APPROPRIATE

MUD STOVES

In EAST AFRICA

By Stephen Gitonga

Contents

List of Abbreviations

ATE	Appropriate Technology Energy
CAMARTEC	Centre for Appropriate Methods in Agriculture and Technology
CCT	Christian Council of Tanzania
DEP	Development and Environmental Project
EA	East Africa
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit
HER	Household Energy Regional
HIAP	Handeni Integrated Agroforestry Project
IFSP	Integrated Food security Programme
IRDI	Integrated Rural Development Initiatives
IT	Intermediate Technology
ITDG	Intermediate Technology Development group
IUCN	International Union for Conservation of Nature
KCJ	Kenya Ceramic Jiko
MATI-U	Ministry of Agriculture Training Institute-Ukiriguru
ODA-JFS	Overseas Development Administration-Joint Funding Scheme
SEP	Special Energy Programme
SWIP	South West Uganda Integrated programme
TaTEDO	Tanzanian Traditional Energy Development Organisation
TRDTF	Tarime Rural Development Trust Fund
TRENCOP	Tree and Energy Conservation Project
UNICEF	United Nations Children's Fund
WWF	Worldwide Fund for Nature
YWCA	Young Women Christian Association

Preface

Mud stoves play an important role in improving the efficiency of household energy use in East Africa. The technology has been used for many decades in areas where fuel wood is scarce. For many years, metal or ceramic stoves have dominated the improved stove texts with little or no mention of the mud stove technology. This book is designed to add value to the mud stove technology and to recognise the immense indigenous knowledge and skills that is indeed the driving force behind the quiet evolution of the technology.

This publication is expected to help stove promoters learn from the existing mud stove technologies and in the process help to disseminate the technology in their communities.
It gives details of the important aspects of the technology and the areas where emphasis should be laid to achieve success in technology dissemination. In addition, it provides a checklist of existing mud stoves in the East African region with a section on ways of improving the efficiency by adhering to certain rules of thumb.

The text is a contribution to the improvement of the quality of life of the many biomass energy users. Every unit of fuel saved through increased efficiency of traditional fires by use of mud stoves goes a long way in ensuring that the objective is achieved.

Acknowledgements

This publication was prepared under the auspices of Intermediate Technology Kenya's, Household Energy Regional (HER) Project. It is a collaborative effort and a product of the contributions of project partners, staff, funders and the communities in East Africa who use mud stoves.

Project partners
The book is a product of deliberations and discussions by participants of the all Kisumu Mud Stoves workshop held in April 1995. They include Peter Kabagambe, Tamace Magembo and Andrew Zirimenya of SWIP, Uganda; Charles Ngabirano of the department of Water Development, Uganda; Cecilia Muchemi a volunteer from Kenya; Joan H. Barbara of the YWCA, Uganda; Beny Mwenda and Mary Sayi of MATI-U, Tanzania; Mary Kimambo of DEP Mt Elgon, Uganda; Concepta Mukasa of IRDI, Uganda and Richard Kizito of ATE, Uganda.

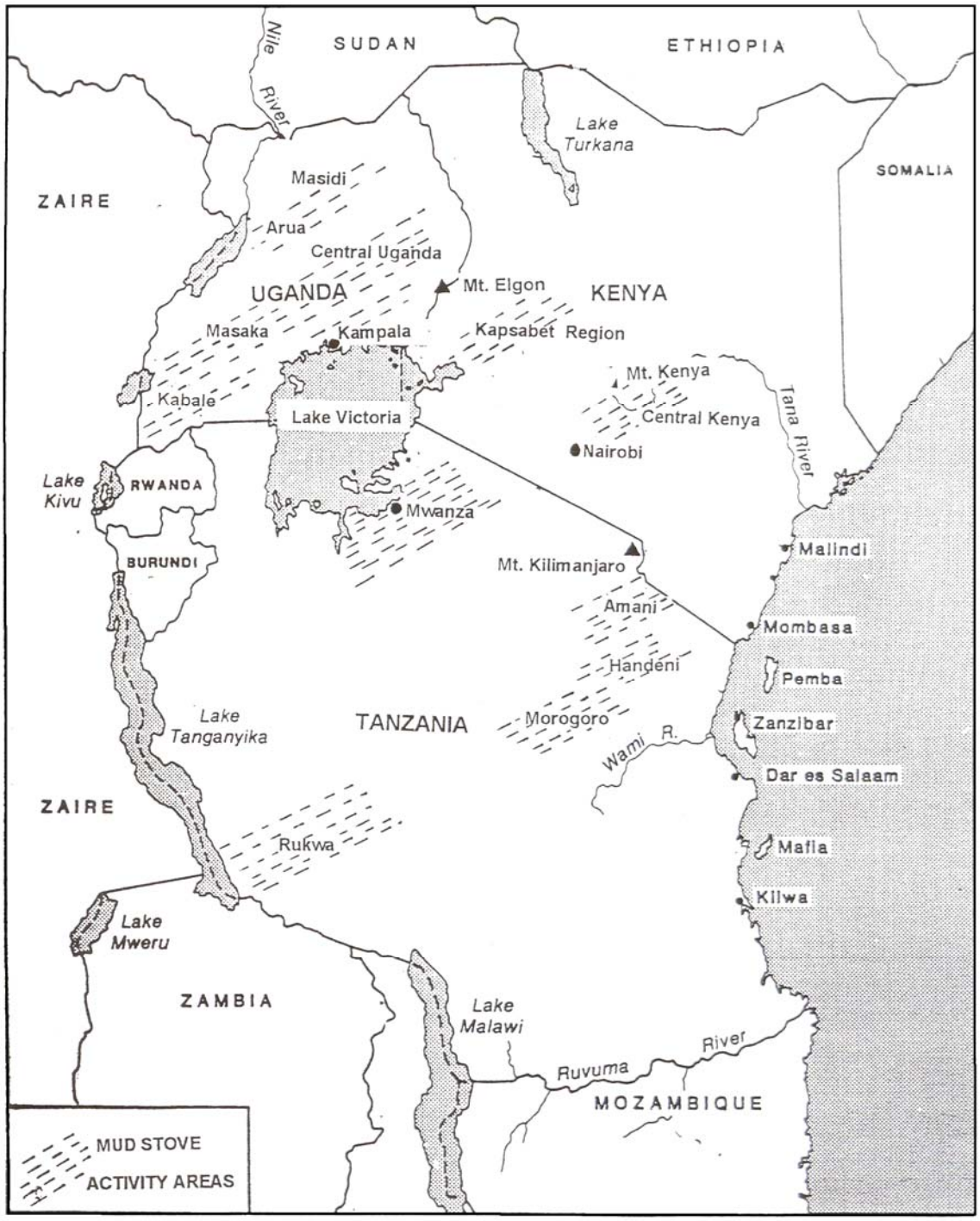
Special thanks to the partners who met in Novermber 1996 to review the draft. They are Richard Kizito of ATE, Sam Bagambo of IRDI, Appolonia Lugemwa and Betty Nsibirwa of Archdiocese of Kampala, Peter Mutuba of DEP Mt Elgon and May Sengendo of Makerere University.

IT Kenya editoprial team
Thanks to the IT Kenya editorial team for their enthusiasm and commitment to the work during the preparation and publication of the manual. They include Betty Rabar, Lydia Muchiri and Mariam Kundu.

Funders
Thanks to ODA Joint Funding Scheme and Charity Projects of the UK for funding the training sessions, the field visits, the promotion of the technology and the compilation and publication of this manual.

Communities
Special thanks to the communities in various parts of Uganda, Tanzania and Kenya for sharing their invaluable experiences,

Map showing mud stove activity areas



Chapter One

Introduction

Household energy activities in East Africa have mainly concentrated on the promotion and dissemination of clay-lined fired stoves and mud stoves which target both rural and urban areas. Improved all-metal stoves are promoted but are not as common as the other two technologies.

Figure 1.1 A ceramic stove

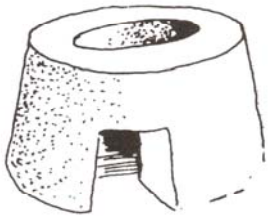


Figure 1.2 A mud stove

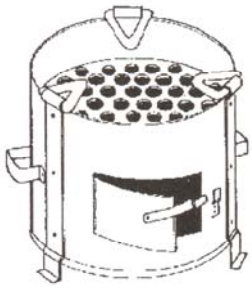


Figure 1.3 A metal stove

Experience from many parts of the world has shown that stove technologies have 'niche' regions and communities. How appropriate a technology is, is determined by the rate at which communities take it up and continue to use it. It clearly depends on communities' energy needs and situations.

Different stove technologies have been described as either being inappropriate or appr9opriate by communities in specific parts of the region, depending on social and economic circumstances. In the promotion and acceptance of stove technologies, issues such as how accessible, how affordable and how easy the stove is to use, are important. Continued promotion of a stove technology hat has proved inappropriate to a community only leads to stagnation of acceptance. One sure solution to this is to give people technology options and a variety of stoves.

History of mud stoves in East Africa

Mud stoves are the oldest improved stove technologies in East Africa. The other technology that was developed to improve on fires is the trench-fire system. Improvement of fires and stoves in the region was practised by communities living in areas where firewood was scarce. The basic principle common to mud stoves and trench fires is the shielding of the fire against draughts. Cow dung missed with mud was the most common material used for shielding fires.

The art of mixing mud is still common in East Africa since the walls of most houses, especially in highlands, are smeared with mud. This is done to protect the occupants from the cold especially during the night, and keep them cool during the day.

In recent years, however, two kinds of improved stove technologies have been promoted by different organizations in the region. The most publicised technology is the clay-lined stove. The stove is made of clay and fired before use. Potters who make clay pots have, in many cases, doubled up to produce pots and improved stoves. The technology, however, requires skills for stove-making and firing. Promotion of improved stoves became more popular in the 1980s and resulted in the development of stoves such as the Kenya Ceramic Jiko (KCJ), Maendeleo (Upesi) Jiko, Uganda Sigiri, Morogoro stove, Jiko la Dodoma and Jiko Bora.

Figure 1.4 The walls of most houses in E. Africa were built of mud

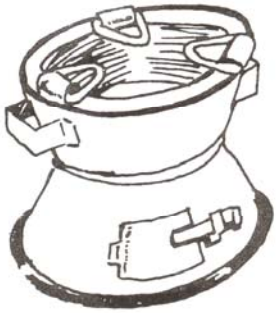


Figure 1.5 The Uganda Sigiri

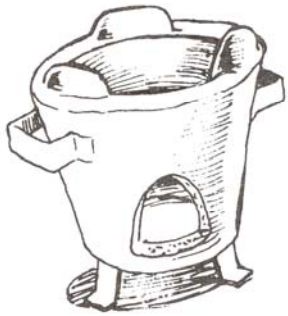


Figure 1.6 The portable Maendeleo jiko

The other technology which has had very little publicity but has persisted is the mud stove technology. Examples of mud stoves include Jiko Sanifu, Unicef, Lorena, Wasambaa, the protected three-stone fire, the improved traditional three-stone stove, one-pot mud stove, Kilakala, Nyungu and the raise fire place.

Chapter Two

About Mud Stoves

Mud stoves do not need to be fired before use. They are usually made by the user and do not require special skills. They are cheap to make since all they require is the person's time, water and soil. They are therefore very appropriate for use by different communities. The main difference between clay-lined stoves and mud stoves is the need for resources to make or possess. In almost all cases mud stoves require mud and the skills of moulding and mixing. The technology for this can be easily adopted and adapted.

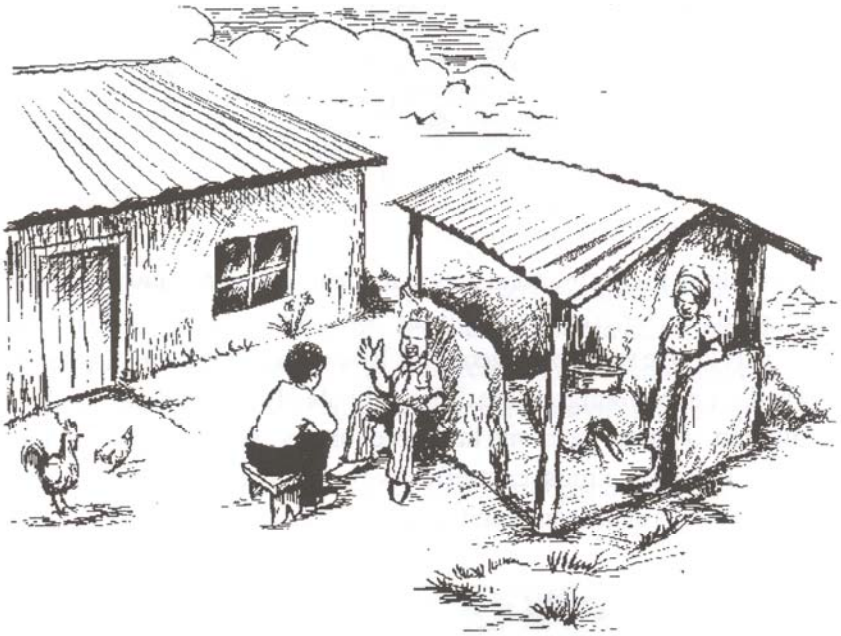


Figure 2.1 Mud stoves are appropriate for use in many communities

Mud stoves provide the alternative technology in biomass energy use where ceramic stoves are not appropriate or accessible. Where the communities are not financially endowed or where transfer of skills is difficult or costly, mud stoves are a feasible alternative.

Appropriateness of mud stoves

Mud stoves are the most accessible type of biomass energy technology in the region. This is because the materials used to make them are easily available and the cost is minimal. Consequently, they are used by many community members, unlike clay-lined ceramic stoves which are expensive. Mud stoves can be designed to suit the needs of the users. The technology is simple and easy to transfer from one region to another, from one individual to another and from one generation to another.

Figure 2.2 Even the young can make mud stoves

In addition, they are cheap to construct and easy to maintain. The skills involved in making mud stoves are easy to transfer, adopt and replicate. Since the user is involved in all stages, it helps the community to give value to indigenous skills and local knowledge. The technology is user-friendly and even the young and the differently-baled can make and use them. The stoves can use different biomass fuels with little need for processing. A combination of the above features make them the most cost-effective way of addressing the stoves and household energy problems of the communities in East Africa.

Figure 2.3 Mud stove technology can be introduced in institutions

Mud stoves are important in emergency situations, especially in refugee camps since they can be made from any available soil material. The technology can be introduced in both the institutional and domestic sectors.

Figure 2.4 Mud stoves are important in refugee camps

In some cases, mud stove designs originate spontaneously from communities responding to firewood scarcity. This happened with the Wasambaa stove in East Usambara in Tanzania and the Nyungu stove in the central region of Kenya. The technologies have developed without outside influence mainly due to necessity and creativity on the part of communities involved.

One noticeable aspect of stove technologies that develop spontaneously is their flexibility in design and style of finishing. Other aspects that relate to appropriateness are the ability to reduce effects from smoke because of increased combustion, there are less accidents in the kitchen, and the kitchen as a work place is beautiful and clean while the owners feel empowered.

Factors hindering appropriateness

Figure 2.5 Mud stoves require constant repair

Despite the general positive aspects of the mud stove technology, it has some weaknesses that hinder promotion. For example, they require constant repair and maintenance. If maintenance is not done regularly, the stove will deteriorate. This discourages the users. Mud stove promotion, therefore, requires constant follow-up. Many of the mud stoves require shelter from rain and other adverse physical effects. In some cases, mud stoves are laborious to make. They are not easily transported as they are bulky and break easily this reduces their commercial appeal. Some communities have complained that mud stoves are not appropriate for roasting maize, sweet potatoes, cassava and other root crops. Another factor hindering appropriateness is that mud stoves require between two to three weeks to dry before use.

Mud stoves take time to light because the walls are cool and absorb most of the heat during the initial stages. The stoves are however, very dependable once the fire is lit because the walls at as insulators.

Figure 2.6 Most mud stoves are not portable

Figure 2.7 Mud stoves require shelter form the rain

Chapter Three

Basic Features of Improved Mud Stoves

All improved biomass stoves have some common characteristics. They include an enclosed burning box or fire chamber, insulated walls, and in some cases, close fitting links between the pot hold and the pot. The basic features of an efficient mud stove are related to the dimensions. Dimensions affect other aspects such as how long the stove will last, cost of production and how it will be used.

The features described in this section help the reader understand the basic rules of thumb that are occasionally used by mud stove promoters. It is not possible to generalise these but some basic guidelines are drawn to help in the dissemination of mud stoves.

One of the most important features is the thickness of the wall. This affects the performance of mud stoves in various ways. The thicker the wall, the better the stove since thick walls conserve heat and reduce chances of cracking.

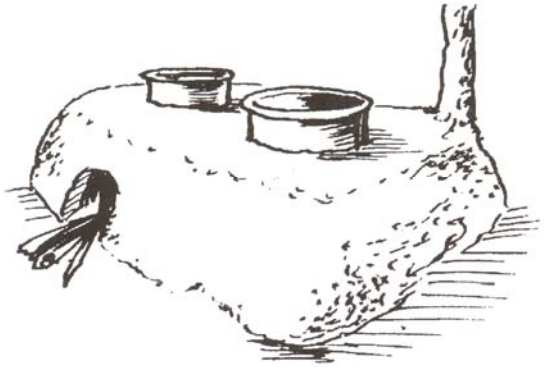


Figure 3.1 Thick walls improve performance of stoves

Figure 3.2 Chimney should be at an angle to the pot holes

However, when the stove is new, thick walls slow down the heating process during the initial stages of lighting as the wall gets heated up. Once the walls are heated most of the heat from the fuel is used to heat the pot and the wall acts as an insulator, thus improving the stove performance.

The chimney should be placed at an angle in relation to the smoke channels to minimise heat loss. This helps retain the heat in the fire chamber.

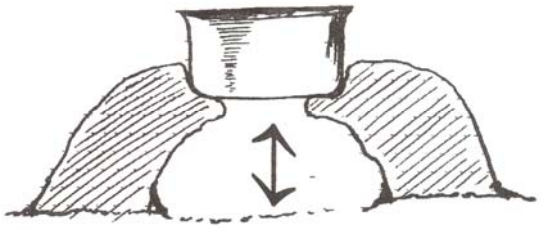


Figure 3.3 Height of the fire chamber

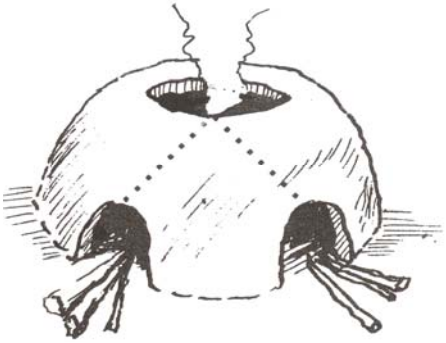


Figure 3.4 Position of the doors in a two-door stove

The height and size of the fire chamber affects the rate of heating of the pot. If the chamber is too low, the fire will engulf the pot resulting in wastage of fuel wood. However, many people mistakenly believe that their food will be ready in a shorter time when the pot is surrounded by flames. A very high chamber, on the other hand, places the pot far above the flames and uses a lot of fuel wood. This is because the pot takes more time to heat up.

For a two-door mud stove, the fire entrances must be positioned adjacent to each other (forming a v-shape towards the pot hole) to allow wind to blow into both holes. Wind should not blow right through the fire chamber, that is, through one hole and out of the other.

The recommended during period of a freshly-moulded stove should be strictly observed to avoid cracking, which affects the stove's efficiency and lifespan.

Enhancing Efficiency

Experience has shown that for a mud stove to be efficient:

- The thickness of the walls should be at least as wide as the palm of your hand.

Figure 3.5 Measuring the wall thickness

Figure 3.6 The height of the pot rest

- The pot rests should be as high as the width of your thumb.
- The height of the fire chamber should not be more than the length of your palm. In Uganda, some promoters use sufurias to determine the height of the fire chamber, which is usually equal to about three-quarters the diameter of the most commonly used sufuria placed with the bottom against the stove.

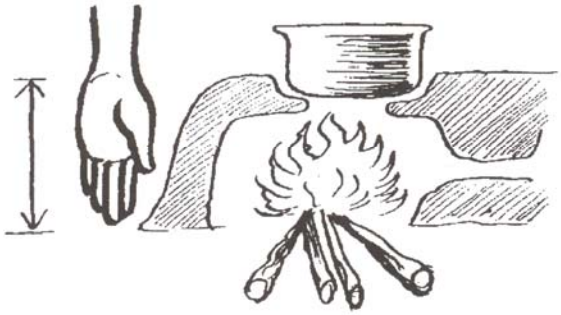


Figure 3.7 The height of the fire chamber

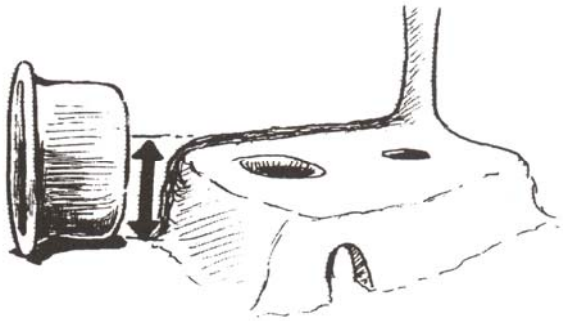


Figure 3.8 Height of fire chamber measured using a sufuria

- Pot holes should be adjacent to each other.
- In cases where a stove has more than two pot holes, the connecting channels should be at least as wide as the fist.

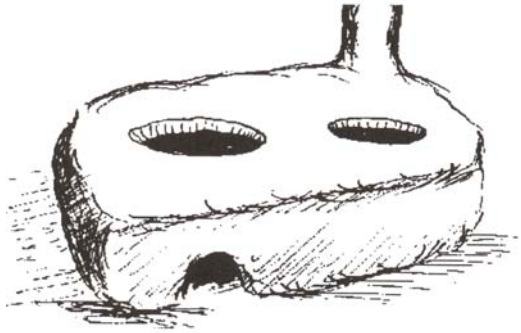


Figure 3.9 Positioning of the pot holes

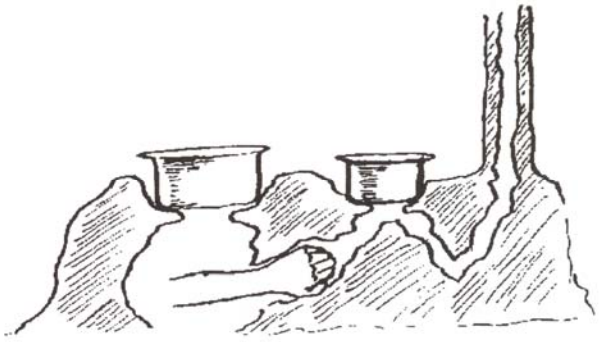


Figure 3.10 The diameter of the connecting channel

- The number of pot holes in one mud stove should not exceed two. Initially promoters encouraged the use of three pot holes but later found that there were frequent chimney blockages. The efficiency of the stove is reduced if it has more than two pot holes because

there isn't enough draught to pull the smoke out. The stoves tend to produce smoke inside the kitchen and end up using more firewood.

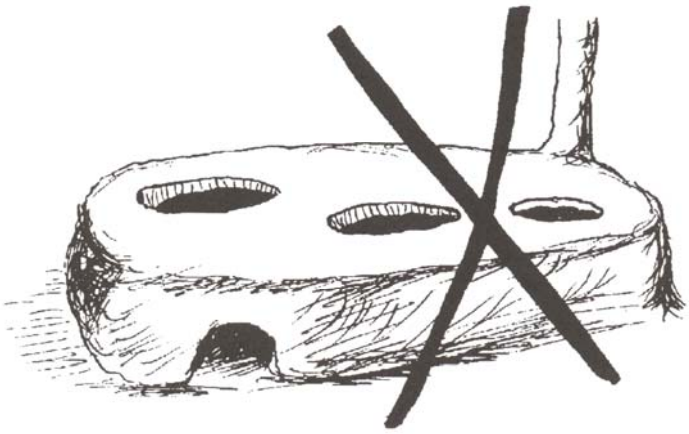


Figure 3.11 The number of pot holes should not exceed two

- If the stove has two doors, they should be on the same side, otherwise flames will blow through the other door.

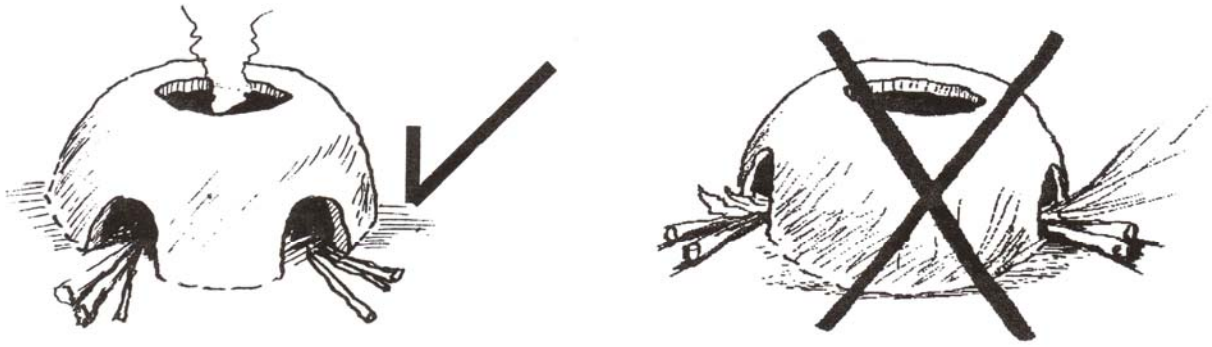


Figure 3.12 the two door positioning is critical to performance

- The height and width of the stove door should be as long as, and as wide as the palm of your hand.
- The channel at the second fire chamber tapers to allow maximum transfer of heat to the second pot.
- The finishing should be appealing enough to attract the users.

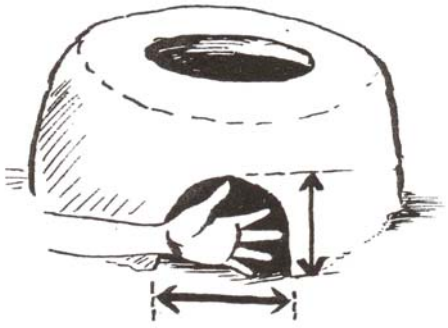


Figure 3.13 The size of the door

Figure 3.14 The finishing should be appealing

The Chimney

- Basically, the diameter of the chimney should be equal to the length of the second finger in the case of household stoves. This is equal to about four inches. But it may be widened if it is for an institutional stove. The diameter of the chimney is determined by the size of the stove; it should not be bigger than the width of the stove door.
- The chimney should be built against the wall, preferably at the corner. This is to avoid damage since it is made from mud reinforced with grass.
- The height of a metal chimney should extend above the roof of the house if it is roofed with iron sheets. The height above the roof should be at least equal to the length of the arm from the fingers to the elbow. In cases where the house is grass thatched, the chimney should be directed out from the highest point of the wall. If the chimney is not high enough it will not create enough draught so smoke will be emitted from the pot holes, making the kitchen smoky. If the chimney is too high, the draught will be very strong and hot flue will be pulled out of the chimney instead of heating the pot. This makes the stove inefficient. The rule of thumb for many promoters is that a chimney passing through the wall should be at least three feet high and four inches in diameter. The length inside the house should be equal to the length of the arm.

Figure 3.15 Ensuring the chimney diameter is correct

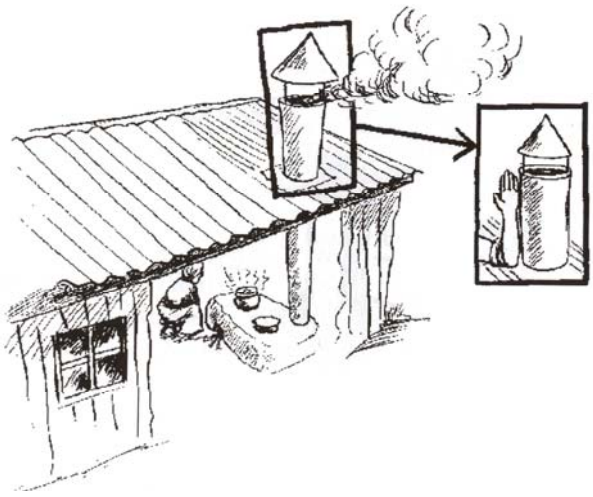


Figure 3.16 The chimney height above the roof

Figure 3.17 The chimney may be directed at the highest point of the wall

Figure 3.18 The recommended height of the chimney in the house

Chapter Four

Some Mud Stove Technologies in East Africa

A range of mud stoves and mud-mixing technologies are found and promoted in East Africa.

Mud-mixing technologies

Communities have developed very innovative ways of mixing and binding mud. The technology lies in the skills of selecting, mixing and moulding mud and binding with or without reinforcement. Grass is commonly used for reinforcement. The binding properties of mud are improved by the use of cow ding, murram and liquid obtained from certain plants such as mlenda, sweet potato vines and several species of the aloe plant. Resistance to heat is improved by use of ash and vermiculite. This helps to prevent cracks.

Some communities have developed mud stoves in response to dwindling firewood supply. Recognition of such stove technologies is one step forward towards enhancing their promotion and dissemination.

Figure 4.1 The aloe plant

Mlenda

One example of a mud-binding enhancing vegetable is the mlenda plant. Makonda is the liquid obtained by soaking mlenda in cold water for at least ten minutes. The liquid when mixed with soil makes the mud sticky. Its binding properties were discovered by potters in the Mwanza region of Tanzania. Mlenda is an indigenous vegetable commonly found in many parts of East Africa.

Figure 4.2 Leaves of the mlenda plant

Makonda is a viscous and slippery liquid. It is usually used in mixing clay soil to make mud for producing pots and other pottery products including stoves in the Ukiriguru area, Mwanza region of Tanzania. The technology is promoted by a team from the Ministry of Agriculture Training Institute – Ukiriguru (MATI-U).

Mud mixed with Cement

This technology is practised by Tanzania Traditional Energy and Environment Organization (TaTEDO) in the dissemination and installation of mud stoves and ceramic stoves around the peri-urban areas of Dar es Salaam. It makes dissemination of the mentioned stoves easy and manageable in a situation where the community does not entirely own its soil materials or land.

Clay soil obtained in the peri-urban areas of Dar es Salaam is mixed with a small quantity of cement and the mixture is used in the installation of the wood burning stoves made by TaTEDO. The practice is only possible in areas where cement is accessible.

Chapter Five

Types of Mud Stoves

Jiko Sanifu

This is one of the most widely promoted mud stoves in the region. It is a one-pot, two-door mud stove developed and promoted by MATI-U in Tanzania.

Figure 5.1 The original Jiko Sanifu

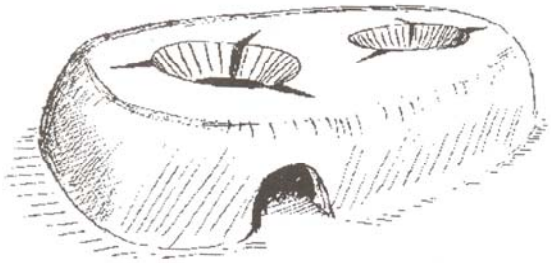


Figure 5.2 The Uganda version of Jiko Sanifu

In Uganda, they promote the one-door, two-pot hole version of the stove. The Uganda model has v-shaped pot holes to allow use of different sizes of pots.
The Jiko Sanifu does not have a chimney. It is usually made from mud bound with Makonda.

Figure 5.3 Makonda Liquid

Material used
Sand clay and Makonda

Mixing ratios
One unit of sand to two units of clay. Ant hill soil could be used where clay soil is not available.

Figure 5.4 A knife, hoe and sufuria

Tools commonly used
Sufuria, knife, bucket and a hoe.

Dimensions
The fire chamber is moulded out around the sufuria. The depth of the fire chamber is made by adjusting the sufuria upwards three times. The thickness of the wall is equal to the length between the base of your palm and the tip of the smallest finger/ the door height is equal to the length between the base of the palm and the tip of the third finger. The distance between the top part of the door hole to the edge of he stove is the size of a fist.

Figure 5.5 Measuring the door

How to make the stove

1. Mix soil and water to make mud using the above mixing ratios.
2. Prepare the foundation by levelling the ground. Sprinkle with water an smear with mud.

3. Wet a sufuria of an appropriate size with Makonda liquid and place it in position.
4. Pack mud around the sufuria until it reaches the rim at the top

Figure 5.6 Mixing soil and water

Figure 5.7 Levelling the ground

Figure 5.8 Packing mud around the surfuria

5. Rotate the sufuria, moving it upwards and continue packing more mud around it to the top. Repeat this once more and remove the sufuria. This leaves you with an opening which will become the fire chamber. It is important to rotate the pot in one direction since it helps to retain the shape.

Figure 5.9 Pack the mud to the top of the sufuria

Figure 5.10 Smoothing out the mud

Figure 5.11 Rotating the sufuria

Figure 5.12 Removing the sufuria

6. Trim the sides with a knife to shape the stove. The width should be equal to the width of the palm of your hand.
7. Smooth out the inside of the stove using Makonda liquid.

Figure 5.13 Trimming the sides

Figure 5.14 Smooth out using makonda

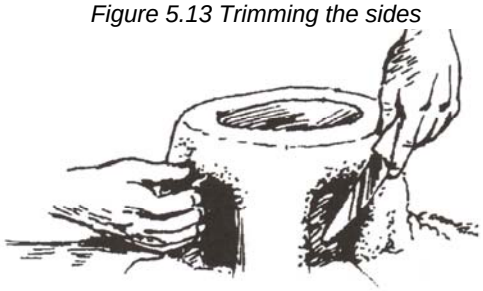


Figure 5.15 Cutting out the doors

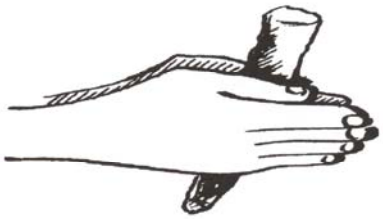


Figure 5.16 Rolling mud to prepare pot-rests

8. Mark out the stove doors adjacent to each other, and cut through the mud using a knife or panga. Remove the mud to form doors through which the firewood will be fed.
9. Prepare pot rests by rolling some mud in your hands. The width shod be equal to the diameter of your wrist. The length of the pot rests should be equal to the length from the base of the palm to the tip of the middle finger.
10. Fix the pot rests against the inner wall of the stove using the three-stone stove position.

Figure 5.17 Fixing the pot-rests

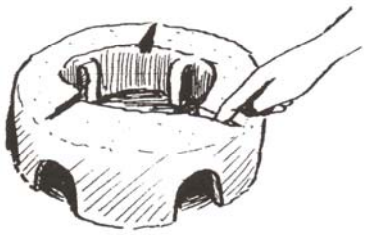


Figure 5.18 Making the smoke outlets

11. Make three smoke outlets between each of the three pot rests using your finger.
12. Let the stove dry for two weeks, then repair any cracks as they appear, and finish the outer walls by smearing with cow dung or ashes. The ratio of mixing cow dung and ash is two units to one. That is, two units of cow dung to one unit of ash. The stove should be left to dry for another two weeks before use.

Lorena two-pot stove

The Lorena stove originated from Guatemala in the early 1980s. It is currently being promoted in Uganda although the version being promoted is made entirely from mud. It is promoted by organizations such as the Mount Elgon DEP-IUCN Project and Integrated Rural Development Initiatives (IRDI).

Figure 5.19 Two-pot Lorena stove

Materials used

Sand or silt, clay or ant hill soil, cow dung, ash, water. For the chimney, grass and metal sheet or banana stem (Refer to Annex 1: How to make a chimney).

Mixing ratios
One part of clay is mixed with thee parts of sand.

Tools commonly used
Hoe bucket, knife and panga.

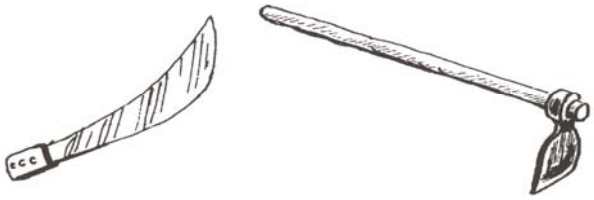


Figure 5.20 A panga and a Hoe

Dimensions
The door height should be equal to the width of your palm from the tip of the thumb to the small finger with the fingers slightly spread. The thickness of the walls should be equal to the width between the tip of the thumb and the first finger with the two spread out.

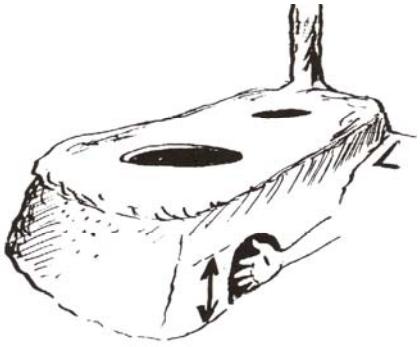


Figure 5.21 The door height

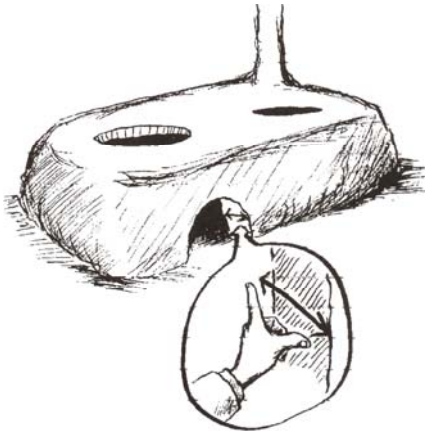


Figure 5.22 The thickness of the walls

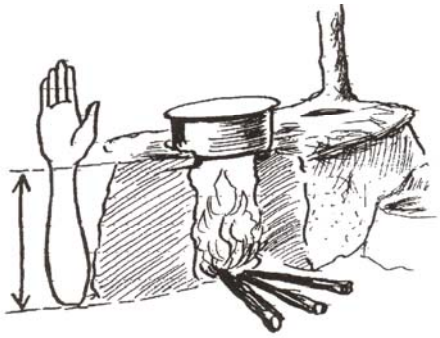


Figure 5.23 The depth of the stove

The depth of the stove should be equal to the length from the elbow to the base of the palm or three-quarters the diameter of the most commonly used sufuria.

How to make the Lorena stove

1. Level the ground where the stove will be built and prepare a platform of a suitable height using bricks or stones. This is optional.
2. Mix the materials together, adding water gradually until it becomes sticky and easy to work. Make the mud into balls to expel the air. This will prevent cracking.

Figure 5.24 The platform of the Lorena stove

Figure 2.25 Mixing the materials

3. Measure the size of the stove and the diameter of the pot holes using the sufurias that are most commonly used for cooking. Use your two palms to space the pot holes
4. Heap the mud balls until the required height is achieved.
5. Use the sufurias and your palms again to mark the pot-hole positions on the mud platform.

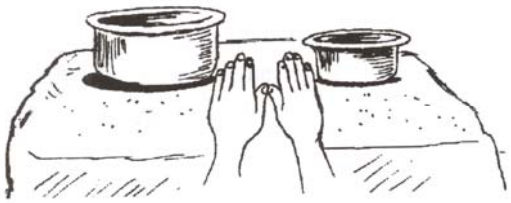


Figure 5.26 Using your palms to space the pot holes

Figure 5.27 Heaping the mud balls

6. Scoop out the mud to create fire chambers. Some promoters prefer to scoop the mud after twenty four hours. Any of the two methods can be used.

Figure 5.28 Marking the Pot-holes position

Figure 5.29 Scooping out mud to create fire chambers

7. Place a larger sufuria over the pot holes and mark around it. Remove mud between the pot hold and the new marks to a depth equal to the length of the first finger. This forms the pot rest for the smaller sufurias.

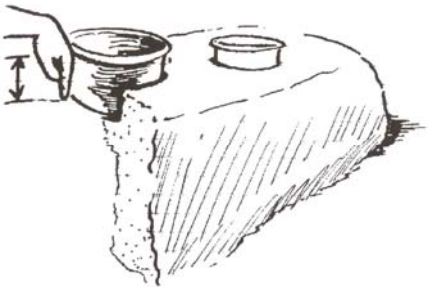


Figure 5.30 Scooping out mud to create fire chambers

Figure 5.31 Cutting out the door

8. Use a knife to cut out the door and insert a banana stem or its equivalent to help retain its shape. Leave the stem in the door until the stove is completely dry.

Figure 5.32 Inserting the banana stem

Figure 5.33 The diameter of the connecting channel

9. Scoop an opening through the wall connecting the two pot holes. The diameter of the opening should be equal to the width of a fist.

10. Make chimney (See Annex 1) and fix onto the stove.
11. Let the stove dry for two weeks and then smear with cow dung or ashes, repairing any cracks that may have appeared. (See Annex 2: Repairing cracks).
12. Leave for another one week before use.
    There are possibilities of using ceramic grates in Lorena stoves. Integrated Rural Development Initiatives in Uganda has tried this in some areas and it has proved effective. These are, however, optional.

Unicef stove

This is a one-pot mud stove which was developed by UNICEF in the mid 1980s in Kenya. After dissemination on a pilot basis in several areas, it was abandoned but later reintroduced in Uganda by stove promoters. It is one of the few mud stoves that are portable though quite heavy.

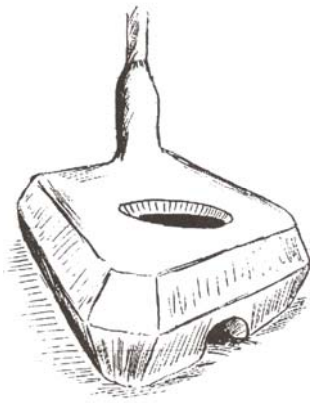


Figure 5.34 The Unicef Stove

Materials used
Sand or silt, clay or ant hill soil, dried grass and ash.

Mixing ratios
Three parts of sand or silt to one part of clay or ant hill soil.

Tools commonly used
A standard mould, hoe, bucket and a panga.

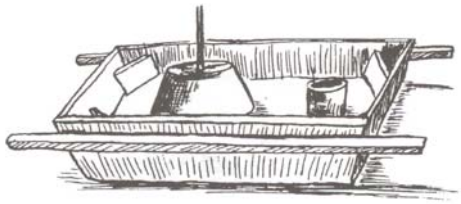


Figure 5.35 Unicef stove mould

How to make the Unicef stove

1. Mix clay and sand with water thoroughly to make mud.
2. Spread grass sparingly on the ground and pack a thin layer of mud over it by throwing mud balls on it with some force.

Figure 5.36 Mixing clay and sand with water

Figure 5.37Spreading grass and throwing mud balls

3. Roll the mud and grass tightly to form along pieces of mud rolls. The grass helps to bind the mud into rolls.
4. Make several pieces, sufficient for making the stove.
5. Sprinkle water and ash in the mould. This will facilitate removal of the compacted mud formation from the mould.
6. Pack the rolls into the mould and use a ramming rod to compact them.

Figure 5.38 Rolling mud to form long pieces

Figure 5.39 Compacting the mud rolls in the mould

7. Turn over the mould to remove the first part of the stove.
8. Repeat this one more to mould the second part of the stove.

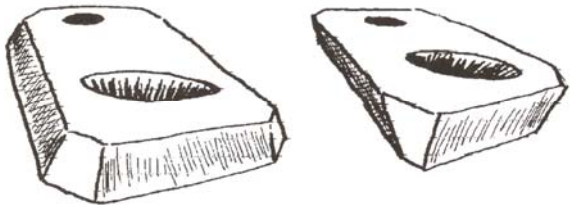


Figure 5.41 The two parts of the Unicef Stove

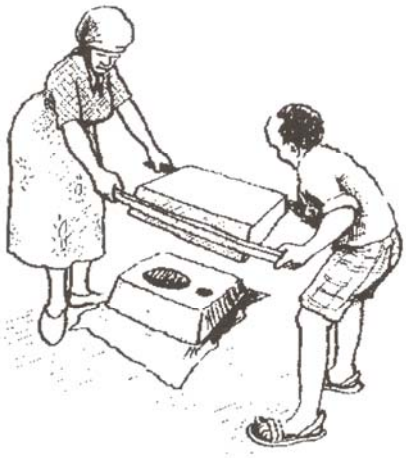


Figure 5.40 Inverting the first mould

9. Invert the lower part of the stove, and using a knife, cut out the stove door and the opening leading to the chimney.
10. With the top side facing up, fix the stove top onto the stove bottom.
11. Prepare the chimney and fix it in position preferably next to a wall for support.

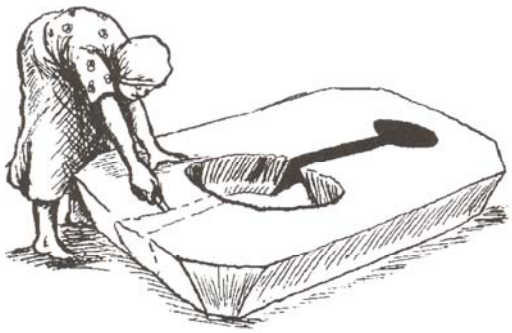


Figure 5.42 Cutting out the door

Figure 5.43 Fixing the top of the stove

12. Complete the walls using cow dung and ash.
13. Let the stove dry for two weeks before smearing and another week before use.

Nyungu stove

Nyungu is the Kiswahili word for cooking pot. In this book, Nyungu refers to the earthenware coking pot. It is made from clay and sand. Cooking pots come in many sizes; they are the oldest item in the African kitchenware history.

The Nyungu stove technology originated spontaneously from communities living in central Kenya and has today developed into a standard community practice in areas faced with lack of firewood.

The stove is made by cutting a door on the side of a pot and fixing the pot in position in the kitchen using mud. Even broken pots can be used.

Figure 5.44 The Nyungu Stove

Materials used

Sand, clay or ant hill soil, water and a clay pot.

Figure 5.45 A clay pot, sand, water and ant hill soil

Mixing ratios

There are no standard ratios but the mud should neither be too wet nor too dry to bind.

Tools commonly used

Saw panga, bucket and hoe

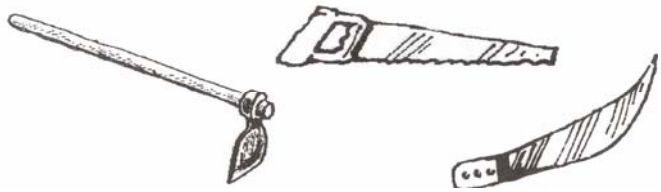


Figure 5.46 A hoe, saw and panga

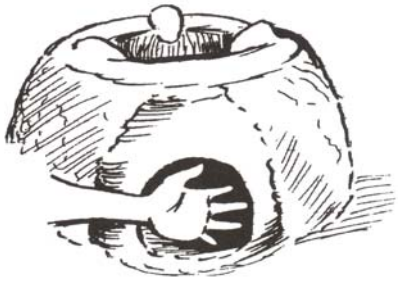


Figure 5.47 The size of the door

Dimensions

The size of the door is equal to the size of the palm with the fingers slightly spread lengthwise. The height of the fire chamber is determined by the depth of the pot. Smaller pots are preferred. This ensures that the fire chamber is not too large. A large fire chamber means that you will need to use more firewood to heat the pot as the flames have to be higher to reach the base of the cooking pot. The wall should be thick enough to hold the pot rests.

How to make the Nyungu stove

1. Cut a door on a cooking pot using a handsaw.
2. Prepare mud by missing any type of soil with water.

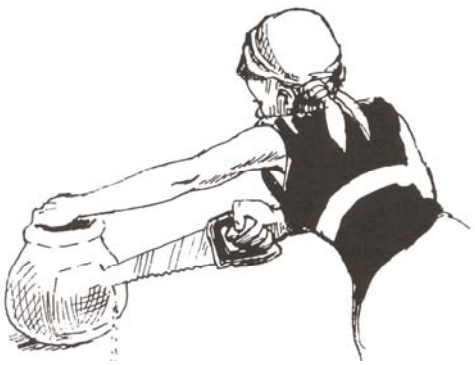


Figure 5.48 Cutting the door

Figure 5.49 Preparing mud

3. Prepare the foundation by levelling the ground sprinkling water and smearing the base with mud.
4. Place the pot on the foundation and pack mud all around it leaving the door opening.

Figure 5.50 Preparing the foundations

Figure 5.51 Sprinkling water

Figure 5.52 Positioning the pot

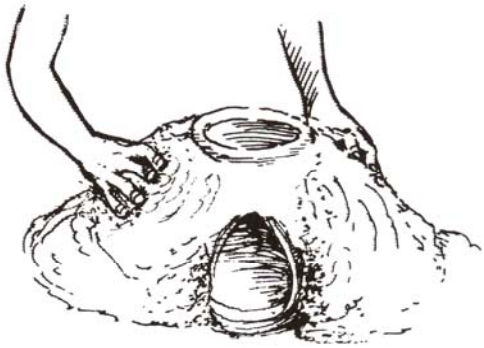


Figure 5.53 Smearing mud around the pot

5. Smear mud to the top covering the rim of the pot.
6. Extend a platform in front of the stove door. This issued for placing firewood.
7. Make pot rests by rolling mud to make three rolls. These should by as thick as the diameter of your wrist. The length should be equal to that from the base of your palm to the tip of the smallest finger.
8. Place the pot rests in position across the rim of the pot in the three stone fire position.
9. Trim the sides to shape it and let it dry for one week.
10. Smear the stove with ash and cow dung and leave for another week before use.

Figure 5.54 Rolling mud to make pot rests

Kilakala Stove

This stove is promoted by the Christian Council of Tanzania – Women Training Centre – Morogoro (CCT-Morogoro). It is built by surrounding three stones with a mud wall and can be either a one-pot or two-0pot stove.

Figure 5.55 A one-pot Kilakala stove

Material required
Building soil (or any other soil with good binding qualities such as clay), grass, sand, cow dung or ashes and water.

Mixing ratios
Three parts of building soil, to one part pounded grass. If the soil is too soft add more to prevent cracking during the drying process. You could also add sand or small pieces of burnt bricks. If the soil is too sandy, mix with cow dung or ashes.

Tools required
A hoe, panga, sufuria, three stones.

Dimensions

Figure 5.36 The wall thickness

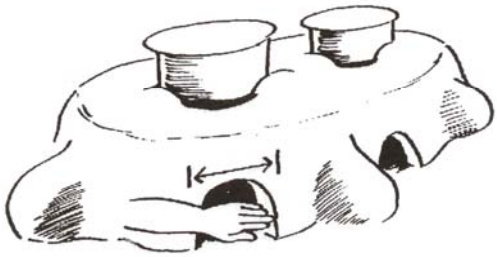


Figure 5.57 The width of the door

The heights from the base 9of the stove to the pot rests should be equal to the height from the base of the palm to the tip of the middle finger the thickness of the wall should be equal to the width of your palm.

How to make the Kilakala stove

1. Mix the building soil, sand and grass with water. Do not use too much water as the mud should be fairly stiff.
2. Store the mud under a shaded place and cover with banana leaves, wet sacks or polythene sheeting, and leave for one week. Sprinkle with water occasionally to prevent the mud from drying.

Figure 5.58 Mixing mud with water

Figure 5.59 Wetting the outside of the sufuria

Figure 5.60 Placing the sufuria on top of the stones

Figure 5.61 Placing mud around the sufuria

3. Level the place where you intend to build the stove and sprinkle with water.
4. Arrange the stones in the three-stone fire position, and try all the pots and pans used for cooking.
5. Take the pan that is commonly used and wet the outside. This ensures that it is easily removed afterwards. Place the pan on top of the stones.
6. Pack mud all around it up to the top, leaving space enough on top for holding the pot.
7. Remove the pot by twisting it round.
8. Smooth out the stove walls, both inside and outside.

Figure 5.62 Packing mud to the top of the sufuria

Figure 5.64 Removing the sufuria

9. Keep the stove covered for one to three days and let it dry until you can push your finger through only up to nail level.
10. Keep the remaining mud save for repairing cracks.
11. Cut three some paths between the three stones, each as wide as three fingers. These should be cut right down to the stove floor.
12. Do not cut off too much mud from the top of the stones to ensure that the pot hold firmly when

Figure 5.64 Smoothing out the stone

Figure 5.65 Cutting the smoke path

Figure 5.66 The height of the stove door

cooking.

13. Cut out the stove door. Measure the height and width equivalent to your palm laced horizontally with the fingers spread out. Mark the position first before cutting. The top of the door should be crescent shaped. Make a small vertical cut above the door to prevent cracking with the stove gets hot and expands.
14. Make two vents through the stove walls on the sides away from the door to enable smoke to escape more easily.
15. Let the stove dry for two to three weeks. Repair cracks immediately they occur by first wetting them and cutting with a knife before filling with mud (See Annex 2).
16. Once the stove is completely dry, smear with cow dung or ashes.
17. Let the stove dry for two weeks before use.

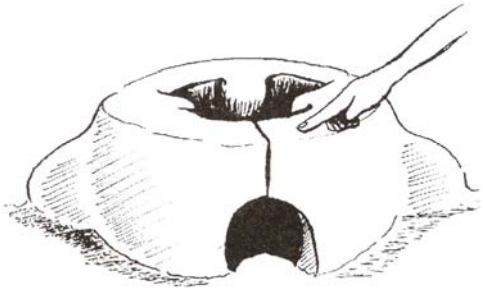


Figure 5.67 The vertical cut

Figure 5.68 Making a smoke vent

Wasambaa Stove

The Wasambaa stove originated from East Usambara in Tanzania and is currently being promoted by Handeni Integrated Agroforestry Project.

Materials used
Clay or ant hill or building soil and water.

Mixing ratios
There are no standard ratios

Tools commonly used
Panga, hoe, bucket.

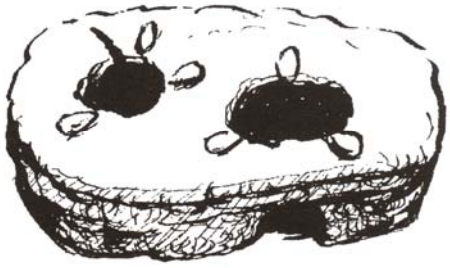


Figure 5.59 the Wasambaa stove

Dimensions
The height of the door should be equal to the length from the thumb to the small finger with the fingers slightly spread and the width should be the distance from the wrist to the tip of the middle finger. The thickness of the walls should be equivalent to the width of your palm.

Figure 5.70 Height of the stove door

Figure 5.71 Length of the stove

How to make the Wasambaa stove

1. Mix the materials with water thoroughly to make a stiff mud.
2. Level the ground where the stove will be built and sprinkle with water.
3. Mark out the size of the stove using the most commonly used sufurias, measuring one palm between the two pot holes and one palm from the pot hole to the edge of the stove.

4. Build the stove walls by first piling mud around the four sides to a height equal to the length from the base of the palm to the tip of the middle finger. Build the wall dividing the two pot holes to the same height. Ensure that you maintain the 'one palm' wall thickness.

Figure 5.72 Mixing soil with water

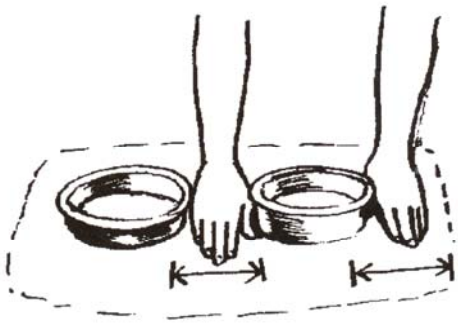


Figure 5.73 Measuring pot hole positions

Figure 5.74 Measuring the width of the wall

Figure 5.75 Building the top of the stove

5. Build the top of the stove starting from the walls, adding a little mud at a time. Leave space fro the pot holes as you proceed.
6. Once the top is complete, smooth out the stove and shapes the pot holes.
7. Cut the door using a knife. The door should be the size of the palm placed horizontally with the fingers slightly spread.
8. Let the stove dry for one week, repairing any cracks as they appear.
9. Smear the stove with cow dung or ashes and leave for another week before use.

Figure 5.76 Shaping the pot holes

Shielded Fires

The Rusinga stove

The Rusinga stove is an improvement of the three-stone fire. Three stones are placed in position and mud is used to cover two sides leaving a mud stove with one door.

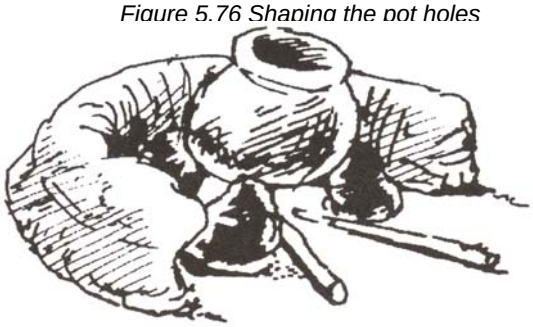


Figure 5.77 The Rusinga stove

Materials used

Three stones, sand, clay, water, ant hill soil where there is no clay or any soil material where cay or sand is not available.

Mixing ratios
There is no standard ratio.

Tools commonly used
Hoe and bucket

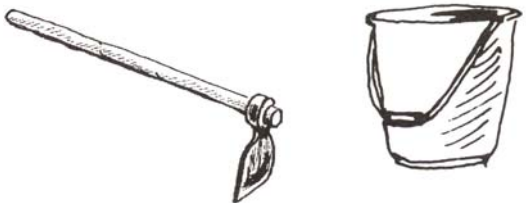


Figure 5.78 A hoe and bucket

Dimensions

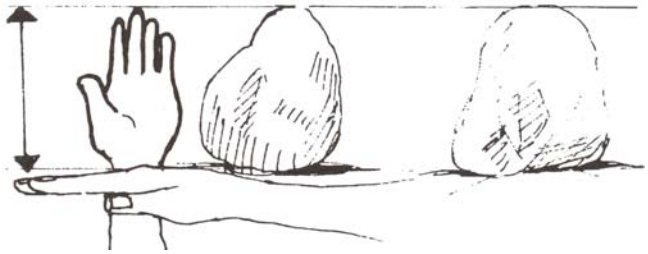


Figure 5.79 Height of the fire chamber

The height of the fire chamber is equal to the length between the base of the palm and the tip of the third finger. The firewood feeding space should be the same as the height of the fire chamber. The thickness of the wall should be the same size as a fist.

How to make the Rusinga stove

Figure 5.80 Arranging the three stones

Figure 5.81 Smearing mud around the stones

1. Mix clay and any soil material with water to make mud.
2. Place three stones in the three stone fire position.
3. Smear mud round the three stones and leave one opening.
4. Continue smearing mud until the height is appropriate.
5. Let the stove dry for two weeks before use.

Twin mud stone in one platform

The stove is the forerunner of the Wasambaa stove. It is an adaptation of the one-pot mud stove and is one of the most practical ways of giving the community a choice between using two stoves or one.

Figure 5.82 Twin mud stove in one platform

Materials used
Three stones, sand, clay, water, ant hill soil where there is no clay, any soil material where clay or sand is not available.

Mixing ratios
There are no standard ratios

Tools commonly used

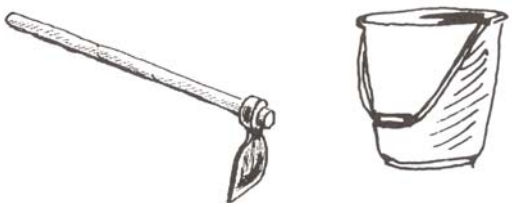


Figure 5.83 A hoe and bucket

Hoe and bucket

Dimensions

The height of the fire chamber is equal to the length between the base of the palm and the tip of the third finger. The firewood feeding space should be the same as the height of the fire chamber. The thickness of the wall should be the size of a fist.

Figure 5.84 the width of the door

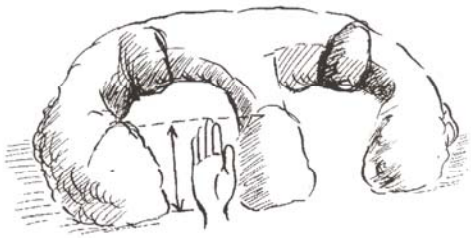


Figure 5.85 The height of the stove opening

How to make the twin mud stove

1. Mix clay or any soil material to make mud.
2. Place three stones in the same position as that in the three stone fire.

Figure 5.86 Mixing mud with water

Figure 5.87 Arranging the three stones

Figure 5.88 Placing the two stones

3. Place mud around the three stones and leave one opening.
4. Continue smearing mud until the height is appropriate.
5. Place two stones as if a second fireplace is being made next to the first one.
6. Smear mud around it to reach the same size as the first one.
7. Leave one side open.
8. The resulting structure is a two-pot, two door stove.

Rhoda Emergency stove

The stove was developed in a Daadab refugee camps by GTZ-RESCUE project. It is a one-pot, one-door stove which is actually an improvement of the traditional three-stone fire. It is ideal for emergency situations as it can be built very quickly using any soil that is available.

Materials used

Figure 5.89 The Rhoda Emergency Stove

Three stones, sand, cow dung, clay, water, ant hill soil where there is no clay. Any other soil material may be used where clay and sand are not ava8ilable. Cow dung is optional.

Figure 5.90 The materials required

Mixing ratios
There are no standard ratios

Tools commonly used
Hoe, bucket and sufuria.

Dimensions
The height of the fire chamber is equal to the length between the base of the palm and the tip of the third finger. The stove door should be equal to the size of the palm placed horizontally with the fingers slightly spread. The thickness of the wall should be the same size as the width of the palm.

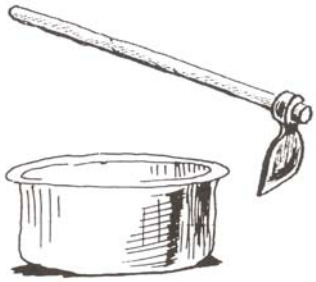


Figure 5.91 Some of the tools required

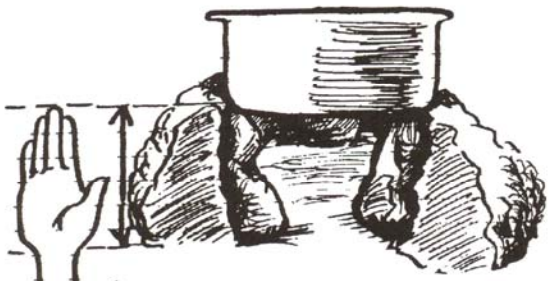


Figure 5.92 The stove height

Figure 5.93 The height of the opening

Figure 5.94 The width of the stove wall

To make the Rhoda Emergency Stove

1. Prepare mud by mixing earth with water.
2. Wet the three stones and place them on level ground in the three-stone fire position. Use a sufuria to establish the appropriate position.

Figure 5.95 Mixing soil with water

Figure 5.96 Sprinkling water on the stones

3. Smear mud around the three stones, blocking two firewood feeding places and leaving one open. Smear mud around until the height of the structure is about the length of your palm.
4. Smooth out the outer and inner walls leaving the three stones protruding inwards to act as pot rests. You could also place metal pegs inside the stove to act as pot rests.
5. Let the stove dry for two weeks before use. The stove could be smeared with cow dung or ashes to improve its appearance and seal the cracks.

Figure 5.97 Smearing mud around the three stones

Hoima mud stove

The stove is promoted by extension workers working in the western Ugandan region of Hoima with the MS Danish Volunteers. It is an improvement on the three stone fire.

Figure 5.98 The Hoima stove

Materials used
Clay, sand, water, cow dung, ash, dried grass and three stones.

Mixing ratios
Three units of clay to three units of sand to one unit of cow dung to one unit of ash.

Tools commonly used
Hoe, bucket and a panga

Dimensions
The height of the fire chamber is equal to the length between the base of the palm and the tip of the third finger. The firewood feeding space should be the same as the height of the fire chamber. The thickness of the wall should be as wide as the palm of your hand.

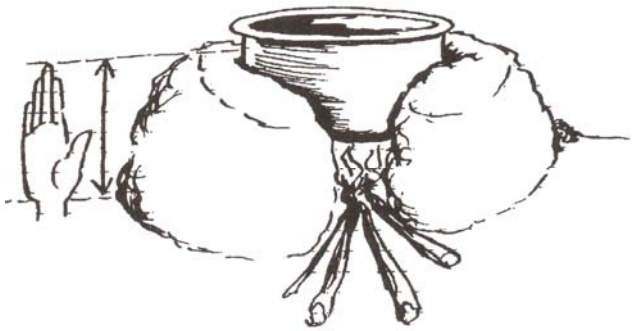


Figure 5.99 The height of the fire chamber

How to make the Hoima stove

1. Prepare mud by mixing soil with water.
2. Using a sauce pan, place three stones on the ground where the stove is to be built.
3. Sprinkle water on the stones.

4. Smear mud around the three stones blocking two firewood feeding places and leaving only one..

Figure 5.100 Mixing soil with water

Figure 5.101 Sprinkling water on the stones

Fixing 5.102 Putting mud around the three stones

Figure 5.103 The completed stove

5. Pack mud all around the three stones until the height of the structure is about the length of the palm and the fingers.
6. Make a platform inside the fire chamber to act as a pot rest.
7. Smooth the outer and inner sides of the stove.
8. Check for cracks at least after a day and repair with mud where necessary.
9. After a week smear with cow dung mixed with clay and water.
10. Use the stove after three weeks.

Chapter Six

Ideas on Dissemination

Consultation

Figure 6.1 Consulting the community is vital

Improved stove dissemination involves planning for the implementation of field activities. The approach used may differ from one community to another but there are basic aspects that ensure effective dissemination.

Before the implementation of activities the community should be consulted. This helps the implementer understand the needs of the community. Consultation is required in order to assess the needs and to find out the existing stove technologies, skills, materials and capacity to build the stoves.

The main benefit of involving the community from the beginning is to develop the technology with them. It becomes their technology and ensures sustainability. It also helps the promoter to learn from the community as the community learns from the promoter.

Giving people options

During the actual implementation of the stove technologies, it is important to give the communities technology options because individual perceptions of benefits differ even in the same community. The promoter needs to be very flexible and willing to adapt acceptable technologies with the community.

Unless the promoter understands the community needs including such aspects as the uses of the fire, cooking habits and the roles of the man and the woman in mud stove making, correct options for mud stoves cannot be achieved.

Options in stove technology and choices in stove design are necessitated by inherent differences between communities, areas, sectors and social categories. When communities are given choices and options of technologies, they are able to choose what is suitable for their needs. This allows for flexibility and in the long run enhances the development of new innovations.

Partners

The involvement of the existing administrative and community-based structures, line ministries, non-governmental organizations (NGOs) churches and mosques could enhance adoption but can also hinder if not well identified and planned.

Networking

Sharing of information as it helps mud stove promoters to learn from each other. A well informed promoter or producer understands the need for quality products. The fundamental aspect in networking is exchange of information and ideas. Through this, quality technologies are easily taken up.

Figure 6.2 Sharing information is vital

It has been recognised that mud stove promoters face similar problems while disseminating stoves. One unique problem faced by many promoters is lack if information about the basic principles of

production of improved mud stoves and the need to recognise indigenous knowledge, local innovations and responses to improved stoves. Lack of networking and information exchange has resulted in promotion of mud stoves that are inappropriate in some areas.

The current situation in mud stove promotion is that the level of knowledge varies and is found in ‘pockets’ of communities in the region. For instance, in Mwanza, North pare and Morogoro in Tanzania, kabala and Masaka in Uganda, and Rusinga Islands, Kapsabet and Murang’a in Kenya. The skills and knowledge are rarely shared amongst mud stove promoters or other interested individuals and groups. This trend has slowed down the development of standard procedures for mud stove making.

Follow up

Like any other development activity, follow-up in mud stove promotion is important. Mud stoves, unlike ceramic stoves, require constant foll9ow-op because of their inherent weakness of deterioration. It allows the promoter to assess the progress of stove activities in the field and to give advice where necessary.

In most cases, follow-up activities help the promoter and the producer to upgrade the technology, modify it, introduce others or re-train the community on various aspects of the stove. It becomes particularly important to respond to the findings of the follow-up activity since mud stoves are prone to deterioration if satisfactory maintenance is not carried out.

Figure 6.3 Mud stoves require constant follow-up

Chapter Seven

Common Problems in Mud Stove Use

Building a stove or even purchasing one does not necessarily mean that it will be used. This is partly because the users may feel that the stoves do not satisfy all their needs. Perceived benefits may not e achieved if the dimensions are not correct or if the stove is not appropriate. Below are some responses to the most common questions.

Q **My stove crumbled and was destroyed when pounded food on it. What do you think went wrong?**

A It may be possible that the thickness of the walls is not adequate and therefore not strong enough to hold the weight of the pot. For your next stove ensure that the thickness is not less than the width of your hand.

Q **Lately, my kitchen gets very smoky when I use my stove. What could be the problem?**

A One reason might be that there are no smoke vents in your stove to allow enough circulation of air.

Figure 7.1 High smoke levels in the kitchen may be due to lack of smoke

Q **Is it advisable to use only one pot if my stove has two pot holes?**

A No it is not. You should use both of them at the same time or cover the second hole with a pot full of water to avoid smoke passing through it. It helps to prevent the loss of heat and therefore ensures efficiency.

Figure 7.2 A deep fire chamber delays the cooking process

Q **I find it difficult to light my new stove. If it lights, it is very smoky and the fire does not burn well. What could be the problem?**

A The most common problem is related to the pot rests the size of the pot rests determine the

flow of air in the stove and therefore the level of combustion and smoke produced If the pot rests are too low the fire will not burn properly and in some cases it is difficult to light the stove.

Q **My stove uses a lot of firewood. Why?**

A Inefficiency may be caused by the height of the fire chamber. When the fire chamber is deeper than required, the pot is high and far from the flames, making the stove inefficient. When it is shallow the flames engulf the pot and much of the energy is wasted.

Q **What size of firewood should I use in my stove?**

A The sizes of firewood you use in your stove is to a large extent controlled by the stove's door size. This is a deliberate way of restricting a stove user to certain sizes in order to enhance stove performance and improve efficiency. The size of the door therefore directly controls the amount 9of firewood used. It also determines the amount of air entering the stove. |t has been observed in some cases that cracking is caused by users trying to push big pieces of firewood through small stove doors.

Q **My stove developed so many cracks when I first used it. Why?**

A Probably you did not give the stove enough time to dry before you started using it. It is important to wait for at least two weeks for a mud stove to dry before use. This will help to avoid cracks and disappointments.

Figure 7.3 Let the stove dry for at least two weeks before use to avoid cracks

Q **My stove takes too long to light in the morning. Is there anything that can be done?**

A One thing you can do is to keep the door of your stove closed when you are not using the stove to keep it warm. If this is done overnight, lighting the stove in the morning becomes easy.

Q **Although I have reduced the amount of firewood that I use quite significantly, I would like to know what other measures I can take to conserve more fuel.**

A Simple cooking practises such as use of lids, chopping wood into small pieces, and soaking dry grains before cooking also help in conserving fuel.

Q **Does putting many pot holes in my mud stove make it more efficient?**

A Experience has shown that mud stoves should not have more than two pot holes. The more pot holes you have in a stove, the higher the chances that some will not be used. When the extra pot holes are not 'productively' used, heat is lost through these unused holes.

Stoves with Chimneys

Q **My chimney is clogged and my kitchen is very smoky these days. What can I do?**

A Constant use of wet wood or firewood that is not well dried results in clogging of the chimney. When a chimney is clogged, smoke is discharged from the firewood feeding door or from the sides of the cooking pot. In some cases the stove does not light. Chimney cleaning is essential, but with mud stoves dismantling the old one may be essential.

Q **My food takes too long to cook. What might be the problem?**

A The reason might be related to the chimney's position and its height. The position of the chimney is very important. It determines the draught created in the stove. The chimney's position in relation to the pot holes determines how well the cooking pots are heated. The height also determines the draught created. If the chimney is shorter than the required height, it creates low draught and a\ lot of heat is lost as it only serves as an extended pot hole. Low draught in the chimney may also result in clogging. When the chimney is too high, it creates excessive draught, resulting in unnecessary loss of heat.

Appendix One

Making a Mud Chimney

This technology was developed n the mid 1980s by Appolonia Lugemwa who works for the Archdiocese of Kampala in Uganda. She started working on possible ways of making chimneys after realising that several people could not afford metal chimneys. She tried several materials but finally experimented with grass reinforced with mud and tied round a banana stem to form a cylindrical shape. The technology first worked in 1986 and since then it has spread to many parts of Uganda. Other mud stove promoters in Uganda picked it up and are promoting it. It is easy to make and is cheaper than a metal chimney.

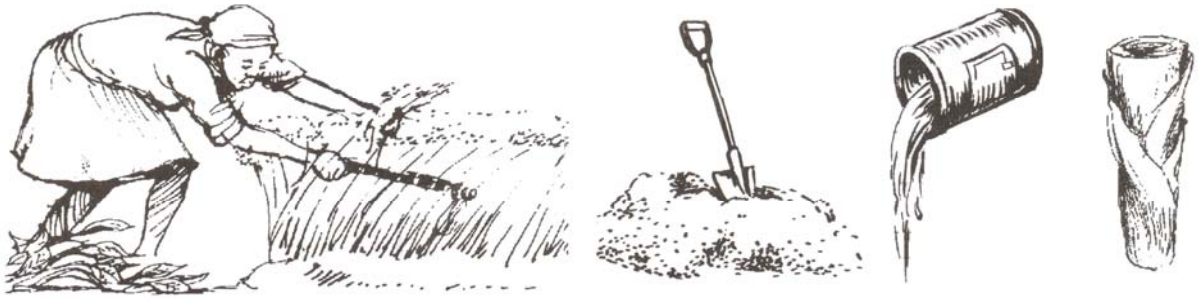


Figure A1.1 The materials required

Materials used
Sand, clay, water, grass and a banana stem (or any cylindrical-shaped item can be used).

Mixing ratios
There is no standard ration but the mud should neither be too wet nor too dry to bind.

Tools commonly used
Panga, bucket and hoe

Figure A1.2 A hoe, bucket and panga

Dimensions

The diameter of the chimney should be equal to the length of the third finger. The height depends on the kitchen size and height to the ceiling. A chimney that passes through the wall should not be less than the length of an arm of an adult.

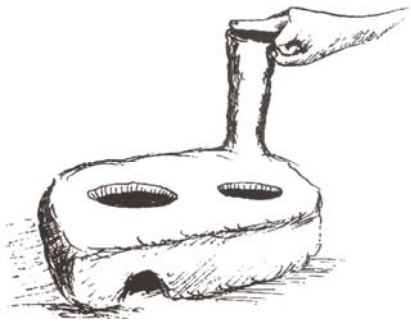


Figure A1.3 The diameter of the chimney

How to make a chimney

1. Mix clay soil with water to make mud.
2. Lay dried grass on the ground using force, paste mud on the grass.

Figure A1.4 Mixing clay with water

Figure A1.5 Pasting mud on the grass

3. Roll the mud and grass tightly to form long pieces of mud moulds. Make enough pieces for making a chimney.
4. Use a piece of wood or metal (in Uganda banana stems are used for this purpose) of the correct diameter (equal to the length of the middle finger) as the mould for making.
5. Wet the banana stem and wind the mud rolls round the stem firmly to the required height.

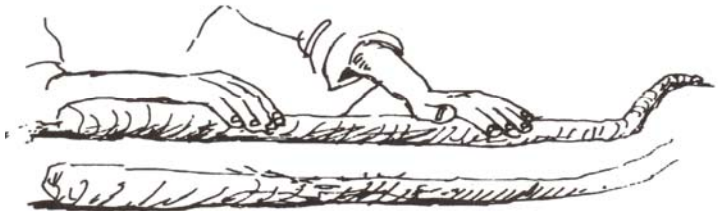


Figure A1.6 Forming long pieces of mud moulds

6. Carefully twist the stem upwards to form a mud pipe. This is usually done about two hours later.
7. Secure the chimney firmly onto the stove.
8. Let it dry for about two weeks before use.

Figure A1.7 Winding the mud rolls around the stem

Figure A1.8 Removing the stem from the mud pipe

Some promoters make the chimney pipe separately from the other part of the stove an after the mud pipe is dry enough it is installed onto the stove. Other prom9oters make the chimney together with the rest of the stove. It is argued by the former that if the stove and the chimney are built at the same time, the chimney tends to lose shape as it is not dry and strong enough to hold its own weight. This may however be rectified if the chimney is made in phases over a period of one week.

Appendix 2

Repairing Cracks

Big cracks sometimes appear on the mud stoves after prolonged use. They sometimes occur because the soil mixture was not correct. The user should not be worried because cracks can be repaired. The following are some simple techniques.

Figure A2.1 Cracks may appear on stoves after prolonged use

Wet stoves

1. Cut out the area where the crack appears with a sharp knife making a v-shape.
2. Sprinkle some water on the opening. Fill the space with mud while compacting to press out trapped air.

Figure A2.2 Cutting the cracked area with a knife

Figure A2.3 Filling in the crack with wet mud

3. Smear mud on both the inside and outside of the stove.
4. Let the prepared area dry for at least seven days before use.

Dry stove

Figure A2.4 The v-shaped cutting

Figure A2.5 Filling in the crack

1. Make a v-shaped cutting on the area where the crack is and remove all the old dry mud.

2. Wet the edges of the crack
3. Prepare wet mud and place it in the crack while compacting it hard
4. Smoothen it out evenly to make it look attractive.
5. Let the place dry fo4r at least seven days before use.

Note that if the crack is very big, you may opt to dismantle the old stove and build a new one from scratch. This in most cases is preferred to mending a big crack.

Glossary

Compacting	using force to make mud bind
Diameter	length from one side of a circle to the other passing through the centre
Dimensions	measurements
Fire chamber	space where fire burns in the stove
Flue	hot gases from the stove
Insulator	any material use to reduce loss of heat
Panga	machete
Portable	that which can be carried
Pot hole	space where the pot is placed on the stove
Reinforcement	strengthen
Stove door	opening used to feed fire wood
Sufuria	the metal cooking pot
Taper	reduce in thickness towards one end
Vent	opening or passage
Vermiculite	clay soil material with calcium found naturally
Viscous	not flowing freely

Written by Spephen Gitonga
Illustrations by Michael Alando & Elijah Njoroge

This booklet was published by IT Kenya (now Practical Action East Africa) in 1997 and originally published by Africa Church Information Service. ISBN 9966-9606-4-3

The manual was produced with the support of the Overseas Development Administration – Joint Funding Scheme (ODA-JFS) and Charity Projects of the UK.

For further information

Practical Action East Africa
P O Box 39493
Nairobi
Kenya
Tel: +254 (0)20 719313, 715293, 719413
Fax: +254 (0)20 710083
E-mail: kenya@practicalaction.or.ke