

Making Waste Work: A Toolkit

How to transform woody waste into fuel briquettes

A step-by-step guide



How-to guide 2

Part of
Making Waste Work: A Toolkit
for community waste
management in low and middle
income countries

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wasteaid.org.uk/toolkit





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- Partnering with local organisations to improve the health, environment and livelihoods of people without waste services.
- Building the skills of local people to deliver practical solutions to the waste management crisis in their own communities.
- Raising awareness of the benefits of proper waste management and campaigning for greater change.

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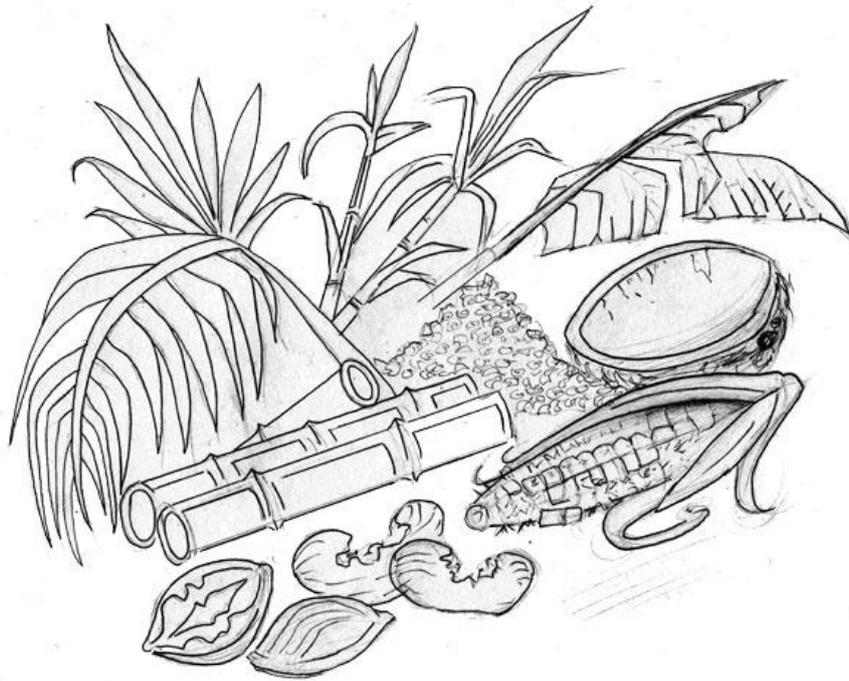
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2 How to transform woody waste to fuel briquettes

Instead of chopping down trees for firewood, you can make a fuel for cooking by using woody waste materials.

Summary: Carbonise the material in a barrel with limited air (like making charcoal), then grind it into a powder and mix with binder. Compress the mixture in a briquette mould and then dry the briquettes in the sun to make a cheap and effective alternative to wood or charcoal fuel for cooking.



Waste materials: Dried leaves, twigs, straw, coconut shells, baobab shells, maize cobs, groundnut shells and sawdust. Do not use anything that is too wet or anything other than dry leaves or woody waste (make sure there are absolutely no plastics in the waste).

Product: Charcoal briquettes.

Benefits: Briquettes are cheaper than traditional charcoal. When used as a fuel for cooking they are less smoky than wood, reducing the problem of indoor pollution. They burn hotter and for longer than traditional charcoal. They do not require the cutting of trees. The equipment is cheap and the process is easy.

Hints:

- To make charcoal briquettes you need to **carbonise** the material. This needs some air but not too much or you will make ash, not charcoal.
- Try out different mixtures of materials that you can find locally – **experiment** with what you can find easily. One example of a mixture that works is 50kg of groundnut or coconut shells plus 25kg mango leaves. You will then need 1kg cassava flour (or another similar starch) and 2 litres of water to create a binder for the briquettes. If you are using leaves, you may want

to try adding some woodier material (like coconut shells) to help bind them. It is better to have a consistent mix of materials so the briquettes burn at a steady rate.

- If you are only using sawdust you do not need to carbonise it – just mix the sawdust with the binder and compress into briquettes. The sawdust briquettes cook fast like firewood; the charcoal briquettes cook more slowly.
- 20 charcoal briquettes is enough fuel to cook a meal for 5 people on 2 pots. The briquettes can be sold for a lower price than the equivalent fuel in firewood, and they are also less smoky.



You will be working with fire and combustion, so make sure you have water nearby to put out any flames.

You will be using heat and fire. Make sure you have fireproof gloves (fabric, NOT rubber), heatproof boots (NOT rubber), and cover your arms and legs with overalls or heavy trousers.

Be aware that the process produces a lot of smoke. Never stand over the smoking barrel, and think about anyone nearby that the smoke may affect.

Stand back when opening the barrel after carbonising, as flames may leap out. Have somebody ready with water to pour on the flames and sprinkle on the material so it does not burn in the open air.

You will need:

- Overalls, gloves, masks, covered shoes or boots
- Dry woody material (it is best to try a range of different materials and combinations of materials, including twigs, leaves and shells)
- 1 metal barrel – an oil drum with several air holes in the underside, handles on two sides and a large hole in the top with a lid or chimney
- Stick or rod to turn the material
- Metal wheelbarrow or heatproof container to hold carbonised material after burning
- Water to sprinkle on the carbonised material
- Mortar and pestle or another way to crush the charcoal
- Gum or starch from cassava or similar as a binder (you can even use clay)
- Cooking stove, fuel and a container to warm and mix your binder with water
- A place to mix your material with the binder (a table or a plastic sheet on the floor)
- Briquette press (see below)
- A place to dry the briquettes – in the sun if it is dry, out of the rain if it is wet.

How to prepare the carbonising barrel

Starting with a standard oil barrel, chisel a large hole in the top (a). The hole needs to be large enough to comfortably fill the barrel with woody waste material.

Then cut some holes in the underside of the barrel, around 6cm across (b). These holes will be used to poke material through and start the fire. You will also need a stick or rod long enough to reach to the bottom of the barrel comfortably.

It is also good practice to attach some handles to the sides of the barrel, and make a chimney that fits over the top (c).

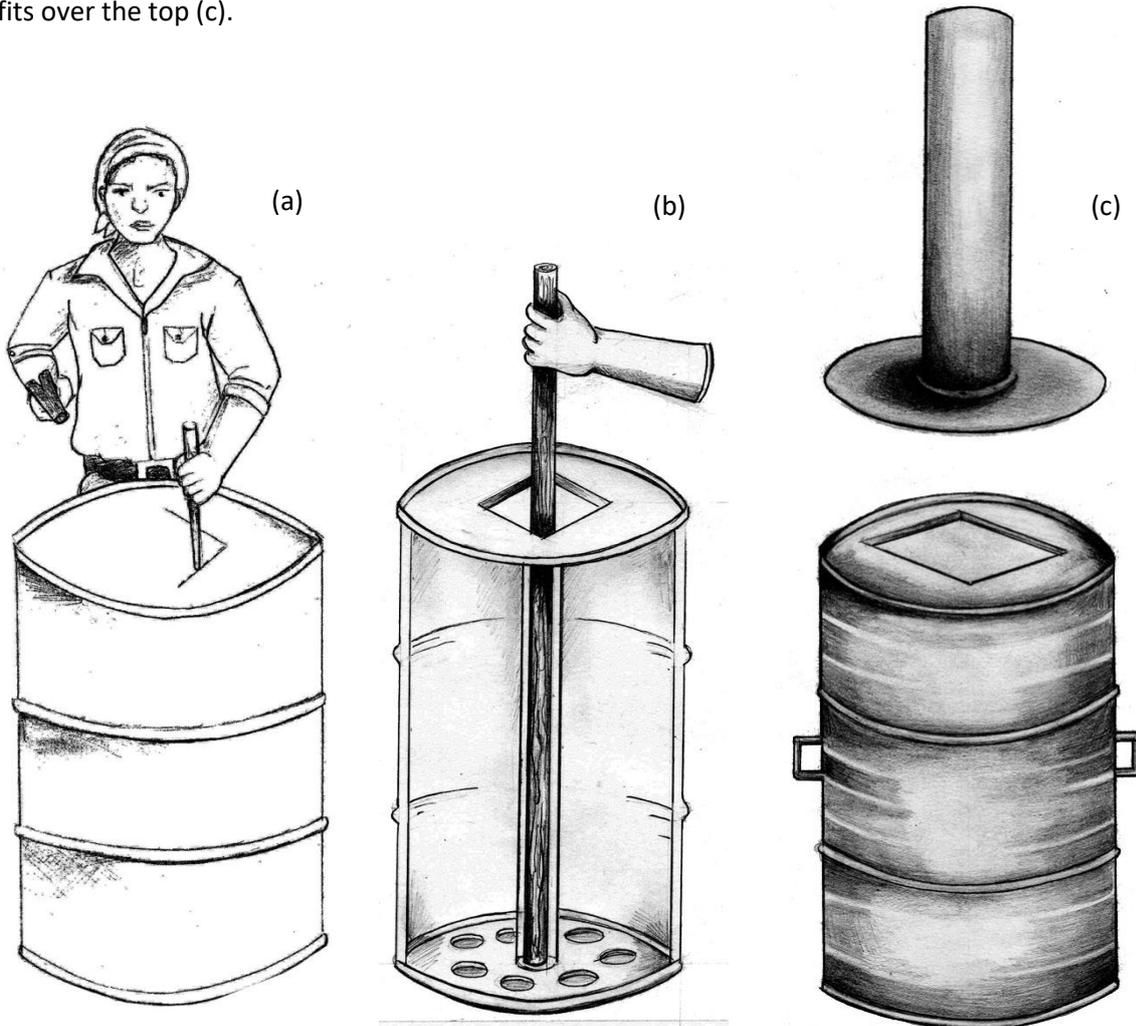


Figure 1: Prepare the barrel by cutting a large hole in the top, a series of small holes in the bottom, and adding handles and chimney. You will need a stick long enough to reach the bottom of the barrel to stir the contents.

How to make a briquette press

There are lots of ways you can make a briquette press and each will make different shape briquettes. This example produces square briquettes.

Drill a hole in the centre of the wooden block, large enough for rebar to fit in it (a).

Make the briquette mould by welding four plates together to make a square tube, and then welding two narrow plates onto an open end, with a channel down the centre wide enough for the rebar to fit through (b).

Weld one piece of rebar onto a plate to make the base (c).

Weld one piece of rebar onto a plate to make a plunger (d).

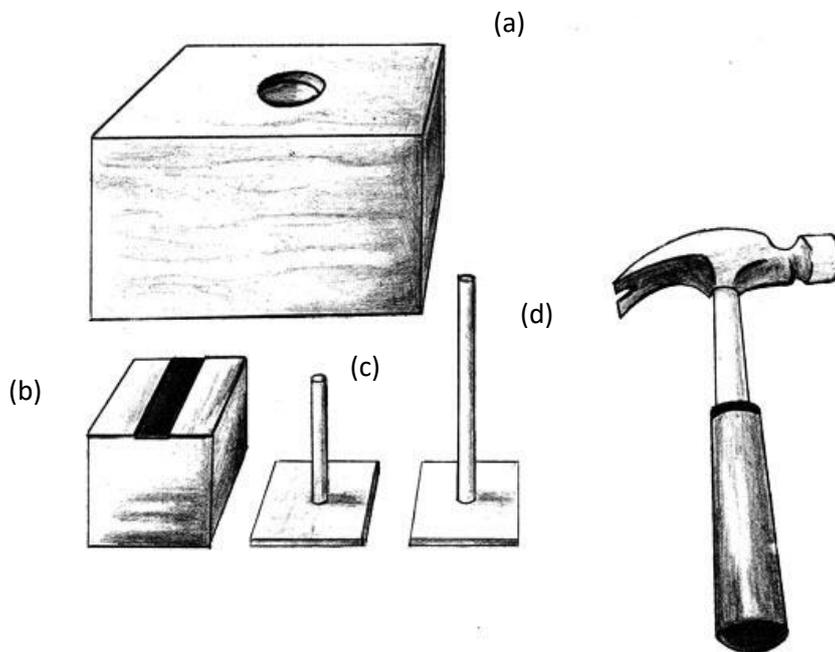


Figure 2: Components of a briquette press, *design concept by Amy Smith, MIT.*



If you don't have a briquette press and cannot make one, you can make briquettes from sawdust and binder by hand, simply squeezing them into balls and leaving them to dry in the sun.

Figure 3: Sawdust briquettes can be made by hand, *concept by Joyce Lockard.*

1. Sort

Choose material that is brown and dry – try different things that you find nearby. **Remove all materials that you do not want in your briquettes.**



Make sure there are no plastics in your mix.

Never burn plastic.



Figure 4: Collect suitable dry, woody waste materials.

2. Light

If you are using sawdust you can skip straight to Step 6: Mix.

Put the material in the barrel and poke dry leaves through the holes in the base. Sit the barrel on three stones (old block is fine). Use the stick to make sure the material is distributed evenly throughout the barrel. Light a fire underneath.

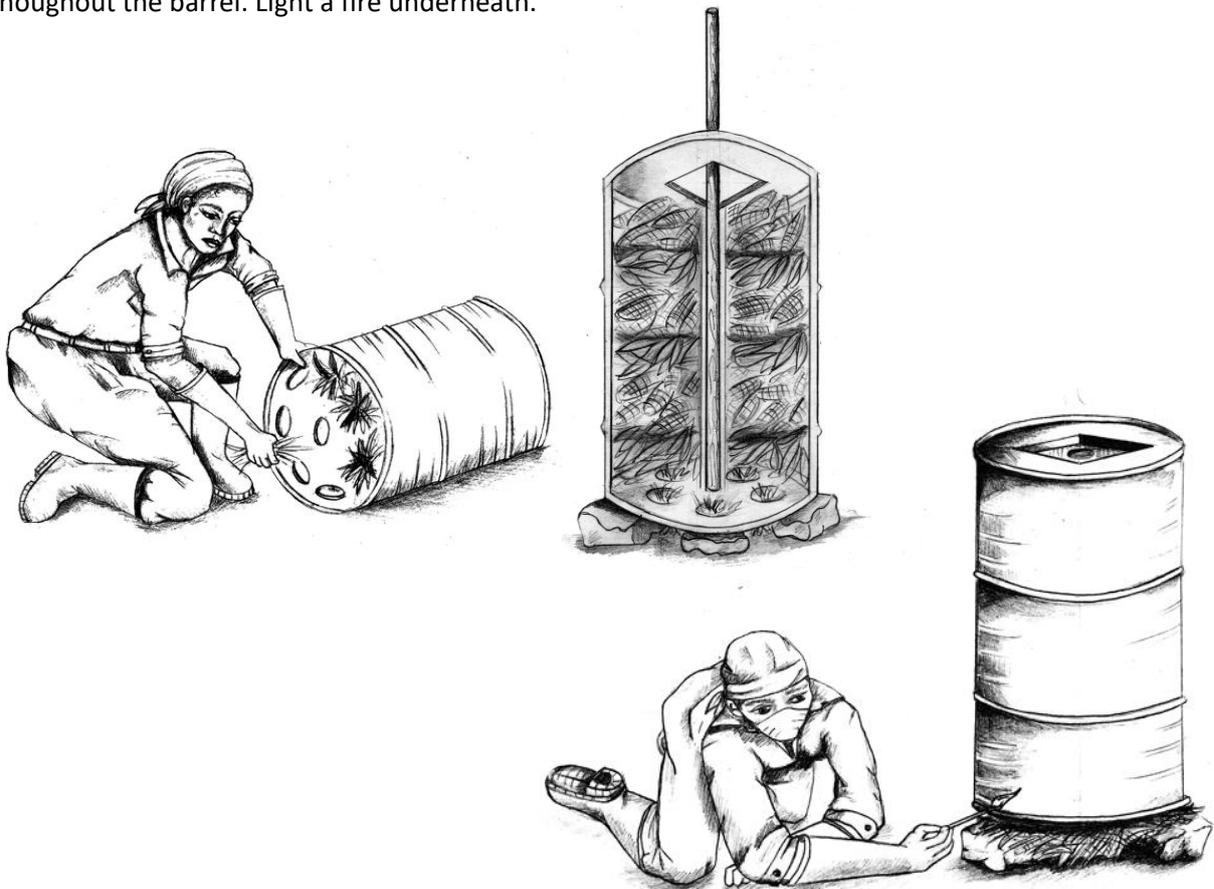


Figure 5: Fill the barrel with woody waste material, place on top of stones and light from underneath.

3. Carbonise

It will produce plenty of smoke. Using the stick, turn the material to make sure it is all carbonised. When the smoke reduces and flames come, wait a few minutes then put the lid on the barrel. Remove the stones underneath and seal any air gaps around the bottom of the drum and the lid with sand or dirt.

Leave for 5 to 10 minutes then check. The material inside should be like small pieces of charcoal (char). If it is not yet carbonised, then leave for longer. Do not leave it for too long or it will turn to ash. Different materials take different amounts of time depending on their water content. For example, coconut shells take 5 to 10 minutes to carbonise. You will need to practise a few times to get it right!

Always be careful when you open the lid. Occasionally there will be flames leaping out, so you should keep your head and arms clear.

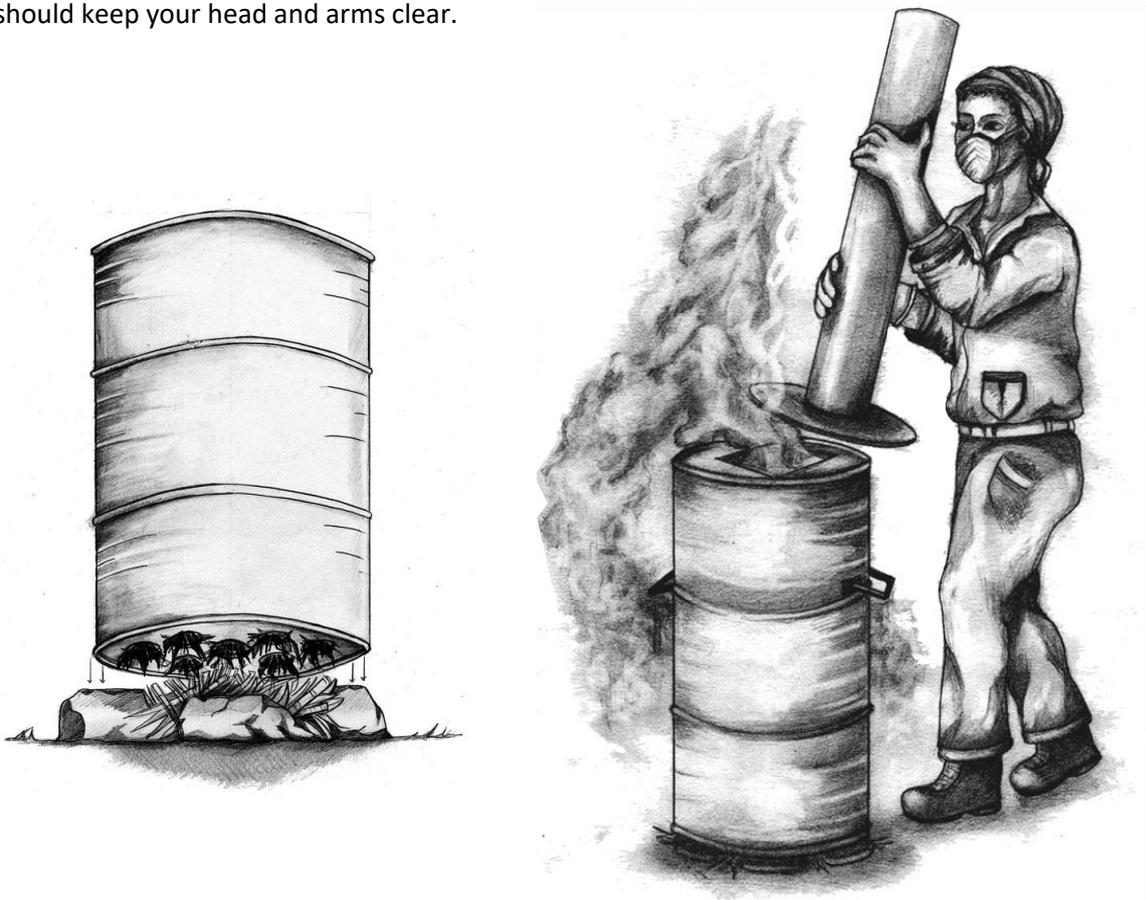


Figure 6: Allow the material to carbonise but do not let it burn completely. A chimney is useful to direct the smoke away.



Always be careful when you open the lid, even if there is no flame. When the oxygen in the air comes into contact with the hot gases it can cause a small explosion. Keep your head an arm's length away from the barrel. Always have water ready in case you need it.

4. Tip

With a person on each side, pick up the barrel and tip the charred contents into a metal wheelbarrow or heatproof container. Sprinkle it with water to stop it burning in the open air.



Figure 7: Tip the contents of the barrel into a wheelbarrow and sprinkle with water to stop it burning.

5. Cool and crush

When the carbonised material has cooled, crush it to powder. You can use a mortar and pestle, or crush it in your hands, or put inside a sack and hit with a stick.

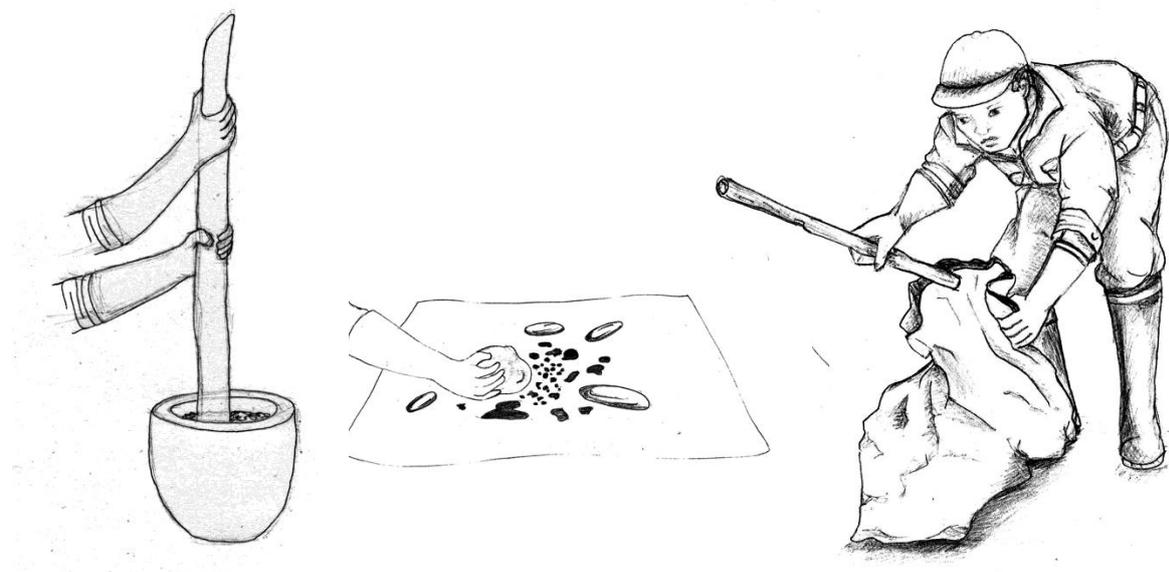


Figure 8: Crush the carbonised material into a coarse powder.

6. Making and mixing your binder

To bind the carbonised powder into a briquette, you will need to mix it with a binding agent. The best binder is starch and the approach is similar for all types of plant starch – just boil a plant or material containing starch in a small amount of water until a thick sticky paste forms, like porridge. Different types of starch include:

- Cassava starch: this is cheap and effective and can be found widely in West Africa
- Corn or maize starch or maize flour: this is more widely used in East and Southern Africa
- Wheat starch or wheat flour, potato starch or rice flour
- Other alternatives include gum Arabic or acacia gum which is harvested from acacia trees. This is very common in semi-arid areas especially in Africa Sahel and in particular Senegal, Sudan and Somalia. You can even use newspaper or mud from termite mounds mixed with water to create a binder paste.



Figure 9: Prepare your binder by mixing it with water and heating it until it turns into a sticky paste.

Use enough binder to hold the mixture together, but not too much that your briquettes fall apart.



Figure 10: Make a mound of powdered char, scoop out a hollow and mix in the binder (like making bread).

7. Mould



See “How to use a briquette press” on next page. Sit the metal base inside the mould and rest the stick of the base inside the hole in the wooden block. Push the material inside the briquette press with your fingers. Put the plunger on top with the stick pointing up and hit with a hammer 5 times, taking care of your fingers.

Twist and remove the plunger. You will be able to see the briquette material, compressed in the bottom of the mould.

Lift the mould out of the wooden block and rest on top. Push the mould down and the briquette will remain on top of the base. Twist to remove and put in a dry place, in the sun if it is not likely to rain.

Figure 11: Using a briquette press.

Depending on the climate, charcoal briquettes take 1.5 - 7 days to dry, sawdust 2-8 days. Turn them for even drying.

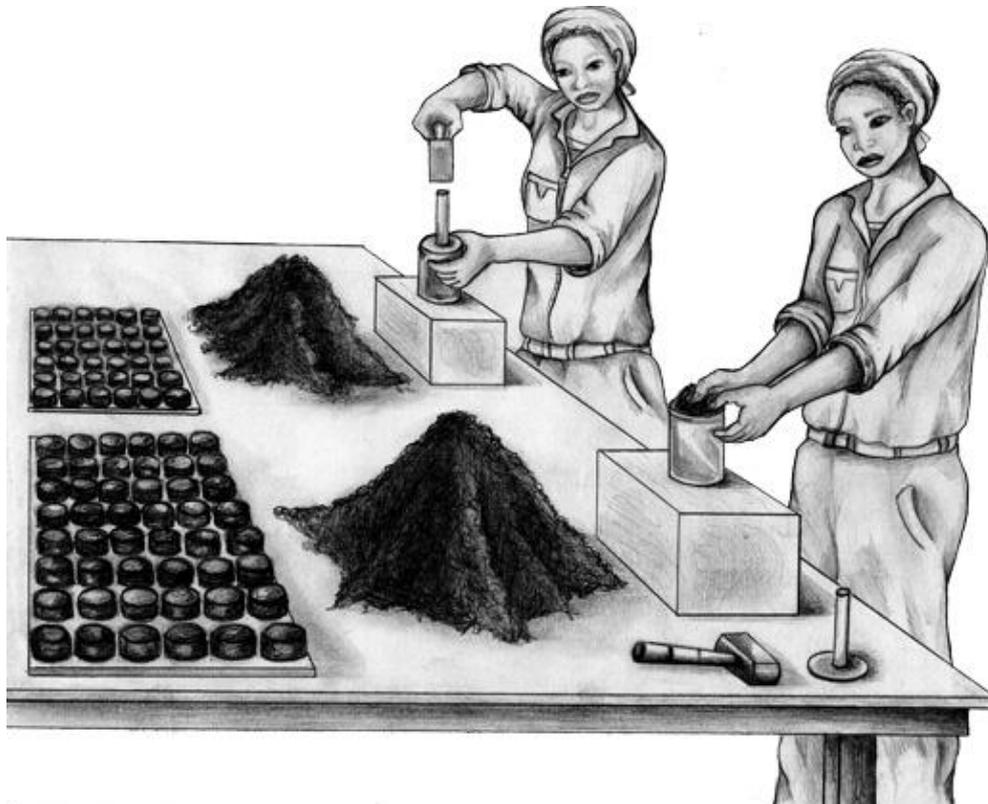
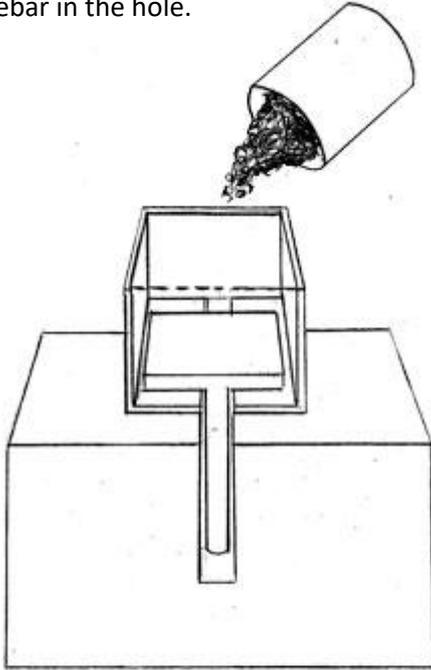


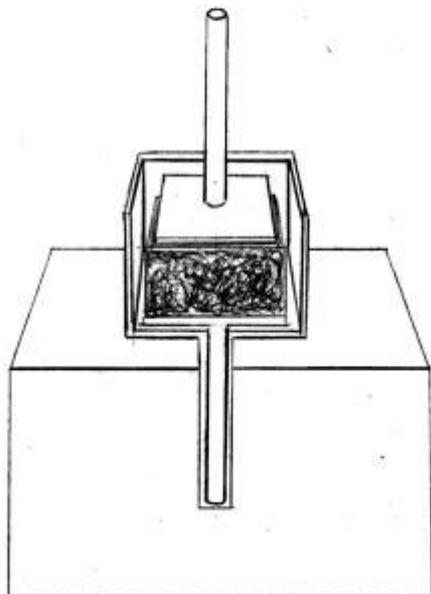
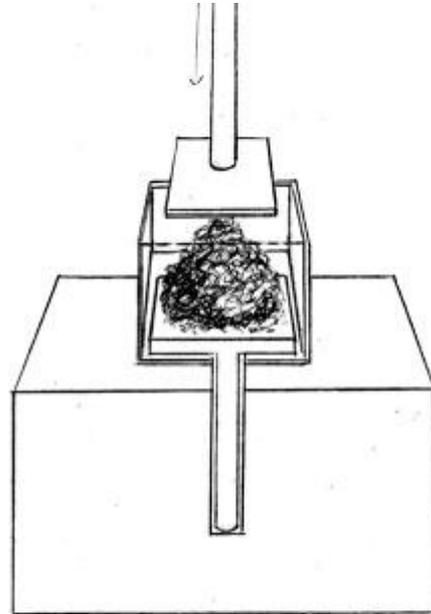
Figure 12: Working as a team, you can produce hundreds of briquettes in a day.

8. How to use a briquette press

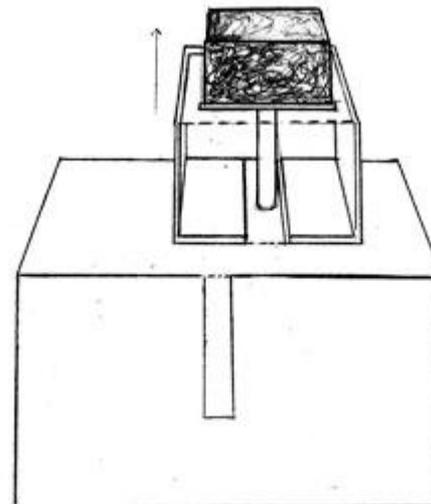
1. Put the base into the mould and sit on the wooden block with the rebar in the hole.



2. Fill the mould with the char and put the plunger over the top.



3. Hammer the top of the plunger to squeeze out the water and compress the char into a briquette shape.



4. Lift the briquette mould out and sit the rebar on the wooden block. Push the mould down and the briquette will pop out. Twist and remove.

Figure 13: How to use a briquette press.

9. Market

You can sell the charcoal briquettes in small daily portions, or in bigger sacks.

Make some and give them to people for free so they understand that they burn hotter and for longer than normal charcoal!

EXAMPLE: In The Gambia, 20 briquettes are used to cook a meal for 5 people (using 2 pots). This costs 20 dalasi (around US\$0.45) and replaces the equivalent in firewood of 35 Dalasi (US\$0.75).

Chapter 9 of *Making Waste Work: A Toolkit*, provides a detailed business case for making charcoal briquettes.

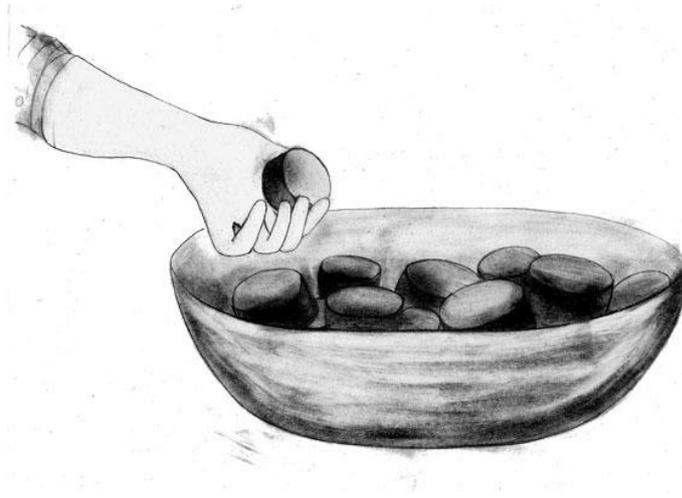


Figure 14: Explain the benefits of the charcoal briquettes to potential customers.

Hint: If you sell the briquettes in paper bags, you can tell people to use the paper to start their fire.
Never burn plastic!

Selling points of charcoal briquettes:

- Low smoke, healthier to use
- Cheaper than firewood and normal charcoal
- Do not require the cutting of trees
- Helps protect the forest
- Helps keep the community cleaner.

Acknowledgement: *Process courtesy of Women's Initiative The Gambia.*

Choosing a fuel

You can use many different materials to make charcoal briquettes. This chart shows how much energy (heat) is released by different materials, with traditional fossil fuels on the left and fuels from waste on the right.

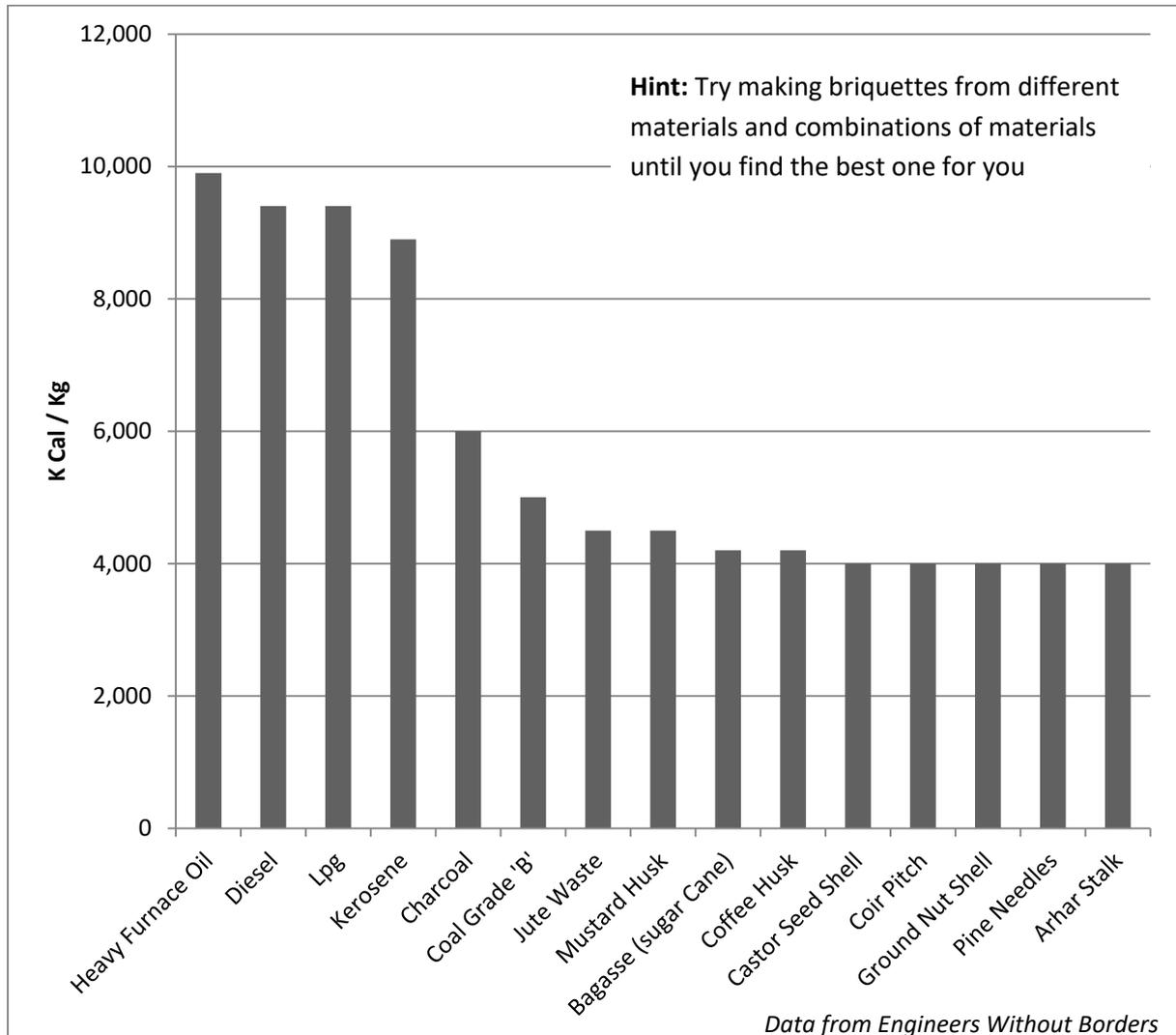


Figure 15: Different woody wastes produce different amounts of energy (heat).