

## **Kisangani Smith Group, Tanzania**

### **Reuben Mtitu**

#### **Blacksmiths develop wood-saving stoves**

##### **Summary**

Blacksmiths are not normally associated with environmental protection, but for the Kisangani Smith Group (KSG) it is an obvious link. KSG was set up in 1996 as a volunteer organisation with a mission to alleviate poverty, and initially focussed on passing on blacksmithing skills to unemployed disadvantaged young people, enabling them to make and sell tools.

Rural blacksmiths need charcoal to run their furnaces, and KSG realised that charcoal was a major contributor to deforestation. The group therefore started an ambitious programme of tree-planting, and has planted 100 hectares of fuel wood and restored 24 hectares of indigenous forest to date. This will eventually provide them with a sustainable supply of wood and income. In return for the use of the land, KSG is helping the local village get electricity by working alongside village members to build a hydro scheme.

Developing more efficient cooking stoves was the logical next step for people with metalworking skills who are committed to forest protection. KSG has developed two types of 'Rafiki wa mazingira' (environmentally friendly) cooking stoves, which can be made by blacksmiths using hand tools. Since 2005, over 3,500 stoves have been made and sold by KSG and its trainees.

The first is an innovative stove made by hand from sheet metal. This stove burns sawdust, which is readily available as waste from the timber and furniture industry in Njombe. Elsewhere in Tanzania it is also used with rice husks and other agricultural residues. When filled with packed sawdust, the stove can burn steadily for up to six hours. Users like the stove because it cooks quickly and cleanly, needs little attention, and above all saves money. A stove costing 35,000 TSh (£16) can save a family over 10,000 TSh (£4.50) per month from purchasing charcoal. Thus the stove pays for itself in three or four months.

The second stove is designed to burn wood more efficiently and has a sheet metal exterior, lined with clay and bricks to form the combustion chamber. Preliminary measurements suggest that this stove uses 75% less wood than an open fire, and opinions of users confirm this. For users, the main advantage of the stove is saving the time and drudgery of collecting wood, but they also find it allows quicker and cleaner cooking.

KSG members have not benefited from higher education, or extensive external support. They have simply used their practical abilities and commitment to make a difference – giving skills and income-generation potential to young people, and developing and selling effective wood-saving stoves, using designs which could be followed by any blacksmith.

## **The organisation**

The Kisangani Smith Group (KSG) was set up as a non-profit organisation in 1996 by a group of volunteer blacksmiths, led by Vincent Mtitu, the brother of the current chairman. It was named after their grandfather, Kisangani Mtitu, who had passed on his blacksmithing skills to Kisangani Smith Group (KSG). The mission of the group is to alleviate poverty through appropriate technology. The initial focus was to train local unemployed young people in metalworking skills, in order to make and sell agricultural and workshop tools. As well as training young people and manufacturing stoves, KSG members work on reforestation and forest management, and have now planted 100 hectares of fuel wood trees and restored 24 hectares of indigenous forest. KSG is also working with a village where one of their workshops is located to develop a micro-hydro scheme.

KSG is a grass-roots organisation, which relies on its volunteer members to keep its work going. Its annual turnover was approximately £30,000 during 2006. It formally registered as an NGO in 2002.

**Address:** PO Box 588  
Njombe  
Tanzania

**Telephone:** +255-754-458 126

**Email:** kisagroups@yahoo.com

**Website:** None

## **Context**

Njombe is a small but important town near the Southern Highlands of Tanzania. There is a range of employment opportunities in the town and surrounding region, including in the large tea and timber industries, also making furniture, tailoring, car repair and metal workshops. Even so young people have difficulty in finding jobs. The region has significant timber plantations and supplies timber to other parts of Tanzania as well as Kenya, so appears well-forested. However, there is growing pressure on wood resources, partly caused by the extensive use of charcoal for cooking in the towns. Wood is the main cooking fuel outside Njombe, where most people cook on traditional three-stone stoves.

The Kisangani Smith Group was initially set up to train unemployed young people in metal working skills, in order to make and sell agricultural and workshop tools. This work required charcoal to fire small furnaces, which the group realised was contributing to deforestation, so KSG started planting trees. Developing more fuel-efficient cooking stoves was a logical next step. Sawdust created by the timber and furniture work is discarded

and just left to rot, with an enormous pile in the centre of Njombe, so the first focus was a sawdust-burning stove.

<b>Statistical information - Tanzania</b>	
Population (2005)	38.5 million
Urban population	24.2%
GDP per capita US\$ (2005)	\$316
- at purchasing power parity	\$744
Population living on less than \$1 a day (2005)	57.8%
Population living on less than \$2 a day (2005)	89.9%
Population with access to grid electricity (2005)	11%
Annual electricity consumption per person (2004)	69 kWh
Annual CO <sub>2</sub> emissions per person (2004)	0.1 tonne
Population undernourished (2004)	44%
Population with access to an improved water supply (2004)	62%
Source: <i>UNDP</i>	

## **Technology and use**

KSG has developed two types of portable stove to replace traditional three-stone fires. The first stove uses sawdust as fuel, and can also be used with rice husks and other agricultural residues. The second stove is an improved wood-burning design. Both types are manufactured at the main KSG workshop in Njombe.

### **Sawdust stove**

The stove is cylindrical, about 420 mm tall and 270 mm in diameter, with feet to raise it off the ground. The lid of the stove has a heat-spreader and pot support, and at one side an entry port at the base serves as the air inlet. This inlet also allows a small amount of wood to be introduced, which is useful for getting the stove started and sometimes for controlling the burn rate as well.

The parts for the stove are cut by hand from mild steel sheet. A set of 13 templates enables the parts to be quickly cut to a standard design using hand or bench shears. Most parts are hammered into shape, using simple formers, and joints are made from folding the metal and then hammering it securely. Rivets are used to attach the handles and feet.

The heat spreader, mounted on the lid of the stove, has a complex shape to direct heat over the whole of the pot base and prevent localised heating. The lid fits tightly over the cylindrical stove body, and a serrated flange on the underside of this lid sinks into the sawdust and prevents hot gases from escaping sideways. A pole guide, used for filling the stove (see below), is welded in the centre of the cylindrical cavity.

The neatly-finished metal stove is normally painted before sale. Nearly all the manufacture is done by hand: the only electric tools used are drills and a spot welder. A complete stove can be made by one blacksmith in three to four hours, although normally

a number of blacksmiths will work on a batch of stoves, each working on one part of the process.

Prior to use, the stove is filled with sawdust. A wooden pole is located in the guide in the centre of the stove body and sawdust is poured in and pushed down by hand. It is then rammed in hard with a specially designed tool, reducing the volume by about 30%. The stove is then topped up with sawdust and compressed again until it is as full as possible. Finally, the wooden pole is carefully removed, leaving an internal 'chimney' connected to the air entry port at the base. Small pieces of wood are put in the entry port and set alight, and the fire is left for about five minutes to become established. The lid is then placed on top, so that the serrated flange is pressed firmly into the sawdust. The stove can then be left largely unattended until the sawdust has completely burned, although (depending on the type of sawdust) it may be necessary to add a small amount of wood in the entry port from time to time.

The sawdust gradually burns away at the bottom and chars at the top. Although the combustion process has not been studied in detail, it is likely that secondary air mixes with the hot gases coming through the heat spreader, and enables these gases to be burned as well, increasing the overall efficiency and reducing emissions. One load of sawdust can burn slowly for up to six hours, so that several pots of food can be cooked and water for washing heated at the end. The expected stove life is three to five years: some early prototypes have been in use for five years.

### **Wood stove**

The wood stove has a similar outside appearance to the sawdust stove, with a cylindrical body about 400 mm tall and 400 mm in diameter, with feet to raise it off the ground. Again, at one side an entry port at the base serves as the air inlet. The lid has a pot stand, but a less complex heat spreader. Stove parts are cut from sheet metal according to eight templates and then fastened by folding and riveting as for the sawdust stove.

Once the metal body and entry port have been made, the floor of the stove is covered with clay. Insulating bricks are fitted around the sides and held in with clay, making sure that the air inlet is kept free. The bricks help to form an internal chimney and direct the combustion gases towards the hole in the centre of the lid. A steel tube is used to pack the clay and smooth the top surface. The stove lid normally remains in place once it has been attached, but it can be removed for maintenance. The wood stoves are simpler to make than the sawdust stove, so trainee blacksmiths learn how to make the wood stoves first.

The stove is lit by inserting burning wood in the inlet port and setting light to it. Once the fire is established, a cooking pot is put in place. Due to the high thermal mass, this stove takes some time to heat up but once the bricks and clay are hot, they retain their heat well. Pieces of wood are continually inserted to keep the fire burning. The expected life of these stoves is three to five years.

### **How users pay**

£1 = 2200 Tanzanian Shillings (TSh) [April 2008]

The retail price of the sawdust stove is about 35,000 TSh (£16) and the wood stove 30,000 TSh (£14). These prices are rising due to the increasing price of mild steel sheet. Stoves are sold mainly through retailers, who place bulk orders with KSG at trade fairs and are given a small discount on the price. Purchasers pay for their stoves in full in cash: no credit system is offered by KSG.

### **Training, support and quality control**

New users receive an instruction leaflet explaining how to use their stove. KSG has held training sessions, but new users find them easy to use even without formal training. The heat spreader on the sawdust stove is the part that sometimes fails, prompting retailers to ask KSG for replacements. KSG supplies new parts or the materials for a local blacksmith to make them. Users are generally very impressed with their stoves.

The training provided by KSG is like an informal apprenticeship programme, with up to 12 trainees at any one time. Trainees work with more experienced smiths, initially making agricultural and workshop tools from scrap metal, and then progressing to wood stoves and sawdust stoves. Trainees do not pay KSG for their training although they have to provide their own board and lodging. After six months or more, they return to their own homes to put their skills to use, with a small set of hand tools provided by KSG. Trainees are dispersed across Tanzania, and KSG does not have the resources for formal follow-up, but keeps in informal contact with many. Some return for further training, and some are given work by KSG when large orders are placed. There are plenty of people keen to be trained.

KSG would like to register trademarks for its stoves but have so far has not been able to afford to do so. The stoves did, however, receive formal Government approval when officials of the Government of Tanzania attended the launch ceremony.

### **Benefits**

KSG and its trainees have manufactured and supplied approximately 1,400 sawdust stoves and 2,100 wood stoves since 2005, benefiting at least 17,000 people since the average household size is about five people.

#### **Direct benefits to users**

Most sawdust stoves have been purchased by householders for cooking family meals. The main motivation to buy such a stove is to save the cost of charcoal. A family cooking with charcoal typically uses about two standard 70 kg sacks per month, costing 5,000 TSh each, or 10,000 TSh (£4.50) in total, and sawdust replaces virtually all this use. The sawdust is free, so the time to repay the cost of the stove through charcoal savings is three to four months. Café owners report that they save about four to six sacks of charcoal per month (20,000 to 30,000 TSh) so for them the stove easily pays for itself within two months. One woman who talked with the visiting Ashden judge had previously paid 2,000 TSh per week for wood, so recovered the cost of the sawdust stove in about five months.

The other feature which users really appreciate is saving time, because food cooks much more quickly on a sawdust stove than on an open fire or charcoal stove. In addition, once the stove has been filled and lit, it can be safely left virtually unattended, whereas a wood stove or charcoal stove needs frequent checking and re-fuelling. The

stove will continue producing heat for six hours or more, before it needs to be refilled, and most people fill the stove only once or twice per day. Women also report less eye irritation and respiratory problems, and just like using the stove. One user told the Ashden judge "I like everything about my stove: it saves time, it saves money and it looks good".

People buy wood stoves to reduce the amount of time needed for collecting fuelwood. This is a heavy burden, and usually undertaken by women. In addition, the wood stove becomes hot more quickly than an open fire, so it becomes possible to prepare hot food and hot drinks in the morning as well as the evening. One stove user reported having headaches when she cooked on wood and charcoal, but that they stopped with the KSG improved wood stove.

KSG has not had the resources to make a full evaluation of emissions from the stoves and their health impacts. However, the feedback from users suggests significant benefits.

### **Environmental benefits**

KSG demonstrated the sawdust and wood stoves to Government officials in 2005, and measured how much wood the two stoves and an open fire used to complete the same cooking task. Based on these approximate measurements, KSG estimates fuelwood use of about 24 m<sup>3</sup>/year for an open fire, compared with 6 m<sup>3</sup>/year for the wood stove and 2 m<sup>3</sup>/year for the sawdust stove. (Wood is needed to start the sawdust stove and keep a controlled flame burning.)

From interviews with users, the amount of charcoal used by a family is about 1.7 tonnes/year. This is equivalent to over 10 tonnes/year of fresh wood, or roughly 20 m<sup>3</sup>/year. In order to make a reasonable estimate of overall wood savings, more detail would be needed on what types of cooking were replaced by each stove. However, it is clear from the measurements made that the savings can be significant.

The direct wood savings and prevention of charcoal production contribute to reducing deforestation and greenhouse gas emissions. However, the extent is difficult to quantify, because of the uncertainty in overall wood savings, and also limited information on the sustainability of supply. In some areas, such as around Njombe, there are relatively good supplies of wood, trees are being re-planted, and charcoal can still be made legally, so a significant proportion of supply is probably sustainable. Other regions, such as Dodoma, have drastic deforestation. KSG knows that the sawdust stoves are being used in Dodoma with other agricultural residues, and these probably replace highly unsustainable wood supply.

### **Economic and employment benefits**

About 120 smiths have been trained by KSG over the past ten years. Some of these now have businesses and employ other staff as well.

### **Potential for growth and replication**

The growth of KSG is currently limited by the fact that all their blacksmiths are volunteers or trainees, so their capacity is limited. Large orders have to be passed onto people who have been trained and are operating their own stove making enterprises.

Most sales come as a result of trade fairs, where retailers from Tanzania and elsewhere place bulk orders. Some sales are made locally, from the KSG workshop in Njombe where samples of all the products are on display. However, little specific marketing has been undertaken. With more guaranteed income, KSG would be able to employ some of its best trainees as full-time staff, and would then be in a position to more actively market its products as well.

However, there is significant potential for replication of the KSG sawdust stoves, and KSG is not aware of any current products that are similar. Any competent blacksmith in Tanzania or elsewhere could produce a set of templates to the KSG pattern, and start producing from these. The stove could be used anywhere that has access to a good supply of sawdust, or other agricultural residues. The wood stove is similar to other designs, but still has potential for replication given its simplicity of manufacture. There may be opportunities for improving the design through collaboration with other groups.

### **Management, finance and partnerships**

The six KSG members are all volunteers: most earn their income from farming. Very few members have been educated beyond primary level, although some are now working through secondary studies. KSG is managed by the Managing Director Reuben Mtitu, supported by a four-member board elected by the KSG members each year. Current board members are Sebastian Mbilinyi, James Malekano, Isaac Mtitu and Helena Mbilinyi. The board makes policy decisions and reports to the whole membership every three months. All members are encouraged to contribute ideas.

Most members are based at the main workshop in Njombe, but some are at the three smaller village workshops in Mkiu/Kiyombo; Mawengi and Ludewa township. These smaller workshops have furnaces for blacksmithing, and hand tools for metal working, but they do not have electricity, so they can be used for making tools but not stoves. Group members are allocated to work with the trainees in the workshops on a rota, producing whatever products they have orders for. When there are large orders for stoves, members from the village workshops come to Njombe to help with production, and some orders are passed on to former trainees.

Financial support from the Small Industries Development Association (SIDO) and the local Government has enabled KSG to participate at trade fairs. This has generated most of its orders and enabled members to make links with other organisations and obtain fresh ideas. Small grants from donor (GORTA IRELAND) have helped to build the three workshop buildings. The NGO 'Tools for Self-Reliance' provided KSG with a bench drill and other tools.

A key partnership is with the village of Mkiu/Kiyombo where one of the KSG workshops is located. The village Chairman has allowed KSG to use land in the hills around the village for tree planting, so that KSG will eventually have a sustainable source of wood and also a sustainable income from the sale of wood. In return, KSG is helping the village to build a hydro-power scheme, which will bring electricity to three villages, and the KSG village workshop. So far the access road and foundations for the hydro canal have been constructed on site, and the runner for the turbine has been fabricated in the main KSG workshop. KSG has also started a small *Jatropha* plantation in the village, and will in future investigate the use of *Jatropha* as a cooking fuel.

This report is based on information provided to the Ashden Awards judges by KSG, and findings from a visit by one of the judging team to see its work in Tanzania.

Dr Anne Wheldon, Technical Director, Ashden Awards  
Jeremy Rawlings, Technical Assistant, Ashden Awards  
May 2008

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