

Pyrolysis for Low Income Households:

How to make better fertilizers and provide household energy from dry organic wastes

A recent scientific paper has highlighted simple methods for recycling organic wastes in low-income countries¹. Nutrient poor and dry wastes can be used to provide energy by pyrolysis. Action is needed to enrich the biochar and so improve its quality as an organic fertiliser. Labour and financial costs should also be considered. If nutrient poor organic wastes are wet, they should either be dried before pyrolysis, used for anaerobic digestion instead.



Nitrogen

Organic wastes with a carbon (C) to nitrogen (N) ratio below 40 are unsuitable for pyrolysis because much of the N is lost to the atmosphere, reducing air quality. The biochar produced has a low N content. It can be enriched to make it a valuable organic fertiliser by using the biochar to capture N from elsewhere on the farm. This can be done by adding biochar to compost heaps or mixing with bioslurry from anaerobic digestion, by diverting urine from animal housing to a tank so it can be used to soak the biochar, or by spreading biochar in animal housing under any bedding. This produces an effective organic fertiliser while also reducing N pollution to the wider environment.

C:N	Description	Solutions	Effectiveness	Factors that limit use			
				Finances	Feedstock	Labour	Water
<40	Excess N. Do not use						
>40	Ideal range	Add to compost or bioslurry to capture ammonium	High			Limits use	
	Low N content	Catch urine in a tank and use soak biochar	High			Limits use	
	Enrich biochar after pyrolysis	Spread biochar under animal bedding or on floors	Medium				
		Pyrolysis > 400°C to retain more C	High			Limits use	

Water content

Biochar can only be effectively produced from dry organic wastes, with a water content lower than 20%. If the feedstock is wetter than this, it can be dried before use. However, drying the feedstock requires more labour which might limit use.

Water content	Description	Solutions	Effectiveness	Factors that limit use			
				Finances	Feedstock	Labour	Water
<20%	Ideal range						
>20%	Too wet	Sun-dry before use	High			Limits use	
		Pyrolysis < 550°C to avoid hydrophobicity	High			Limits use	

¹ Smith et al., 2026. Environ. Res. Commun. 8, 042002 <https://doi.org/10.1088/2515-7620/ae59f6>

Energy

If the household needs energy from pyrolysis, a top-lit updraft cookstove can be used to produce biochar while cooking. If the energy is not required, alternative methods can be used. In-field techniques reduce labour but generally produce lower-quality biochar than purpose-built kilns. These kilns, however, require upfront investment, which may limit adoption by some farmers.



Description	Technologies	Effectiveness	Factors that limit use			
			Finances	Feedstock	Labour	Water
Required by household	Top-lit updraft cookstove	High			Limits use	
	Mound soil over burning crops residues	Low				
Not required by household	Soil pit	Medium			Limits use	
	Metal cone or dome	Medium			Limits use	
	Brick-kiln, earth mound kiln or retort kiln	High	Limits use		Limits use	
	Top-lit updraft kiln	High	Limits use		Limits use	

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