



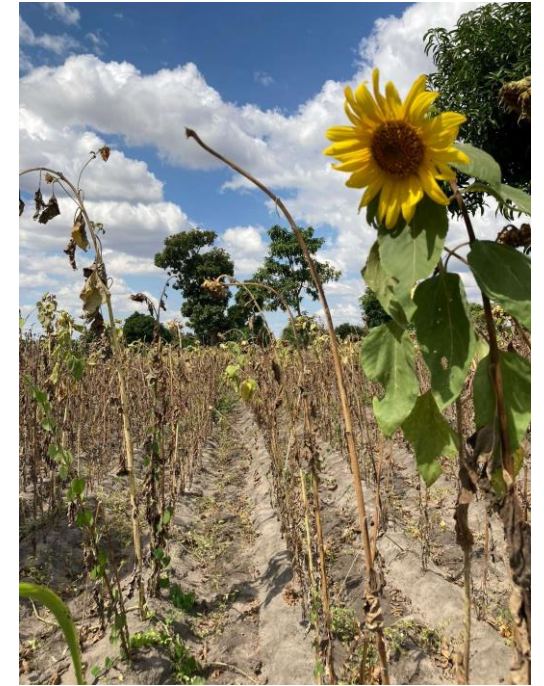
# Benefits and challenges using agricultural residues as fuel for clean cooking

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# What are Agricultural residues?

- ❖ Cooking fuel comes in the form of woody biomass collected directly from forests
- ❖ Biomass fuels beyond firewood and charcoal can be by-products of agricultural production
- ❖ Agricultural residues are generated in large volumes every season
- ❖ Residues of straw, stems, stalks, leaves, husks, shells
- ❖ Transportation costly when collected (limited energy value per volume) when not processed
- ❖ Relevant for communities that live close to where the biomass is produced
- ❖ Agricultural waste products are becoming increasingly important as fuel,
- ❖ To substitute firewood and decrease deforestation



*Groundnut shell*





# Cooking with Agricultural residues

## Benefits and challenges

- ❖ Locally available and free of charge for farmers or to a low cost in its natural state on the field.
- ❖ Waste product from food crops, more sustainable than cutting trees for firewood
- ❖ Unprocessed the biomass has lower energy density than wood which give a shorter burning time
- ❖ Contains much more ash-forming substances (3-10 %) than wood (1-2 %) which can affect the emissions during combustion and wears down the equipment faster
- ❖ The influence depends on the shape of the biomass, type of stove and material of the stove
- ❖ The ash has a value, it can be taken back to the field and used as plant nutrient



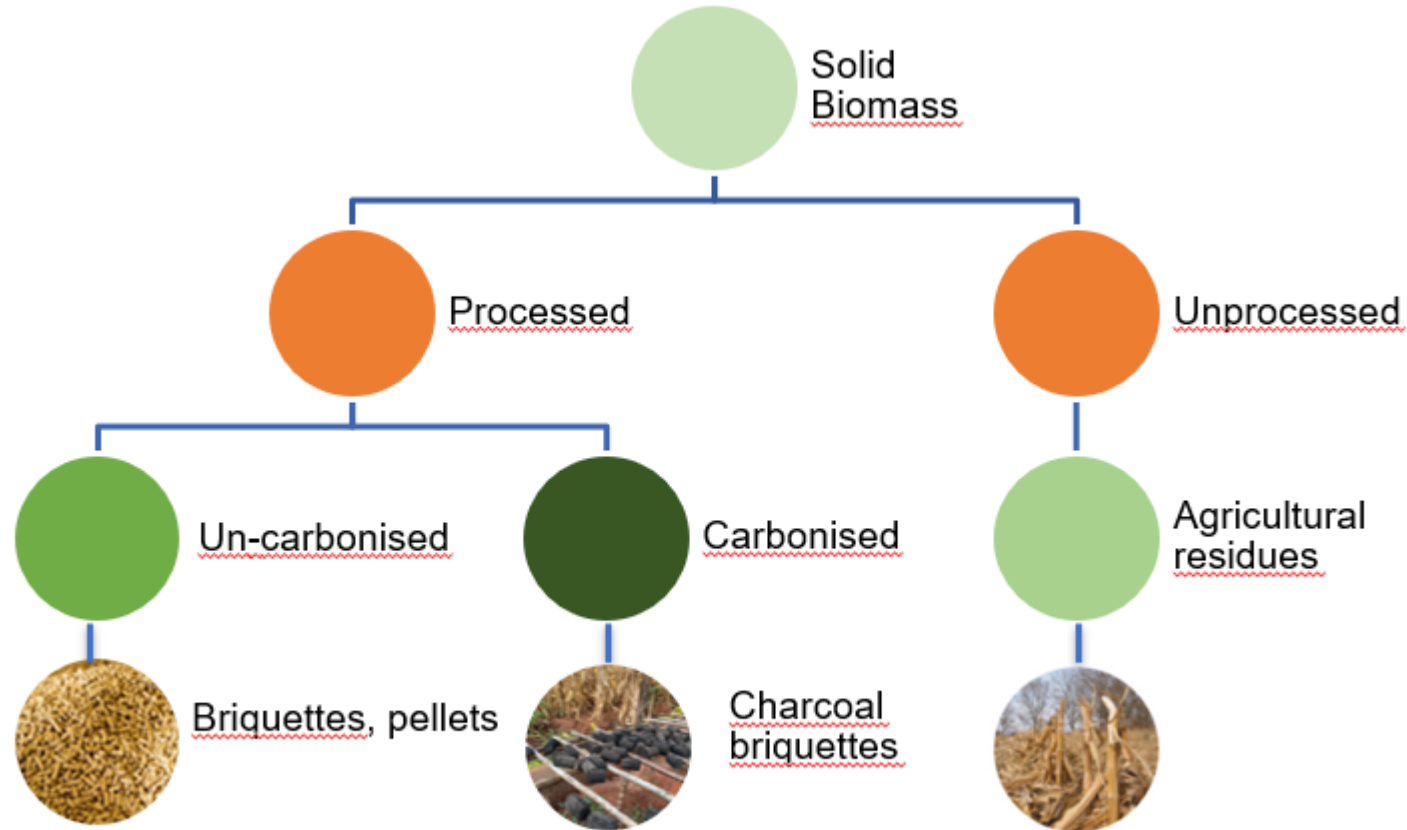
*Cooking with MIG BioCooker in Malawi*



*Sunflower stalks from the field*



# Processing of biomass to increase quality





# Right shape to right cookstove

Briquettes can be pressed to many different shapes depending on the technology



Pellets



# Different cookstoves

- ❖ Each type of the combustion cookstove has its own fuel requirements
- ❖ Some use unprocessed fuelwood and others require processed fuels in the form of pellets
- ❖ In general, an advanced technology with the demand to produce low emissions, the quality of the fuel gets more important



*Traditional three stone fire*













*Improved cooking stove Chitetezo Mbaula*



*Advanced cooking stove MIG BioCooker*



# WHO definition of clean, transitional, and polluting fuels and technologies used for cooking

Clean fuels/technologies	Transitional fuels/technologies	Polluting fuels/technologies
 Solar	 Biomass stoves classifies as tier 3 for PM <sub>2.5</sub> emissions and tier 3 or 4 for CO emissions	 Kerosene
 Electric		 Unprocessed coal
 Biogas		 Biomass stoves meeting tier 0, 1, or 2 standards for PM <sub>2.5</sub> and CO emissions
 Liquefied petroleum gas (LPG)		
 Alcohol (i.e. ethanol)		
 Biomass stoves classified as tier 4 or 5 for PM <sub>2.5</sub> emissions and tier 5 for CO emissions		





# Performance of cooking stoves and cost

- Testing standard for cooking stoves.
- The emissions (CO, PM2.5), efficiency, safety
- The test is voluntary
- Help manufacturers access new funding or new markets
- The standard is rating cookstoves on six performance indicators
- The indicators are designed to be reported separately



	STOVE TECHNOLOGY & FUEL	EFFICIENCY	VENTILATION	TIME	COST	IMPACT
<b>TIER 0-1 NO ACCESS</b>	<p>Open fire, three-stone stove or traditional stove with traditional solid fuel (e.g., firewood, charcoal, dung, agricultural residue).</p>	<p>Less than 20%</p>	<p>Poor</p>	<p>More than 7 hours per week for fuel acquisition and preparation</p>	<p>Stove cost \$0-\$5</p> <p>Fuel cost per month \$0-\$30</p> <p>Fuel is often collected for free or purchased through local market.</p>	<p>Significant negative health, climate, and gender impacts.</p>
<b>TIER 2-3 IMPROVED</b>	<p>Improved cookstove (e.g., rocket stove, natural draft gasifier with traditional solid fuel, pellets/briquettes, or kerosene).</p>	<p>20%-40%</p>	<p>Improved</p>	<p>Less than 7 hours per week</p>	<p>Stove cost \$10-\$30</p> <p>Fuel cost per month \$0-\$18</p> <p>Fuel switching is not required. Households save fuel expenditure or time required for collection due to stove efficiency improvement.</p>	<p>Good climate and gender equality improvement due to reduced fuel usage. Limited health improvement as indoor air can remain polluted.</p>
<b>TIER 4-5 MODERN</b>	<p>Modern cooking appliance with clean cooking fuel (e.g., biogas, LPG, ethanol, electricity, and natural gas or forced air gasifier with pellets).</p>	<p>Above 40%</p>	<p>Good</p>	<p>Less than 1.5 hours per week</p>	<p>Stove cost \$40-\$100</p> <p>Fuel cost per month \$10-\$30</p> <p>Downstream infrastructure cost per household \$50-\$1,000</p> <p>Household spends less than 5% of the total expenditure on fuel cost</p>	<p>Negative health, climate, and gender impacts are significantly mitigated.</p>

Source: Clean Cooking Association of Kenya





# Clean cooking and sustainable fuel

- ❖ Potential for developing sustainable fuel supply chains with agricultural residues
- ❖ Wood a limiting resource, not possible to produce wood pellets everywhere
- ❖ Clean cooking stoves are too pricey for most households
- ❖ The cheaper transitional stoves will continue to play an important role



THANK YOU!



Footer text

