Quantifying impacts on low-income communities through battery-as-a-service model in rural Tanzania

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Busara

Shell Foundation

Jaza

UKaid from the British people

Transforming Energy Access

Executive Summary

This report contains the results and analysis of research conducted in Kigoma and Mtwara regions of Tanzania to examine the impact of Jaza Energy and the battery-as-a-service model on Jaza Hub Operators ("Jaza Stars") as well as current, former, and potential Jaza Customers. Key results include the following:

Demographics of Jaza Customers

- The average age of current customers is 36 years old.
- 82% of account holders are men.
- The average customer household size is seven people; 84% of customers have children, with 51% having four or more children. 82% of customers' children are school age.
- Jaza customers are more likely to have higher levels of education, to have higher rates of monthly expenditure than non-customers and are more likely to own a smartphone (and more likely to use their phone to get information and read the news) than non-customers. However, Jaza customers are *less* likely to save than non-customers.
- Nearly half of all customers' primary source of income is crop farming, and Jaza 60Wh battery users are more likely to experience seasonal variation in income.

Jaza's Impact

- Employment as a Jaza Star meaningfully improves the material circumstances of low-income women and their families.
- Jaza serves Tanzanians with significantly higher rates of disability than the national average.
- Jaza batteries are sometimes used to support income-generating opportunities, both directly and indirectly.
- Jaza contributes significantly to progress toward several of the 2030 Sustainable Development Goals, including SDGs 4, 5, 7, and 8.
- Female Jaza customers report greater control over their schedule and domestic tasks as a result of using Jaza batteries.
- Jaza customers with school-age children report a positive impact on their child or children's academic performance due to using Jaza energy.

Following the results contained in this report, we recommend that Jaza take the following actions:

- Investigate the feasibility and potential benefit of increasing its offerings across spectrums of cost, power, and battery life.
- Explore new payment structures.
- Continue to use promotions and incentives to facilitate customer recruitment and retention.
- Increase sensitisation to and awareness of the benefits of its batteries.
- Increase communication and engagement with customers.
- Ensure that batteries are available for replacement at its hubs.
- Continue to establish hubs in close proximity to target markets.
- Additionally, our findings suggest that the following topics merit further, deeper investigation:
    - Whether customers are using the 180Wh battery for entertainment, one of the pillars of its advertisement;
    - Customers' use of its batteries in generating income;
    - Jaza's impact on childhood education; and
    - Decision making among customers and target markets.

Contents

Abbreviations

IDI: In-Depth Interview

TZREA: Tanzania Rural Energy Authority

SDG: Sustainable Development Goals

SE4ALL: Sustainable Energy For All

TREEP: Tanzania Rural Electrification Expansion Programme

TZS: Tanzanian Shillings

Wh: Watt-hour

Background

Fewer than 40% of Tanzanians have access to electricity, with 64% of the population living off-grid.[1]

<40%

Access to electricity

64%

Living off-grid

In rural areas, as much as 66% of the population rely on kerosene lamps as a lighting source which, in addition to being expensive, is a significant source of atmospheric black carbon and is associated with negative health outcomes.[2] While the Government of Tanzania has prioritised expanding access to energy through its Sustainable Energy For All (SE4ALL) action agenda, relevant regulatory frameworks, projects like the World Bank-funded Tanzania Rural Electrification Expansion Programme (TREEP), and other avenues, Tanzania's widely-dispersed population makes grid expansion economically unfeasible in many areas.[3] Despite TREEP's moderate success, significant barriers remain. even in areas where grid-based electricity is available: households must pay a connection fee of at least $200, while overloaded transformers and distribution lines render grid-based electricity largely unreliable.[4]

Though the Tanzanian Rural Energy Agency (TZREA's) subsidised growth of the solar home system (SHS) market has enabled penetration of over 100 "mini-grids" across the country, solar energy only accounts for 2% of lighting supply in rural areas, and most rural communities remain without access to reliable electricity.[5] This low level of penetration is due in part to high upfront capital costs, difficulties with maintenance and repair, and challenges associated with Tanzania's seasonality where customers report poor performance of home solar systems during the rainy season. Despite

[1] World Bank Group (2016); IPSOS Tanzania (2017)

[2] IPSOS Tanzania

[3] World Bank Group; IPSOS Tanzania

[4] U.S. Agency for International Development, 2018.

[5] IPSOS Tanzania; U.S. Agency for International Development

the progress made on expanding access to electricity in rural areas, these barriers lead many to continue using kerosene for lighting. While kerosene may be used for lighting, it cannot double as a power source for cell phones or household appliances and is harmful to both physical and environmental health.[6]

In response to these challenges, Jaza Energy has found innovative ways of expanding access to high quality, sustainable energy. Jaza Energy brings affordable electricity to low-income customers in rural and remote parts of Africa through a network of solar energy hubs from which customers may rent solar-charged batteries for home lighting and other household energy needs. Jaza Energy's battery-as-a-service model allows customers to affordably swap portable battery packs to meet household energy needs. After signing up for Jaza's services and providing a guarantor for their account, customers may rent batteries with either 60Wh or 180Wh capacity, with average battery charge lasting for 1-3 days, depending on usage. Customers may pay across several schedules, ranging from payment-per-transaction to monthly payments. In addition to its work in Tanzania, Jaza Energy has recently announced the expansion of a pilot programme into Nigeria.

Jaza's solar energy hubs are managed entirely by local women. Each hub is operated by two women from the community who receive a base salary in addition to monthly commission. Beyond overseeing operations at each hub, these "Jaza Stars" are responsible for attracting customers through word-of-mouth and community advertisements. Jaza Stars are provided with training on their core responsibilities (using the mobile app, battery management, and sales skills) while also receiving soft skills training including sessions on goal setting, financial literacy, and developing confidence. Jaza Stars are connected to one another through regional WhatsApp groups to provide ongoing support, peer learning, and to develop community empowerment. Jaza Stars may advance in their careers through the Super Star programme, whereby more experienced Jaza Stars develop managerial skills such as onboarding, training, and mentoring new hires or even overseeing the operations of multiple hubs.

As part of its ongoing partnership with Jaza Energy, the Shell Foundation is looking to fully understand and quantify the impacts of a battery-as-a-service model in rural Tanzania on low-income consumers, Jaza Stars, and the broader ecosystem. In support of this effort, the Busara Center for Behavioral Economics–a leading research and advisory firm with extensive experience in designing and testing behavioral interventions that contribute to poverty alleviation in the Global South–collaborated with Jaza Energy and the Shell Foundation to design and conduct qualitative and quantitative research among current, former, and potential Jaza customers as well as Jaza Stars. This report contains the results of this research, analysis of those results, and recommendations informed by those results.

[6] US Agency for International Development

Methodology

Research was divided into two "workstreams," with Workstream 1 unpacking the potential impact of Jaza Energy and the battery-as-a-service model on Hub Operators and Workstream 2 examining the potential impact of Jaza Energy on current, former, and potential Jaza customers. Busara implemented a mixed methods approach, with a more extensive customer and non-customer survey, along with deep dives into customer profiles that give insight on key topics including gender. Detailed descriptions of each workstream's methodology are described below.

Workstream 1: Unpacking the potential impact of Jaza Energy and the battery-as-a-service model on Hub Operators

Workstream 1 exclusively focused on qualitative research. In parallel with the In-Depth Interviews (IDIs) conducted in Workstream 2, the research team held IDIs with a total of 15 Jaza Stars in Kigoma and Mtwara regions. In addition to collecting key demographic information, IDIs focused primarily on examining Jaza Stars' experiences of work and exploring the differences in their lives pre- and post- employment as a Jaza Star.

Workstream 2: Understanding the potential impact of Jaza Energy on current and potential Jaza customers

To better understand the potential impact of and gain insights into the behavior of current, former, and potential Jaza customers, two primary research activities were conducted:

First, IDIs were held among 30 current customers and 15 non-customers in Kigoma District and Mtwara District. While not intended to be statistically representative of the respective population, participants were selected to approximate the diversity of experiences within the population. All participants were 18 years of age or above, span the variation of income and education levels, and come from a regionally representative variety of ethnic backgrounds. Customers were categorised into segments based on average usage frequency, with more than 20 days of usage qualifying as "high usage", 10-20 days counting as "medium usage", and 0-10 days as "low usage". Five participants were selected from each segment in each district, for a total of 30 customers.

Interviews solicited demographic information, experiences with different lighting and power sources, awareness of and motivation for using Jaza Energy (where applicable), experiences using Jaza Energy, and gender-related outcomes of using Jaza Energy. All interviews were conducted in Kiswahili in late January and early February of 2022 and subsequently translated into English for coding and analysis.

Second, between 8 March and 18 March 2022, 427 randomly selected current or former Jaza customers and 100 randomly selected non-customers from Mtwara and Kigoma districts participated in a telephonic survey administered in Kiswahili. Following up on insights from the IDI analysis, the survey collected information on respondent demographics (including income levels and education status), as well as their experiences with or awareness and perceptions of Jaza. Particular attention was given to assessing Jaza's impact on gender equity, accessibility, and childhood education. Upon completion of the survey, the research team conducted an array of analyses ranging from summary statistics to significance testing and causal inference.

Findings

Unpacking the potential impact of Jaza Energy and the battery-as-a-service model on Hub Operators

"I have become [self-assured] because of Jaza… and now I believe in myself. Jaza has instilled me with confidence and [now] I can go anywhere and express what Jaza is and what it does"

- ***Jaza Star, 31, Mchori***

"Others who never took me seriously… now they respect me"

- ***Jaza Star, 19, Kalege***

Providing an income source for women who work as Jaza Stars is an important goal of Jaza's battery-as-a-service model. For these women, the battery-as-a-service model provides a new income source which in turn impacts their financial wellbeing and opportunities, as well as those of their families. Beyond improved financial status, Jaza Stars receive holistic investment in their overall wellbeing through the development of life skills and connection to a broader community of Jaza Stars. In order to fully understand how women benefit from Jaza's model, Busara conducted qualitative research to understand how Jaza Stars interact with and benefit from their roles. The average Jaza Star interviewed was approximately 24 years old, single (but with multiple dependents including parents, siblings, and in some instances children), had completed some secondary schooling, and previously earned income primarily through farming. All Jaza Stars interviewed report enjoying and getting fulfillment from their roles, due to the direct material benefits they receive along with numerous spillover effects. A 19-year-old Jaza Star from Kalege explains, ***"I like the way I talk to my customers and the way I provide service to them…this encourages me to be charming and to have friendly talk with people."***

Financial Benefits

Employment as a Jaza Star provides compensation in the form of a base salary and commission. Interviews with Jaza Stars confirm that Jaza Stars often use this compensation to increase their wealth, productivity, and wellbeing through the accumulation of key assets. Across all Jaza Stars interviewed, reports of assets purchased with money earned as a Jaza Star included home furnishings such as mattresses and living room furniture, phones, televisions, other technology, and productive assets like livestock, including goats and poultry.

The majority of Jaza Stars were farmers before working for Jaza, and many have continued since beginning their positions. Jaza Stars often invest funds earned from their employment into their other income-generating activities. One Jaza Star from Mndimba reported being able to significantly increase her farm's productivity, saying: ***"Now [after working for Jaza] I can hire people and cultivate my farm to up to 2 or 3 acres. It was not easy before I was employed."*** Another Jaza Star who generates income through farming shared that she "only use[s] the earnings from Jaza energy to fund [her] farming activities," through "paying farm laborers and…buying fertiliser." She reports that she has doubled her land under cultivation and is now able to generate an extra TZS 30,000 per month from selling produce.

Jaza Stars also report improved financial decision making coming from their improved material conditions and strengthened by the training they receive. Examples provided by a 19-year-old Jaza Star from Kalege and a 40-year-old Jaza Star from Kasulu illustrate each phenomenon, respectively. The Jaza Star from Kalege notes: "***Before I had no money and thus it was difficult for me to make decisions on buying things but now I can manage to make decisions."*** Noting the holistic growth and skills development stemming from her employment, the Jaza Star from Kasulu reports that "***Jaza has helped me make better financial decisions. Thanks to Jaza, it has expanded me mentally, intellectually too."***

Other evidence of improved financial decision making is apparent in the fact that almost all Jaza Stars interviewed can save money because of their employment. While none report being formally banked, almost all Jaza Stars participate in savings groups or save by putting aside mobile money.

Social Benefits and Empowerment

> Working for Jaza has empowered me; I am not like the ones who do not work for Jaza"
>
> - ***Jaza Star, 31, Mchori***

In instances where Jaza Stars are not their household's primary decision maker, their ability to contribute to household finances tends to increase their role in decision making; 62% of Jaza Stars interviewed report an increased role in household decision making associated with elevated household status gained through employment.

62%

Increased role in decision making

As a 19-year-old Jaza Star from Kalege stated, ***"When I was only a farmer, my family were not considering me in making decisions, but now after being working with Jaza I participate in decision making."*** A 31-year-old Jaza Star from Mchori adds, ***"I can help my husband in the business. I can sit with my husband and plan the business; I can dictate which business we get into and give him the capital."***

Jaza Stars do not only report greater input in household decision making, but also greater autonomy in their own financial decisions, as illustrated by a 22-year-old Jaza Star from Mhunga: ***"When I was home, the little money earned was [subject to parental oversight], but now I am free with the money I get, I do the things I want for myself."*** This autonomy can also be seen in reports that Jaza Stars develop a stronger sense of self-efficacy through their experiences as hub operators. Many Jaza Stars report that, since beginning work as a Jaza Star, they have the ability to change things in their life.

Interviews with Jaza Stars illustrated that the sense of empowerment is not limited to household or personal decision making, but in increased confidence and social status. A 19-year-old Jaza Star from Kalege explains, ***"Previous[ly] it was difficult for me to stand in front of men and explain something, but now I have confidence of doing it and I do it as a service provider… [it] has given me courage on how to talk with people in my society."*** Many Jaza Stars report that their employment has helped them feel like a leader in their community, like a Jaza Star from Mndimba who explains, ***"I am now invited to the community meeting to contribute my opinions."*** A 23-year-old Jaza Star from Kalege reports: ***"Now I feel more respected than before*** **[I became a Jaza Star].*"*** A 32-year-old Jaza Star from Kasulu adds: ***"People used to call me 'Mama someone' but now they call me 'Jaza.'"***

While few Jaza Stars report that their goals have changed after employment, many say that their salaries contribute to them achieving their goals and that employment as a Jaza Star constitutes progress toward their individual goals. For example, a 23-year-old Jaza Star from Kalege reports that her personal goal to own land predates her employment with Jaza, but that she did not have access to the funds needed to realise that goal until becoming a Jaza Star. Another Jaza Star, a 22-year-old from Mhunga shared a similar experience, saying "***My goals are to have enough money, so I can buy galvanised steel and fix our house, and if possible, to save money and buy a plot of land. [My goals] have not changed, but I have hope that I will fulfill them in the future."*** Other Jaza Stars, like a 31-year-old from Mchori, are focusing their goals on professional growth in their position: ***"I just want to be honest and work hard for Jaza; for my supervisors to trust me in order to be promoted."***

Skill Development

The majority of Jaza Stars interviewed reported gaining several new "hard" and "soft" skills while working for Jaza Energy. Hard skills include technical elements of their job (such as connecting the battery to devices), using new technologies like phones, and managing and inspecting inventory and storage of hub equipment. Soft skills include public speaking, strengthened communication abilities, and other customer service skills. As described by a 22-year-old from Mhunga: ***"At first, I did not know what a Jaza battery is, but now I understand. I also did not know how to use a smartphone but now I can even send reports and scan a battery."*** A 20-year-old Jaza Star from Mcholi illustrates

how work as a Jaza Star has helped her develop soft skills, saying: ***"Now I can speak in front of people ... [Jaza] has given employment to women but also empowers you in such a way that you can stand in front of men and explain to them how batteries work."***

Community Benefits

Jaza Stars do not only support their community through hub operations; their employment affords them the opportunity to directly assist friends and family in ways that benefit the entire community. As reported by a 19-year-old Jaza Star from Kalege, "***I have been able to take my sister's children to school….A person can be sick and I can be able to buy them medicines."*** A Jaza Star from Mndimba shared that her salary allowed her to pay her young sibling's school fees and to finally buy herself a mosquito net.

Jaza's promotion of gender equity does not end with its investment in Jaza Stars. A Jaza Star from Mndimba reports observing a positive impact on other women in the community because of Jaza, explaining that "***many women are using Jaza in the market to get light. Before they used solar and other sources of light, but the quality was low but with Jaza they can do business up to night."***

Conclusion

The findings detailed above suggest that the Jaza Star programme helps reduce gender inequities across a number of established impact measurements, and contributes toward achieving SDG Target 8.5, “Achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value.”[7] The Jaza Stars programme is a meaningful and high-impact effort to support gender equity both in the workplace and community and to increase female earnings and workplace inclusion. The programme’s successes are clear: Jaza Stars report high degrees of job satisfaction and improved material circumstances for themselves and their families as a direct result of their employment.

[7] Impact measurements include, but are not limited to: IRIS+ Metrics PI9467 (Gender Ratio of Promotions), OI2444 (Permanent Employees: Female), OI3236 (Permanent Employees: Minorities / Previously Excluded), OD4232 (Women’s Career Advancement Initiative), OI4884 (Fair Career Advancement Policy), OI1571 (Full-time Employees: Female Managers, OI4724 (Employees Earning a Living Wage or Higher); UN General Assembly (2015)

Understanding the potential impact of Jaza Energy on current and potential Jaza customers

Demographics

Age

Survey respondents – whether current customers, former customers, or non-customers were – similar to one another across many demographic factors. Respondents' age ranged from 18-80 years old. The mean age of all respondents was 36 years, as was the mean age of current customers. The mean ages of former customers and non-customers were 38 years and 33 years, respectively.

Gender

Men were disproportionately represented in this survey across all groups, with 80% of all respondents identifying as male. Approximately 82% of current customers identified as male, compared to 80% of former customers and 71% of non-customers. As customers were randomly selected from Jaza Energy's customer database, this bias in former and current customers is most likely due to gender norms influencing the name under which households tend to register their Jaza account. The cause of male overrepresentation in the non-customer segment is unknown but may

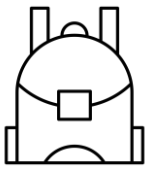
be due to similar gender norms affecting phone ownership in the surveyed population. These forms of bias are particularly likely, as evidence suggests that the female population of mainland Tanzania is in fact slightly larger than the male population across all age groups.[8]

As men are overrepresented across all segments, insights here should be understood not to illuminate the experiences of all Jaza *users*- indeed, qualitative evidence confirms that household use of the Jaza Energy battery is not restricted to the account holder. Therefore, this report's insights into customers and their experience(s) are better understood as the experiences of customers who are or were also account holders.

Marital Status and Children

Most respondents (77%) are married, with slightly higher rates among current customers (79%) than former customers (77%) and non-customers (71%). A sizable majority of respondents across all segments have children. Overall, 82% of respondents are parents, with 84% of current customers, 82% of former customers, and 77% of non-customers reporting that they have children.

Most respondents who have children have multiple children. Among all respondents, 51% have 4 or more children, identical to the percentage of current customers with 4 or more children. Former customers reported having larger families, with 50% reporting having 5 or more children, while non-customers reported having smaller families, with 61% reporting having 3 children or fewer. Sizable majorities of parents across all customer groups report having at least one school-age child, with 79% of all respondents reporting at least one is school-age child. This rate is 82% for current customers, 77% for former customers, and 71% for non-customers.



82%

Of current customers have at least one school-age child

Though none of the differences in average age, marital status, parenthood, number of children, or presence of school age children are statistically significant, there are other demographic measures in which statistically significant differences between customer segments are observed.

Household Size

Customers–whether current or former–are more likely to have larger households than non-customers. There is a statistically significant positive correlation ($p<0.05$) between household size

[8] World Bank Group; Statistician General, Government of Tanzania

and and customer status. The mean household size was 7 for current and former customers, and 6 for non-customers. This finding suggests that Jaza customers have more dependents than non-customers, which likely influences their energy and lighting needs.

7

Average household size of current customers

Education Level

There is a statistically significant positive correlation ($p<0.05$) between level of education and having ever been a Jaza Energy customer. While 10% of all customers (11% of current customers, 8% of former customers) have at least completed their higher-level secondary education, only 4% of non-customers have progressed to that level of educational attainment. Among current customers, there is a strong statistically significant positive correlation ($p<0.05$) between education level and use of the Jaza 180Wh battery, and the relationship between education level and use of the Jaza 60Wh battery is approaching statistical significance ($p=0.08$).

While a detailed examination of the relationship between education level and being a Jaza customer is beyond the scope of this report, it is plausible that educational attainment influences energy consumption behavior in a way that leads more highly educated individuals to use Jaza batteries. For instance, it may be the case that more highly educated individuals are more acutely aware of the negative impacts associated with kerosene-powered light sources and more inclined to pursue clean, sustainable energy sources such as Jaza batteries. Whatever the reason, this finding suggests that the average Jaza customer has a higher level of educational attainment than other members of their community.

Finances and Financial Behaviors

Primary Earner

Over 75% of respondents in each segment, and 78% of all respondents' report being their household's primary earner. Primary household earners are somewhat more common amongst current and former customers than among non-customers (75%), though this difference is not statistically significant. In the context of the observed male overrepresentation in account holder status described above, thorough examination of the potential connection(s) between gender disparities in phone ownership, earning ability, and account holder status merits further investigation.

Primary Source of Income

Respondents reported their primary source of income, selecting from the following options: Crop farming, fisheries, poultry farming, masonry or construction, auto driving, carpentry, formal employment, business, or other. Nearly half of respondents across all segments reported crop farming as their primary source of income: 47% of all respondents, 46% of current customers, 42% of former customers, and 56% of non-customers primarily earn income through crop farming. However, the observed differences between segments are not statistically significant.

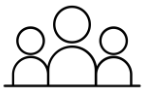
Figure 1 - Source of Income by Customer Segment

	Customer Segment			
Source of Income	**Current Customer**	**Former Customer**	**Non- Customer**	**All Respondents**
Crop Farming	137	56	56	**249**
Fisheries	21	15	5	**41**
Poultry Farming	2	0	0	**2**
Masonry/ Construction	6	4	2	**12**
Auto Driving	8	3	6	**17**
Carpentry	11	6	5	**21**
Formal Employment	22	6	2	**30**
Business	43	20	16	**79**
Other	45	22	9	**76**
Total	**295**	**132**	**100**	**527**

Average Monthly Income

Respondents were asked to report their average household monthly income in Tanzanian Shillings from 5 “brackets”: Less than 100,000; 100,001-270,000; 270,001-500,000, 500,001-1,000,000; and over 1,000,000. Given the known prevalence of seasonality affecting income in regions like Kigoma and Mtwara, respondents could also respond that their income varied significantly by season. Respondents who reported significant seasonal variation of income were asked to estimate their average monthly income in high season (or in their typical higher-earning periods) and their average monthly income in low season (or in periods of low earning).

Responses were similar across customer segments: 50% of all respondents report an average monthly income of less than or equal to TZS 270,000 ($116.08, or approximately $3.87 per day), with 48% of current customers, 52% of former customers, and 55% of non-customers reporting the same.



50%

Respondents reported average incomes less than or equal to

TZS 270,000

($116.08 per month, or $3.87 per day)

The largest concentration of responses was between TZS 100,001-270,000, representing 27% of all respondents, 24% of current customers, and 35% of non-customers. Though 25% of former customers also reported this level of average monthly income, slightly more (27%) reported making less than an average of TZS 100,000 per month.

For each segment, income is affected by relatively high rates of seasonality. For all respondents, 18% of respondents reported that their average monthly income varies significantly by season. This was observed for 19% of current customers, 15% of former customers, and 22% of non-customers.

19%

Of current customers report high levels of seasonal variation in income

While no statistically significant relationship was observed between average monthly income and customer segments, there is a statistically significant positive relationship ($p<0.05$) between significant seasonal variation in average monthly income and use of the Jaza 60Wh battery, meaning that customers who experience severe seasonal fluctuations in their income are more likely to primarily use the Jaza 60Wh battery.

Seasonal Income

In total, 97 respondents of the 527 surveyed (18%) reported significant seasonal variation in income. Reported seasonal high income differed from nonseasonal average income, but not significantly so: 40% of all respondents reported an average monthly seasonal high income of less than or equal to TZS 270,000, compared to 33% of current customers, 45% of former customers, and 55% of non-customers.

For all seasonally affected respondents, 27% reported earning between TZS 100,001-270,000, with 30% of former customers and 36% of non-customers earning in that range during the high season. While 22% of current customers reported the same, slightly more (27%) reported earning between TZs 270,001-500,000.

For all customer segments, the largest concentration of average low season income was in the lowest bracket: less than TZs 100,000. Among all respondents, 37% reported earning in this range during low season, broken down by 33% of current customers, 40% of former customers, and 45% of non-customers who reported significant seasonal variation in income.

Despite these variations in seasonal earnings across customer segments, there is no statistically significant relationship between seasonal average earnings, customer status, or customer behavior based on average high season or low season incomes.

Average Monthly Expenditure

Respondents were asked to estimate their average monthly expenditure and given the same expense "brackets" as they were when asked their income. Though reported income level has few associations with customer behavior or status, there is a statistically significant positive correlation ($p<0.05$) between average monthly expenditure and customer status. Households with higher average monthly expenditures are significantly more likely to currently be or once have been a Jaza customer. While 22% of current and former customers who were willing to share this information reported an average monthly expenditure exceeding TZS 270,001, only 13% of non-customers reported the same.

This relationship may intuitively be explained in part by the fact that current Jaza customers have an obvious expense that their non-customer counterparts do not share —namely, spending on Jaza Energy. That former customers persist in having higher average monthly expenditures than their non-customer counterparts may suggest a behavioral difference between those who have ever been Jaza customers and those who have never been Jaza customers: a potential tendency toward savings or dissavings (see "Savings" below for further examination). Alternatively, former Jaza customers may have maintained their levels of expenditure while reallocating funds toward other sources (such as returning to Kerosene lamps or batteries).

Savings

Supporting the hypothesis that there is a behavioral or dispositional difference between customers and non-customers around savings or dissavings, there is an observed statistically significant positive correlation ($p<0.05$) between having savings and never having been a Jaza customer. While a majority of all respondents across each segment report that they do save whatever leftover money they have (primarily through savings groups and mobile money), 71% of non-customers report

savings behavior compared to 61% of all respondents, 59% of current customers and 58% of former customers. Future research into current, former, and potential Jaza customers may benefit from particular exercises examining the groups tendencies toward savings or dissavings.

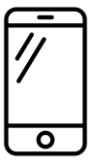
Non-Energy Expenses

In order to better understand Jaza customers' spending priorities, respondents were asked to select their household's top non-energy priority expenses from the following list: food, healthcare, transport, school fees, clothing, rent, minor expenses, or other. The three most common responses were consistent across all customer segments. Food, followed by minor expenses, and then healthcare were the three most common responses.

For all respondents, 95% listed food as a top priority expense, followed by 68% listing minor expenses and 56% listing healthcare. Among current customers, 94% listed food as a top priority expense, followed by 64% listing minor expenses and 45% listing healthcare. Former customers had similar response rates for these categories, with 95% listing food, 66% listing minor expenses, and 43% listing healthcare as top priority expenses. All non-customers reported food as a top priority expense, with 80% listing minor expenses and 39% listing healthcare as top priority expenses for their household. No statistically significant difference between reported top priority expenses was observed between groups.

Phone Ownership and Usage

Investigators asked respondents several questions regarding phone ownership and use.[9] Among all respondents, 83% reported using a feature phone, while 24% reported using a smartphone.



83%

Of respondents own a feature phone

[9] For purposes of this study, researchers did not differentiate between outright ownership and financed ownership of phones.

Current customers reported the highest rate of smartphone ownership, with 30% responding that they own a smartphone, and 79% saying they own a feature phone, compared to former customer ownership rates of 15% and 87%, respectively. Among non-customers, 21% reported smartphone ownership and 87% reported feature phone ownership.

There is a strong, statistically significant positive correlation ($p<0.01$) between smartphone ownership and current customer status, suggesting that current customers are much more likely to own a smartphone than former customers or non-customers. While determining the exact causes of this relationship requires further investigation, there are several possible and plausible explanations for this observation: Given the cost of smartphone ownership, customers may feel a stronger-than-average desire to ensure continued access to and usage of their smartphone, thus motivating them to remain active Jaza customers. Alternatively, the greater number of functionalities of a smartphone relative to a feature phone may make the phone a more used and useful tool, leading to increased motivation to maintain access to a reliable energy source.

Respondents were asked to report how frequently they use their phone, selecting from the following options: Daily, it is always with me; sometimes; occasionally; hardly; and other. The vast majority of respondents across all segments (83% overall) reported daily use of their phone. Current customers reported the highest percentage of daily usage (84%) compared to former customers (80%) and non-customers (81%), however the differences in frequency of use were not found to be statistically significant.

An even larger majority of respondents reported that the phone they use is their personal phone, and not shared with family / relatives, community members, or friends outside of incidental occasions. Among all respondents, 95% reported that their primary phone is their personal phone. Non-customers had the highest response rate for this category at 99%, followed by current customers at 94% and former customers at 92%.

Respondents were next asked to select their primary phone usages from the following menu: Social / family communication; to get information / read news; work or business; and others. All respondents (100%) reported using their phone for social and family communication. The second most common response was “work or business”, with 28% of all respondents reporting their phone being used for work. Among current customers, 29% reported using their phone for work or business, compared to 26% of both former customers and non-customers.

There is a statistically significant positive correlation ($p<0.01$) between current customer status and using one’s phone to get information or read the news. The most plausible explanation for this observation is collinearity among education level, smartphone ownership, and using one’s phone to get information or read the news. That is, holding all other variables constant, more educated

individuals are more likely to own a smartphone, and are therefore more likely to use their phone to get information or read the news.

Holding smartphone ownership constant, however, education level is not independently associated with customer status. This phenomenon suggests that smartphone owners are more likely to be Jaza customers than non-smartphone owners for any given education level, and that the positive relationship between education level and smartphone ownership may be driving any association between education level and customer status.

Disability

Prior customer research has suggested that Jaza Energy may hold particular value for individuals with disabilities. To investigate these reports further, the survey incorporated the Washington Group "short set" of six disability questions to be able to disaggregate beneficiaries based on disability per UK International Climate Finance guidance. In order to assess rates of visual disabilities, auditory disabilities, mobility disabilities, cognitive disabilities, and functional disabilities, respondents were asked to report whether they, or anyone in their household, have difficulty with relevant tasks. For

each question, respondents could select from the following list: No difficulty, some difficulty, a lot of difficulty, cannot do at all.

As the survey questions asked not just about individuals, but about individuals in respondents' households, a comparison for statistical significance required the creation of a similar population-level statistic. Individual-level data on mainland Tanzanian disability rates from the 2014 Integrated Labour Force Survey was combined with mainland Tanzanian household size data (mean=4.80) from the 2012 Tanzanian National Census to create a population-household disability rate for testing our sample data against population means. To illustrate: The 2014 Integrated Labour Force Survey found a population-level rate of visual disability of 2.25% among mainland Tanzanians. With an average household size of 4.80, the household-population rate is calculated to equal 10.80% (0.0225*4.8 = .108).

> *Our findings present very strong evidence to support the claim that Jaza Energy serves Tanzanians with significantly higher rates of disability than the national average.*[10]

This finding merits further investigation to determine whether this is due to the batteries' simple design and ease of operation making Jaza a more accessible option, whether the higher quality of light and reliable power for devices holds particular value for individuals with disabilities, or any other possible causal relationship.

Visual Disabilities

To establish household rates of visual impairment respondents were asked whether they, or anyone in their household, have difficulty seeing even if wearing glasses. In total, 20% of respondents who had ever been a customer (current and former customers) responded that they, or someone in their household, has at least some difficulty seeing, even when wearing glasses.

20%

Difficulty seeing (even when wearing glasses)

[10] This finding can be considered a high degree of impact along IRIS+ metric PI6266 (Client Individuals: Disabilities).

Compared to the population-wide household mean of 11%, there is a very strong statistically significant correlation (p<.0001) between household presence of visual impairment and being a Jaza customer.

> *Among visually impaired customers, 95% reported that the quality of Jaza's light helps them see more, and the same percentage reported that they find Jaza simpler to use than other power sources.*

Both the high quality, bright light provided by Jaza's batteries and bulbs and the simplicity of design have equity impacts far greater than their aesthetic value. For visually impaired individuals, being able to see more due to good lighting may, for example, prevent injury caused by tripping over an unseen object or obstacle. A power source that is streamlined, simple to use, and does not require reading or the manipulation of fine, hard-to-see instruments to operate is one that can be used more readily and effectively by those with visual impairment. Further evidence in support of these hypotheses is examined below, under Customer Behavior and Perceptions.

Auditory Disabilities

To establish household rates of hearing impairment, respondents were asked whether they, or anyone in their household, have difficulty hearing even if using a hearing aid(s). In total, 13% of respondents who had ever been a customer (current and former customers) responded that they, or someone in their household, has at least some difficulty hearing.

13%

Difficulty hearing

Compared to the population-wide household mean of 5%, there is a very strong statistically significant correlation (p<.0001) between household presence of hearing impairment and being a Jaza customer.

Further statistical analysis reveals a significant positive correlation (p<0.01) between household presence of hearing impairment and use of the Jaza 180Wh battery. Qualitative evidence suggests that many customers who report using the Jaza 180Wh describe using it to power subwoofers and other amplifying devices. While the exact causal mechanism is unknown, evidence suggests that the

Jaza 180Wh battery supports accessibility to the hearing impaired by providing sufficient power for sound amplification devices at an affordable rate.

Mobility Disabilities

To establish household rates of mobility impairment, respondents were asked whether they, or anyone in their household, have difficulty walking or climbing steps. In total, 14% of respondents who had ever been a customer (current and former customers) responded that they, or someone in their household, has at least some difficulty walking or climbing steps.

14%

Difficulty walking or climbing stairs

Compared to the population-wide household mean of 9%, there is a strong statistically significant correlation ($p<0.01$) between household presence of mobility impairment and being a Jaza customer.

Respondents report that both Jaza battery models are highly portable and easy to carry, and that their nearest Jaza Hub is often approximately 5 minutes away by foot.

> *Among customers with mobility impairments, 91% report that Jaza Energy batteries are easier to transfer or carry than other energy sources they have ever used.*

As such, it is likely that the significant correlation between mobility impairment and customer status is due to Jaza's lightweight, compact design promoting accessibility for the mobility impaired. Additional evidence in support of these hypotheses is examined below, under Customer Behavior and Perceptions.

Cognitive Disabilities

To establish household rates of cognitive impairment respondents were asked whether they, or anyone in their household, have difficulty remembering or concentrating. In total, 15% of respondents who had ever been a customer (current and former customers) responded that they, or someone in their household, has at least some difficulty remembering or concentrating.

15%

Difficulty remembering or concentrating

Compared to the population-wide household mean of 6%, there is a very strong statistically significant correlation (p<.0001) between household presence of cognitive impairment and being a Jaza customer..

> *Of all customers who reported that they, or someone in their household, experiences cognitive impairment, 83% reported that they find Jaza to be easier to use than other power sources.*

For individuals with difficulty remembering or concentrating, the simplicity of Jaza's battery design as well as the easy battery return, and exchange process helps support energy access.

Functional Disabilities

To establish household rates of functional impairment were asked whether they, or anyone in their household, have difficulty with self-care, such as washing all over or dressing. In total, 7% of respondents who had ever been a customer (current and former customers) responded that they, or someone in their household, have some difficulty with basic functional tasks. Compared to the population-wide household mean of 4%, there is a very strong statistically significant correlation (p<0.01) between household presence of functional disability and being a Jaza customer.

> *Among customers who reported household incidence of functional disability, 91% reported finding Jaza Energy's batteries easier to transfer or carry than other energy sources they have used, and 82% reported that they believe Jaza is easier to use than other power sources.*

Neither result, however, is statistically significant. Functional impairment may be somewhat collinear with mobility impairment (i.e., the cause for an individual's difficulty walking or climbing stairs may be the same as the cause of their difficulty with self-care such as washing all over or dressing) and/or collinear with cognitive impairment (i.e., an individual's difficulty concentrating or remembering may impact their ability to function). However, it is also possible that one would find

similar assessments of Jaza's ease-of-use and portability among the total population - that is, that Jaza energy batteries are objectively easier to use and more portable than most power sources. Further investigation (such as focus groups with non-customers) may provide a baseline for overall assessments of Jaza's comparative ease of use and portability.

Communicative Disabilities

To establish household rates of speech impairment, respondents were asked whether they, or anyone in their household, have difficulty communicating (understanding or being understood) when using their usual language. In total, 5% of respondents who had ever been a customer (current and former customers) responded that they, or someone in their household, has at least some difficulty communicating. Compared to the population-wide household mean of 3%, there is a statistically significant correlation ($p<0.05$) between household presence of speech impairment and being a Jaza customer.

The relationship between communicative disabilities and Jaza customer status is less readily apparent. While 75% of respondents who reported the presence of communication impairment in their household also reported having favorable or very favorable views of Jaza's customer service, there is not a statistically significant relationship between communicative disability and views on Jaza's customer service. This rules out the hypothesis that Jaza Stars' highly rated customer service skills are not especially effective in supporting customers with communication impairments. The causal relationship between communicative impairment and customer status currently remains unclear, and merits further investigation.

Impact of Using Jaza Energy

By its very nature, Jaza represents a significant contribution toward achieving SDG 7, “Ensure access to affordable, reliable, sustainable and modern energy for all.”[11] Specifically, Jaza helps to increase the proportion of population with access to electricity (Indicator 7.1.1) and the proportion of population with primary reliance on clean fuels and technology (Indicator 7.1.2). Jaza also increases the renewable energy share of total final energy consumption (Indicator 7.2.1). Beyond this direct progress toward supplying affordable, reliable, sustainable and modern energy, there is strong evidence of positive externalities from Jaza’s operations, particularly regarding gender equity and childhood education.

Impact on Gender Equity

Building gender equity is a core pillar of Jaza’s business model. Beyond its efforts to empower women in remote and rural areas through employment as Jaza Stars, evidence suggests that Jaza batteries support progress toward SDG 5 - achieve gender equality and empower all women and girls. In order to evaluate Jaza’s contributions toward SDG Target 5.4–recognise and value unpaid care and domestic work through the provision of public services, infrastructure and social protection policies and the promotion of shared responsibility within the household and the family as nationally

[11] UN General Assembly

appropriate–female survey respondents were asked a series of questions pertaining to Jaza's role in their performance of unpaid care and domestic work.[12]

Female respondents were asked whether Jaza energy has helped reduce the amount of time spent on the following tasks: Cooking; dishwashing; cleaning and upkeep of the dwelling; laundry; ironing; gardening; caring for pets; shopping; installation, service, or repair of personal and household goods; childcare; and care of the sick, elderly, or disabled family or household members.

While a majority of respondents only noted Jaza's contributions toward reducing time spent cooking, any progress made toward SDGs is noteworthy. Moreover, no respondents reported spending *more* time on these tasks after beginning to use Jaza. Qualitative evidence suggests that the reduction in time spent cleaning and washing dishes is primarily caused by Jaza providing consistent lighting for these tasks as well as increasing the window of time in which these tasks may be performed. As a 32-year-old woman from Kitema Village noted, ***"Previously I was cooking early but for now I cook after coming back from business. Before I could not iron during the night and had to iron in the morning, which would make me late for work. Now, I can iron in the night because I have light."***

Further examination of Jaza's effects on key indicators pertaining to SDG 5.4 reveals that they are not felt evenly across all income levels:

- For women whose average monthly household income is TZS 100,000 or less:
  - **75% report that Jaza has helped reduce time spent cooking**
  - **55% report that Jaza has helped reduce time spent on cleaning and upkeep of the dwelling;**
  - **50% report that Jaza has helped reduce time spent dishwashing;**
  - **44% report that Jaza has helped reduce time spent on childcare.**
- For women whose average monthly household income is between TZS 100,001 and 270,000:
  - **63% report that Jaza has helped reduce time spent cooking**
- For women whose average monthly household income is between TZS 270,001-500,000:
  - **71% report that Jaza has helped reduce time spent cooking**
  - **71% report that Jaza has helped reduce time spent dishwashing.**
- For women whose average monthly household income is between TZS 500,001-1,000,000:
  - **100% report that Jaza has helped reduce time spent cooking.**

[12] UN General Assembly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Impact on Childhood Education

> "My son…was supposed to enter the standard seventh, but due to lack of light, he was sent back to standard sixth. After access [to Jaza's] light, his teacher told me that his progress has increased: he now holds sixteenth position out of the eighty children. They usually have self-study groups and often come to study here"
>
> - ***Male, 61, Mbangani***

Household use of Jaza Energy has particular benefits for children and supports progress toward SDG 4 - "to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all."[13] Among its many uses, most parents of school age children report that Jaza Energy has had

[13] UN General Assembly

a positive impact on their academic performance. Of the 203 current customers surveyed who reported having school age children, 87% reported that Jaza Energy has allowed their child or children to spend more time studying or doing schoolwork.

87%

Of customers report their children spend more time studying or doing schoolwork due to Jaza

A 32-year-old female commented on this critical benefit of Jaza battery usage, saying: ***"My children use it for studying during night… [and] their performance [has] increase[d]...Previously they failed to study in the night because of the smoke from the kerosene lamp, but for now they spent more time studying."***

While further investigation is needed to quantify the impact of Jaza on childhood education, the reported sizable increase in time spent studying and accordant qualitative evidence suggests that Jaza may be contributing toward SDG Target 4.5: "eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including…children in vulnerable situations" and SDG Target 4.6: "ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy" by extending the window in which children and families may invest in academic achievement.[14]

Impacts of Typical Power Sources

In this section, we sought to learn more about how the participants' typical power sources have impacted their lives and the communities in which they live. This includes the social, economic, and environmental impacts that can be identified by the members of the community.

Participants articulate concerns about how their typical power sources have impacted their quality of life, while also acknowledging receiving benefits from their power sources. Participants generally stated that the men in the households are usually responsible for obtaining the energy sources they use in their homes, further supporting the hypothesis that exogenous community gender norms influence male overrepresentation in account holder status.

[14] UN General Assembly

While non-customer respondents often stated that they have benefitted from their typical power source by gaining access to power relative to lacking any power source, respondents also cited financial difficulties associated with their primary power source, such as purchasing or maintaining energy sources like as batteries, which may corrode and stop working due to time, weather conditions, or both.

> "Maybe solar has improved something - it means for instance when at night you could sleep while you have performed certain activities, so those lights help you to perform those activities smoothly"
>
> - ***Female, 26yrs, Shuga***

> "Yes, financially our energy source is expensive especially for us; per month that is TZS 1500"
>
> - ***Male, 45yrs, Ngunja***

Participants also illustrated an awareness of the negative environmental impacts and negative health outcomes associated with power sources such as kerosene, wood, or charcoal.

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