



Stopping Climate Change One Tiny Farm at a Time

by Dr. D. Michael Shafer

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The Trench: Best biochar technology for the poor

We are mesmerized by the new and the high-tech – proven or not. Sure, social media took off really fast, but it is the exception. As a rule, new technologies take a long time to bring to scale. Our climate is at the tipping point; *we do not have a lot of time*. We need to change our thinking. Forget the cool. It is time to make our mantra: ***Scale up what is already working!***

And what is already working?

Biochar.

And where is there unexplored room to scale? In the poorest corners of the world where 10 gigatons of crop waste are burned annually – but could be converted into biochar.

What is the least expensive, most practical biochar making machine for the poor who live there that is especially good for charring awkward stuff like bamboo, corn stalk and rice straw?

A hole in the ground.

Really.

Let's start with the four big problems confronting would-be biochar makers at the poor, rural fringe of the developing world: ***cost, weight, lack of water*** and ***awkward feed stocks***.

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Cost: The gold standard of poor man's biochar tech is the 200-liter drum TLUD. It's ugly, but it's simple, efficient and foolproof. The TLUD, however, has limits in the lands of the truly poor. (1) 200 l. drums are prized and, where available, are costly. (2) You can make a TLUD without a power drill or cutter, but I can tell you personally that it is hard work. (You try pounding all those holes in a drum's bottom with a piece of sharpened re-bar and a big rock.) (3) Although you can smother a TLUD, it takes hours. If you can afford just one, production is limited to two burns per day. (4) Why not quench with water? Because few poor people have any in their fields or enough at home to waste.

Weight: TLUDs are a pain to carry up steep slopes, but nowhere near as hard as the next best biochar technology – the trough/Kon-Tiki/flame cap kiln. Troughs are great for charring all the stuff that won't go in a TLUD – stalks, branches, bamboo, straw. But like TLUDs, troughs have limits. (1) A trough tough enough to take into the field is made of steel. You can cut costs by scavenging recyclers' yards, but you must still pay a welder. (2) Even if farmers can manage the cost, the weight of troughs often defeats them. Dragging a trough up and down a steep mountain cornfield or even through a hillside orchard is hard work. (3) Troughs can be smothered, but it takes even more work than smothering a TLUD.

Lack of water: Much of the densely populated developing world experiences a weather cycle of three months rain, nine months dry. Crops get planted with the rains and harvested early in the dry season. If the dry season starts slowly enough, farmers may squeeze in a second crop before the ground dries hard. Most places, however, no second crop is possible. Water may run out by March or April and is at a premium. Whatever the potential benefits of biochar, quenching it with water during the dry season is out of the question.

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Awkward feedstocks: TLUDs eat corncobs and love any form of neatly chunked feedstock that does not pack densely. (Anything from pinecones to big, dry wood chips work great, but beware coffee hulls and rice husks!) Unfortunately, most char-able stuff just won't go in a TLUD without a lot of work. The poor, however, lack the time or energy to pack corn stalk into a TLUD, let alone cut dry bamboo to length. Low density feed stocks such as straw and high density, naturally long ones like bamboo and branches require an "open mouth" char technology – that isn't a costly, heavy, water-dependent trough.

What to do?

Dig a hole.

Why?

Cheap.

Weights nothing.

Requires no water.

Great for awkward feedstocks.

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Trench of millet stalk biochar open with roofing sheet at side

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Instructions for Making Char in a Trench

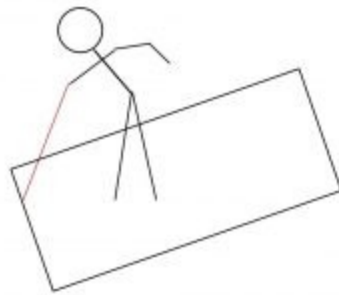
Learn how easy it is to do:

What you will need

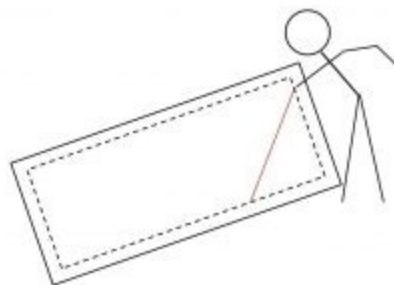
- A hoe
- A sheet of corrugated roofing metal, the longer the better. NOTE: It does not need to be new. Any old piece will work as long as it does not have holes so big that you cannot block them with dirt.
- A long stick. Two meters is great.

How to make your trench

Lay the sheet of roofing metal on flat ground where you want to make your trench.



Using a stick, outline it by drawing all around its edges.



Set the roofing sheet aside.

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Inside the rectangular outline of the roofing sheet you made in the dust, draw a second, smaller rectangle. Make the sides of the second rectangle at least a full hands' breadth inside the sides of the original outline.

With your hoe, dig out the area *inside the inner, smaller rectangle*. Dig down approximately 70 centimeters (about the length of your arm). Make the sides of the trench slope in toward the bottom. Not much, maybe 10 cm.

Scrape the dirt you dig from the trench outside of the original outline of the roofing sheet. Leave it piled around all four sides.

When you are finished digging, test your trench by laying the roofing sheet over it. You have a good fit it:

- If the trench is too wide or too long and you cannot cover it completely with the roofing sheet, ***dig a new trench***. The gaps will allow air to enter. Your biochar will burn up!
- The roofing metal should lie flat on the ground. Scrape all the loose dirt from the hole back so that the roofing sheet lies flat on the ground all the way around. No bumps!
If the roofing metal does not lie flat, scrape back any loose dirt. If that is not enough, use your hoe to level the ground around the trench.

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The roofing sheet covers the trench with no gaps around the edges.

How to use your trench

- When you are satisfied that you have a good trench, set the roofing sheet aside again. You will not need it until the end.
- Start a small fire at the bottom of the trench and feed it. When it is going well, spread the fire the length of the trench.
- When you have a good fire going along the bottom of the trench, begin to add feedstock.

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Good trench use practice

Anybody can make a fire. You are not making a fire. You are making biochar. You are making biochar (1) to stop the smoke that just burning the feedstock would produce and (2) because you want as much biochar as possible from the work you are doing. To succeed at (1) *and* (2) takes practice and know-how.

Fires smoke when they are not hot enough

- If you add feedstock too slowly and your fire begins to die down, it will smoke unless you feed it better.
- If your feedstock is wet, it will not char until the moisture has evaporated. This cools the fire and your trench will smoke. Do not use wet or green feedstock.
- If your feedstock is straw or anything else that comes in bundles, it will smoke because it partially smothers the fire. Do not throw bundles of stuff into the trench. “Sprinkle” them in.
- You want balance when using a trench and balance takes practice. You have to watch your fire and think about your two goals. You want a fire big enough not to smoke but small enough not to waste carbon.
- Really big fires do not smoke, but they burn up a lot of your biochar, too. It is very satisfying to build a bonfire in your trench. Unfortunately, bonfires burn lots of carbon leaving you with less biochar. Restrain yourself.

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- **Here are three other tips.**

- If you are using a low-density feedstock – say, millet or maize stalk, rice or wheat straw – poke the burn regularly with your long stick. The char will crumble and you will be able to make much more char per trench.
- If you are using tree branches or bamboo, always use pieces that are roughly the same diameter. If you do not, either the small stuff will be consumed by the time the big stuff is ready or the big stuff will be only half done when the small stuff is ready.
- If you have a bit of clay handy, especially nice reddish clay, sprinkling it onto your fire will improve the quality of your char. Just toss a handful or so on every few minutes.
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Finishing your burn

- You can stop adding feedstock at any time; you must stop when the trench is completely full of biochar.
- When you want to stop, simply stop adding feedstock.
- Watch the flames. For a minute or two, the surface of the char will be covered with dancing orange flames. When these die down to almost nothing, your char is ready.
- Place the roofing sheet over the trench.
- Scrap the loose dirt over the edges of the roofing metal and pack it down with your feet.

If you see any smoke escaping from gaps under the roofing sheet, put dirt over them and pack it down. Your object is to seal the trench so that no air can get in.

Now wait – a long time. Biochar is stubborn stuff. A trench can take five hours to go out.

Warning!

- When you open your trench, use your hoe or long stick to turn the biochar. Watch it carefully. If it begins to go grey – anywhere – or to smoke – even just little wisps – close the trench up again and wait some more. *If you do not, your biochar will all burn up.*

Honest.

There are great stories about guys who left their truck overnight with a load of new char in the back only to return to a gutted, melted ruin in the morning.

Wait.

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Production

The best thing about using a smothered trench is that the char is bone dry. If you are charring anything soft/flexible (not bamboo or wood), the char also does not require grinding, but will powder under foot. If you are charring wood or bamboo and need a fine, regular grain, you may need a grinder. If you do not, spread the char on hard ground and stomp on it. Kids on bikes, motorbikes and even pickups also do the job. Warning: The dry char will produce a lot of fine dust that is **very** bad to breathe. Unless you need bone dry char, consider spraying some water about. If you are in a confined space (a shed or barn), absolutely spray some water about to avoid an explosion risk.



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- How much char you get from a trench depends on your feedstock. We assume about 5 kg of dry char from a trench fed corn stalk, more for tree branches, less for rice straw.
- If you have a ready supply of feedstock (straw, stalk), it should take no more than 10-15 minutes to fill a trench.
- We, therefore, recommend that you prepare as many trenches as possible during or just after the rains when the ground is soft. If your feedstock is naturally centralized (for example, straw piles left by threshers), dig there. If your feedstock is on a steep slope (for example, mountain corn), dig a row of trenches across the bottom of the field.
- Consider your only real limit to be the number of roofing sheets you can afford. After all, if you have 30 sheets, two of you can probably do 15 trenches in the morning, 15 in the afternoon and then refill the 15 from the morning to leave to smother overnight with the 15 from early afternoon.
- We have found the easiest way to move char is to shovel it into old rice bags. A full bag of dry char should weigh no more than about 10 kg, which makes it easy to carry out of the field.
- If possible, wear an N95 rated mask. We do not recommend the basic N95 without a side vent because you will find it hard to breathe. An N95 mask with one or two side filters should do fine and will allow you to pant.



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But stop!

What if the people you are working with are too poor to be able to afford roofing sheet? (This is not a joke. Warm Heart's partner in Malawi wrote to say that the first draft of this set of instructions was very nice, but useless in Malawi – because farmers could not afford roofing sheet.)

Panic not. There is a good solution.

If you cannot afford roofing sheet, do not want to use it or simply want to make more trenches than you have sheets for, here is an elegant solution from southern Africa.

Just add dirt.

Fill your trench to the very, very top with biochar and beat the char down with your long stick. When the trench is absolutely full, push the dirt you dug out of the trench back on top of the hot char. Spread it out carefully to leave no char exposed. Look for any smoke. If you see any smoke, put dirt on it. Pack the dirt down with your feet. (Be careful!) Add more dirt. Look for smoke. If you see any.... And so on.

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Leave for at least five hours before you open the trench up.

Remember, if it turns gray or smokes, you must cover it up again or else...!

Don't worry if you get a bit of dirt mixed in with your char. It will make no difference.

Best biochar tech for the poor.

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Warm Heart Worldwide Stop the Smoke

Biochar Project

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