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Research Application Summary

Carbonized briquettes as a climate smart energy and business option for the beef value chain actors in the cattle corridor of Uganda

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Abstract

Deforestation and charcoal burning have devastated forests in Uganda with current rates estimated at 80,000ha annually. One of the options for addressing this is out-scaling the use of carbonized briquettes. This option is attractive because it utilizes agricultural waste. Women and girls spend hours gathering firewood for cooking and others use wood charcoal whose production is depleting forests. Beef production is one of those enterprises that generate large quantities of cow dung that can be used in combination with other organic waste materials in the production of briquettes. The briquettes provide a climate-smart option for cooking energy and an income source for women and youths. Briquette business is also a potential source of income for beef-producing households during periods when there are no cattle sales. Women and youths in three cattle corridor districts; Masindi, Mbarara and Isingiro, were trained in the production of carbonized briquettes which were tested to assess the time they took to ignite and the time they took to burn to ashes. These parameters were compared to those of wood charcoal. The carbonized briquettes had a shorter ignition time than the wood charcoal by 35% ($p<0.05$) and burnt 6 times longer ($p<0,05$) than the wood charcoal before turning to ash. As such, replacement of wood charcoal with carbonized briquettes provides potential for reduction of greenhouse gasses from animal waste and depletion of forest cover with net positive environmental effects on the rangeland ecosystem and beef production. Production of briquettes should therefore be mainstreamed in future interventions.

Keywords: Carbonized briquettes, cooking energy, Uganda, wood charcoal

Résumé

La déforestation et la combustion de charbon de bois ont dévasté les forêts en Ouganda avec des taux actuels estimés à 80 000 ha par an. L'une des options pour résoudre ce problème consiste à généraliser l'utilisation de briquettes carbonisées. Cette option est intéressante car elle utilise des déchets agricoles. Les femmes et les filles passent des heures à ramasser du bois pour cuisiner et d'autres utilisent du charbon de bois dont la production appauvrit les forêts. La production de

viande bovine est l'une de ces entreprises qui génèrent de grandes quantités de bouses de vache qui peuvent être utilisées en combinaison avec d'autres déchets organiques dans la production de briquettes. Les briquettes offrent une option intelligente face au climat pour l'énergie de cuisson et une source de revenus pour les femmes et les jeunes. L'activité de briquettes est également une source potentielle de revenus pour les ménages producteurs de viande bovine pendant les périodes où il n'y a pas de vente de bétail. Femmes et jeunes dans trois districts du corridor de bétail ; Masindi, Mbarara et Isingiro ont été formés à la production de briquettes carbonisées qui ont été testées pour évaluer le temps qu'elles mettaient à s'enflammer et le temps qu'elles mettaient à se réduire en cendres. Ces paramètres ont été comparés à ceux du charbon de bois. Les briquettes carbonisées avaient un temps d'allumage plus court que le charbon de bois de 35% ($p<0,05$) et brûlaient 6 fois plus longtemps ($p<0,05$) que le charbon de bois avant de se transformer en cendres. En tant que tel, le remplacement du charbon de bois par des briquettes carbonisées offre un potentiel de réduction des gaz à effet de serre provenant des déchets animaux et de l'épuisement du couvert forestier avec des effets environnementaux positifs nets sur l'écosystème des parcours et la production de viande bovine. La production de briquettes devrait donc être intégrée dans les interventions futures.

Mots-clés : Briquettes carbonisées, énergie de cuisson, Ouganda, charbon de bois

Introduction

Rapid destruction of forest cover in Uganda for charcoal burning is currently a source of srious environmental degradation. Rate of deforestation estimated at 73,000ha of private forests and 7,000ha of protected forests annually which is a great contributor to climate change and variability effects in the cattle corridor (Okurut, 2020). Production of carbonized briquettes to replace wood charcoal is a very attractive strategy because it utilizes solid agricultural waste. Women and girls spend hours searching for and gathering firewood for cooking and others use charcoal whose production is depleting the forest cover. Beef production is one of those enterprises that generate large quantities of cow dung that can be used in combination with other waste materials such as bean and coffee husks in the production of briquettes. It is estimated that one Tropical Livestock Unit (TLU) produces 837 kg(DM) of dung annually (Harmen den Braber, 2021). The briquettes provide a climate-smart option for energy for cooking and provide a business opportunity for women and youths, particularly those not involved in cattle farming. In addition, briquette production is a potential source of income for beef-producing households who have easy access to crop and livestock organic matter and provide alternative sources of income during periods when there are no cattle sales. The current price of carbonized briquettes from Jijji online shop is 1,450 Uganda Shillings per kg. We selected and trained women and youth from three districts namely; Masindi, Mbarara and Isingiro, in the cattle corridor in which beef and crop production are major activities and therefore provide a cheap source of raw materials for briquette production. The aim of the training was to (i) impart skills to women and youths in the production of carbonized briquettes (ii) test the quality of the briquettes produced during the training.

Research Approach

Three sites per district were selected based on their level of engagement in both crop production and cattle rearing. A fair balance of both was required to ensure that there would be the availability of adequate organic matter for the production of the briquettes. Focus group discussions (FGDs) were held with both women and youths. These groups were composed of 7 to 26 persons per group

while observing the COVID control 19 measures. The FGDs were conducted using a checklist to establish the types of cooking fuel used by the households and energy/fuel-related business activities in their areas.

Table 1. Locations where Focus Group Discussions were held and number of women and youth participants in the districts of Masindi, Mbarara and Isingiro

District	Location	Women	Youths
Masindi	Miirya	14	12
	Myeba	4	17
	Kimengo	7	
Isingiro	Buyojwa	8	4
	Kabingo	7	3
	Ruhimbo	11	
Mbarara	Kashaka	4	6
	Kahooma	6	4
	Rwanyamahembe	6	2

Through collaboration with the Agricultural Engineering and Appropriate Technology Research Institute (AEATRI), three sets of briquette making machines; carbonizer, crasher mixer and pressing machines were fabricated. Participants to the FGDs who were interested in acquiring the briquette making skills as well as pursuing the briquettes business were trained on how to produce briquettes using the machines. At the close of the activity, one set of machines was handed over to each district for demonstration purposes. 30% of the training time was allocated to theoretical work and 70% of the time was allocated to practical work at each training venue. Theory covered basic knowledge on the concepts of environmental conservation and management and the need for recycling solid organic waste materials as sources of energy used for making briquette, different types of briquette machines, and how to identify good briquette machines. The knowledge about briquette marketing, packaging, branding and entrepreneurial skills was included.

Women and youth groups collected the organic materials including bean husks, coffee husks, dry banana leaves and cow dung and cassava flour and molasses were obtained as binders. Materials were sun dried for about 2 to 3 days in order to achieve a moisture content of 20% and below and thereafter were carbonized. Carbonization is the process of converting organic matters like plants and dead animal remains into carbon through destructive distillation. This process is carried out in a kiln at temperatures of about 850-875 degrees celcius for 108 hours with airflow that is controlled at various stages of the process. The organic material which contained at least 40% cow dung was carbonized until it changed into char (char is a burnt black solid). The char was then crushed to powder for easy mixing and compatibility with the binder (Cassava flour and Molasses) during the pressing process. The crashed carbonized material was then mixed with the binder according to the following ratio; Molasses/Cassava flour, Clay and Char in the ratios of 1:1:40. The mixture was then pressed to form solid blocks called briquettes and these were sun-dried.

Participatory evaluation and demonstrations of the cooking quality of the briquettes were done in

each district. Dry beans were cooked using both the Briquettes and wood charcoal in a stove of diameter 180mm and depth 60 mm. Parameters observed and recorded included time to ignite, and length of time taken for the briquettes to burn completely to ashes for the briquettes as well as wood charcoal.

Data collected were entered in excel and analysis was done using IBM SPSS STATISTICS Version 20. Descriptive statistics were generated to produce means and their standard deviations and one sample T-tests were done to compare the briquettes' time to ignite and time to burn to ashes with that for wood ash. The parameters for the wood ash against which the one sample T-tests were done are standard values used at AEATRI.

Results

Overall 67 women and 48 youths were trained in briquette making and by the close of the training period each district had produced at least 400 quality briquettes. A set of briquette making machines was handed over to each district for demonstration and enable them train more people in briquette making as well as utilize the machines to test briquette business models.

The briquettes produced had no difference ($p>0.05$) in ignition time (Fig. 1) and time to burn to ashes (Fig. 2) across the three districts. On the average across the 3 districts the ignition time was1.83 seconds per gram and the time to burn to ashes was 0.89 minutes per gram. The briquettes had a shorter ignition time compared to that of wood charcoal and overall ignition time for the briquettes was 35% faster ($p<0.05$) than that of wood charcoal. Time taken to burn to ashes for the wood charcoal was 6 times faster ($p<0.05$) than that for the briquettes (Table 1).

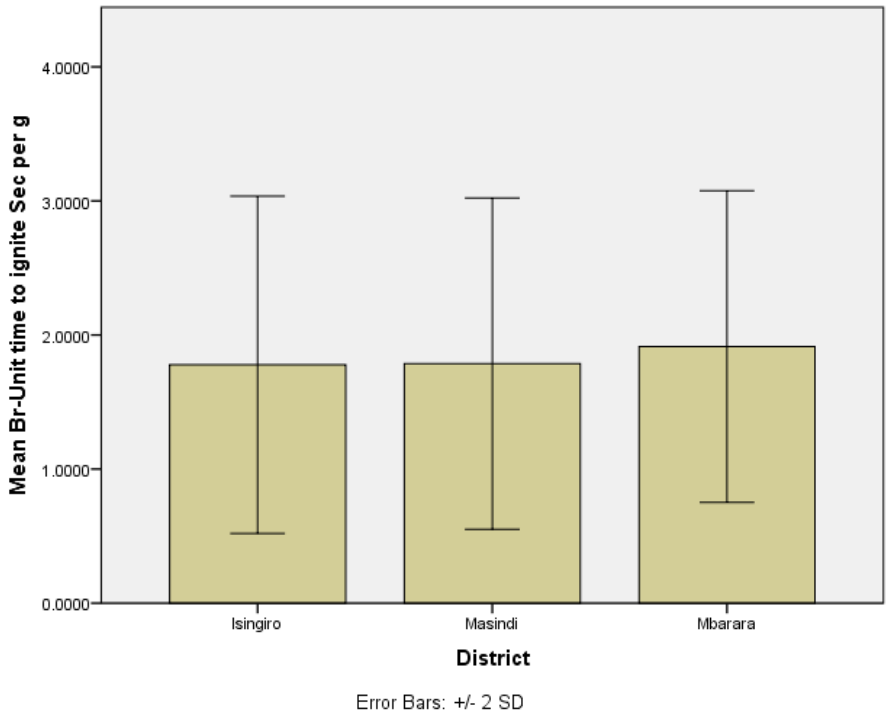

Fig. 1. Time taken to ignite the briquettes produced in Masindi, Mbarara and Isingiro districts

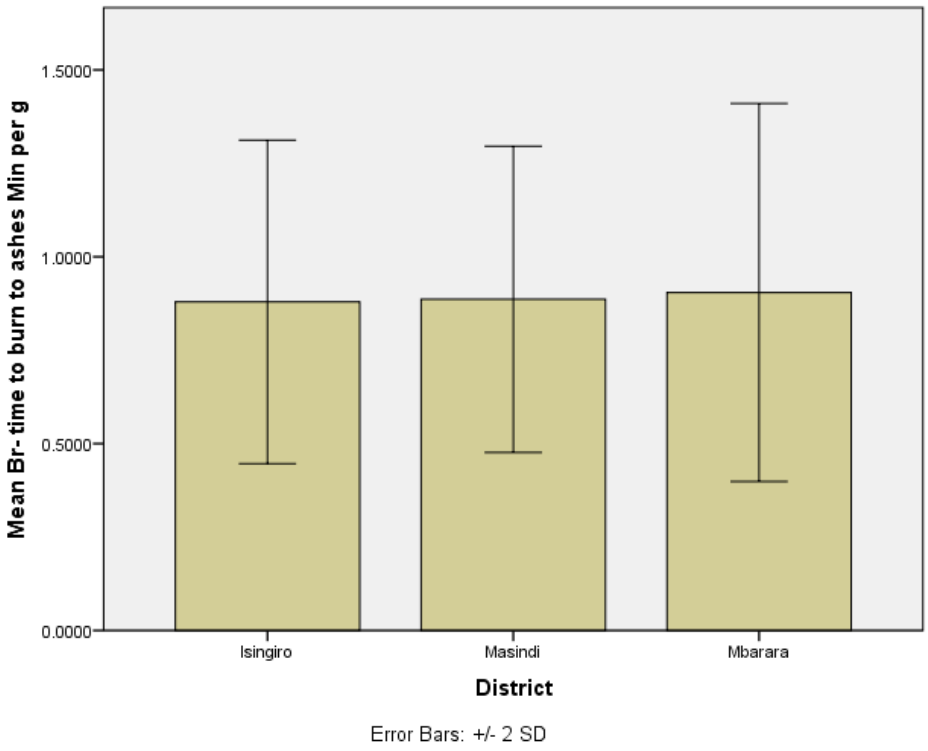

Fig 2. Time taken to burn to ashes for the briquettes produced in Masindi, Mbarara and Isingiro districts

Table 1. Comparison of the time taken to ignite and burn to ashes for both the briquettes (BR) and wood charcoal (WC)

Parameter	Briquettes	Wood charcoal	P-value
Mean time (SD) to ignite (sec/gram)	1.826 (0.532)	2.82	0.01
Mean time (SD) to burn to ashes (mins/gram	0.900 (0.196)	0.15	0.000

NB: The wood charcoal values are standard values used at AEATRI

Discussion

The faster ignition time and the longer time to burn to ashes by the carbonised briquettes when compared with wood charcoal aligns well with results obtained by Mahoro *et al*. (2017) in studies carried out in Kampala district. The study found that briquettes maintained their heat for a longer period of time while the wood charcoal burnt out faster. Briketi Energy Saving Solutions, estimate that 0.8 kilograms of briquettes is equivalent to one kilogram of traditional charcoal of average quality. The Observer (2012) also recorded an observation in their article that briquettes burn 3 times longer than wood charcoal. The briquettes faster ignition time is possibly a result of their moisture content being lower than that of wood charcoal and as a result the flame will not first burn moisture before igniting the solid material (Mambo, 2016). The longer burining time a possibly

a result of the higher density of the briquettes compared to wood charcoal which gives the flame and fire more material to burn. In addition, the inner hole of the briquette enlarges the contact surface area of the briquettes with air and as a result, improves the burning efficiency. These call for further research to gain deeper understanding to enable growth of the briquette industry. With cow dung contributing 40% of a briquette weighing 137 g means that one Tropical Livetsock Unit (TLU) has capacity for production of 2 tonnes of briquettes annually when mixed with crop residues and binders. This could replace 6 times as much wood charcoal saving destruction of forests. This would also have a capacity to contribute to generation of annual revenue amounting to UGX 2,900,000 (from one TLU) for a cattle corridor business or hosusehold.

Conclusions and Recommendations

Production of quality briquettes in the three cattle corridor districts; Masindi, Mbarara and Isingiro is possible. The briquettes have the ability to substitute wood charcoal as a source of cooking energy and the briquette making machines; carbonizer, crasher mixer and pressing machine, once obtained can drive a briquette business. Women and youths trained in the three districts and the machines left with each district for demonstration present a foundation for groups intending to pursue briquette business. Future interventions would add value by carrying out market surveys and supporting the establishment of the businesses.

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