



**Enhancing Women's Involvement in Briquette Production and
Marketing as an Alternative Source for Clean Energy to Charcoal and
Firewood in Uganda**

ENDLINE Report

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ACKNOWLEDGEMENTS



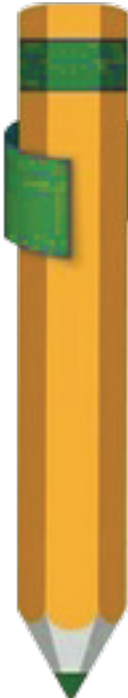
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EXECUTIVE SUMMARY

This impact evaluation report provides insights from an 18 months project on “Enhancing women’s involvement in briquette production and marketing as an alternative clean energy source to charcoal and firewood in Uganda.” The project was supported by the International Development Research Centre (IDRC) through the Aspen Network for Development Entrepreneurs (ANDE). The project targeted four female-owned briquette enterprises in the districts of Mpigi, Wakiso and Mukono in the Greater Kampala Metropolitan Area (GKMA). It involved the design and deployment of a gender inclusive briquette machinery, stove manufacturing and capacity building of briquette machinery users.

The impact evaluation aimed to document the immediate outcomes of the gender-inclusive technology on the utilization of briquettes as an alternate source of energy to

wood, fuel and charcoal. The endline survey assessed the adoption and performance of gender-inclusive briquette technology, production outcomes, women’s participation in the briquette value chain, skills development and capacity strengthening, market demand and product acceptance, and sustainability and scalability. This report also provides key recommendations, conclusions and lessons learned. To achieve the objectives of the study, a team of researchers from National Association for Women’s Action in Development (NAWAD), employed a cross-sectional design, with a qualitative approach using in-depth interviews (IDIs), and key informant interviews (KIIs), to document the experiences of owners and employees of the four (4) female owned briquette enterprises selected to participate in the project. The findings across the identified themes are highlighted below.

Key Findings

Findings from the evaluation indicate improvements in enterprise operation and production processes for women within the participating enterprises. The introduction of the dual power machine reduced physical effort associated with manually operated production machinery and enabled some women to participate more directly in machine operation and production processes. The respondents explained that women had previously concentrated on packaging and drying of the briquettes, but following deployment of the gender responsive technology and the related training, women transitioned to newer roles such as machine operation and supervision of production activities previous a male domain. The extent of this transition varied across enterprises and gendered division of labour continued to influence task allocation within the production processes.

The evaluation further indicates that the intervention contributed to increased batch production, shorter production timelines, and improved drying especially during rainy seasons. Respondents explained that the mechanized production system reduced the time required for briquette production. Some enterprises reported reducing production timelines from approximately one week to three or four days, while others indicated increases in production output compared to the previous manual production system. Participants involved in the study indicated that the briquette dryers reduced reliance on open sun drying and enabled enterprises to continue production during rainfall season that had previously disrupted operations because of reliance on sun drying.

The project also contributed to skills development among enterprise owners and employees. Participants acquired practical skills in briquette production, raw material preparation, machine operation, maintenance, stove fabrication and marketing. Some women who initially had limited experience in briquette production reported increased confidence in operating the machinery and participating in technical production processes. However, technical knowledge remained concentrated among a few individuals within some enterprises, creating operational dependency where production relied heavily on specific machine operators.

Conclusion and Recommendations

The findings show that semi-automated briquette machinery has a great potential for enhancing women's involvement in briquette production. The implementation of dual power briquette machines and dryers greatly enhanced operational efficiency, diminished the intensity of physical labour, and allowed women to take on more technical roles directly. This represents a significant change from initial conditions, where women's roles were largely limited to less demanding and lower-value tasks.

From an enterprise performance perspective, the project effectively boosted both production capacity and market demand, with numerous businesses reporting demand levels that exceed their current supply. Nonetheless, the increase in production has not been fully reflected in market output, primarily due to limitations in drying efficiency, working capital, and raw material availability. Regarding sustainability, the project has laid a solid foundation through skill enhancement, technology implementation, and the establishment of market connections. However, the continued operation after the project has concluded will rely on the enterprises' capacity to overcome financial challenges, maintain their equipment, and stabilize their supply chains for inputs.

Lessons LEARNED

- The introduction of gender-inclusive briquette technologies has reduced some of the physical barriers that had previously limited women's participation in production activities. However, the study notes that technological improvements alone do not substantially alter existing gendered labour patterns within enterprise operations.
- Increased production capacity does not automatically translate into stable enterprise growth where constraints such as limited working capital, drying inefficiencies, and raw material shortages persisted.
- Sustainability depends not only on skills acquisition, but also on the extent to which knowledge is shared across enterprise teams rather than concentrated among a few individuals.
- Finally, while demand for briquettes appears to be increasing, wider adoption remains dependent on continued sensitization and improved access to compatible cooking technologies.

ABBREVIATIONS



ANDE	Aspen Network of Development Entrepreneurs
F.E.W	Friends of Environment and Wealth
GKMA	Greater Kampala Metropolitan Area
IDI	In-Depth Interview
IDRC	International Development Research Centre
KII	Key Informant Interview
NAWAD	National Association of Women's Action in Development

1.0 INTRODUCTION

1.1 BACKGROUND

Clean energy enterprises in Uganda are on a rise with the private sector leading the response to the growing concerns on climate change resulting from unsustainable energy generation practices (Kimuli et al., 2022; Twinomuhangi et al., 2021). Briquette production and marketing is currently at the forefront of Uganda's clean energy transition path for cooking but with deployment of heavy and manually operated briquette machinery, which requires hard labour to operate (Elasu et al., 2025). This hinders women's productive participation in the briquette value chain through segregation, as they are viewed as weak to be able to operate such machines.

Consequently, most medium-large scale briquette enterprises including those owned by women entrepreneurs largely employ men to operate the briquette infrastructure with higher pay, pushing women into low paying jobs in the sector (Okello et al., 2018a). Additionally, the motorized briquette machines are very expensive both in terms of the initial investment and operation costs, since they require 3-phase power to operate, making scaling of briquette production difficult and less economically viable.

With support from the International Development Research Centre (IDRC), through the Aspen Network for Development Entrepreneurs (ANDE), the National Association for Women's Action in Development (NAWAD) implemented a project titled "Enhancing women's involvement in briquette production and marketing as an alternative clean energy source to charcoal and firewood in Uganda." The 18 months project (October 2024 to 31st of March 2026) aimed at improving women participation in clean energy production and marketing with a focus on briquette technology as an alternative source of energy to fuelwood and charcoal. The specific objectives of the project were to:

- 1 Assess women's involvement in the briquette value chain,
- 2 Characterize potential alternative raw materials to charcoal dust with intent to recommend the most potential alternatives for briquette production,
- 3 Promote women's participation in briquette production through deployment of gender-inclusive briquette infrastructure,
- 3 Strengthen capacity of briquette enterprises on the use of gender inclusive machinery

The main research question was: ***"How can women's involvement in briquette production and marketing as an alternative source of clean energy be harnessed to reduce gender bias and increase their participation in the sector?"***

NAWAD undertook various activities including stakeholder mapping, a baseline survey, design and deployment of a gender inclusive briquette machinery and capacity strengthening of the recipients of the briquette machinery. Following a few months of deployment of the briquette machinery, an impact evaluation was conducted. The objective of the impact evaluation was to:

- Document the impact (intermediate outcomes) of the gender-responsive technology on women's participation and the utilization of clean energy solutions such as briquettes as alternate sources of energy to fuelwood and charcoal.

2.0 METHODOLOGY

2.1 STUDY DESIGN

The study employed an action-oriented research design with a qualitative approach involving in-depth and key informant interviews. This approach was found appropriate because it enabled the recording of varied perspectives, experiences and short-term outcomes of using the briquette infrastructure in collaboration with the female briquette entrepreneurs and employees. To achieve an impact process, the study followed an iterative implementation phase that included the following:

Phase 1: Baseline survey and reflection

An initial stakeholder mapping and baseline survey was undertaken among briquette owned entrepreneurs. The baseline was informed by a mapping exercise that facilitated the identification of briquette enterprises in the study sites. The baseline survey provided information on the status of women's involvement in the briquette value chain and the capacity gaps in Greater Kampala Metropolitan Area (GKMA) including Kampala, Wakiso, Mpigi and Mukono districts. Data generated from the baseline survey guided the selection of four (4) enterprises that participated in project implementation.

Phase 2: Design and testing the intervention

This phase involved a number of activities namely;

- Collection and characterization of different briquette raw materials, carbonization of the raw materials to bio-char, briquette production from bio-char, and testing for briquette quality.
- Design, fabrication and deployment of 4 semi-automated, dual-power briquette machinery.
- Construction of 4 briquette dryers to ensure quality briquettes and customized 2-in-1 integrated briquette cook stoves.
- Conduct of training for users (i.e., project beneficiaries) in operation, maintenance and repair mechanics.
- Performance monitoring of briquette infrastructure to provide support.

Phase 3: Observation and reflection

During this phase, we carried out follow-up reflective interviews to gather information on the intervention, especially regarding what worked and didn't work during testing phase.

Phase 4: Endline/Impact Evaluation

The endline data collection involved participatory engagement with selected briquette enterprises (owners, and employees). Key informant interviews and in-depth interviews were conducted with male and female participants in the selected enterprises. The data generated enabled the research team to document the outcomes from deployment of the gender-inclusive technology and the utilization of briquettes as an alternate source of energy to fuelwood and charcoal.

2.2 PROJECT SITES

The project was implemented in the GKMA. Geographically, GKMA lies in the central region of Uganda, surrounding the capital city, Kampala. It covers an estimated area of over 8,000 square kilometers and is home to more than 10 million people, accounting for nearly a quarter of Uganda's total population. The region is characterized by rapid urbanization, population growth, and increasing demand for energy, housing, and services. GKMA was selected as the study site because the area has experienced significant urban growth for many decades and is currently the second-fastest-growing urban area in Eastern Africa. It is an industrial, commercial and educational center, and vital to the country's economic growth. However, the urban growth of GKMA impacts the environmental resources (Kasimbazi, 2020), where over 300,000 tons of charcoal is consumed annually (Tumuhimbise, 2021). In addition, the cost of charcoal is highest in Kampala (Daily Monitor, 2023), which presented a business opportunity for cheaper and clean alternatives like briquettes. GKMA was considered because it has a higher and diverse population of small-scale briquette producers and consumers than any other part of Uganda. Additionally, being a major urban center, GKMA offers access to potential markets for briquettes and enables visibility of women's roles in clean energy innovation and entrepreneurship.

The GKMA is the main urban area in Uganda capable of delivering economies of scale in terms of concentrated demand, specialization, diversity and depth of skills and innovation (Guloba et al., 2018). As the country's main urban, industrial center and economic engine, with one of the world's fastest growing and youthful populations, as well as its unique cultural diversity, greater Kampala has the potential to spur growth and drive prosperity. The area hosts a significant proportion of the urban population and presents a mix of both peri-urban and rural settings.

While the baseline survey covered the whole of the GKMA, the final project beneficiaries were selected in two districts of Mukono and Wakiso located in the GKMA. In Mukono district, the project sites were in Seeta working with Beta Energies and Mummy's Kitchen. In Wakiso district, the project sites were located in Maganjo and Bombo areas with Masupa Enterprises and Friends of Environment and Wealth (F.E.W) respectively selected.

2.3 PROJECT BENEFICIARY SELECTION

Briquette enterprise owners and employees from the four (4) enterprises provided the data and were female owned. While the initial project plan was to target three (3) female owned enterprises and one (1) male enterprise for support, the baseline assessment we conducted revealed that all the male owned enterprises were well established with heavy machinery and production capacities. Given the fact that project aimed at targeting non-established

enterprises, the study focused on female enterprises slowed by several gaps and yet to improve their production capacity.

Consequently, the endline assessment targeted women and men of different socio-economic status and working with the beneficiary briquette enterprises. The study employed a systematic sampling method in which 11 employees from the enterprises were selected and interviewed. Nine (9) were female and two (2) male participants. For purposive sampling, four (4) key informant interviews (KII) were conducted with the briquette enterprise owners, including seven (7) in-depth interviews.

2.4 DATA COLLECTION METHODS

Key Informant Interviews (KII)



KIIs were conducted among briquette enterprise owners to capture their experiences of engaging with semi-automated briquette machinery, to understand the marketing dynamics of clean energy entrepreneurship and the involvement of women in the briquette value chain.

In-depth Interviews



These interviews focused on employees to document their experiences with the briquette infrastructure and the entire value chain operations. The interviews were conducted using a structured guide focused on their participation in the briquette value chain, briquette marketing and distribution, management and administrative roles.

2.5 DATA ANALYSIS

Qualitative interviews were transcribed and narrative reports produced that were later subjected to thematic analysis. The thematic analysis involved inductive and deductive coding of the transcripts to identify patterns of emerging themes on the adoption and utilization of gender-inclusive briquette technology, gender and social inclusion outcomes, production outcomes and market performance, market demand and product acceptance, and skills development and capacity strengthening. Additionally, themes such as challenges and constraints affecting enterprise performance and women's participation, sustainability and scalability were explored.

2.6 STUDY LIMITATIONS

- The project had a limited scope with a small sample of the project beneficiaries and thus the findings cannot be generalized across the entire briquette industry in Uganda.
- Technology interventions need a lifelong investment and thus a long-term follow-up which is very important for uptake, sustainability and scalability. The deployment of the technology was less than a year and so the findings on impact related to intermediate outcomes rather than long term impacts.

3.0 FINDINGS

The findings are organized following key emerging themes such as adoption and utilization of gender-inclusive briquette technology, gender and social inclusion outcomes, production outcomes and market performance, market demand and product acceptance, skills development and capacity strengthening, challenges and constraints affecting enterprise performance and women's participation, sustainability and scalability. The first section describes the briquette technology that was designed and deployed.

3.1 DESCRIPTION OF THE GENDER-INCLUSIVE BRIQUETTE TECHNOLOGIES DEPLOYED

One of the major barriers to women's participation in the briquette industry was limited access to appropriate technology. The heavy reliance on manual machines excluded many women from core production activities due to the physical energy required. The project designed and deployed a semi-automated briquette technology to improve women's participation in briquette production and address operational challenges affecting enterprise performance. The deployed technology included the dual-power briquette machine, the briquette dryer, and the customized 2-in-1 briquette stove. These technologies responded to key constraints identified during the baseline assessment, including the physically demanding nature of manually operated machines, unreliable drying during rainy seasons, and limited access to affordable, clean cooking solutions. This technology was reported to have contributed to increased production output, shorter production cycles, continuity of production during rainy seasons, and enterprise capacity to meet growing market demand for briquettes.



The dual-power briquette machine was designed to reduce the physical labour traditionally associated with briquette production. Unlike manually operated machines that required significant physical strength and often excluded women from machine operation, the deployed machine uses a hydraulic compression system that is easier to operate and more accessible to women. The machine was also designed to operate using single-phase electricity and solar power, reducing operational costs and improving flexibility within enterprise production systems. In addition, the machine can produce different briquette sizes through interchangeable molds, increasing production versatility.

The project also deployed briquette dryers to improve production continuity and address challenges associated with weather-dependent drying methods. Prior to the intervention, most enterprises relied on open sun drying, which significantly slowed production during rainy seasons and affected briquette quality and availability. The deployed dryer was intended to support faster and more reliable drying throughout the year, thereby improving operational consistency and market supply.



To support the utilization of briquettes at the household level, the project further introduced customized 2-in-1 briquette stoves designed to improve cooking efficiency and encourage the adoption of briquettes as an alternative clean cooking fuel. The stove was developed as a complementary technology to strengthen the briquette value chain and improve user experience through reduced smoke emissions, improved efficiency, and lower cooking costs.

The technologies were deployed alongside user training aimed at strengthening women's participation in production, improving enterprise competitiveness, and increasing access to cleaner and more affordable cooking energy solutions. Overall, the intervention sought to address both technological and gender-related barriers within the briquette value chain by introducing production systems that are more accessible and adaptable to the operational realities of small-scale briquette enterprises.

3.2 ADOPTION AND UTILISATION OF GENDER-INCLUSIVE BRIQUETTE TECHNOLOGY

The findings indicate that the introduction of the dual power semi-automated briquette machine and dryer changed how production is carried out within participating enterprises by replacing previously manual, labour-intensive processes with mechanised systems. Across sites, participants described a transition from older production methods to the new technology, which became actively integrated into daily operations. At Friends of Environment & Wealth (F.E.W) enterprise, one respondent explained how the technology simplified production work and enabled women to independently engage in machine operation:

“I don’t need help with the new machine. I mix the materials, produce the briquettes, and transfer them for drying. It is really easy to operate.” (KII, Female, F.E.W Enterprise, Wakiso)

Additionally, respondents noted that the introduction of the briquette machinery has been positively received, supported increased and improved briquette production:

“Otherwise, there is no major problem with the machine. We have already produced briquettes and sold them, and we have not received any negative feedback from customers. In fact, the demand is increasing, especially during this rainy season, so we are trying to ensure that we meet customer demand.” (KII, Female, Masupa Enterprise)

“Compared to our old machine, production has improved. Previously, we were producing about two batches at a time, but now we are able to produce four. At first, operating the machine was slow because people were still learning and the machine required patience. Some workers still see it as difficult work, especially because of carrying the mixture, but if the mixer is brought closer, that inconvenience will be reduced.” (KII, Female, Masupa Enterprise)

Similarly, at Beta Energies Uganda, respondents described the mechanised system as less physically demanding than the manual production methods previously used. One key informant noted:

“Before we used to use the manual way which was costly and needed manpower, but with the new technology, work became simpler and production increased. We just compact and work is done automatically by the machine.” (KII, Female, Beta Energies Uganda)

This reflects not only acceptance of the technology but also its practical usability by women who were previously excluded from certain production stages. Similarly, enterprise owners and employees emphasized how the new system shifted participation patterns within production. Under the manual system, women depended on male assistance for physically demanding tasks such as lifting and machine operation, as explained:

“During the usage of the manual machine, the ladies didn’t have the ability to use it more so at the stage of lifting, we could always hire a man to help out... but the modern way, everything is done by us ladies.” (KII, Female, Mummy’s Kitchen)

“However, in terms of opportunities, men and women are not equal. Women may not be able to operate the manual machines effectively. As a man, I can produce over 300 briquettes a day, which a woman may not be able to achieve.” (IDI, Male, Masupa Enterprise)

This demonstrates that adoption of the technology was accompanied by a redistribution of roles within production processes, enabling women’s direct engagement in technical operations.

The findings further indicate that this new technology lowered the physical barriers that previously restricted women’s involvement in production. The tasks that required physical effort under the manual system became more accessible, which increased participation of women within enterprise activities. While conducting the endline interviews, participants noted:

“Even someone with little physical strength can operate the dual-power machine, unlike the manual machine, which requires a lot of energy.” (KII, Female, FEW Enterprise)

“With increased technology and automation, we actually expect labour to reduce over time because machines now do much of the work. For example, when we introduced electricity and the mixer, production became faster and more efficient. Recently, workers managed to produce about 200 to 300 large briquettes in a short period because of the mixer.” (KII, Female, Masupa Enterprise)

“Since the project began, my work has become easier because the dual-power machine requires less physical energy compared to the manual one.” (IDI, Female, Masupa Enterprises)

This reduction in physical labour requirements enabled women to engage more directly in machine operation and other technical roles that had previously been male-dominated. In some enterprises, respondents explained that women had transitioned from supportive production roles into direct operation of the machinery. One participant stated:

“At the beginning women were mostly based on sorting and mixing with assistance from men, but now in this enterprise, they get engaged in all stages of briquette making because they are well skilled by experts.” (IDI, Female, Beta Energies Uganda)

Similarly, another respondent noted:

“I currently operate the dual-power machine and I enjoy the work because it is not physically demanding.” (IDI, Female, Masupa Enterprises)

This indicates not only increased access to technical roles but also improved user experience and confidence among women operating the machinery.

Participants also highlighted improvements in the overall production environment linking it to the new technology. Compared to the manual machines, respondents described the dual power machine as cleaner, more stable, and easier to manage:

“The new technology is easier to use. It stays in one place, does not make much noise, and the production process is cleaner compared to the manual machine.” (KII, Female, FEW Enterprise)

At the enterprise level, the new technology production system also contributed to increased employment opportunities for women. There has been an increase in production capacity and rising market demand, which has created a need for additional labour, resulting in the recruitment of more women into enterprise operations activities:

“During baseline I was by myself... but later advancing to modern technology I hired two women to work with because the demand got higher.” (KII, Beta Energies Uganda)

This suggests that the intervention influenced women’s participation not only through technology accessibility, but also through expanded enterprise operations linked to increased production demand.

Beyond production itself, participants also reported improvements in economic benefits and financial independence. They linked involvement in briquette production and marketing activities to increased income generation and savings behaviour. One participant noted:

“Women became independent since we make briquettes and sell them for a source of income, thus women’s saving culture increased.” (KII, Female, Beta Energies Uganda)

While adoption of the technology was positive, participants also described a gradual learning process. Some users explained that full competence required time, patience, and continuous practice. Some users explained that building confidence in machine operation and production processes took time and needed practical experience:

“The new technology requires a lot of patience... We are still studying it and learning how to use it effectively.” (KII, Female, FEW Enterprise)

This highlights that utilisation of the technology continues to evolve through ongoing adaptation and experience within enterprise operations.

The solar dryer was also integrated into enterprise operations, enabling enterprises to continue production during rainy seasons when sun-drying methods were less effective. One respondent explained:

“Before we used the manual way of putting them under the sun, but now we produce our briquettes even during the rainy season since it’s the machine that dries them up.” (KII, Female, Beta Energies Uganda)

This improved continuity in briquette production and reduced weather-related disruptions that had previously constrained production activities.

Despite these positive shifts, the findings also show that women’s participation within the briquette value chain remains shaped by persistent social and structural constraints. Division of labour within enterprises still follows gendered patterns in some contexts, with women remaining more concentrated in less physically intensive activities while men continue to dominate some high-output production tasks. This was reflected in perceptions expressed by some respondents, including:

“As a man, I can make over 300 briquettes... which a woman cannot do.” (IDI, Employee, Masupa Enterprise)

“We work as a team with women... mixing, it's me myself because it needs a lot of energy compared to leaving it to women and, lastly, on the machine part, I operate it myself... Women help us a lot in holding the trays during the production process.” (IDI, Employee, Beta Energies Uganda)

Such perceptions continue to influence task allocation even in contexts where the technology has reduced some of the physical barriers previously associated with production.

Overall, the findings indicate that the introduction of gender-inclusive briquette technologies reduced labour intensity and enabled women to participate more directly in machine operation. However, women's participation continues to be shaped by gendered division of labour, perceptions about women's physical capacity and domestic responsibilities that affect their consistency of engagement within the enterprise activities.

3.3 GENDER AND SOCIAL INCLUSION OUTCOMES

The project contributed to noticeable changes in women's participation across production, marketing, management and enterprise coordination within the briquette value chain. Findings from the interviews show that the introduction of the new briquette technologies, combined with training enabled women to participate more actively in areas that were previously dominated by men, while also expanding women's involvement in income generation, marketing and enterprise decision-making. One of the major shifts observed across enterprises was the increased involvement of women in leadership, coordination, and enterprise management activities. In several enterprises, women were not only participating as labourers but were actively involved in planning production activities, coordinating marketing, mobilising customers, managing enterprise operations and participating in financial and operational decisions. At Beta Energies Uganda, women were reported to coordinate sensitisation activities, plan marketing strategies and supervise sales activities within and outside their communities. One respondent explained:

“I am in the marketing management. I make sure I plan on how we can advance to make more sales.” (IDI, Female, Beta Energies Uganda)

Women were also involved in operational decision making within enterprises. A female enterprise owner explained that women workers participated in discussions regarding raw material acquisition and enterprise management because production conditions and market demand constantly changed:

“The ladies who work for me are single mothers who take part in all decision-making, either acquiring raw materials or anything, because in briquette making, things change so we respect each other's opinions or decisions.” (KII, Female, Beta Energies Uganda)

The findings further show that women became central actors in briquette sensitisation and community outreach. They described themselves as responsible for teaching communities about briquettes, conducting demonstrations, distributing samples, and encouraging households to adopt briquettes as an alternative cooking fuel. At Beta Energies Uganda, one participant explained:

“Most times on Saturdays we go out to the field to sensitize women... first teach them through showing them how it is all done and also giving out samples to people.” (IDI, Female, Beta Energies Uganda)

Similarly, another respondent explained that women played an important role in influencing adoption because they were directly familiar with household cooking challenges and fuel use practices:

“It’s women who use charcoal so they go on sensitizing other women on the use of briquettes.” (IDI, Female, F.E.W)

Participation in the briquette enterprises also contributed to women’s income generation and economic independence. Women earn income through production and sales activities, which enable them to support household needs and improve their savings practices. One respondent noted:

“The women became independent since we make briquettes and sell them for a source of income, thus women’s saving culture increased.” (KII, Female, Beta Energies)

A male respondent also acknowledged the economic and social changes associated with women’s participation.

“Briquette production has exposed women’s mindset of not being home idle but rather be creative and business oriented.” (IDI, Male, Beta Energies Uganda)

The findings suggest that women’s participation increasingly extended beyond wage labour toward entrepreneurial aspirations. Some respondents explained that women were interested in acquiring briquette production and marketing skills in order to establish their own enterprises in the future. Women’s involvement in training and market engagement exposed them to business opportunities and expanded their networks beyond their immediate communities.

Despite these positive outcomes, gendered divisions of labour within enterprises continued to shape the nature of women’s participation. Women remained more concentrated in activities such as sensitisation, packaging, sorting, drying, and customer engagement, while men continued to dominate physically demanding tasks such as heavy mixing and some machine operation activities. At Beta Energies Uganda, one respondent explained:

“Mixing, it’s me myself because it needs a lot of energy compared to leaving it to women.” (IDI, Male, Beta Energies Uganda)

“Women boil the porridge we are to use; the men do the mixing of the raw materials... at the end they do the cleaning of the machine... lastly, we men are not based in the market, it’s the women because they are so convincing.” (IDI, male, Masupa Enterprises)

Similarly, another respondent noted:

“Women normally pick out the ready briquettes... as well as marketing.” (IDI, Female, Beta Energies Uganda)

These findings show that although women’s participation increased substantially, task allocation within enterprises continued to reflect perceptions regarding physical strength and socially defined gender roles.

Women's participation was also affected by constraints beyond the workplace. Respondents frequently identified transport limitations, inadequate capital, and unpaid domestic responsibilities as barriers affecting women's consistent participation and mobility. Women involved in sensitisation and marketing activities often travelled long distances carrying briquette samples and stoves without reliable transport support. One respondent explained:

“Transportation is a big challenge... because I have to take some samples for experiments.” (IDI, Female, Beta Energies Uganda)

Another Participant similarly noted:

“Women travel to far places to sensitize people so they carry stoves and briquettes and other things to sample people and this affects their field because they lack means of transportation.” (IDI, Male, Beta Energies Uganda)

Limited financial resources also affected women's ability to stock raw materials and expand production activities independently. Respondents repeatedly identified inadequate capital and shortages of charcoal dust and wood dust as key limitations affecting enterprise growth and women's ability to scale up participation.

Beyond the workplace, other factors continue to shape the depth of women's participation. Domestic responsibilities, particularly unpaid care work, were frequently cited as constraints on consistent engagement in production activities. In addition, limited access to financial resources restricts women's ability to scale their participation beyond employment into ownership or independent enterprise development.

“Women sometimes delay because they have to care for their children and homes.” (IDI, Female, F.E.W Enterprise)

At the same time, there are indications that women's engagement in the sector is evolving beyond wage labour. Some participants expressed a clear preference for acquiring skills and transitioning into independent business ownership. As one respondent explained:

“I have observed that many women prefer to learn the skills and later start their own businesses rather than continue working together with others.” (KII, Female, F.E.W Enterprise), suggesting that inclusion is also taking the form of entrepreneurship pathways rather than only employment within existing enterprises.

The project has contributed to meaningful but partial gender inclusion. Technology has played a creditable role by lowering entry barriers into production, while increased production capacity has created additional opportunities for women's employment and income generation. However, constraints like social norms, labour divisions, unpaid care responsibilities and financial limitations continue to shape the extent of women's participation.

Gender inclusion in the briquette value chain is not determined by technology alone, but by the interaction between technological change and wider social and economic structures. As such, sustained progress toward full inclusion will require complementary interventions that address both production systems and the underlying structural barriers that shape women's participation.

3.4 PRODUCTION OUTCOMES AND MARKET PERFORMANCE

3.4.1 PRODUCTION CAPACITY AND OPERATIONAL EFFICIENCY

The introduction of the dual-power briquette machine and dryer transformed production processes across participating enterprises by increasing output, reducing production delays, and improving the consistency of briquette supply. Unlike the baseline period where production was largely manual, slow, and dependent on physical labour, enterprises reported that the gender inclusive system enabled them to sustain larger-scale and more organised production processes.

Respondents linked the new technology to increased production volumes and faster turnaround times. At Beta Energies Uganda, the enterprise owner explained that production had expanded to approximately 20 boxes of briquettes per month, with each box containing more than 1,100 briquettes, excluding additional sales made to small-scale buyers. Another respondent explained that production speed had improved under the production system:

“During the baseline, one sack of charcoal dust was used for two days, whereas with modern technology four sacks can be used in just hours.” (KII, Female, Masupa Enterprise).

The new technology changed not only the speed of production but also the organisation of enterprise operations. Under the manual system, enterprises operated on smaller production cycles because output depended heavily on physical labour and time-consuming compression processes. With the introduction of the dual-power machine, enterprises began planning production around higher output levels, continuous machine operation, and advance stocking of raw materials. One respondent explained:

“We have learnt to stock raw materials adequately since the machines are faster.” (KII, Female, Beta Energies Uganda)

The technology also contributed to improved product consistency and quality. Respondents distinguished the newer honeycomb briquettes from the earlier manually produced stick briquettes, describing the newer products as stronger, cleaner, more durable and more attractive to customers. One machine operator explained:

“The best skill I have obtained is making the honeycomb hard and of standard that if you hold it tight it cannot break compared to when we were still in the baseline.” (IDI, Male, Beta Energies Uganda)

Several respondents reported that improved product quality strengthened customer demand and market confidence in the briquettes. It was noted that across enterprises, the customers preferred honeycomb briquettes because they burned longer, produced less smoke and maintained cleaner cooking environments compared to charcoal and earlier briquette designs. A female marketer explained:

“The customers prefer these briquettes because they are durable, they last for 5 to 6 hours and save money.” (IDI, Female, Beta Energies Uganda)

Similarly, another respondent explained that the newer briquettes had become more popular because of their cleanliness and efficiency:

“People have highly adjusted to the modern briquettes which are the honeycombs and because they keep the environment clean, don’t produce ash and as well don’t produce smoke and, as well save.” (IDI, Female, Beta Energies Uganda)

The dryer played an equally important role in stabilising enterprise operations, particularly during rainy seasons. Prior to the intervention, production depended heavily on sun drying, which slowed production and interrupted supply whenever weather conditions changed. This dryer enabled enterprises to continue production throughout wet seasons and reduced dependence on unpredictable weather conditions. Participants explained:

“Initially, our neighbours complained about the briquettes because they were not drying well, but now they are taking properly dried briquettes and are satisfied. At least now the team appreciates the dryer because even during the rainy season, some briquettes are drying successfully.” (KII, Female, Masupa Enterprise)

“The dryer simplified work more so now in the rainy season where by before we used the manual way of putting them under the sun but now, we produce our briquettes even during the rainy season since it’s the machine that dries them up.” (KII, Female, Mummy’s kitchen)

This has enabled enterprises to continue producing briquettes while maintaining more stable market supply throughout the year. At Beta Energies Uganda, respondents explained that briquettes were now available “no matter the season,” allowing enterprises to respond more consistently to customer demand.

The increased production capacity also had implications for labour demand within enterprises. As production volumes and customer demand increased, enterprises recruited additional workers to support production and marketing activities. One enterprise owner explained:

“Later advancing to modern technology, I hired two women to work with because the demand got higher.” (KII, Female, Beta Energies)

Despite these improvements, production efficiency continued to be affected by structural and operational challenges. Unstable electricity supply emerged as the most frequently reported constraint across enterprises. Respondents explained that power interruptions disrupted machine operation, delayed drying processes, and sometimes resulted in raw material losses after mixing had already taken place. Respondents explained:

“The main challenge we face mostly us the women is electricity; it may be a general problem but affects us more because it doesn’t only disrupt the production process but also adds up more work to do manually carrying out the briquettes outside to dry up.” (IDI, Female, Beta Energies Uganda)

“The biggest challenge is electricity. It’s never stable and it affects us so much more so when we have finished mixing the raw materials.” (IDI, Female, Beta Energies Uganda)

“Electricity is the major problem its always on and off which affects the production more so when the raw materials are already mixed thus, they can easily dry up and get to waste so here we use the local dryers which is the sun or advancing to buying solar power.” (KII, Female, Mummy’s Kitchen)

“Recently, workers managed to produce about 200 to 300 large briquettes in a short period because of the mixer. Even today they had planned to continue production, but electricity went off.” (KII, Female, Masupa Enterprise)

Similarly, another respondent noted:

“The drier affects us a lot during no electricity whereby we mix our raw materials and it leads us behind.” (IDI, Male, Beta Energies Uganda)

Enterprises attempted to cope with these disruptions through temporary sun drying, reducing production volumes during outages, and proposing investment in generators or solar energy systems to improve reliability.

Raw material shortages also affected operational efficiency, particularly shortages of charcoal dust and wood dust, which respondents described as increasingly difficult to access because of high demand and environmental restrictions. Several enterprises responded by stocking raw materials in bulk whenever available, while others experimented with alternative materials such as dry leaves and peelings.

Overall, the findings indicate that the mechanised briquette technology substantially improved enterprise production capacity, strengthened workflow organisation, enhanced product quality, and enabled more reliable year-round production. These improvements contributed to stronger market demand and enterprise expansion, although operational performance continued to be constrained by unstable electricity supply and inconsistent access to raw materials.

3.4.2 MARKET DEMAND AND PRODUCT ACCEPTANCE

The findings on market demand and product acceptance show that the improved production systems were accompanied by increasing consumer interest in briquettes across the participating enterprises. Respondents consistently reported that demand for the improved honeycomb briquettes had grown compared to the earlier manually produced stick briquettes, particularly because of their longer burning hours, reduced smoke, cleanliness, and cost-saving potential for households and commercial users.

Across several enterprises, participants explained that customers increasingly preferred the newer honeycomb briquettes because they lasted longer and reduced fuel expenditure. A marketer from Beta Energies explained:

“The customers prefer these briquettes because they are durable, they last for 5 to 6 hours and as well save money mostly for extended families.” (IDI, Female, Beta Energies Uganda)

Similarly, another respondent noted that the honeycomb briquettes had become more preferred than the older stick briquettes because they kept cooking spaces cleaner and produced less smoke:

“People have highly adjusted to the modern briquettes which are the honeycomb because they keep the environment clean, don’t produce ash and don’t produce smoke.” (IDI, Female, Beta Energies Uganda)

These findings suggest that product acceptance was strongly linked to users' practical experiences with the briquettes, particularly fuel efficiency, cleanliness, and reduced indoor smoke exposure. Respondents repeatedly described these characteristics as important selling points during community sensitisation and marketing activities.

The findings also show that some enterprises were struggling to meet the growing customer demand due to production limitations and resource constraints. Enterprise owners and workers explained that the new technology increased output, but market demand in some cases exceeded the quantities enterprises could consistently produce. One respondent from Masupa Enterprises explained:

“Even 2,000 is not enough when the demand is around 3,000.” (KII, Female, Masupa Enterprises)

Similarly, respondents indicated that enterprises were intentionally trying to maintain continuous stock availability because of increasing customer purchases:

“We make sure that briquettes are available in plenty because we always make sure we have 10 boxes full and each box has around 1,200 briquettes.” (IDI, Male, Beta Energies Uganda)

The expanding demand was also reflected in the diversification of customers purchasing briquettes. While households remained important consumers, some enterprises reported increasing uptake among institutional and commercial users such as poultry farmers. One respondent explained:

“The biggest clients are the poultry farmers who buy the big sized briquettes... I always get good feedback mostly from poultry farmers who used to spend a lot when brooding is taking place.” (KII, Female, Mummy’s Kitchen)

This suggests that briquettes are gradually becoming accepted not only as a household cooking fuel but also as an alternative energy source for small-scale commercial activities.

The findings further indicate that market acceptance was heavily supported by continuous sensitisation and product demonstrations conducted by enterprise workers, particularly women involved in marketing. Many community members initially lacked awareness about briquettes and required practical demonstrations before adopting them. A female marketer from Beta Energies explained:

“Most times on Saturdays we go out to the field to sensitize women... first teach them through showing them how it’s all done and as well giving out samples to people.” (IDI, Female, Beta Energies Uganda)

Similarly, another Participant noted:

“In my community it’s popular because we have put in a lot of time to teach many of the community people about briquettes as a source of fuel.” (IDI, Female, Beta Energies Uganda)

These findings demonstrate that market growth was not occurring automatically, but was being actively driven through awareness campaigns, demonstrations, exhibitions, workshops, and direct engagement with potential consumers.

However, despite the positive market response, participants identified barriers limiting wider market expansion. The most frequently cited challenge was low public awareness about briquettes, which respondents felt slowed adoption rates. A number of participants explained that many people still lacked knowledge about how briquettes work or their advantages compared to charcoal and firewood. Others pointed to transport limitations, particularly for women marketers who carried briquettes, stoves, and demonstration materials to sensitization activities in distant communities.

In addition, respondents highlighted that the honeycomb briquettes required specialized stoves, which created affordability challenges for some customers. One participant explained:

“The honeycomb is better than the long stick because it keeps the environment clean and doesn’t produce smoke, but the issue comes with the stove... they cost 45,000 to 50,000 UGX.” (IDI, Female, Beta Energies Uganda)

This suggests that while customers appreciated the product itself, the cost and accessibility of compatible stoves remained an important barrier to wider adoption.

The findings suggest that briquettes are increasingly being accepted as an alternative cooking fuel within the communities, with demand driven largely by positive user experiences. Participants associated the improved briquettes with longer burning hours, reduced smoke, cleaner cooking environments, and lower fuel costs compared to traditional cooking fuels. However, the expansion of the market continues to depend on sustained sensitization and demonstration activities, as well as improved access to compatible briquette stoves, which many respondents identified as a major limitation for wider household adoption.

3.5 SKILLS DEVELOPMENT AND CAPACITY STRENGTHENING

One of the changes reported across the enterprises was the shift from limited technical knowledge to active participation in briquette production and machine operation, particularly among women who previously had no experience working with mechanized production systems. Participants repeatedly described how the training introduced them to skills that extended beyond manual briquette making into machine handling, drying technologies, product improvement, and marketing.

Women explained that before the intervention they mainly participated in simple manual activities such as sorting raw materials, packaging, or carrying briquettes. However, after the training and introduction of new technology, many became directly involved in operating production equipment and managing different stages of the production process. A female employee from Beta Energies explained:

“We have obtained the skill of making the modern briquettes called the honeycomb and also how to operate machines. We were trained by Engineer Edmond and now we are experts.” (IDI, Female, Beta Energies Uganda)

Similarly, another participant reflected on the extent of her personal transformation:

“When I first came into the organization, I knew nothing but right now, I can produce briquettes, mix raw materials, dry and also know how to make and repair stoves.” (KII, Female, F.E.W Enterprise)

These experiences suggest that the intervention did not simply increase labour participation but expanded women's technical competence across multiple stages of the briquette value chain. The training also appears to have reshaped women's confidence in engaging with mechanized production systems that were previously perceived as difficult or male-oriented. Several respondents explained that women who initially feared operating machines gradually became more comfortable handling production equipment through continuous practice and mentorship. Respondents explained:

“At the beginning women were mostly based on sorting and mixing... but now women get engaged in all stages of briquette making because they are well skilled by experts.” (IDI, Female, Beta Energies Uganda)

“I have learned how to operate the machine. Moving from manual production methods to this new technology and learning how to operate it has been a major skill for me. We received training from the team that came to deploy the machine.” (IDI, Female, Masupa Enterprise)

Beyond production itself, participants described gaining skills in customer engagement, product promotion, and market mobilization. Women involved in marketing activities explained that they had learnt how to conduct sensitization campaigns, demonstrate briquette usage, and engage customers during exhibitions and workshops. One marketer explained:

“I have obtained more marketing skills, which have widened my connections.” (IDI, Female, Beta Energies Uganda)

The development of these marketing skills became important because enterprises relied heavily on demonstrations and community sensitization to expand acceptance of briquettes within local communities.

Participants also linked skills development to improvements in product quality. They learnt how to produce stronger and more durable honeycomb briquettes compared to the earlier manually produced stick briquettes. According to one machine operator:

“The best skill I have obtained is making the briquettes mostly the honeycomb hard and of standard that if you hold it tight it can't break.” (IDI, Male, Beta Energies Uganda)

This suggests that the intervention strengthened enterprise capacity not only to increase production, but also to improve product consistency and competitiveness within the market.

However, the findings further show that technical expertise within some enterprises remains concentrated among a small number of trained operators. Machine operation and maintenance responsibilities were often handled by a few individuals who possessed greater technical confidence and experience. In some cases, respondents acknowledged that women were still hesitant to independently operate machinery because of fear of machine noise or limited familiarity with technical procedures. One respondent explained:

“Women get scared of the machine sound most times... so we request for more training and also ear pads for the women.” (IDI, Male Machine Operator, Beta Energies Uganda)

This suggests that while the training successfully introduced new technical skills, continued mentorship and internal knowledge sharing are still needed to strengthen wider technical confidence across enterprise teams and reduce dependence on a few specialised operators.

3.6 CHALLENGES AND CONSTRAINTS AFFECTING ENTERPRISE PERFORMANCE AND WOMEN'S PARTICIPATION

Despite the improvements in production capacity, women's participation and market demand, the findings show that enterprises continue to face several financial, operational, technical, market and gender related constraints that affect both enterprise performance and the sustainability of women's participation within the briquette value chain.

One of the most consistently reported challenges across the enterprises was inadequate working capital. Although they had increased production capacity and growing customer demand, the respondents explained that they lacked sufficient funds to sustain production, purchase raw materials in bulk, transport briquettes and expand operations. At Beta Energies Uganda, respondents explained that raw materials such as charcoal dust, wood dust, and molasses had become expensive and difficult to maintain in adequate quantities. One participant noted:

“Inadequate capital to stock enough raw materials, for example, the wood dust and charcoal dust are on high demand.” (IDI, Female, Beta Energies Uganda)

Another enterprise owner explained that production continuity depended on the ability to buy and store raw materials in advance:

“The only way to overcome this is to stock the raw material in plenty to avoid shortage.” (KII, Female, Beta Energies Uganda).

Although enterprises were attempting to adapt through bulk purchasing and storage, limited financial capacity restricted production consistency and enterprise growth.

Raw material shortages emerged as another challenge affecting enterprise sustainability. Participants identified charcoal dust as the most difficult raw material to access because of its high demand and scarcity. Some enterprises explained that they were being forced to explore alternative feedstocks such as dry leaves and peelings when charcoal dust became unavailable. One enterprise owner explained:

“Some raw materials are hard to be accessed, for example, charcoal dust whereby we have to stock in plenty or advance to use other raw materials like dry leaves, peelings and others.” (KII, Female, Masupa enterprise)

Similarly, another Participant noted:

“Inadequate raw materials, mostly the charcoal dust which is on a high demand affects our production process because it's a core raw material.” (IDI, Female, Beta Energies Uganda)

These findings indicate that enterprise operations remain highly dependent on unstable raw material supply chains, creating uncertainty in production planning. Unstable supply of electricity was also identified as one of the most disruptive constraints affecting the use of gender-inclusive technology. Across nearly all enterprises, respondents explained that unreliable electricity interrupted production processes especially when raw materials had already been prepared and mixed. These power outages

delayed production, caused waste of prepared materials and forced enterprises to temporarily revert to manual production methods. One of the machine operators pointed out that power interruptions often force the enterprise to pause production mid-way, leading to material waste and delayed output:

“The biggest challenge is electricity... when we have finished mixing the raw materials and the only way is either, we pause but the mixture will go to waste or else we use the manual way.” (IDI, Female, Beta Energies Uganda)

Another Participant noted:

“Electricity is always on and off which affects the production more so when the raw materials are already mixed thus, they can easily dry up and get to waste.” (KII, Female, Mummy’s Kitchen)

Participants further explained that electricity interruptions affected the dryer especially during rainy seasons when sun drying was less reliable. One machine operator explained:

“My biggest challenge is the drier... during no electricity whereby we mix our raw materials and it leads us behind and sometimes makes us do damages so I request we advance to generator for our drier machine.” (IDI, Male, Beta Energies Uganda)

These experiences suggest that while gender responsive technology improved production efficiency, enterprise operations remain vulnerable to infrastructural limitations, particularly unstable electricity supply.

Women involved in marketing and sensitization activities particularly emphasized the burden created by limited transport support. Since outreach activities require that briquette samples, stoves and other promotional materials are taken to communities, transport costs directly affect the scale of these activities. A marketing staff member from Beta energies explained:

“Transportation is a big challenge since we have no personal means which affects me a lot because I have to take some samples for experiments.” (IDI, Female, Beta Energies Uganda)

Similarly, another respondent observed:

“The other challenge disturbing women is transport means... because they travel to far places to sensitize people so they carry stoves and briquettes and other things to sample people.” (IDI, Male, Beta Energies Uganda)

Transport limitations continue to constrain both market expansion and awareness creation efforts within communities. Although the project improved women's access to production technologies, gendered divisions of labour within enterprises still remained visible. In the participating enterprises, men continued to dominate tasks perceived as physically demanding, such as mixing raw materials, lifting heavy materials and operating machines continuously for long hours while women remained more concentrated in packing, drying, cleaning and marketing for the products. One respondent explained:

“Mixing it’s me myself because it needs a lot of energy compared to leaving it to women.” (IDI, Male, Beta Energies Uganda)

Similarly, another respondent noted:

“Women normally pick out the ready briquettes... as well as marketing.” (IDI, Female Marketer, Beta Energies Uganda)

While the technology reduced some physical barriers, workplace roles continued to be shaped by social perceptions about physical strength and gender appropriate works.

Some respondents also pointed to challenges specifically affecting women's confidence in machine operation. Some women are still hesitant to operate machinery because of fear associated with machine noise and limited protective equipment. One respondent stated:

“Women get scared of the machine sound most times... so request for more trainings and also some ear pads for the women.” (IDI, Male, Beta Energies Uganda)

Others explained that inadequate protective gear such as overalls and boots also discouraged women from participating more actively in machine operation.

“We lack enough safeguarding equipment like overalls, boots... reason as to why women rarely operate the machines because of the kind of clothes they wear.” (IDI, Male, Beta Energies Uganda)

Beyond enterprise operations, unpaid domestic responsibilities continued to affect the consistency of women's participation. Women frequently balanced production work alongside childcare and house responsibilities, which affected attendance and time availability for enterprise activities. One respondent explained:

“Women sometimes delay because they have to care for their children and homes.” (KII, Female, FEW Enterprise)

The findings, therefore, suggest that women's participation within the briquette value chain continued to be shaped not only by enterprise conditions, but also by broader household and social responsibilities.

Market-related constraints also persisted despite customer demand for briquettes. Participants explained that low public awareness about briquettes continued to slow wider adoption within some communities. Several respondents described the need for continuous sensitisation and exhibitions to educate potential users about briquette usage and benefits. One respondent explained:

“Poor sensitization about briquettes to the people whereby people have no knowledge about them at all and it lowers our market.” (IDI, Female, Beta Energies Uganda)

Participants also explained that although customers appreciated the honeycomb briquettes, adoption remained constrained by the cost of compatible stoves:

“The honeycomb is better than the long stick because it keeps the environment clean and goes for a long time but issue comes up with the stove... they cost 45,000 to 50,000 UGX.” (IDI, Female, Beta Energies Uganda)

This indicates that access to complementary cooking technologies remains an important factor influencing broader utilisation of briquettes within households.

Overall, the findings show that despite improvements in production and market performance, enterprises continue to operate within conditions that constrain efficiency, consistency and growth. Challenges related to electricity instability, raw material shortages, limited transport, inadequate sensitisation, and persistent gendered labour expectations continue to affect both enterprise operations and women's participation across the briquette value chain.

4.0 SUSTAINABILITY

This section examines whether the benefits introduced under the project are likely to continue after the end of external support. Sustainability was assessed based on technology use, skills retention, market demand, and operational continuity while scalability was examined through market readiness, technology adaptability, and institutional capacity. The sustainability of project outcomes is supported by strong evidence of continued technology use, and retained skills. However, sustainability is not uniform across enterprises and is shaped by financial capacity, input availability, and operational stability.

4.1 CONTINUED USE AND MAINTENANCE OF THE BRIQUETTE INFRASTRUCTURE

From findings, participants demonstrated capacity and intention to continue operation of the machines and support maintenance post project timeline. One respondent stated that: ***“Servicing of the machine will be done regularly... and monitoring the oil used.”***

This reflects a shift from externally supported use to locally managed maintenance, which is key for sustainability. Enterprises are no longer dependent on project actors for day-to-day functionality. In some cases, this ownership extends further into technical understanding and adaptability:

“We have seen how it was made... if anything ever happened, I have the knowledge... I can even direct someone.”

This indicates that the technology has been partially internalized, not just as a tool, but as a system that users understand and can replicate or repair. Such knowledge reduces long term dependency on external technical support.

At the same time, some level of external linkage remains important. As noted at Masupa Enterprises:

“Even though the project is ending, we still have contacts of the technicians and engineers like Henry. Since he has been supportive and has continued helping us whenever we face challenges, we believe we can still contact him for technical support even if we may need to cover some costs such as transport and labour.” (KII, Female, Masupa Enterprise)

4.2 SKILLS RETENTION AND INSTITUTIONALIZATION

Skills development is one of the strongest drivers of sustainability, particularly where it enables enterprises to operate independently of continued training support.

Participants reported acquiring practical production and marketing skills:

“I am now skilled on how to use the operating machines... and my marketing skills have widened my connections.”

This combination of technical and market-oriented skills supports not only production continuity, but also ongoing market engagement, which is essential for sustained operations.

However, the distribution of these skills remains uneven. In some enterprises, technical expertise is concentrated among a small number of individuals. This creates a structural vulnerability and if those individuals are unavailable, production may be disrupted.

“Roles are mainly distributed according to physical ability, experience, and skill level. Men are mostly involved in physically demanding activities such as mixing raw materials, transporting materials, carbonizing, and operating the manual machines. Women are more involved in operating the dual-power machine, packaging, drying and marketing activities. At the beginning of the project, women were mostly involved in packaging and drying only. However, after the introduction of the dual-power machine and the training provided, some women are now participating in machine operation and production.” (IDI, Female, Masupa Enterprise)

While skills exist, they are not yet fully institutionalized within enterprises. Sustainability, therefore, depends not only on skill acquisition but on how widely and consistently those skills are shared and applied.

4.3 OPERATIONAL CONTINUITY AND MARKET-DRIVEN SUSTAINABILITY

From a market perspective, sustainability is reinforced by consistent demand for briquettes. Enterprises are operating in a demand-driven environment, where the challenge is meeting demand rather than generating it: ***“People keep asking us when we will produce more.”*** This creates a clear economic incentive for enterprises to continue production beyond the project period. Unlike interventions that rely on external subsidies, this model is anchored in real and sustained market need.

Positive customer feedback on product quality, particularly burn efficiency and reduced smoke, further strengthens this foundation, as it encourages repeat usage and customer retention. However, operational continuity is constrained by financial limitations. As explained:

“The biggest challenge is working capital...we cannot produce enough without funds.”

This affects multiple aspects of sustainability, including:

- Consistent procurement of raw materials.
- Ability to maintain continuous production cycles.
- Reliability of labour through timely payment.

In this context, sustainability is limited by financial constraints that restrict the ability to operate at a stable scale.

4.4 GENDER INCLUSION AS KEY TO SUSTAINABILITY

Sustainability also depends on whether women who are central to the project's design are able to maintain their level of participation over time. The introduction of the technology has enabled women to take on production roles more easily: ***“Now I operate the machine... it is not hard work.”***

Another respondent stated that:

“Women are more involved in operating the dual-power machine, packaging, drying and marketing activities. At the beginning of the project, women were mostly involved in packaging and drying only. However, after the introduction of the dual-power machine and the training provided, some women are now participating in machine operation and production.” (IDI, Female, Masupa Enterprise)

This suggests that the technological barrier to participation has been reduced in a way that is unlikely to persist beyond the project. However, sustained engagement is influenced by factors beyond the production environment. Respondents highlighted competing domestic responsibilities as key barriers to women's participation, particularly in enterprises where work schedules are not flexible. This, therefore, calls for flexibility in work schedules to support women's participation.

In addition, the mode of enterprise operation and gender preference for demanding roles remain discriminatory to women, indicating that full inclusion has not yet been achieved across all stages of the value chain. This means that while women's participation is likely to continue, its depth and consistency may vary depending on how these structural constraints are addressed. A respondent stated:

“Other women are hired on a contract basis when the organization needs extra labour. They are usually engaged part-time.” (IDI, Male, Masupa Enterprise)

“Roles are distributed based on work experience. Currently, we have a woman who is in charge of training new workers. The other hired women assist in sieving charcoal dust, carbonising, and cooking, which are considered lighter tasks suitable for women. The men are overall workers; they are involved in all activities and assigned any tasks available.” (IDI, Male, Masupa Enterprise)

5.0 CONCLUSION & LESSONS LEARNED

5.1 OVERALL ASSESSMENT

The findings show that the semi-automated duo power machine and dryer has a great potential for increasing women's participation in briquette production. At the production level, the machinery significantly improved operational efficiency, reduced physical labour intensity, and enabled women to engage more directly in technical roles. This marks a clear shift from baseline conditions, where women's participation was largely constrained to less physically demanding and lower value tasks. However, increased participation has not fully translated into equitable control over production processes or resources. Gendered divisions of labour persist, particularly in physically intensive tasks, indicating that technology alone is insufficient to transform entrenched social norms within enterprise operations.

From an enterprise performance perspective, the project successfully stimulated production capacity and market demand, with several enterprises reporting demand levels that exceed current supply. Despite this, production gains have not been fully realized in market output, primarily due to constraints in drying efficiency, working capital and raw material supply.

In terms of sustainability, the project has established a strong foundation through skills development, technology adoption, and market linkage creation. However, continued operation beyond the project period will depend on the ability of enterprises to address financial constraints, maintain equipment and stabilize input supply chains.

Overall, the project demonstrates that integrating gender-responsive technology with skills development and market engagement can drive meaningful improvements in women's economic participation, but sustained impact requires complementary interventions that address financial, technical and social barriers.

5.2

LESSONS LEARNED

1

One of the takeaways from the project is that introducing this improved technology has made a positive difference in how women engage in briquette production, but it did not automatically solve deeper issues. The machines reduced the physical effort required and made it possible for more women to take part in production, especially in roles that were previously considered too demanding. However, even with this change, the way work is divided between men and women did not shift completely. Some tasks are still seen as more suitable for men, which shows that social norms continue to influence how work is organized, even when the technology changes.

2

Another important insight is that increasing production capacity alone is not enough to improve overall performance. While enterprises were able to produce more briquettes using the new machines, they were not always able to convert this into higher sales or income. This is because other parts of the process, especially drying, could not keep up with the increased production. As a result, the full benefit of the new equipment was not always realized. This shows that improving one stage of production without addressing the others can limit overall impact.

3

The project also showed that training plays a key role in making new technologies useful, but the way skills are shared within enterprises matters just as much as the training itself. In several cases, only a few individuals became confident in operating the machines or handling technical issues. This created a situation where others depended on them, which can become a risk if those individuals are not available. For long term sustainability, it is not enough for skills to be demonstrated by a few individuals, they need to be spread across the entire team.

4

Another lesson is that there is an increased demand for briquettes, and people are willing to use them. Customers appreciate that briquettes last longer, produce less smoke, and can reduce fuel costs. However, demand alone does not guarantee widespread adoption. Some potential users are unable to use briquettes simply because they do not have the right stoves, while others are not yet familiar with how the product works. This teaches us that market growth depends not only on producing more briquettes, but also on making sure that users have the tools and information they need to use them.

5

Financial limitations came out as one of the most consistent challenges across all enterprises. Even when demand was high and production capacity had improved, enterprises were often unable to operate at full scale because they lacked enough working capital. This affected their ability to buy raw materials, pay workers on time and maintain steady production. It became clear that without access to reliable financing, other improvements cannot translate into sustained growth.

6

Finally, there are signs that women's participation in the sector is beginning to shift in an important way. While many women are involved as workers, some are more interested in using the skills they have gained to start their own businesses. The project has not only supported participation within existing enterprises, but has also created pathways toward entrepreneurship that were not anticipated.

6.0 RECOMMENDATIONS

To sustain and expand the benefits from this project, the immediate priority should be to address the constraints that limit enterprise performance like access to working capital and production efficiency. Across all the research sites, it was evident that limited capital directly affects the ability to procure raw materials, maintain continuous production and meet existing demand. This makes financial support an important incentive for stabilizing enterprise operations. Without this intervention, the technology and increased demand of the briquettes will remain underutilized.

Attention should also be given to strengthening internal technical capacity across enterprises. While training has been conducted, the concentration of skills among a few individuals creates a risk to operational continuity. Follow up training should, therefore, focus on ensuring that multiple workers within each enterprise can confidently operate and maintain the machinery used in the briquette production chain. This is a practical step that can be implemented quickly and will improve resilience at the enterprise level.

There is a need to strengthen raw material supply systems to ensure production stability. Current reliance on charcoal dust presents a long term risk, and future programming should support the identification, testing, and adoption of alternative raw materials such as agricultural waste. This would not only

improve sustainability but also position the model for expansion into areas where charcoal by-products are less available.

From a policy perspective, longer term engagement (beyond 18 months) will be required to address structural constraints that individual enterprises cannot solve on their own. This includes improving access to affordable financing for small scale clean energy enterprises, as well as strengthening infrastructure, such as reliable electricity, which directly affects production efficiency. There is also a window to exploring the role of enacting policy support in promoting the adoption of clean cooking solutions more broadly, including incentives or support mechanisms for the private sector players to scale up production that enhances briquette use and stove access. These shifts would create a more enabling environment for enterprises to grow sustainably.

In terms of follow-up actions for the current target participants, continued technical and business support will be important to ensure that the enterprises do not regress after the end of the project. This includes maintaining linkages with fabricators and technicians for equipment maintenance, as well as providing periodic mentorship and advisory support to enterprise owners. There is also a clear opportunity to support women who are interested in starting their own briquette businesses. Facilitating access to start-up support, mentorship, and small-scale financing would allow these participants to transition from employees to entrepreneurs, extending the impact of the project beyond its initial scope.

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NATIONAL ASSOCIATION FOR WOMEN'S ACTION IN DEVELOPMENT

Plot 3378, Block 223 Kyaliwajala - Namugongo Road

P.O.Box 106555, Kampala - Uganda

Tel: +256 707 274993, +256 760 260097;

Toll-free: 0800-365-365

Email: nawad@nawad.co.ug

Web: www.nawad.co.ug