?
12. Can the project have flexible phasing and start off on a small-scale?
13. How are the commercial sector/informal artisans integrated into the project? Will they assist with promotion and marketing?
14. What can be learned from the present marketing linkages and strategy?

Personnel

1. What is the minimum number of staff required to meet the programme's objectives? What is the number of staff/unit cost of the stove programme? (Unit cost is a measure of complexity of programme.) Will this be acceptable to funders?
2. Can the senior project staff be hired to help develop the project before it commences?
3. Are there sufficient personnel available that have experience in the area where they are to work?
4. What measures can be taken to gain real commitment of field staff to the project?

5. What type of training will be necessary and how will it be carried out?
6. Is it possible to hire an experienced public relations officer?
7. Will it be possible to integrate outside staff or overseas consultants easily into the project?

Finance/economics

1. Can funding be assured for longer than 5 years?
2. Will funding go directly to the implementing organization (on an annual basis) or will it have to be acquired from another agency?
3. Will the cost of the technology be less than 5% of the families' income? What level of subsidy will be necessary to reach this level? What are recurrent costs and what are savings on income?
4. What financial incentives can be given to staff? Will this cause friction with other organizations and constrain the project? How will the incentives be fairly apportioned/ assessed?
5. Is finance from commercial companies available? What will be the period before they may show a return on investment?
6. Can the programme be structured so that some communities can see a net increase in income (i.e. can some communities export stoves or stove builders to other areas)?
7. Can the benefits/risks of participation to individuals/communities be clearly identified?

Social

1. What is the level of awareness of the fuel-wood problem amongst the population?
2. Is there already a predisposition towards/ against stoves, i.e. 'they are something for the poor'?

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