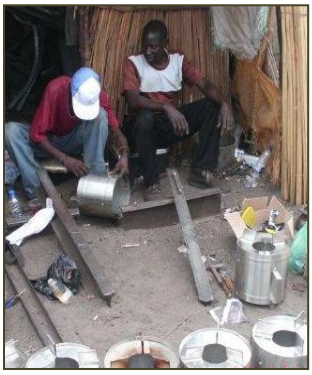
PROJECT REPORT

BIOCHAR PRODUCTION
USING
THE PEKO PE STOVE
IN
ZAMBIA 2011



Miombo Postal address: 7120 Leksvik, Norway Telephone: +47 47 75 17 40 E-mail: miombo@miombo.no Org nr: 986 434 712 NO	PROJECT TITLE Biochar production using the Peko Pe stove in Zambia CLIENT Norwegian Geotechnical Institute (NGI) DISTRIBUTION NGI, Miombo	
	AUTHORS Terje Hoel Otto Formo	DATE 9 May 2012

ABSTRACT

This report details project work during introduction of 18 stoves to farmers in Zambia, October to November 2011.

The Peko Pe stove is characterized as a pyrolytic gasifier stove, producing a smokeless flame, providing heat for household cooking. In addition the stove produces biochar for use in agriculture.

The project transferred knowledge on stove use and production of biochar through arranged stove sessions with farmers in Kaoma, Mongu and Mkushi. The stove introduction was followed up with a later visit to the same farmers, verifying use and proper biochar production.

The adoption of the Peko Pe stove is believed to benefit from the stove's biochar production capability. Indirectly this capability responds to farmers' need for a change mechanism that leads to reduced demand for fertilizer and reduced biomass consumption in household cooking.

Corncobs are a widely available waste product in rural Zambia and tests proved that the Peko Pe stove worked well with this type of fuel.

The high stove adoption rate with corn cobs as fuel, experienced during the pilot-project are encouraging and positions the Peko Pe stove for large scale implementation with farmers and for production of biochar.

Preface

Miombo is grateful to the Norwegian Geotechnical Institute for the opportunity to present the Green Solution Concept to farmers in Zambia and for having worked on the biochar project in Zambia.

An equal acknowledgment is extended to the organization Conservation Farming Unit for assistance during our work in Zambia. Special thanks go to the regional office of CFU in Mkushi for valuable input to the report.

Table of contents

Executive summary

Household energy use and biochar in developing countries have gained a tremendous interest in the past decade. Gender issues in particular, have put stoves on the agenda to policy decision makers and opened up for large scale implementation of new energy efficient stoves.

Stoves based on pyrolytic gasification technology may hold the key to alleviate several third-world defined challenges. One of them being deforestation, another is sustainable and efficient agricultural practice, a third is health related diseases occurring as a result of toxic fumes spreading in enclosed kitchen environments.

Pyrolytic gasification stoves are energy efficient units with low levels of emissions. In some cases, less than 50% fuel consumption and 90% emissions reductions have been reached, compared to existing practice. These stoves possess a great flexibility with regard to choice of biomass. Residual waste products within forestry and agriculture are often used as feedstock for these units. In addition to heat, pyrolytic gasification units turn the biomass into biochar; a product expected to be in high demand in future agricultural practice.

Norwegian Geotechnical Institute (NGI) contracted Miombo in September 2011 to execute a pilot stove project in Zambia. The pilot called for Miombo to supply and introduce 18 units of the pyrolytic gasification stove Peko Pe to farmers in Zambia during October and November 2012.

The project had two main objectives. One was to introduce farmers to the Peko Pe stove for use in household cooking. The other was to facilitate stove introduction as a biochar production unit. NGI operates a NORAD funded biochar project in Zambia, seeking a wider use of biochar in agriculture, using conservation farming techniques.

The farmers were located in two different regions of Zambia: Kaoma and Mongu in Western Province and Mkushi in Central Province of Zambia. At each location, selected farmers were individually introduced to the Green Solution Concept and stove functionality. The Green Solution Concept focuses on using biomass waste resources. As such, corn cobs were selected as fuel for cooking and biochar production.

The Green Solution Concept permits low income households, farmers and communities:

- To use solid waste biomass as fuel for cooking
- To live in a less polluted and healthier kitchen environment
- To produce biochar for use on land used by the farmer or community
- To create more jobs within the existing value chain for charcoal
- To enable reduced costs on biomass

The 18 units were transported from Norway to Zambia as carry-on air luggage. Out of these 18 stoves, 6 units were complete units, while 12 units were produced as flat-packs. An aspect of the Green Solution Concept is to involve local artisans and tinsmiths for the production of the stoves and a mechanical workshop in Lusaka and tinsmiths in Mongu were assigned stove assembly. The tinsmiths immediately accepted the stove and responded with comments on the uncomplicated assembly procedure.

The main conclusion from the field work in Zambia is that the micro-gasification Peko Pe stove was adopted and embraced by farmers and households. The different types of fuels that can be used in the stove and the fact that the stove produces biochar are value added characteristics.

The positive response from farmers and others are encouraging and motivates to a future large scale-up in Zambia.

1.0 Introduction

Norwegian Geotechnical Institute (NGI) stated an interest in July 2011 to retain the pyrolytic gasification stove Peko Pe for its current NORAD funded agricultural project in Zambia: "Biochar in conservation farming in Zambia", hereafter referred to as “NGI Biochar Project”.

The purpose of the NGI Biochar Project is to "… investigate the potential of organic waste biochar to sequester carbon and improve the quality of weathered and/or acidic Zambian soils"[1]. Early results have been very promising with reported yields on corn up to four times versus control[2]. The project is organized as a collaborative project between NGI and the Zambian farming organization Conservation Farming Unit (CFU).

NGI contracted Miombo in October 2011 to execute the pilot project in Zambia. A total of 18 Peko Pe stoves were ordered by NGI under a contract, calling for stoves to be placed with a similar number of farmers participating in the NGI biochar project. The farmers were located at Kaoma, Mongu and Mkushi in Zambia. In addition to stoves, the contract included services related to training, guidance and verification of stove usage – both in household cooking and production of biochar.

2.0 Motivation

There are four main motivators for use of pyrolytic gasification stoves in developing countries.

- Health issues related to reduced emissions
- Reduced deforestation and reduced biomass consumption
- Climate change mitigation and adaption
- Biochar production

On top of the list is the immediate effect of improved health. WHO has issued several publications[3] documenting the high third world death rates caused by pollutants from open fire and air polluting stoves. The current cooking practice is dubbed "killer in the kitchen"[4] as women and children are directly exposed to pollutants during cooking. The high death rates and disease incidents have caused much indignation and rage as industrialized countries have paid little attention to this basic third world problem. The heightened interest to reduce these problems has made possible the formation of The Global Alliance for Clean Cookstoves (GAAC)[5] and unprecedented funding levels from several countries have helped the organization move rapidly and with strength. The organization aims high and seeks introduction of new stoves with 90% reduction in air pollutants and 50% reduced biomass consumption, all compared to existing practice. Norway is a founding partner for this organization. Miombo is acknowledged as an implementing partner and is actively working within this organization as a member of the working group: "Technology and Fuel".

[1] G. Cornelissen, "Improved crop yield and storing carbon, Progress report March 2011", NGI, 2011
[2] G. Cornelissen, personal communication
[3] See e.g. "Fuel for life : household energy and health", WHO, 2006, and the UNDP-WHO joint report “The energy access situation in developing countries”, 2009.
[4] "Fuel for life : household energy and health", WHO, 2006.
[5] See cleancookstoves.org/

Climate change issues have put focus on efficient use of biomass. With little economic access to fossil fuels such LPG and kerosene, third world populations are relented to use biomass for cooking and other household energy. This practice is most often linked to deforestation and other climate change effects. New stoves have higher thermal efficiencies causing less biomass to be used for cooking.

Figure 1: Peko Pe stove user in Zambia
Photo: Miombo

The gender effect from less biomass consumption is seen as reduced time for women spent on biomass collection. New efficient stoves will indirectly effect changes in social structures and exemplifies why stove introduction need to be viewed in a value chain perspective.

Lastly the motivation for introduction of stoves with pyrolytic gasification technology is founded in the possibility to produce biochar. The Peko Pe stove is a solution provider for small scale farmers, seeking a biochar production unit for agricultural use of biochar on their own farm. The qualities of biochar are reduced fertilizer use and increased crop-yields. Both of these factors are income generators for local farmers. The society on a whole benefits from more sustainable farming practices.

3.0 Project objectives, organization

3.1 Objectives

The objectives of the pilot-project were:

1. <u>Introduction of stoves</u>
   The primary objective was to secure placement of stoves with a preselected number of farmers.
   - To introduce the Peko Pe stove to 18 rural households
   - To facilitate the introduction of the Peko Pe stove as a biochar producing unit and to produce biochar in small quantities using corn cobs as feedstock.

2. <u>Verification visit</u>
   Production of biochar was NGI's primary motive for integrating the Peko Pe unit into the existing project. The pilot project therefore aimed at:
   - Transfer of knowledge and verify proper use of stove and biochar production by end-users

3. <u>Preparatory work for a phase 2</u>
   Planning activities were considered for a phase 2 project with large scale stove implementation. An aim of the pilot-project was therefore:
   - To review and plan for a phase 2, where the Green Solution Concept could be fully implemented on a larger scale

3.2 Project Organization

Otto Formo from Miombo was assigned the task to organize the pilot-project and set-up a team to execute tasks in Norway and Zambia.

The diagram in figure 2 shows project organization. The work tasks reported on in this report relates to work tasks with Terje Hoel and Otto Formo as assigned personnel.

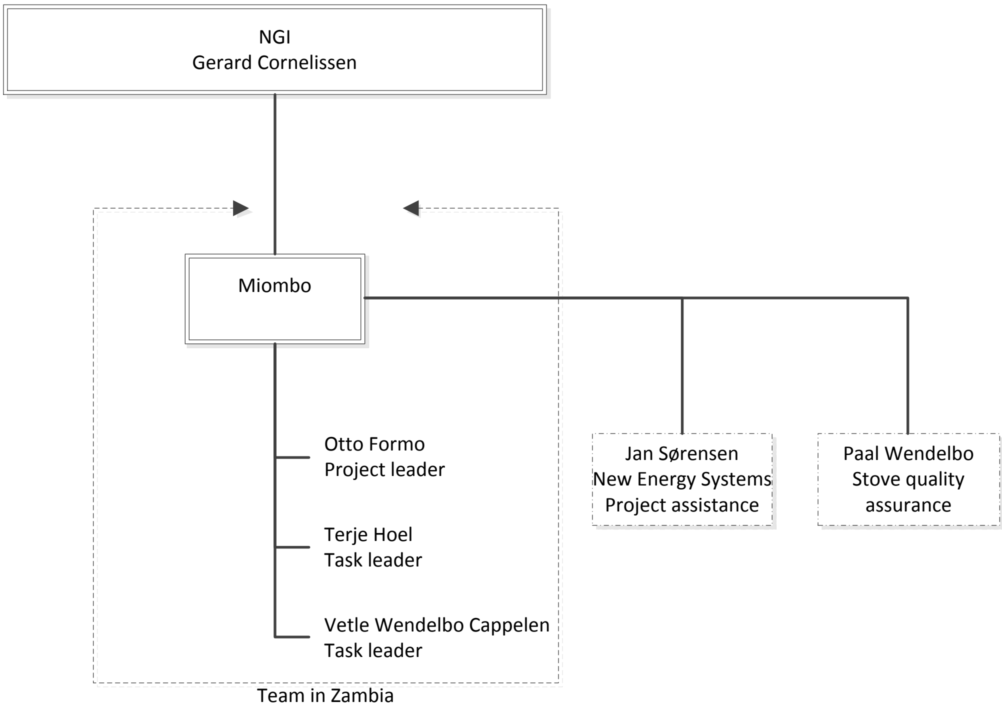


Figure 2: Project organization

3.3 Work packages

Miombo's work was separated into preparatory work in Norway and stove introduction related tasks in Zambia.

The table below shows individual work packages (WP) and assigned personnel as the work proceeded during the project. The table as such differs from the original project planning document.

WP No	WP description	Location	Result	Responsible	Personnel
1.0	Introduction of the Peko Pe stove				
1.1	Production of stoves	Norway	18 Peko Pe stoves	Vetle Wendelbo Cappelen	Otto Formo Terje Hoel Paal Wendelbo Vetle Cappelen
1.2	Introduction in stove use and production of biochar	Zambia	Transfer of knowledge on stove use, and a limited production of biochar	Otto Formo	Otto Formo Terje Hoel
1.3	Verification visit	Zambia	Transfer of knowledge, verification of stove use and production of biochar	Otto Formo	Otto Formo Terje Hoel
2.0	Preparatory work for a phase 2 project				
2.1	Preparatory work for a phase 2	Zambia	Data collection	Terje Hoel Vetle W. Cappelen	Otto Formo Terje Hoel Vetle Cappelen
3.0	Project administration				

Table 1: Project work packagesHousehold energy and biochar

3.4 The household energy sector in Zambia

In Zambia, like in many other developing countries, more than 80% of the energy demand is covered by biomass, mainly as firewood or charcoal for household cooking. Charcoal is the most common commodity, produced in rural areas and used in urban settings. It is an important business sector of the nation, estimated to involve 500 000[6] persons or roughly 3 % of the Zambian population.

Figure 3: Traditional charcoal making
Photo: Miombo

[6] Gumbo, Presentation 2011
www.ciga.unam.mx/redd/images/charcoal/presentations/8_Gumbo_Mwaanga_Zambia_Kapiri_poverty_LUC.pdf

The use of charcoal and open three stone fires is an inefficient use of energy. Producing charcoal in a traditional kiln typically causes an energy loss of more than 60%[7]. At the same time emissions from open fires contribute to climate change (methane, CO_2) and causes substantial release of toxic emissions (CO, PM).

Zambia has abundant amounts of waste biomass, both as forestry- and agricultural waste. Most of this waste does not find a use. These resources may well replace wood and charcoal as fuel. For low income households in rural areas, unprocessed fuel e.g. corn cobs, can be collected for storage, and be an inexpensive year round household fuel. An often found biomass residual product is sawdust. Sawdust finds no use and piles up at company sites. With low tech pellets machinery, adapted for developing countries, this waste product may be processed to pellets and sold in urban areas for use in the Peko Pe stove.

Figure 4: Charcoal bags ready for transportation to urban areas
Photo: Miombo

3.5 The Green Solution Concept

Miombo has for several years targeted the household energy sector in developing countries through its Green Solution Concept. The concept provides a framework for other processes using pyrolytic gasifiers such as a change mechanism.

Figure 5 shows the circular value chain of the Green Solution Concept. The Peko Pe stove is one part in a set of linked elements. Of utmost concern is the selection of suitable waste biomass, sourced in a sustainable life cycle perspective. The concept includes biochar and the possibility for increased agricultural yields and related income through carbon offsets. Agriculture and Sustainable Forest Management is a natural part of the concept. The concept addresses a cluster of other development priorities including health, gender issues and natural resources management and climate change.

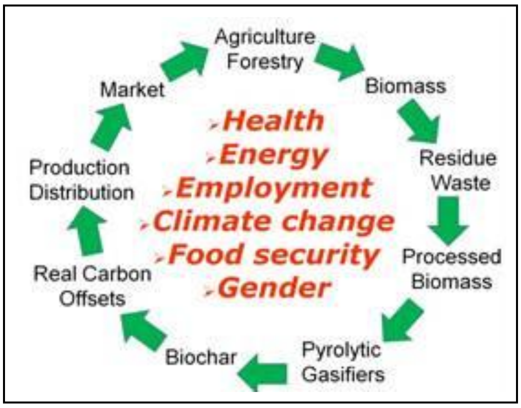


Figure 5. Schematics of the Green Solution Concept
Source: Miombo

An important prerequisite of the concept is the availability of local biomass resources suitable for use in pyrolytic gasifiers. The concept is relevant for other energy sources such as biogas, ethanol, wind and solar, either as a combination of energy units or as a modified concept to suit particular areas or needs.

[7] SINTEF, personal communication 2011

The concept is based on introduction at the community level to benefit low income households and small scale business development and job creation. This can either be linked to collection or production of fuel, or the skills of tinsmiths to produce the stove. For further references on the Green Solution Concept, see poster (Annex 3).

Definition:
The Green Solution Concept is based on the use of pyrolytic gasifiers, combined with suitable processed or unprocessed waste biomass, searching sustainable life-cycle processes. The pyrolytic gasifiers are clean burning, energy efficient, and adaptable for low income households and easy to produce or replicate locally by tinsmiths. The stoves produce biochar for use by local farmers as a soil improver and carbon sink.

3.6 The Peko Pe stove

The Peko Pe stove converts biomass to a smokeless flame for use in cooking, heating. It is a micro charcoal kiln designed for use in low income households in developing countries. Its principal feature is a smokeless flame. The stove's products are heat and biochar.

The Peko Pe is a pyrolytic gasification unit, which accepts a wide range of different types of biomass, such as corn cobs, chopped wood, a variety of nut shells, straw, etc. The stove belongs to the stove category of TLUD-ND (Top Lit Up Draft – Natural Draft).

The stove’s flexibility with regard to biomass allows end-users to choose between different sources of biomass, many of these categorized as waste products.

The simple design and construction, based on natural draft combustion principles and assembled in an uncomplicated manufacturing process, makes the stove easily accepted by local tinsmiths.

The Peko Pe combines the processes of gasification and pyrolysis. The heat used for cooking originates from the combustion of gases provided by the biomass gasification process. Before gasification, the biomass is reduced to combustible vapours in an oxygen starved atmosphere.

Figure 6: Peko Pe stove
Photo: Cacious Mubita, CFU

During gasification, the flames burn with a temperature between 550 to 750°C dependent on the conditions for combustion. In the fuel chamber, the pyrolysis process operates at a temperature of 400 to 500°C. At the end of the burn, the flame will run out and the charcoal temperature drops down to approximately 300°C. The temperature is reduced with the reduction of heat in the simmering of solid carbon. The Peko Pe stove is at the end of the burn useful for low temperature cooking such as water simmering and to keep food warm. The limited air in the fuel chamber makes the simmering of carbon long lasting.

The characteristics of pyrolytic gasifiers are that the outputs of charcoal and combustible gases are separated in time and place. This leaves an opportunity to collect the charcoal for other purposes after cooking on the combustible gases.

An alternative use of charcoal is to combine the use of the Peko Pe with a charcoal stove such as the Mbawula. Charcoal from the Peko Pe may be used for further cooking in the Mbawula with temperatures of 700-900°C.

To use the charcoal as biochar is another option. Biochar is crushed charcoal used as a soil improver. Due to pyrolysis temperatures between 400 and 500 °C, it is expected that the Peko Pe produces biochar of high quality[8]. The charcoal is emptied from the fuel chamber and sprinkled with water or sand to stop the combustion process. It is stored for later spreading on land and mixed into soil with available tools.

Figure 7: Biochar in planting basins, conservation farming
Photo: Miombo

The biochar yield in the Peko Pe is typically 25%. The carbon content in the biochar is roughly 90%.

A limited number of improved cook stoves have the capability to reduce consumption of wood by 50% and reduce emissions of toxic gasses by 90%[9]. The Peko Pe stove has not been tested with the specific intention to compare against these rigorous standards, but it is Miombo's view that the Peko will pass these standards. This is based on experience from field work and Miombo held verification tests. The stove is currently (March 2012) undergoing testing at U.S. Environmental Protection Agency (EPA) and Miombo awaits the results from these tests.

Based on prior stove testing at EPA, TLUD stoves seems to have the best potential to comply with stove air quality requirements and stove efficiency requirements. They are flexible in choice of fuel, but need dry biomass for stove processing. Some waste biomass categories need no pretreatment and can be used in the stove as-is e.g. corn cobs, forestry debris and shells from a variety of nuts.

The Peko Pe was developed over an extended period of time by the architect Paal Wendelbo. The stove was at first introduced in the East Moyo refugee camp of Ajumani in Uganda in 1995. In this camp the stove was adopted and in use by a cook for up to three times a day for one year, using Hyperhenia Rufa grass as feedstock. The women named it Peko Pe, which in the local language means “It will solve our problems”. The stove was tested at the Technical University of Copenhagen in 1996.

[8] T.J. Kinney, C.A. Masiello, B. Dugan, W.C. Hockaday, M.R. Dean, K. Zygourakis, R.T. Barnes. Hydrologic properties of biochars produced at different temperatures. Biomass and Bioenergy, 2012.
[9] "Biomass Cookstoves Technical Meeting: Summary Report", U.S. Department of Energy, 2011, page VII.

3.7 Fuel for the Peko Pe

Use of solid biomass as a fuel in the Peko Pe should adhere to the following characteristics:

- Biomass should be "dry", which means a moisture content of preferably below 10%. Any water in the fuel will have to be evaporated at the expense of heat availability for the actual cooking. High moisture content also influences stove operation as well.
- The biomass should be "energy-dense". If the fuel has low energy density, the same cooking tasks requires the burning of much higher volumes. This may result in inconveniences for the user. The user either has to accept a much larger stove (batch feed) or a very cumbersome cooking process (frequent refuelling continuous feed stove).

The mentioned Green Solution Concept emphasizes that biomass should not compete with resources allocated for food production. Examples are land, water, labour, fertiliser etc., or any higher value use, such as a building material.

Other qualifying factors are that biomass should not negatively impact biodiversity of the locality; must generate profits at relevant sublevels of the value chain; must be sustainably managed so that it truly may be identified as a renewable energy source.

Figure 8: Various sources of biomass for the Peko Pe
Photo: Miombo

The Peko Pe stove allows different types of fuel such as: corn cobs, chopped/chipped wood, branches, grass, groundnut shells, briquettes and pellets.

Table 2 is reproduced from FAO[10] and lists various wood and crop fuels. Excluded from a list of possible feedstocks are municipal refuse products. These potential feedstocks are characterized by a high variability and do most often contain toxic elements.

[10] FAO, Forestry Department, "Unified Bioenergy Terminology ", 2004
ftp://ftp.fao.org/docrep/fao/007/j4504e/j4504e00.pdf, page 9

Table 2: Classification of Biofuel sources by different characteristics

		woody biomass	herbaceous biomass	biomass from fruits and seeds	others (including mixtures)
		WOODFUELS	**AGROFUELS**		
Energy crop	direct	- energy forest trees - energy plantation trees	- energy grass - energy whole cereal crops	- energy grain	
By-products*	direct	- thinning by-products - logging by-products	crop production by-products: - straw	- stones, shells, husks	- animal by-products - horticultural by-products - landscape management by-products
	indirect	- wood processing industry by-pro-ducts - black liquor	- fibre crop processing by-products	- food processing industry by-products	- biosludge - slaughterhouse by-products
End use materials	recovered	- used wood	- used fibre products	- used products of fruits and seeds	**MUNICIPAL BY-PRODUCTS** - kitchen waste - sewage sludge

Table 2: Classification of biofuels
Source: FAO, 2004

Crop residues from agriculture are the largest source of non-timber biomass fuel. Common types are:
straw, stem, stalks, leaves, husk, shells, peels, lint, stones, pulp, stubble, etc. which come from cereals (rice, wheat, maize or corn, sorghum, barley, millet), cotton, groundnut, jute, legumes, coffee, cacao, olive, tea, fruits (banana, mango, coco, cashew) and palm oil.

Figure 9: An example of crop residuals; corn cobs used in the Peko Pe during the pilot-project
Photo: Miombo

Agricultural residues are generated in large volumes, season by season, and are often discarded as waste and not put to use. A summary of advantages and disadvantages of waste products for use in the Peko Pe is listed in table 3.

Advantages	Disadvantages
• Agricultural residues are available for free or at low cost • Application of waste products in energy devices is first-rate waste management. Huge rotting piles exhausts productive land when stored or destroy soil organisms in the fields while being burnt • Residues are often available close to the household; reducing women's time for harvesting and transport • Agricultural residues are often easier to lit than wood and charcoal • Agricultural residues substitute or complement firewood and puts less stress on timber-resources	• Agricultural residues often require appropriate stoves to burn well, e.g. gasifier stoves. • Agricultural residues are bulky and storage requires more space • Agricultural residues are often limited to seasonal availability of crops • Agricultural residues may have a shorter burn time per volume/weight of fuel. For the same cooking task, more fuel is required as compared to wood. • If agricultural residues contain large proportions of oils or proteins, the burning properties change (e.g. smoke) and need to be addressed with an appropriate stove technology

Table 3. Summary of waste product characteristics, Source: Miombo

3.8 Production of the Peko Pe stove

The stove consists of an inner combustion chamber with a bottom plate, four legs, outer cylinder, two handles, top lid and a three pot stand.

Primary air intake limits the volume of air into lower part of the stove, but sufficient to keep air flow and maintain the biomass gasification process to run continuously. A gap between the combustion chamber and the top lid secures secondary air for mixing of gases and complete combustion.

It is recommended to manufacture the Peko Pe in acid proof stainless steel to assure long life span. Other materials such as mild steel will corrode more easily. In addition, mild steel transfer heat more easily to the outer cylinder, causing mild skin irritation when touched.

The use of acid proof stainless steel is up to five times more expensive than mild steel, and market preferences will determine the choice between the two materials. The expected life span with acid proof stainless steel is expected to be 10 years making this material a first choice.

Early cost analysis shows that the stove will be manufactured at a cost of between ZKw 50.000 (US$ 10) to 300.000 (US$ 57). The material costs is expected to vary between ZKw 30.000 (US$ 6) to 200.000 (US$ 38) depending on material.

Figure 10: Tinsmith producing the Peko Pe
Photo: Miombo

Critical sections, such as primary and secondary air inlet, must be precisely assembled and attached during production. These inlets ensure optimal combustion. Quality assurance may be implemented using pre-fabricated flat-packs. Flat-packs may function as templates and will influence tinsmiths to use standardized materials and sizes.

It is anticipated that assembly lines established in larger cities and towns will have production rates of ten to twelve Peko Pe stoves per person a day.

Using flat-packs have the added advantage of easy transport to rural areas. The Peko Pe is characterized by simple design and uncomplicated assembly, matched to the skills of trained tinsmiths, a common trade in e.g. Africa.

An assembly line will have low tool requirements. Necessary tools are: simple hand tools, hammer, metal scissor, spikes, screw driver, truck springs or parts of a railway line.

3.9 Distribution of stoves and biomass fuel

Several strategies for the distribution of the Peko Pe stove could be considered. Besides introducing the stove to networks of end-users, a promotion campaign would be necessary to create a wider interest in the market. Introduction of new stoves is within the intimate sphere of family life, and attention from politicians and traditional leadership would have strong effects on legitimacy.

Training programs of local tinsmiths to manually manufacture stoves could be one strategy. The tinsmiths could use templates and local materials and assemblestoves individually.

Pelletized sawdust and wood may be distributed within the existing value chains for charcoal. The opportunity therefore exists to exploit present distribution structures and at the same time engage and support these structures through added commercial activity.

Another strategy is to establish hubs to manufacture stoves in combination with or linked to storehouses for fuel. It is believed that such a strategy would create linkages between tinsmiths, fuel producers and transporters through e.g. promotion and use of a common trademark fostering job creation and local business development.

3.10 Distribution and carbon offset programs

Carbon offset programs are a promising way of financing projects aiming at climate change mitigation. Carbon offsets represent emissions of carbon dioxide (CO_2) and may be traded as certified carbon credits on the international carbon market. The Clean Development Mechanism (CDM) under the Kyoto Protocol and Voluntary Carbon Credits under the Gold Standard, are two well known systems where stove projects may find carbon credit purchasers.

Figure 11: Transport of charcoal
Photo: Miombo

Through offering carbon credits, a stove project may obtain long term financing and operate profitable. Carbon offset programs for stoves are strongly related to the distribution of stoves and its fuel.

Fuel efficient stoves are more expensive than existing charcoal stoves. The challenge is therefore to find new business models that permit large scale distribution of new efficient stoves.

The performance characteristics of the Peko Pe stove makes it apt for inclusion in carbon offset programs. Many stoves, the Peko Pe included, are fuel efficient and reducewood consumption.. Generated stove carbon offsets are based on thermal efficiency differences compared to existing practice. The amount of avoided CO2 in tons, related to the use of a Peko Pe stove, can be measured and will qualify for carbon credits.

Recent carbon offset developments suggest to incorporate the mitigation effect of reduced emissions from CO2, particular matter (PM) and other green house gases. It is believed that the emissions of these pollutants, often described as black carbon, increases global temperatures by absorbing heat and forces ice melting. The Peko Pe stove's ability to avoid carbon emissions by 50% should be of interest to carbon credit purchasers.

The Peko Pe is furthermore producing biochar, which enables it to be used as a soil improver and to be used as a long-term storage medium for carbon. Several sources describe biochar's capacity to permanently store carbon[11]. Scientists are assured that this occurs on scale of at least several hundred years[12].

To obtain carbon credits a project would need substantial funding to produce the required documentation, as well as cover the costs of tests and validation. A system for verified stove use has to be developed and may consist of a unique serial number stamped on each stove (or flat-pack) and a related database for storage of serial number, cell-phone number, as well as name and address of the user. This information may later be used for retrieval of warranty claims and claims for carbon offset credits.

[11] See e.g. "Biochar for environmental management: science and technology", Lehman & Joseph (eds), Earthscan, 2009
[12] Ibid.

3.11 The Mbawula and the Peko Pe

There are many different types of stoves on the market in Zambia. Most often these stoves are associated with low thermal efficiencies.

New stoves are therefore introduced with the promotional pitch of having high thermal efficiencies. Their lower biomass consumption makes them act as fuel saving devices. Social structures are difficult to modify. Even though new stoves are more efficient, low income households in Zambia mostly use the traditional three stone fires or the charcoal stove, Mbawula.

The main challenge in new stove introduction is to divert focus away from stoves and on to the biomass available as fuel for the end-user. With different types of biomass as fuel, end-users can choose according to season and area.

Figure 12: Mbawula stove with simmering char from corn cobs. Photo: Miombo

The charcoal stove, Mbawula, is the most common stove in Zambia. It was introduced in the 1970's and an estimated 420 000 units[13] are in use in Lusaka, Zambia. Cecil Cook estimates that life span is at 15 months with costs ranging between K6 000 to K50 000 (USD 1 – USD 12.50) depending on size and material used. An average retail cost is put at K7500 (USD 1.75)

Miombo estimates that the Mbawula consumes 1.7 kg of charcoal per day at a common household.

3.12 Use of biochar in conservation farming

The most suitable areas in Zambia for biochar use seem to be on sandy soils with low moisture content and typically acidic soils with low capacity for farming purposes.[14]

Farmers in Zambia use industrialized fertilizer. Deliveries are sporadic and often too late for the planting season. An option to the farmer is to buy fertilizer from the private sector, but most farmers do not have the economic foundation for this choice as the fertilizer is too expensive.

Early test results show that conservation farming techniques in combination with biochar is a favourable arrangement[15]. Corn gives residual products as stalks and corn cobs. These resources are excellent fuel for the Peko Pe.

[13] Personal communication, Cecil Cook, Lusaka 2011
[14] G. Cornelissen, "Biochar in conservation farming in Zambia", NGI, 2011
[15] G. Cornelissen, "Biochar in conservation farming in Zambia", NGI, 2011

A crude calculation gives an average biomass consumption of 2.5 kg per day for household cooking. A farmer would be able to produce 230 kg of biochar annually. It is estimated that four tons of biochar is needed to give some notable influence on crop yields on 1 hectare of land. The amount of biochar needed for an average small scale farmers unit of 1 lima (0,25 hectare) will take 4 to 5 years. This is considered a long term investment, and must be distinguished from fertilizers which need to be added every year.

Figure 13: Corn cobs as biochar left and placed in the soil, using conservation farming techniques. Photo: Miombo

4.0 Project methodology

4.1 Project planning

Miombo's assignment in Zambia spanned a three week period, starting end of October 2011. Preparations in Norway included planning and stove production.

A day to day activity plan for the stay in Zambia was made prior to departure, and divided activities into four specific tasks:

- Stove production
- Stove introduction and verification visits
- Test production of biochar
- Phase 2 review

In accordance with a schedule provided by NGI, introduction of stoves was planned for two days at each location (6 farmers), with a follow up 2-4 days later. The time-gap was allocated to the study of biomass resources and identification of local decision makers and future partners in a phase 2.

The diagram below shows activity blocks of the project.

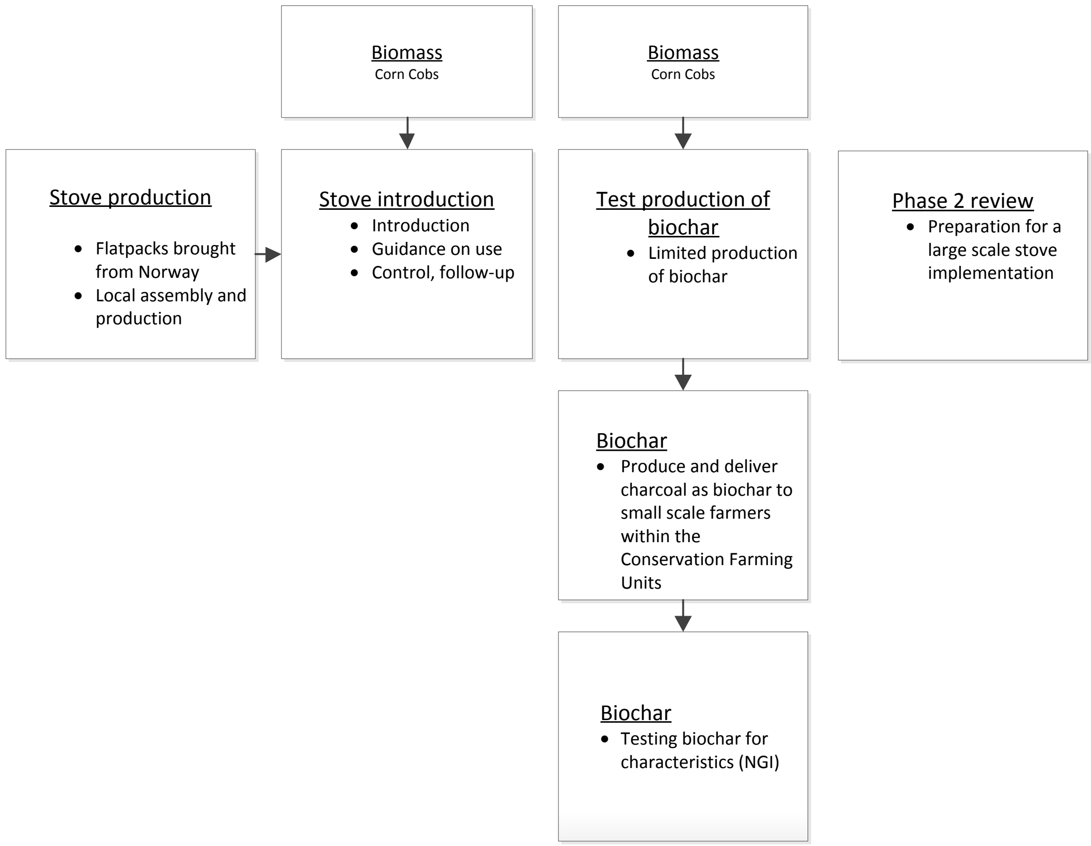


Figure 14: Project activity blocks

4.2 Stove production

A total of 18 stoves were placed with farmers in Zambia. Of the 18 stoves, 6 were produced as complete units, while 12 were prepared as flat-packs to be assembled in Zambia or to be used as templates for additional production. The assembly process of the 6 complete stoves emulated manual tinsmith techniques in Zambia. The stoves was packed and brought to Zambia as ordinary carry-on air luggage.

The stoves and flat-packs were fabricated under supervision of the inventor of the stove, Paal Wendelbo. He was also assigned stove quality assurance in the project.

The Peko Pe 6 L model was selected for production and made out of Acid Proof Stainless Steel. This metal type secures: higher fuel efficiency, longer durability, safe handling and makes the stove more attractive to end-users. A fuel chamber of 6 litres was expected to provide a sufficient volume for low density corn cobs as fuel. The stove is intentionally designed for uncomplicated assembly and local duplication.

The assembly of the twelve flat-packs was assigned to local tinsmiths. Main tasks included rolling the main cylinders and fold pieces for legs, pot stand and the handles. These parts were then put together with screws.

Figure 15: Tinsmiths in Zambia
Photo: Miombo

The 6 complete stoves were used as planned for the stove introduction and handed over to farmers at Kaoma. Stoves made from flat-packs were initially planned to be assembled by local tinsmiths in Kaoma and Mongu. The project identified a possible lack of tinsmiths in Kaoma and a decision was made to use tinsmiths in Lusaka to assemble stoves from the flat-packs.

A workshop in Lusaka was engaged and twelve stoves from flat-packs were manufactured. Unfortunately, the qualifications and the capacity of the workforce was not checked and resulted in a delay of 2-3 days and minor damages on the stoves. This incident is however not believed to reflect the general competence level of tinsmiths in Lusaka.

4.3 Stove introduction

Introduction of new stoves calls on new cooking techniques and appropriate support in stove use. Many stove projects in the past 10-20 years have failed due to factors such as: lack of local commitment, suitable fuel, inadequate handling of fuel, constraints of the stove construction and inappropriate adaption to traditional cooking methods[16]. New stove technology has in several instances failed to compete effectively with existing practices since the value added benefits have been fuzzy and unclear with no change in cooking practice taking place.

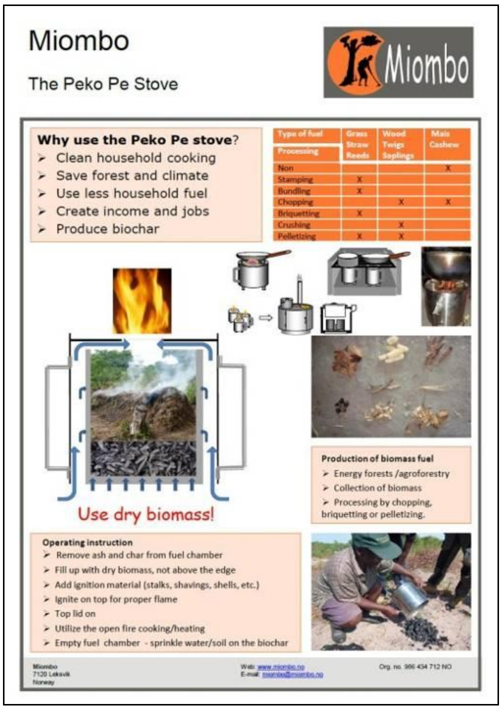


Figure 16: Peko Pe stove end-user guide
Source: Miombo

Miombo's experience is that stoves handed over to end-users for free during or after a brief demonstration rarely will find a use in household cooking.

The introduction was therefore conducted in a two- step process. First a demonstration was held with stove hand-over and then a later follow-up verifying use.

[16] Roth, C., "Micro gasification: Cooking with gas from biomass" GIZ-Hera, Germany, 1st edition, 2011.

The demonstration was held individually at each household for 1-2 hours. The demonstration included the following elements:

- A poster and an end-user's guide, see figure 16. The end-user guide was used to explain benefits and stove technology. The poster was also handed out to each household as a paper copy.
- A demonstration of stove functionality including detailed presentation of lessons learned regarding use and collection of various fuels, kindling materials, other factors that may influence stove performance such as weather (wind) conditions.
- A general discussion with the household regarding cooking habits and available fuel resources.
- Interviews and data collection

A certain amount of time during the pilot-project was allocated to ascertain the importance of proper stove introduction. The work allocated to this effort tried to find indices that could be used to benchmark stove adoption.

Each household was interviewed for data collection, including registration of certain issues such as fuel consumption. The interviews took the form of conversations, but had a base set of questions, providing structure to the interview, see annex 1. Project resources and time constraints did not allow an in-depth survey on household energy practices.

Due to project-delays at the end of the project period, the introduction of stoves to the last four farmers in Mkushi was done by members of Conservation Farming Unit (CFU). Data from these interviews were received for two households by email in January 2012.

Figure 17: Measuring daily firewood consumption in households.
Photo: Miombo

<u>Test production of biochar</u>

During the pilot-project Miombo's stove introduction was preceded one day by an NGI introduction of biochar and its use in conservation farming.

The purpose of introducing stoves and biochar in one operation aimed at creating a circular process, whereby farmers can gain a level of self-sufficiency. The Peko Pe stove produces biochar, which has the potential to cause reduced fertilizer when used in conservation farming.

As part of the demonstration of the stove and its subsequent use, each farmer had the option to produce biochar while cooking.

The farmers were during demonstrations encouraged to search for available fuel and store the more valuable biochar, rather than use it as charcoal in other stoves. The farmers were furthermore urged to store the biochar in bags for next season, to protect and enhance the value of a measurable production.

Figure 18: Biochar production in Zambia using the Peko Pe.
Photo: Miombo

4.4 Verification visit

The intention of the project was to make a follow-up to all households a few days after stove introduction. The verification visit was planned as a short visit, seeking confirmation of proper stove use and provide households with additional information.

The verification visit was also an opportunity to identify preliminary results of stove adoption on the use of stoves, including fuel handling and biochar production.

Unfortunately only seven households were provided with a verification visit because of delays outside Miombo’s control. No visits were conducted in Mongu and only three could be visited in the Mkushi area. Two of the visits in Mkushi were conducted by CFU.

Figure 19: Feedstock verification: chopped wood as fuel
Photo: Miombo

4.5 Phase 2 review

Dependent on the outcome of the NGI Biochar Project, it is the intention of both NGI and Miombo to cooperate on using the pilot project as a base for a phase 2 project.

A phase 2 project would establish a value chain for the manufacturing and distribution of a large number of stoves and establish a system of fuel production to meet the needs of all farmers practicing Conservation Farming.

An important aspect of a phase 2 project would be to make available an energy alternative matched to low income households.

Figure 20: Maize crop in Zambia. Charcoal dust on left, control in the middle and biochar on right
Photo: NGI

5.0 Results and discussion

5.1 Project work

The pilot-project in Zambia was conducted within a three week period from the 29th October to 18th November 2011. Actual project duration is estimated to 10 days or about 25 man-days. The project transferred knowledge on stove use and production of biochar to 18 preselected households in Kaoma, Mongu and Mkushi. The households were identified by NGI and its Zambian partner organization Conservation Farming Unit (CFU).

5.2 Interviews from stove introduction

In order to gain insight into stove use, stove users[17] were interviewed and presented a structured set of questions. The interviews were held with respondents in Kaoma, Mongu and Mkushi.

<u>Household income and demographics</u>
The data collected on household income and demographics did not show any major differences between the three locations. The exception being respondent in Mkushi, which have higher annual income. The majority of the households derive their income from farming. Other income is based on job availability such as bricklaying, carpentry and trading.

[17] The low number of respondents disallows statistical analysis. In some cases data analysis may offer different interpretations. A note is inserted at these instances. The results and the tables presented must only be seen in the context of an attempt to gain insight into stove use for knowledge to be further exploited in a pilot test study.

Many farmers were of age and some had income from pension. The data reveals that farmers with their sole income from farming have a higher annual income than the average 3 mill. ZKw (US$ 568). It is notable that a few households did not consider themselves to have any annual income.

Household characteristics	**Maximum**	**Minimum**	**Average**	**n**
Members of household	21	1	7	15
Children in households	12	0	4	15
Household pr. village	153	2	42	13
Household annual income (ZKw)	9 000 000	0	2 558 462	13
Household annual income (USD)			500	13
	Number	**Percent**		**n**
Income based on farming only	10	67 %		15

Table 4. Household income levels

<u>Household fuel, consumption, availability and social context</u>
The most common fuel is firewood, used for three stone open fires usually inside an "African kitchen". The fuel is collected in nearby forests on an average distance of 2 km. Many households have an Mbawula. This stove is fuelled with charcoal and used for some meals. Respondents indicated a daily consumption of firewood with average of 13 kg per day and charcoal use at about 2 kg per day (moisture content measured between 4% and 8%).

Daily consumption of fuel	**Maximum**	**Minimum**	**Average**	**n**
Firewood, kg	22	8,5	13	5
Charcoal, kg	2	2	2	1
Distance to collect fuel (km)	4	0,3	2	13
Type of fuel	**Only firewood**	**Only charcoal**	**Both**	**n**
Number of households	10	1	4	15

Table 5. Fuel consumption

Data interpretation: The table registers total fuel consumption. The figure includes fuel for cooking and fuel used for other household purposes. Fuel for cooking is therefore assumed to be lower than registered. More than half of the households (6 of 11) indicated that they extinguish the fire after cooking. Some kept the fire burning throughout the whole day, which leads to a high consumption figure.

Information on stove purchase and fuel collection indicates a high rate of responsibility sharing between household members, including the head of household and children. The stove purchase decision appears to be equally shared between men and women. The women have a slightly higher share of fuel collection. Information during interviews unveiled however that long distance collection of firewood is usually done by men.

Social context	The man	The woman	In cooperation	n
Who buy the stoves	6	6	0	12
Who collect fuel	2	5	5	12

Table 6. Decision making at home: stove purchase and fuel collection.

Cooking routines and pots

The result indicates that the respondents have 2 or 3 meals every day. Of these meals, breakfast is sporadically taken.

Number of meals per day	**Number**	**Percent**	**n**
1 meal per day	0	0 %	15
2 meals per day	7	47 %	15
3 Meals per day	8	53 %	15

Table 7. Cooking practice as per number of meals

Cooking time and relevant kitchen equipment

The duration of cooking is indicated to be from 15 minutes (breakfast) and up to 3 hours. Water consumption varies from 2,5 to 30 litres.

Duration of cooking, minutes	**Maximum**	**Minimum**	**Average**	**n**
Breakfast	90	15	32	8
Lunch	180	45	76	11
Supper	120	45	65	11
Consumption of water, liters	30	2,5	13	15
Number of pots of different sizes				
Small pots (Diameter < 15 cm)	4	1	2	14
Medium (Diameter approx. 20 cm)	3	1	2	13
Large pots (Diameter >25 cm)	2	0	1	13

Table 8. Cooking time and relevant kitchen equipment.

Data interpretation: It is believed that the respondents in several instances reported on the total time of making a meal. Included is the time of eating as well as making the dishes. The same applies to water consumption, which in some cases probably included water for bathing and garden watering. The time required to make the staple food Nshima (maiz porridge) takes a maximum of 45 minutes. It is assumed that the duration of cooking in general is about 1 to 1,5 hour. Breakfast is assumed to have a cooking time of 15 minutes to half an hour. Some replies also reflected meal types, where maximum time of cooking is associated with cooking beans or similar food which needs long boiling. This is however meals that are consumed sporadically and seasonally.

Figure 21: Peko Pe stoves at assembly
Photo: Miombo

In a stove development context it would be of interest to know the households use of pots. The result indicates the use of many small and medium size pots, equally divided. The number of pots is related to the number of people in the household. An up to 8 pots was registered in use with an average of 4,3. A small number of households use pots with a diameter wider than 25 cm.

<u>Other comments:</u>
Through spontaneous comments during introduction, 9 households indicated that the stove would not create any major change in cooking routines. The most common question from the respondents were whether charcoal could be used as fuel for the Peko Pe stove (which is neither recommended nor cost effective) and if it is manufactured.

The project faced initially a challenge of identifying suitable ignition material, but this was solved at the third introduction by using wood-shavings. Later the project also found maize husk as a good alternative.

The corn cobs in the stove of 6 liters burns about 30 minutes, and which is less than expected. This makes it necessary to refill and re-ignite the stove once for meals such as lunch and supper. A stove with a larger fuel chamber would be an advantage, and which could be combined with better stability of the stove.

The challenge of using the stove in windy conditions is a previous identified problem, which was also faced in this project. Generally, this can be solved by a wind shield or do cooking within a cooking stand or an “African kitchen”. However, modifications on the stove to better handle wind should be considered for further development of the stove.

5.3 Verification visit

A verification visit[18] was conducted at 7 households. Spontaneous comments gave indications of a high stove acceptance. More than half of the households used the Peko Pe stove at every meal and had started to prepare fuel for future use. Almost half of the households had stored biochar in bags for later use, see table 9.

One household had since the stove introduction, not used firewood at all. Lack of dry corn cobs was a challenge for 2 households, where one had prepared chopped wood as an alternative. Households stated benefits such as easy ignition, fast cooking and the ability for indoor use with low smoke production. The only negative aspect mentioned was related to stove instability when using large pots.

Stove adaption – household practice after stove introduction	Replies	n
Stove used for every meal	5	7
Biochar collected in bags	3	7
Lack of dry corn cobs	3	7
Collected fuel for storage	4	7
Stopped using firewood	1	7
Easy stove ignition	4	7
Fast cooking	3	7
Indoor use and low smoke production	4	7
Unstable stove	4	7

Table 9. Data collected during verification visits

Figure 22. Biochar produced in Kaoma while cooking.
Photo: Miombo

[18] Note: Verification visits were done at 7 households, ref. Chapter 5.4.

Report on stove use from Cacious Mubita, CFU January 2012

Referring to chapter 5.4, the majority of stove introductions and verification visits in Mkushi was conducted by the regional office of CFU. On request from Miombo, Mr. Cacious Mubita by the regional office reported the following in January 2012:

"The stoves have not been put to effective use as intended by all the benefiting farmers, the reason being that it is coming in as a new product of which farmers need to make adjustments to their usual way of cooking. Despite some farmers having large amounts of maize cobs, they failed to make full use of the stove.

Figur 22 Stove introduction and follow up with end-users is essential for stove adoption.

Note: Cathrine Chaya managed to collect about 120 kg of biochar after using the stove for about 1.5 months, and she really appreciated it in this time period.

Bottlenecks:

- The size of pots used by most of the farmers came out to be a challenge in that the stove is too small to hold the pots, hence the need for farmers to build a stand were the pot should be resting and the stove put underneath.

- the need for refilling of the stove after about 40 to 55 minutes was also seen to be a challenge for most of the food stuff cooked takes several minutes before they get ready. As a result the stove has just been seen to be ideal for warming up food instead.

- a lack of materials to be used in the stove also came out, but this can be due to the time period the stove was being introduced, for the trend with the farmers has been that they do not seem to care about the remains after shelling.

- in the villages farmers are kind like used to leaving fire for the whole day in the cooking place so that they do have to undergo the process of starting a fire at different cooking intervals."

This initial indication of less stove adoption by the farmers in Mkushi could have several reasons, but not possible to detect by this project. However, the consequences of missing verification visits should in future monitoring be seen by comparing results in Kaoma and Mongu. The extent and quality of stove introductions could also have impact on the result.

6.0 Conclusions

Peko Pe stove adoption is believed to benefit from the stove's biochar production capability. This stove feature responds to farmers' need for a change mechanism that enables reduced fertilizer use and reduced biomass consumption in household cooking.

Corn cobs are a widely available waste product in rural Zambia and tests proved that the Peko Pe stove worked well with this type of fuel. The main challenge in new stove introduction is to divert focus away from stoves and on to the biomass available as fuel for the end-user.

Verification visits indicated that the stoves placed with households are in use for daily cooking. The high stove adoption rate experienced during the pilot-project are encouraging and positions the Peko Pe stove for large scale implementation with farmers and for production of biochar.

Conclusions regarding the production of Peko Pe stoves:

- Lifespan for stainless steel Peko Pe stoves is expected to be more than 10 years.
- Initial inputs from the households indicate advantages of increasing the volume of the stove to burn longer with corn cobs. This can be combined with increasing the diameter to allow better stability for cooking with big pots.
- Modifications on the stove to better handle wind should be considered for further development of the stove.
- Brief cost analysis shows that the stove can be manufactured at a cost of between US$ 12 and 57. This might be a too high price for low income households in Zambia.
- A further review will have to include cost-benefit analysis on materials and how the stove could be part of a carbon credit financing scheme.
- The pilot-project's limited resources and its limited timeframe did not allow for detailed on site analysis of stove information campaigns, but such activity would take an essential part in a possible large scale stove implementation.

Today's concerns over man's environmental disturbances and influence on climate change are main motivators for stove implementation projects. These challenges lie outside of farmers' daily habitual work and have no bearings on farmers' willingness to adopt energy efficient stoves. New programs for stove adoption must be accompanied with strong political will and financial support.

7.0 List of annexes

1. Stove introduction interview - questionary template
2. The Peko Pe stove – introduction poster
3. The Green Solution Concept – concept poster

Annex 1: Stove introduction interview - questionary template

Questionary

Name of interviewer:.. Phone:...

General questions

Question	Reply		
Name of village			
Name of contact		Phone number:	
Household members?		No. of children?	
No. of households in the village?			
Type of income	1	2	3
Household income?	pr	pr	pr
Comments			

Cooking

Question	Reply			
Meals pr day and time	1	2	3	4
Cooking equipm. in use				
Cost/duration of stove	/	/	/	/
Duration of cooking				
Duration of fire				
Fuel, daily consume, kg				
Diameter of pots or S,M,L,XL.	1	2	3	
Liter of water/food				
Who decide to buy stove?				
Who collect fuel (firewood) or buy fuel?				
Distance to collect fuel or to buy fuel?				
Other use of fuel (firewood) than cooking?				
Comments				

Fuel for cooking

Question	Reply			
Existing fuel in area	**1**	**2**	**3**	**4**
kg and price				
Comments				

Peko Pe stove – User after demonstration

Question	Reply		
Priority benefits ?			
Priority bottlenecks ?			
Need for change of cooking habits?			
Questions from user?			
Comments			

Annex 2: The Peko Pe Stove – introduction poster

Miombo

The Peko Pe Stove

Why use the Peko Pe stove?

- Clean household cooking
- Save forest and climate
- Use less household fuel
- Create income and jobs
- Produce biochar

Type of fuel / Processing	Grass Straw Reeds	Wood Twigs Saplings	Mais Cashew
Non			X
Stamping	X		
Bundling	X		
Chopping		X	X
Briquetting	X		
Crushing		X	
Pelletizing	X	X	

Use dry biomass!

Production of biomass fuel

- Energy forests /agroforestry
- Collection of biomass
- Processing by chopping, briquetting or pelletizing.

Operating instruction

- Remove ash and char from fuel chamber
- Fill up with dry biomass, not above the edge
- Add ignition material (stalks, shavings, shells, etc.)
- Ignite on top for proper flame
- Top lid on
- Utilize the open fire cooking/heating
- Empty fuel chamber - sprinkle water/soil on the biochar

Miombo
7120 Leksvik
Norway

Web: www.miombo.no
E-mail: miombo@miombo.no

Org. no. 986 434 712 NO

Annex 3: The Green Solution Concept– introduction poster

Miombo

The Green Solution Concept

Miombo is a non-profit NGO located in Norway providing technical assistance on rural development based on the principles of economic, ecological and social sustainability. We focus on forest and water resources as the foundation for a stable climate, food production and social welfare.

Miombo has identified the improvement of **the household energy sector** as a leverage point for addressing a cluster of other development priorities including health, gender issues, natural resources management and climate change.

Miombo promote **The Green Solution Concept**, which aims to develop a sustainable system based on pyrolytic gasifier stoves combined with suitable processed biomass, being clean burning, energy efficient, adaptable for households, and easy to produce or duplicate locally by the existing stove and energy market, as well as utilizing the opportunites of biochar. The Peko Pe stove, invented by the architect Paal Wendelbo, is one of the most promising cooking stove design currently available for such a concept.

Stoves – a part of the solution

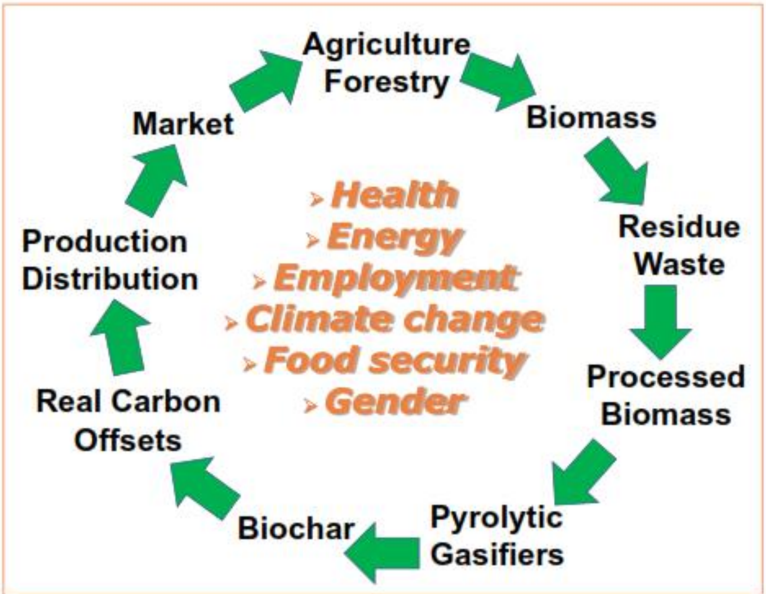
Stoves should be selected for the total benefit of being clean burning, energy efficient, suitable for local fuel, adaptable for households, and easy to produce or duplicate locally.

The Peko Pe stove

Invented by Paal Wendelbo in the early 90's. Named Peko Pe (No Problem) by women in Ajumani refugee camp, Uganda. The Peko Pe was the first to be put into practical action based on pyrolytic gasification technology.

Household Energy – local resources and appropriate technology

The developing world needs alternative sources of energy to replace charcoal and firewood. The existing energy business should be engaged with and supported in order to switch to more sustainable types of fuel.



Real Carbon ++ and soil benefits

Gasifier stoves produce a carbon rich bi-product which is known as biochar. When added to soils, it can sequester carbon for hundreds of years. The amount of carbon sequestered can be measured directly as - Real Carbon Offsets. In addition to land use emission reductions by using gasifier units, this makes the Green Solution Concept highly relevant for inclusion in carbon offset programs, as well as preventing soil degradation.

Miombo welcomes

- Scientific tests and approval of stoves
- Pilot projects on improved biomass technology and production
- Studies on the impact of the use of charcoal and wood as a source of energy
- Studies on quality and impact of bio-char from small scale household energy projects
- Development of Real Carbon Offsets programs for the low income households.

Miombo
7120 Leksvik
Norway

Web: www.miombo.no
E-mail: miombo@miombo.no

Org. no. 986 434 712 NO
Bank account: 6401 06 31015