RICE HUSKS TO COOKING FUEL – A GRASSROOTS EXPERIMENTER'S JOURNEY

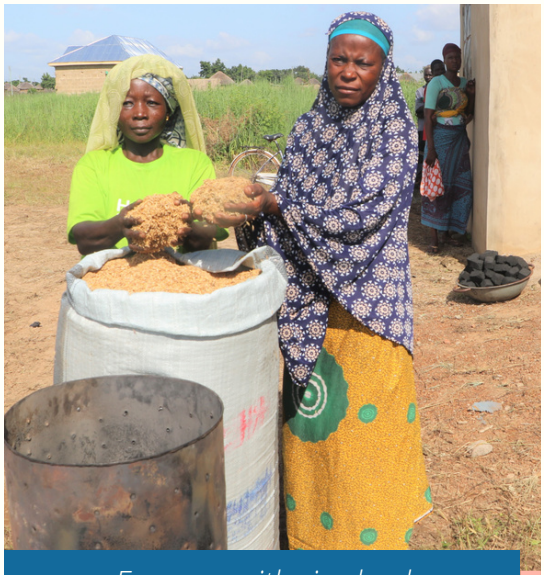
DECEMBER 2021

Women happily displaying the rice husks briquttes.

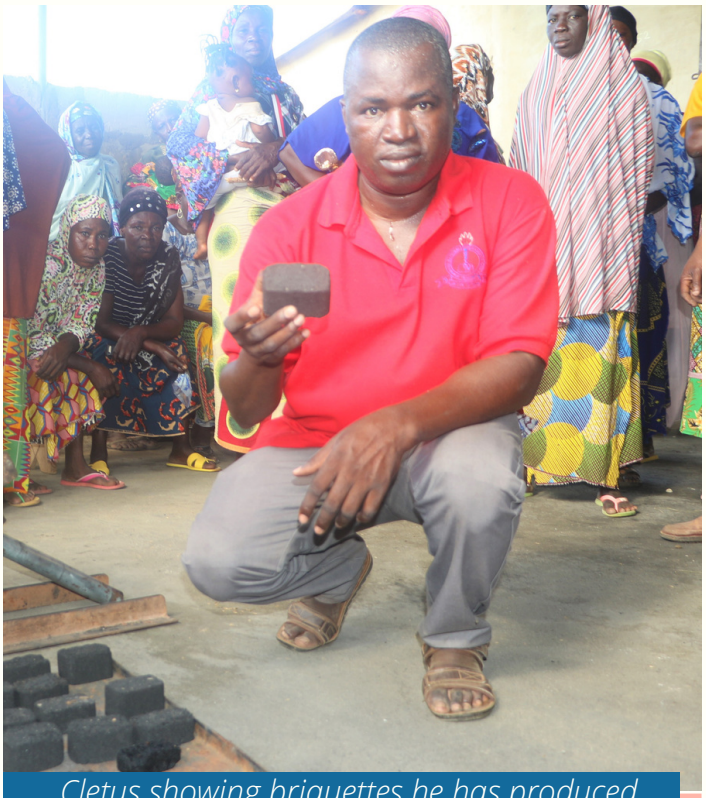
The potential of rice husks as cooking fuel

Some years ago, Cletus Baalongbuoro noticed smoke billowing from rice husks being burnt on farms not too far from his home in Tamale in Ghana's Northern Region. The thick smoke was polluting the atmosphere, making it difficult to breathe.

Ghana's annual rice production is estimated to be over 900,000 tons, equivalent to over 650,000 tons of milled rice. There is extensive cultivation in the Northern Region, which along with the Upper East and Upper West regions accounts for 50% of paddy rice production. After harvesting and milling rice, farmers often leave the husks as waste to rot.



Farmers with rice husks



Cletus showing briquettes he has produced.

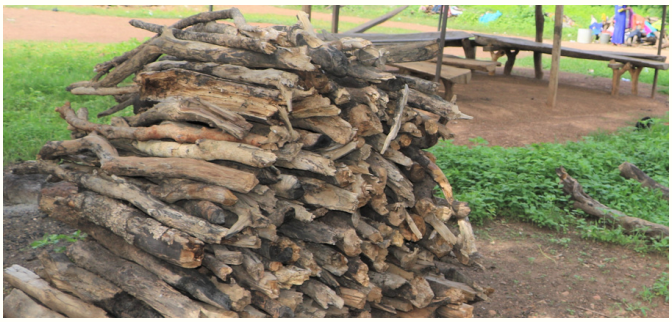
Cletus recalled his lessons from graduate school, where a lecturer had described the potential of turning biomass into briquettes. Briquettes are uniformly shaped blocks of coal and an eco-friendly alternative to wood-fuel charcoal.

Fuelwood and charcoal are the primary fuel for domestic cooking in many parts of Ghana, including the Northern region. Negative environmental impacts of producing charcoal from wood fuel, including deforestation are well documented. Ghana's deforestation rate is about 2% per annum – and disappearing forests could be valuable carbon sinks and sources of livelihood for local communities.

In line with the UNDP Accelerator Lab's goal to accelerate learning to achieve Agenda 2030, the Ghana Accelerator Lab is learning about deforestation in the Northern Region first-hand. Production of charcoal from wood fuel is an active business, with some preferring charcoal from shea trees, believing it to be cheaper and more efficient than liquefied petroleum gas (LPG). In 2021, wood fuel and charcoal have gone through periods of short supply, with prices rising to Ghc 55 to 60 (about $10) per 25kg bag of charcoal. There are unintended consequences of increased agro-processing, including large quantities of wood fuel used in processing shea butter in the Northern region, contributing to deforestation.

Wood fuel (firewood) is sold by size (small, medium, or large). The small size which sells for about Ghc1 and medium-size Ghc (1.50 – 2) are often used by households, with a bundle costing just over Ghc5. An average household could use Ghc50 worth of wood in a month, and shea and neem firewood sell at a premium.

Could greater use of briquettes reduce the harmful environmental impact and generate incomes for local farmers from biomass?



Firewood and Bags of Charcoals

The UNDP Accelerator Lab Team with Cletus on the field.

To investigate this, the UNDP Accelerator Lab in Ghana, through its COVID-19 Innovation Challenge, awarded grants to innovators including Cletus Baalongbuoro of Ponna Briquettes.

For Cletus, his grant is to help him develop his concept of moving communities from unsustainable wood charcoal production to sustainable briquette production.

Biomass

In line with previous research, the innovators tried different combinations of biomass to produce briquettes and found that corn cobs have greater potential than rice husks. Under laboratory conditions, rice husks have an estimated calorific value (energy per kg exuded during combustion) of about 15.0 MJ/kg, less than corn at about 17 MJ/kg. However, corn is a seasonal crop in Northern Ghana, while increasingly rice is being cultivated in different months of the year under irrigation. The team chose to experiment with rice briquettes.

The Process

On a busy day, Cletus and his team (5 men and 15 women trained in briquette production) visit neighbouring farms to collect rice husks. Husks are placed in a perforated metal drum with an inverted chimney, along with a charring agent. Charring maximizes calorific value. After charring, a binding agent (cassava starch) is added and combined in a mixer. Clay was tried as a binding agent, but while it burns well, it generates more smoke and carbon residue. The mixture goes into a compacting machine where briquettes are formed under high pressure. Charring, mixing, and compacting machines are made by local artisans and the Gratis Foundation. The funding through UNDP was used to buy a mechanized compacting machine.

A member of Cletus Team using the metal drum to char the rice husks.

User Experiments

Women running the experiments .

The UNDP Ghana Accelerator Lab collaborated with Ponna Briquettes to conduct group discussions and experiments to test briquettes from an end-user perspective. The rationale is that while chemical properties (e.g. calorific value) are critical, involving households in testing generates an understanding of factors that might influence real-life decisions to use briquettes and possibly lessons for scaling up the innovation.

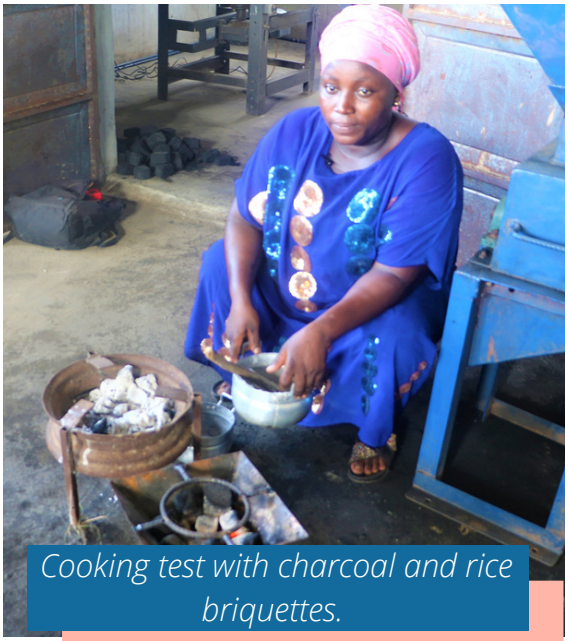
30 local women were recruited through purposive sampling and given 5kg of rice briquettes each to test and compare cooking experiences with briquettes to wood charcoal on a scale of *Much Better; Better; Same; Worse* and *Much Worse.* They fed back later in group discussions.

All rated the briquettes as being at least Better, for reasons including better heating and cooking time (reaching the desired temperature quickly and cooking thoroughly), generating less ash and longevity (could be used multiple times without replacement), leaving less dust/residue on the hands, and generating little, or no smoke. Some felt that a product of this quality would be more expensive than wood charcoal.

Further experiments then took place, with 10 local women as product testers. The testers placed equal weights of charcoal and briquettes on two local cooking stoves ("coal pots") and ignited them, to prepare equal quantities of cassava starch in similar saucepans. The charcoal generated smoke quickly (within about a minute), while briquettes were virtually smokeless. Smoke makes cooking in small or enclosed spaces, very uncomfortable.

Charcoal also took longer to reach the cooking temperature preferred by the testers. The starch reached desired consistency on the briquettes before the charcoal. By the end of the experiments, a larger proportion of the charcoal had turned to ash, while many briquettes had not. On average, the briquettes kept burning twice as long as the charcoal.

Similarly, the testers boiled equal quantities of white rice in similar saucepans on similar coal pots, to test cooking time. Most said the rice cooked quicker on the briquettes compared to charcoal, by an average of 10 minutes. In both experiments, the women noted there was less dust/residue on their hands from the briquettes.



Cooking test with charcoal and rice briquettes.

Challenges with compaction

Currently, the main challenge in producing rice briquettes is the compaction process. Compaction at high pressure is critical to avoid producing briquettes that easily shatter, and heat poorly.

The innovators have tried both manual and mechanized compaction. In manual compaction, human pressure is applied to moulds, to produce 12 briquettes at a time. Mechanized compaction creates greater pressure and produces more briquettes. During the experiments, the testers noticed differences in texture and performance between the manual and mechanized compaction briquettes and expressed a clear preference for the mechanized compaction briquettes.

While the UNDP funding has enabled the purchase of a mechanized compacting machine, this requires electricity which is often intermittent in the local area.

Estimated cost

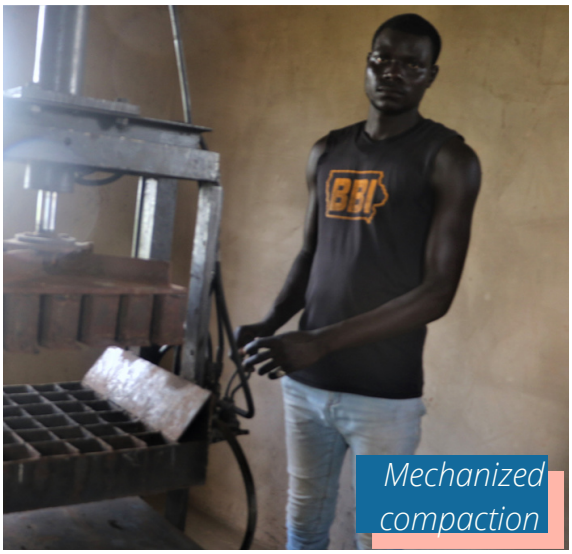
At full capacity, the briquette factory operated by Cletus can produce about 2 tonnes per day. Currently, the cost of setting up a similar factory is around $12,000, which includes the costs of premises, machinery and training of local people to produce the briquettes. Operating costs are estimated to be $1500 a month including staff costs, as well as energy and transportation.

Eco-system support

a) A more reliable energy supply is required. Power outages have severely affected production.

b) Additional support is also required, in terms of packaging the product for different market segments and linking to a reliable distribution system.

c) Support is also required to promote the product more innovatively and widely, including by developing the Ponna Briquettes website further. Through the website, enquiries have already been received from major cities in Ghana.



Mechanized compaction

Lessons

1. Involving local women as grassroots experimenters to test briquettes in real-life settings points to high levels of satisfaction among these potential consumers.
2. Given the abundance of rice husks in the Northern Region and the Government's Planting for Food and Jobs policy to encourage investment in farming, there are opportunities to develop rice briquettes as a grassroots-led energy solution. In addition to reducing deforestation, this may be a source of income for the youth and women.
3. There are opportunities to leverage the African Continental Free Trade Area agreement (AfCFTA) to position the Northern Region to export environmentally friendly briquettes.
4. Ponna Briquettes forecasts a selling price of Ghc1 per kg, compared to Ghc 1.50 per kg for charcoal. However, increased demand for rice husks could mean they are no longer free at the farm-gate. There are also costs associated with using charring, mixing, and compacting machinery at scale which must be factored in, but this must be seen in the context of potential fuel savings for consumers.
5. The experiments suggest that briquettes can last up to twice as long as charcoal i.e., for every 2kg of charcoal used, only 1kg briquette is required, reducing monthly expenditure on cooking fuel by at least 50%.

Experiment

6. The UNDP Ghana Accelerator Lab is working with Ponna Briquettes to optimize production and explore avenues for scaling up.
7. With more partnerships, rice briquettes could be adopted on large scale, as eco-friendly fuel to help save many trees from being cut for charcoal. Saving more trees means we could deliver more than 40 per cent of total emissions reductions offered globally by low-cost solutions.

Footnote

Written by: Allen Anie: Head of Experimentation, Praise Nutakor: Head of Communications & Partnerships and Gaeten Agbaam: Experimentation Associate, all of UNDP Ghana.

Photos & Design @Praise Nutakor