Unlocking the Benefits of Productive Uses of Energy for Women in Ghana, Tanzania and Myanmar

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Cover photo: Car mechanic, welder and corn miller in the Brong Ahafo region of Ghana

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1. INTRODUCTION

Access to modern energy, including electricity and clean cooking, is increasingly recognised as a key enabler of economic growth and poverty reduction in developing countries. Electricity, in particular, can drive economic and social development by increasing productivity, enabling new types of job-creating enterprises and reducing household workloads, hence freeing up time for paid work.

Productive uses of electricity are particularly important for income generation and poverty reduction among consumers, but also essential for the financial viability of electricity suppliers whether on or off-grid. When electricity is only used for lighting during a few hours in the evening, as often happens in poor rural communities, expensive power generation and distribution infrastructure remain idle for most of the day. This leaves electricity providers with two undesirable alternatives: either recover upfront investments by charging expensive tariffs for the few kWh consumed; or charge affordable tariffs but face bankruptcy. When electricity is used productively during the length of the working day, upfront costs can be shared among more kWh and cheaper tariffs are possible. At the same time, the resulting income improves consumers' ability to pay, starting a virtuous circle of affordability and financial sustainability.

Harnessing the income generation potential of electricity is not straightforward, though. So far, the literature on PUE has not provided conclusive evidence of its impact on the creation of enterprises or the improved performance of existing ones (as reviewed in Pueyo & Hanna, 2015; Pueyo, Gonzalez, Dent & DeMartino, 2013; or Mayer-Tasch, L., Mukherjee, M. & Reiche, K., 2013). Most authors agree that electricity is a necessary but not sufficient condition for income generation and poverty reduction. The most cited complementary factors are: access to finance for electric appliances (Khandker, Samad, Ali, & Barnes, 2012) ; access to markets for the additional production (Peters, Vance, & Harsdorff, 2011); skills for entrepreneurs to identify the new opportunities created by electricity and to prepare sound investment plans (Neelsen & Peters, 2011); access to other infrastructure or services (Kirubi, Jacobson, Kammen, & Mills, 2009); and a high quality of the electricity supplied (Kooijman-van Dijk, 2012; Kooijman-van Dijk & Clancy, 2010).

The literature on gender and energy, on the other hand, has so far mainly focused on the realm of the household, where women suffer heavily the burdens of energy poverty in their role as carers (see for example reviews by Winther, Matinga, Ulsrud, & Standal, 2017 and Rewald, 2017). The specific literature about PUE and gender focuses on women, and also takes the household as its main unit of analysis, looking at the labour supply effects emerging as electricity extends the length of the day and shifts women's time allocation to paid and unpaid work. The PUE literature tends to agree that women's paid employment increases with electrification, and that women move out of agriculture to a larger extent than men. However, the evidence is thin and inconclusive with regards to the quality of these new activities and the impact on actual earnings (as reviewed in Pueyo and Maestre, 2018 forthcoming). Besides, literature of gender and PUE in urban settings is nearly inexistent.

Existing literature, therefore, provides insufficient insights about the different benefits that men and women derive from the use of modern energy at work. This omission is

significant, because women are less likely than men to be employed, more likely to operate informally, and are overrepresented in a narrow range of low productivity occupations (Addati, Bonnet, Ernst, Merola, & Wan, 2016b; Campos, Goldstein, McGorman, Boudet, & Obert, 2015; Morton, 2013; De Haan, 2016; Cirera & Qasim, 2014). Women's productive activities keep on relying heavily on process heat and metabolic energy after electrification (Clancy & Dutta, 2005). On the other hand, men occupy the most electricity intensive sectors, like construction, manufacture and repair (Bardasi, Sabarwal & Terrell, 2011; Campos, Goldstein, McGorman, et al., 2015). Further understanding on the gendered impact of modern energy, and in particular electricity, for productive uses is therefore essential to design gender equitable interventions pursuing energy access and economic growth.

This research report provides empirical evidence from three case studies in Tanzania, Ghana and Myanmar to address the existing gap in the literature about gender and PUE. Three specific research questions are addressed: What is the differential benefit of the PUE for men and women? What explains the differences? And which interventions can successfully address the constraints that women face to benefit as much as men? Our case studies combine rural (Tanzania and Myanmar) and urban (Ghana) contexts, in two countries with relatively low rates of access to electricity (Tanzania and Myanmar) and another with relatively high access rates (Ghana). In Tanzania and Myanmar, more than 90% of the population depends on traditional cooking fuels, like charcoal and firewood, whereas Ghana has made further progress to introduce modern cooking fuels. In terms of economic development, Ghana presents the highest income per capita, and Tanzania the lowest. The comparison of three countries with such different circumstances, provides opportunities to highlight inequalities in the PUE that persist and others that can be transformed with economic development and urbanisation.

The remaining of this research report provides a more detailed background about our case studies, before describing the methodology used. Section 4 presents the empirical evidence organised around our three research questions. Section 5 discusses this evidence, highlighting similarities and differences across countries, and providing policy recommendations. The final section concludes.

2. BACKGROUND TO CASE STUDIES

Empirical evidence draws from case studies in Tanzania, Ghana and Myanmar. Table 1 displays some key indicators of these three countries, to emphasise their differences and similarities. The best performer for each indicator is highlighted in green, and the worst in red. Both Ghana and Myanmar hold Lower Middle Income (LMI) status, whereas Tanzania is still a Lower Income country, aiming at becoming LMI by 2025. Tanzania is one of the countries with lower electricity access rates in the world, with just 35% of the population having a connection. On the other hand, Myanmar is the country with the lowest level of access in South East Asia, and would hold the last position in Asia as well, if it was not for North Korea. Tanzania, however, has been making fast progress in increasing electrification rates, and adopting off-grid solutions, being one of the rising stars in the SE4ALL Global Tracking Framework report (World Bank, 2017). On the other hand, Myanmar expects to achieve universal electrification by 2030, mainly through grid extension.

Electricity reliability is poor in the three countries. All of them experience frequent blackouts, which in the case of the two African countries can last for many hours. As a result, a large share of enterprises in Ghana and Tanzania use private generators to provide a back-up for the main grid, which may considerably raise the cost of electricity. Poor electricity supply is pinpointed as their biggest obstacle to grow for 25% of enterprises in Tanzania and 19% in Ghana. In Myanmar, the share is lower, at 13%.

The three countries need to make progress towards gender equality. All of them rank at the bottom half of countries in the Gender Inequality Index, with Myanmar closer to the middle. In all cases, the countries have enacted policies to promote women's social and economic empowerment, but women are still disadvantaged in the labour market.

Table 1: Key economic, gender and energy indicators for the three target countries

	Tanzania	Ghana	Myanmar
Population	57.31	28.8	53.37
GNI (current USD Billions)	50.36	42.92	63.48
GNI per capita (current USD)	910	1490	1190
Income group	LI	LMI	LMI
Human Development Index (HDI) 2017	154 rank	140 rank	148 rank
Gender Inequality Index (GII) (rank out of 187 countries)	130 rank	131 rank	106
Female share of employment in senior and middle managment	n.a.	26.7	28.3
Access to electricity (% total)	33%	84%	59%
Rural access to electricity (%)	17%	71%	44%
Population without access to clean cooking (%)	>95%	71%	94%
Number of blackouts per month	8.9	8.4	11
Average duration of blackouts	6.3	7.8	1.3
% enterprises with generators	43%	52.1%	15.4%
% enterprises choosing electricity as their biggest obstacle to growth	24.9%	18.7%	13.4%

Source: World Development Indicators https://data.worldbank.org/products/wdi ; and World Bank Enterprise Surveys http://www.enterprisesurveys.org/

The remainder of this background section describes in more detail the target regions and PUE interventions analysed in each country. In all the countries, the research was done in collaboration with GIZ country offices, and focused on some of the energy, gender and productive uses interventions that they had supported: improved electricity supply in light industrial zones (LIZ) in Ghana, promotion of PUE and gender in villages supplied with solar mini-grids in Tanzania, and promotion of mini-grids and entrepreneurship in Myanmar.

2.1. Tanzania

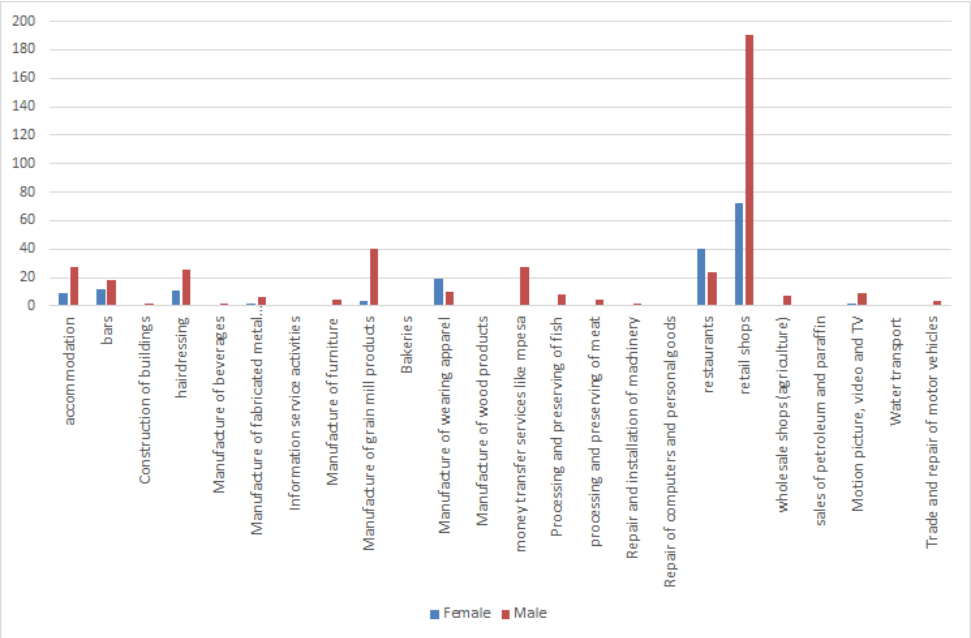
Our research in Tanzania focused on five villages located in three different islands in Lake Victoria:

- Bwisya village, in Ukara island, where a mini-grid has been in operation for over a year and a gender programme has been implemented to support women entrepreneurs consuming electricity in their business.
- Murutunguru and Bugolola villages on Ukerewe island, that have been connected to the main grid for several years but where gender programmes have not been implemented.
- Sambi and Nabweko villages in Irugwa island, without access to electricity from the main grid or mini-grids or gender programmes. Access to electricity in the village is possible through individual solar home systems or diesel/petrol small generators. Mini-grids would be installed in the second half of 2018, after our fieldwork took place.

The economy of all villages is highly dependent on fishing in the Lake Victoria as well as small-scale subsistence agriculture. Fishing is a male dominated activity, and is both for what the communities call "big fish" (tilapia and Nile perch) and sardines. Agriculture, on the other hand, is an important sector for women economy, and the main agricultural crops are cassava, sweet potatoes, and rice. Other economic activities are small business like restaurants, retail shops, or mobile-money agents.

An enterprise census was prepared as part of the research, showing a majority of male owned enterprises. Only 29% of the total census of 598 are female owned. Men dominate all productive activities, except for tailoring and food preparation, which are female dominated. Retail trading is the most common activity across the five surveyed communities, representing 44% of the census. Manufacture is limited and typical of rural settings, including food-related activities such as grain millers, butchers, bakers or fishmongers, as well as tailors, welders and carpenters. The gendered distribution of businesses across activities is illustrated in Figure 1.

Figure 1- Enterprise census per owner's gender and type of activity for the five villages (number of businesses)



The solar minigrid operating in Bwisya was installed and is managed by private company JUMEME Rural Power Supply Ltd., a joint venture between three European companies and a Tanzanian University, mainly financed through a European Union grant. The mini-grid currently serves 300 customers in Bwisya, but JUMEME aims at reaching 13,000 customers in 9 islands within Lake Victoria and in the mainland regions of Katavi, Rukwa and Kigoma.

Productive uses are key for the financial sustainability of JUMEME's mini-grids. In Bwisya, even if only 16% of customers are commercial and productive, they represent 80% of electricity demand. Productive uses include retail shops, hospitality and personal services, as well as energy intensive activities like milling, carpentry, bakeries or metal working. No fish processing activities take place in the island. JUMEME has supported local businesses with access to finance and equipment and contacts with final customers.

The project Unlocking the Benefits of Energy for Women (UBEW) project, introduced a gender perspective in the productive use of electricity from mini-grids in Bwisya. UBEW was developed in partnership between GIZ Employment for Sustainable Development in Africa (E4D) and JUMEME to enhance equal social and economic opportunities for women and men as part of JUMEME's electrification Project. The project consists of affirmative actions in support of women starting and growing businesses. UBEW started with a gender based baseline study of Bwisya in January 2017, after which project activities were defined around three areas: awareness raising at community level; mentoring women to develop electricity consuming enterprises; and changing attitudes in the community with regards to women's involvement in paid work. These activities were implemented for 14 months (November 2017 – December 2018) as a pilot for gender mainstreaming.

2.2. Ghana

This research looks at PUE and gender in three towns in Ghana's Brong Ahafo Region: Techiman, Tuobodom[1] and Berekum. Brong Ahafo is a transition zone between the relatively poorer Northern regions and the more densely populated and wealthier central and coastal regions, where the economic hubs of Kumasi and Accra are situated (Peters, Sievert and Vance, 2013). Agriculture is the most important source of income, with commercial crops like maize, yams, cassava, plantain or cocoa. The non-agriculture sector is dominated by trading and the surveyed towns have large markets operating at least once a week. Techiman in particular has one of the biggest markets in West Africa. Manufacturing activities include palm oil production; grain milling, woodworks, nuts roasting, tailoring, shoemaking, welding, and numerous car repair and maintenance services.

Techiman, Tuobodom and Berekum were targeted by the Industrial Zone Development component of the Programme for Sustainable Economic Development, implemented by GIZ from 2007. The promotion of LIZ aimed at expanding Ghana's economic growth beyond the capital and the major cities of the South. Some of the challenges faced by SMEs in the targeted areas were: unsecure land tenure, which decreased willingness to

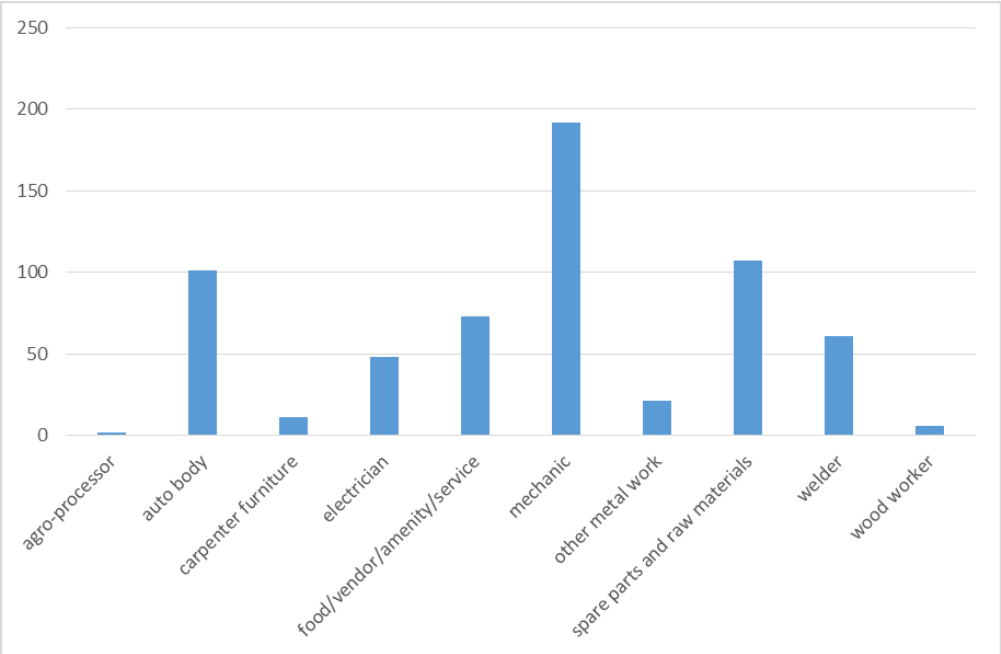
[1] Techiman and Tuobodom use to be a single municipality, but a new border was recently set. For that reason, some data is presented jointly for both towns.

invest; missing access to infrastructure like electricity and roads; unregulated business causing environmental degradation; and road congestion in the town centre. The project provided entrepreneurs with land and business capabilities and served industrial zones with improved infrastructure, such as grid extension, road access, water supply and sanitary facilities. Enterprises also received business development services and the district government was offered technical assistance. The three main actors that participated in project implementation, and their key roles are:

- Local Governments and Business Associations: identified and acquired land; prepared the land for infrastructure; provided access to roads, drains, water supply and latrines, and paid labor costs for electricity hardware installations.
- GIZ: Advised on planning, design, implementation and management of the sites; supported local economic development processes and sets up dialogue platforms; procured and delivered the electricity hardware; supported management and environmental training.
- Utilities: provided technical assistance for network design, cost estimates and installation.

LIZ in Techiman, Tuobodom and Berekum clustered automotive maintenance and related industries and are managed by garages associations. However, since their creation, many other supporting businesses have joined such as restaurants, shops and barbers. Figure 2 shows the number of businesses, per sector of operation, jointly for all LIZ analysed as of the December 2016. Car mechanics are the most frequent trade, followed by autobody and share of spare parts.

Figure 2- Number of business per sector of operation in Techiman and Berekum LIZs as of December 2016



Source: authors, from GIZ monitoring data

Table 2 shows the main characteristics of the two towns and their LIZ. In this research, within Techiman municipality we also include Tuobodom, because this new municipality was created by introducing a new border in what used to be Techiman after the time of

the LIZ intervention. Even if Techiman municipality is larger, Berekum's LIZ hosts more enterprises.

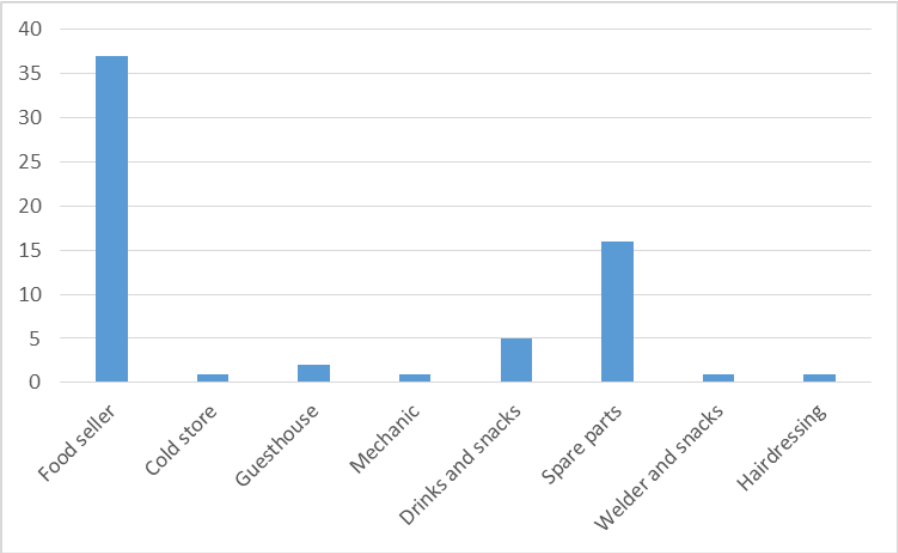
Table 2- Key characteristics of Techiman, Berekum and their industrial zones.

	Techiman-Tuobodom	Berekum
Population of municipality	206,856	129,628
Area of municipality (km2)	669.7	955
Date of grid connection	1990	1990
Implementation of LIZ	2007	2007
Number of enterprises at the site (December 2016)	160	477
Number of workers	974	2450
Number of women-led enterprises	11 (7% of total)	72 (15% of total)
Number of enterprises connected to electricity	73 (46%)	200 (42%)

Source: Field survey, 2018

Gender data included in the previous table was extracted from GIZ's monitoring records. Women's participation is very small, with just 7% of the total enterprises in Techiman and 15% in Berekum. As illustrated in Figure 3, food vending is the most common female activity, followed by the sale of spare parts.

Figure 3- Female owned businesses in Techiman and Berekum LIZ, per sector of occupation



Source: authors, from GIZ monitoring data

GIZ's rationale for the support of LIZ was that a service package including infrastructure, training, access to microfinance and clustering of enterprises, to take advantage of agglomeration effects, would be more effective than providing these services individually. Electricity in particular would improve business productivity, allowing the use of new equipment (Peters et al, 2013). However, two impact evaluations carried in 2011 and 2013 did not show these positive results.

The first impact evaluation assessed the impact of LIZs on firms' performance and energy usage. It included enterprises within LIZ in Techiman, Berekum and Goaso-Min involved in manufacturing (welding and carpentry) and car repair (car body, upholstery, electricians, other metal work, and mechanics). A before-after comparison was used as counterfactual. Findings showed that access to land was the main reason why companies had relocated to LIZ, with access to electricity being just a secondary reason. There were encouraging signs of investment picking up, as 44% of firms with access to electricity purchased new equipment after relocation, and increased their credit uptake. However, monthly profits and customers per week decreased, due to increased competition among clustered enterprises. Therefore, the LIZ had not led to positive impacts for companies, even if they had benefitted from land and services (Peters, Sievert and Strupat, 2012).

The second impact evaluation extended the scope to include enterprises both in and out of LIZ in Techiman, Berekum, Goaso Min and Nkoranza; and across a wider set of sectors, including services (hairdressing, communications, electrical services, mechanics, and restaurants) and manufacturing (dressmaking, tailoring, metal works, and carpentry). It described energy use patterns in the firms and analysed the impact of electricity use on firm performance. The counterfactual were firms not connected to electricity. No significant effect of electricity on firm performance was found, showing that electricity does not increase income by all means. This research aims at extending the scope of previous evaluations by providing gender disaggregated data, and using a wider diversity of methods.

2.3. Myanmar

Research in Myanmar focused on five locations in Shan Estate, Bago Region, Magway Region and an island in the South. Among them, one village has been connected to the national grid for one year (Myaning); two villages have had mini-grid setup following a Government call for proposals (Oak Pho and Kenti); and two locations have no access to electricity yet but plan to receive it soon (Hti Ne and Kan Gyi Taw). Table 3 provides further details about electricity supply in the three villages where it is available.

Table 3- Key characteristics of electricity supply in Oak Pho, Kan Ti and Myaing.

	Oak Pho	**Kan Ti**	**Myaing**
Electricity Source	Solar and Diesel Hybrid mini grid	Solar and Diesel Hybrid mini grid	Connected to the national grid
Provider	Private Provider (T&T)	Private Provider (Tecno Hill)	Government
Capacity	20kW (30 kW diesel backup)	63kW (50kW diesel backup)	N/A
Households connected	122 HH of 276 (63 HH committed)	300 HH of 350	380 HH of 420
Installation Costs	200,000 Kyats	350,000 Kyats	N/A
Unit Costs	500 Kyats per unit	300 Kyats per unit	N/A
Year of connection	2017	2017	2016

Private sector operators installed mini-grids under the government programme, supported by GIZ, whereby infrastructure is financed in a 60:20:20 ratio, where the Department for Rural Development (supported by the World Bank and GIZ) provide 60%, the community contributes 20% and the private operator the remaining 20%. Both companies tendered successfully their proposals to the government during 2016. The communities agreed to pay in instalments.

In Oak Pho, Talent & Technology (T&T) installed a solar mini-grid with capacity for 20 kW with a 30kW diesel generator back up. They are planning to hand over the management of the mini grid plant to the village after 5 years. In 2016, during the feasibility study, 185 households (out of 276) agreed to contribute the 20% (200,000 kyats/household) in a 4-stage instalments plan, with the last one to be paid once they got connected. Currently 125 (out of the 185) households have connected to the mini grid. At the point of the research, the T&T Director confirmed that they had provided 33 commercial use meters and 125 'home' use meters since 2017

Tecno Hill Engineering installed the solar mini grid in July 2017 in Kenti, with a 63 KV capacity (with 50kV diesel backup) and plans to extend it to an additional 61 KV next year. Given the expansion plans, they will aim to handover the management of the plant in 15 years. They have installed 308 meters for 300 households. Tecno Hill, together with Pact Myanmar, has provided some training for villagers in order to promote PUE, linked to access to finance to pay for installation costs or new equipment to start new businesses.

The economy of all villages is highly dependent on small-scale subsistence agriculture but in Hti Ne and Kan Gyi Taw some NGOs have set up community tourism programmes. In Kenti, which is located on an island, the economy is dominated by fishing, a male dominated activity. Both men and women work in agriculture equally. The main agricultural crops vary per region. Other economic activities are small business like restaurants, retail shops, carpenters, tailors or beauty salons.

3. METHODOLOGY

The analysis in Ghana and Tanzania used a mixed methods approach where quantitative data was drawn from an enterprise survey, and qualitative data from semi-structured interviews (SSI), key informant interviews (KII), and participatory focus group discussions (FGD). In Myanmar, only qualitative methods were used due to the difficulty in finding research partners able to provide high quality quantitative data. Mixed-methods approaches provide the rigour required in complex environments like the ones found in the three target countries, where randomisation of the PUE interventions is not possible and where several gender and/or entrepreneurship programmes have already taken place, which made them difficult to isolate their effects (Chambers, 2017).

The identification strategy in each country consisted in:

- Tanzania: comparing outcomes of men and women owned enterprises located in three regions, one with access to electricity from mini-grids and gender interventions (Bwisya), another only with access to grid electricity

(Murutunguru), and another without access to grid or mini-grid electricity, or gender interventions (Irugwa)

- Ghana: comparing outcomes of men and women owned enterprises located in and out of Light Industrial Zones in three towns with grid electricity: Techiman, Tuobodom and Berekum.
- Myanmar: comparing uses of energy in villages that currently have access to energy for productive uses with those that are still not connected to any stable source of electricity. The five surveyed villages were clustered in two groups according to the electricity supply systems they are exposed to: 1. Myaing, Oak Pho and Kenti village with access to stable sources of energy, being use for productive uses; and 2. Hti Ne and Kan Gyi Taw, with no stable access to electricity and no productive uses.

The same research tools were used across the three countries, to facilitate comparison of results. Research tools included: enterprise census, enterprise questionnaire, guidelines for key informant interviews (KIII) and Semi Structured Interviews (SII), and four different participatory focus group discussions (FGD). FGD tools consisted of: community and energy mapping, activity and energy use mapping, access to and control over resources, and gendered value chains. Table 4 displays the size of the sample targeted by each of our research tools, disaggregated by gender.

Table 4- Sample sizes, per tool and country

	Tanzania	Ghana	Myanmar
Enterprise questionnaire	**316** F: 118 M: 198	**400** F: 147 M: 253	-
Key informant interviews	**10** F: 2 M: 8	**10** F: 3 M: 7	**17** F: 3 M: 14
Semi-structured interviews	**26** F: 13 M: 13	**40** F: 20 M: 20	**33** F: 17 M: 16
Focus Group Discussions	**74** F:36 M: 38	**80** F:35 M: 45	**87** F: 46 M: 41

In Tanzania, the sampling frame was created drawing from the full census elaborated by the researchers, including all the sectors and oversampling women owned enterprises. In Ghana, in the absence of an up to date census, we drew the sampling frame LIZ monitoring data from GIZ and from an old baseline prepared by GIZ before their LIZ intervention. Given the large size of the population of enterprises in Ghana, we preselected 11 sectors of operation, based on their availability in the area, but excluding small scale retail.

For Ghana and Tanzania, where quantitative data were collected, the analysis of enterprise data starts with descriptive statistics, showing differences in means of a number of indicators for men and women enterprises, and for different regions. Descriptive data is organised around the three research questions. Firstly, we show

differences in energy consumption patterns for productive uses by men and women owned enterprises. Then we look at data to support or refute the following hypothesis about gender differences: in business size and performance; in access to financial and physical capital and skills; in domestic care responsibilities; in motivations to run businesses; and in occupational segregation.

Following the descriptive statistics, the report presents results of several Ordinary Least Square (OLS) regressions looking at outcomes of interest related to enterprise performance and energy consumption. An experimental design was not possible, due to the impossibility to randomise electricity provision in our context. Quasi-experimental approaches were challenging as well, due to the difficulty of finding enterprises not connected to electricity that share all other characteristics with those connected, or credible instrumental variables. Our OLS results, therefore can only be able to establish whether the correlations among our variables of interest are statistically significant, without the possibility of claiming for causality. The model used for this analysis is presented in Equation 1:

$$y_i = \alpha_i + \beta_i X_i + \gamma Female_i + \delta Electricity_i + \theta Industrial\ Zone_i + \varepsilon_i$$ [2]

The dependent variables y_i are a set of business-related indicators about economic performance (including profits, customers, sales, opening hours and business expenditure) and energy consumption (measured as monetary expenditure for energy and electricity). The paper details the results for monthly profits, energy expenditure, and electricity expenditure[3].

The list of covariates in X includes a set of control variables accounting for business, individual and household characteristics. The following Table 5 summarizes the list of control variables, common for all estimated regressions.

Table 5- List of control variables

Business	**Individual**	**Household**
Number of workers	Age	Number of children
Starting capital	No Education/Primary Education	Number of elderlies
Member of an association	Migrant[4]	
Officially registered	Married	
Keep books	Bank Account	
Permanent Building		
Requested Loan		

The dummy variables $Electricity$ and $Female$ account for, respectively, whether the business uses electricity, whether the business is female-owned. The variable $Industrial\ Zone$ is only applicable for the Ghanaian case study and reflects whether the business is within an industrial zone. Finally, all sample regressions include sector and region fixed effects. For sector fixed effects, in Tanzania we take retail, and in Ghana "Processing and preserving of food and vegetables" as the sectors of reference, against

[2] For all outcome variable relative to electricity, the variable $Electricity$ is omitted.

[3] Results with other economic and energy indicators are reported in the Appendix

[4] Every individual not born in the same village where the business is located is defined as migrant

which performance of the other sectors is compared. These sectors were selected because both men and women were represented and there were many observations. For the regional fixed effects, Bwisya in Tanzania and Berekum in Ghana were taken as the reference regions.

Qualitative analysis took place for the three case studies. The information gathered through FGD, SII and KII was transcribed and then organised around themes to provide answers to our research questions. The qualitative data analysis used purposively developed coding framework, based on our conceptual framework (Pueyo and Maestre forthcoming). The joint analysis of quantitative and qualitative data analysis allowed for cross-fertilisation and triangulation and provided for more robust responses to the questions.

4. RESULTS

4.1. Do men and women benefit differently from the PUE?

Case studies of PUE interventions in Ghana and Tanzania showed that male dominated sectors were more likely to benefit than female dominated ones from improvements in electricity supply. This is because men typically operate more and larger enterprises, which consume more electricity than female enterprises. Female led enterprises, instead, dominate cooking fuels like firewood, charcoal and LPG.

Table 6 presents the types of fuel used by men and women enterprises in Tanzania and Ghana, highlighting those where differences are significant. Electricity is the most commonly used fuel by men and women in both countries, although some villages in Tanzania have only recently got access. Still, a significantly higher share of men use electricity than women. With regards to cooking fuels, in both countries charcoal is the most frequently used, and is dominated by women. Whereas Ghanaian women have significant access to LPG, this has not reached Tanzanian villages.. Men instead dominate the use of diesel and, in the case of Ghana, a significantly higher share of men uses only physical energy for work. Even though quantitative data is not available for Myanmar, qualitative data displays a similar pattern. Women were the main users of firewood and charcoal for cooking and ironing, while men the main users of diesel to run generators.

Table 6- Share of enterprises using each type of energy in Ghana and Tanzania

	Ghana			Tanzania		
	All	Male	Female	All	Male	Female
None	**14%**	**18%**	**6%**	14%	13%	16%
Dry cell batteries	**3%**	**1%**	**6%**	11%	11%	9%
Rechargeable battery	1.5%	2%	1%	6%	5%	7%
Gas (LPG)	**13%**	**7%**	**23%**	0.3%	0%	1%
Diesel/ Petrol	7%	8%	4%	**5%**	**9%**	**0%**
Kerosene	-	-	-	1%	0.5%	2%
Charcoal	**25%**	**5%**	**59%**	**17%**	**9%**	**31%**
Firewood	**10%**	**3%**	**23%**	**11%**	**5%**	**21%**
Candles	-	-	-	3%	2%	4%
Electricity	**68%**	**74%**	**60%**	**66%**	**73%**	**55%**

Note: figures underlined and in bold highlight significant differences between men and women enterprises

Average monthly expenditure in different types of fuels for both countries is presented in Table 7. Total figures show differences in expenditure across countries, with for example higher expenditure in firewood, electricity and LPG in Ghana, as compared to Tanzania, but similar expenditure in charcoal. In both countries, male enterprises spend more on electricity, but the difference is only significant for the case of Ghana. On the other hand, in Ghana, among businesses using cooking fuels, women show lower expenditure than men on charcoal and firewood, but the difference is not statistically significant. In Tanzania, female enterprises using cooking fuels spend more than men, and the difference is statistically significant for firewood. Total energy expenditure is not significantly different among genders, showing that the lower electricity expenditure of women is compensated with higher expenditure on cooking fuels. Another interesting result is that energy expenditure in Tanzania is higher than in Ghana, in spite of having smaller and less capitalised enterprises. This implies that the cost of energy is higher in Tanzanian islands. This is likely due to the higher cost of reaching remote rural locations.

Table 7- Average monthly expenditure in different fuels, by gender (USD)[5]

	Ghana			Tanzania		
	All	Male	Female	All	Male	Female
Dry cell batteries	3	7	2	4	4	2
Rechargeable battery	5	1	15	6	10	1
Gas (LPG)	38	26	45	10	-	-
Diesel/ Petrol	25	31	5	72	-	-
Kerosene	-	-	-	4	10	1
Charcoal	20	30	18	21	14	24
Firewood	43	58	40	**19**	**11**	**22**
Candles	-	-	-	2	2	2
Electricity	**32**	**38**	**19**	24	30	11
Total energy expenditure	56	56	56	71	76	60

Note: figures underlined and in bold highlight significant differences between men and women enterprises

Table 8 shows the number of hours that each type of fuel is used, by gender. Results for this indicator differ by countries. In Ghana, women use electricity for longer than men, while in Tanzania the opposite is true. In both cases the difference is statistically significant.

Table 8- Daily use of each type of energy, by gender (hours)

	Ghana			Tanzania		
	All	Male	Female	All	Male	Female
Dry cell batteries	3.9	6.3	3.1	3.7	4.0	3.2
Rechargeable battery	0	0.0	0.0	10.3	10.5	10.0
Gas (LPG)	5.8	5.8	5.8	3	-	-
Diesel/ Petrol	4.8	5.5	2.3	8.8	-	-

[5] Conversion rates applied throughout the paper are 1 TZSH = 0.00044; 1 GHC = 0.2 USD, as of 12th of October 2018

Kerosene	-	-	-	2.7	3.0	2.5
Charcoal	6.3	6.8	6.2	6.2	5.2	6.6
Firewood	7.3	7.7	7.2	**6.1**	**4.2**	**6.8**
Electricity	**9.6**	**9.1**	**10.7**	**10.7**	**11.4**	**9.2**

Ownership of electric appliances was common in Ghana, but very marginal in Tanzania. With regards to characteristics of electricity supply, in Tanzania our sample displayed three different types of supply, depending on the island where enterprises were located. Table 9 shows that mini-grids offer higher quality service, with higher availability and less outages than the main grid. However, costs are significantly higher than the main grid per kWh, although they require a lower connection fee. SHS appear as a convenient alternative in the island without grid options. They offer reasonable upfront costs and a good quality of service, in addition to no consumption cost. The disadvantages of SHS are low peak capacity, hence lower possibilities of use, and lower availability.

High costs of mini-grids were often raised as a problem by villagers in our interviews. For example, a woman running a guest house said "high electricity costs are a barrier for me to diversify to other businesses, such as horticulture, requiring a pressure pump". A female food vendor from the same village, not connected to electricity, indicated that "many people who use electricity are complaining about its high cost, but if the price dropped, I would aspire to use it as it would improve my health, cooking speed, and would allow me to do many things at the same time". A male welder in the village seconded the view of the high cost of electricity: "My main dislike from this business is the high cost of electricity: I am paying 14,000TZS per week regardless of having orders for welding or not. Some weeks I pay from my own pocket (...) Many people here are convincing me to stop using electricity from JUMEME but I feel sorry for my grandson who has started this welding as his employment".

Users of electricity from the main grid in Ukerewe island complained about its poor reliability. For example, a miller indicated that frequent power cuts make him lose business, while an entrepreneur running several businesses was planning to purchase a solar system as a back-up for the main grid.

Finally, the main complaint of SHS users was low power output. For example, a male restaurant owner explained: "I use solar power for lighting but it is not capable of running entertainment in my work like television or radio and can switch off any time (...) I think I could attract more customers by having a television and cold drinks". A male pharmacist aspired "to use electricity from the main grid as it would help me to operate advanced equipment when doing various medical tests. I could store cool drinks and medicine which need cool temperature"

Table 9- Characteristics of electricity supply in Tanzania

	Main grid	Mini-grid	SHS
Peak Capacity (W)	240.1	2851.2	116.6
Availability (hours per day)	19.3	22.9	14.1
Average number of outages per week	2.51	0.35	0.04
Average duration of outages (hours)	7.94	0.28	0.1
Upfront investment - connection fee (USD)	143.7	22.7	212.8
Tariff per kWh (USD/kWh)	0.14	1.18	--

Table 10 shows characteristics of electricity supply in Ghana, per gender. Outages are prevalent, and more so in women based enterprises, probably due to their location outside of light industrial zones. The duration of outages is lower than in Tanzania, as well as the upfront connection cost. Consumption fees, are however similar to those of Tanzania's main grid.

Table 10- Characteristics of electricity supply in Ghana

	Gender differences			
	Male	Female	Diff	p-value
Availability (hours per day)	9.24	9.64	-0.40	0.552
Availability in the evening (hours)	7.32	7.16	0.17	0.738
Average number of outages per week	2.63	5.03	-2.39	0.000
Average duration of outages (hours)	3.50	3.87	-0.37	0.410
Upfront investment - connection fee (USD)	82	47.2	34.82	0.039
Tariff per kWh (USD/kWh)	0.14	0.14		

Poor reliability was a concern for businesses in all the countries. In Ghana, for example, a car mechanic explained "When someone has given his car to be done and for the past three days the lights have been off, there is a problem because the person needs the car for work and you have seized it". A female sprayer shared her frustration "If power is reliable, you are able to meet the deadline as promised to your customers thereby keeping the bond between you and the customer. He or she will pay for the services happily, but when light goes off, they are highly disappointed and may reduce the price agreed". A hairdresser also explained that "when potential customers find there is no power, they just leave, and we can spend 3 days without business". Not only power cuts reduce sales, but also they can damage equipment: "the straighteners over there are damaged because of on and off power" (female hairdresser from Berekum). To deal with frequent outages, some businesses aspire to purchase diesel powered machines or solar PV systems that provide a backup for the grid. According to a female grain miller from Berekum "Due to frequent light out, I plan on getting the diesel version of the machine to provide a support. This has been my dream for long (…) but my best wish is that the government minimizes power cuts and if possible eliminates them because it is really worrying".

The use of electricity brought many benefits for entrepreneurs in all countries. Modelling results presented in section 4.3 consistently show better business performance outcomes for enterprises. In Tanzania, where enterprises had only recently obtained electricity, the benefits were more evident as compared to a situation without electricity. For example, the female owner of a guesthouse in Bwisya, was now using electricity for lighting, ironing, TV, radio and water pumping. She estimated that the cost of water supply after the arrival of electricity was one third of what it was before, when water was carried manually from the lake to the guesthouse. In her words: "electricity is very important to make my business sustainable and profitable as everything needs power". Two women in Bwisya explained that they had started a number of activities that would not have been possible without electricity, including making ice cream, pop-corn and smoothies, and a laundry shop that uses an electric washing machine to provide services to itinerant fishermen. Like the cases previously described, women's new activities normally relate to their domestic roles. One female tailor in Bwisya described how after purchasing an

electric sewing machine and being trained to use it, she is able to offer more types of sewing styles and embroidery than her competitors. This has allowed her to increased her income from 80k TSH, which she made selling children clothes, to approximately 200k TSH, with her new products. An additional advantage is that embroidery products are not seasonal, which allows her to have a more stable income than what she got with just children clothes. Finally, a beautician in Bwisya said that since she started using electricity and purchased an electric dryer, her monthly income raised to around 300k TSH.

Men in Tanzania also described the benefits that electricity had brought to their businesses. For example, a miller connected to the main grid in Bugolola indicates that "the availability of the national grid has made it possible for my business to dramatically reduce costs as compared to diesel or petrol. I can now produce large quantities in a short time thanks to electricity". An entrepreneur running several businesses in Murutunguru, and connected to the main grid explained "I use electricity to operate the saloon equipment's such as TV, clippers, shaving machines & radio and bar equipment (fridge, freezer and radio). Electricity is everything if you want to do profitable businesses".

Entrepreneurs in Myanmar described several benefits. For example, a woman in Kenti said: "Electricity is pretty helpful. I now can freeze jelly that I buy at 50 ks in the fridge and I can sell iced-jelly for 100 ks. With the profit I make, I can pay the electricity bill'. A female tailor in Oak Pho mentioned increased income as well, by doubling the amount of clothes she can finish in one day '…I could finish 3 – 4 clothes in the past, but now I can finish 5 – 6 clothes in the same time. I get more earning than in the past. It is better'. A tailor and hairdresser in Kenti explained 'It is about 6 years that I started making clothes and 4 years that I started straightening hair. In the past, I used an engine dynamo to straighten the hair, so it was not quite convenient. Later, I bought an Honda portable generator. Now, it is so convenient that we have got solar electricity'. A male from Myaing explained 'the carpenters are improving. Before, it took 2-3 days to finish one task as they had to work by hand. Now, they are faster as they work with machines.'

In summary, in all locations men and women benefit from the use of electricity at work, but men are more likely to be targeted by PUE interventions as they own the majority of enterprises, are more likely to use electricity than women, and spend more on it. Women instead use cooking fuels (charcoal, firewood, LPG) more frequently than men, and spend more on them. Taking into account all fuels, energy expenditure is similar across genders, but when PUE interventions focus only on electricity they are more likely to reach men. In Ghana, men more frequently use just their physical energy for their businesses. Reliability was a key concern for entrepreneurs from all our case studies, and could cause significant losses.

4.2. Which gender constraints affect women's chances to benefit from the PUE?

This sub-section looks for the reasons behind gendered patterns of energy consumption for productive purposes. Drawing from the literature on gender and entrepreneurship, and gender and PUE (as reviewed in Pueyo and Maestre, forthcoming), evidence is organised around five different areas: gender differences in size and profitability of

enterprises; in access to skills and resources; in care responsibilities; in motivations; and occupational segregation.

4.2.1. Differences in size and profitability of men and women enterprises

Ghanaian and Tanzanian enterprises are very different in size. Table 12 presents Tanzanian enterprises as mainly survivalist, while Ghanaian enterprises show a bigger potential. In Tanzania, male enterprises perform significantly better than female enterprises for all indicators except customers in the low season and annual profits. In the last two cases men also outperform women, but the difference is not statistically significant due to a large standard deviation. In Ghana, on the other hand, men owned enterprises outperform women's in sales and profits, but the difference is not statistically significant. On the other hand, women have a significantly higher number of customers than men. The evidence of women's enterprises performing worse than men's is hence weaker than in Tanzania. However, Ghana's sample excluded retail trading, which is typically very small and female dominated, whereas Tanzania's sample included all sectors.

Table 11- Means of business performance indicators by gender (USD)

	Ghana		Tanzania	
	Male	Female	Male	Female
sales in high season (weekly)	496.2	370.4	**4.8**	**1.0**
sales in low season (weekly)	173.8	173.2	**1.6**	**0.3**
customers in high season (weekly)	**13.2**	**32.2**	**42.2**	**32.2**
customers in low season (weekly)	**6.6**	**18.6**	16.5	12.2
Profit (last month)	253.4	193.2	**83.9**	**45.2**
Profit (annual)	2841.4	2338.4	701.7	471.5
Expenses (monthly)	552.5	568.3	**1.3**	**0.6**

Most enterprises in Tanzania had no employees apart from the owner, but men entrepreneurs had twice more employees than women on average[6]. Ghanaian enterprises, as evidenced by their revenues figures, are larger. In this case, women's businesses display higher number of employees, as presented in Table 12. However, employees in women's enterprises perceive significantly lower salaries than those in female run enterprises. Besides, men typically hire men, and women typically higher women.

Table 12- Gender differences in employees, Ghana

Ghana	Male	Female	Diff.	p-value
Number of workers***	2.8	3.6	-0.8	0.001
Female workers***	0.2	3.3	-3.0	0.000
Male workers***	2.6	0.3	2.2	0.000
Weekly salary of workers (GHC)***	201.7	92.5	109.3	0.000

[6] Men owned enterprises had an average of 0.43 employees, while women had 0.22 employees on average.

Whereas men's owned businesses show better management practices than women's in Tanzania (businesses are registered and keep accounting books), we observe no such differences in Ghana. In Tanzania, women indicated that they were particularly disadvantaged by business registration policies due to the smaller size of their businesses, and more vulnerable to harassment by officers. In Ghana, men's businesses more frequently organise in business associations, which are typically trade associations. Some of the benefits of trade associations as detailed by the president of the association of small scale industry (ASI) in a Ghanaian town were: "pulling resources for specialised training; engaging with the authorities to get fair tax bills; organising apprenticeships; and targeting markets together, by for example persuading local institutions to buy local". In Tanzania women are more frequently part of associations, mainly Village Saving Groups.

Table 13- Business practices by gender of entrepreneur (% of enterprises)

	Ghana		Tanzania	
	Male	Female	Male	Female
Formal registration	20.2%	17.7%	**57.8%**	**37.0%**
Keeps accounting books	15.4%	16.3%	**45.1%**	**33.9%**
Part of an association	**65.6%**	**47.6%**	**23.0%**	**42.5%**

Finally, Ghanaian companies are more open to external markets than those in Lake Victoria. Whereas more than 50% of enterprises in Brong Ahafo sell outside their district, and 10% outside their country, just 5% venture outside their district in the Tanzanian sample. In Tanzania, there are significant gender differences in openness to external markets, but these do not exist in Ghana.

Table 14- Access to external markets (% enterprises selling to each market)

	Ghana		Tanzania	
	Male	Female	Male	Female
Customers from this village	99.6%	99.3%	84.3%	90.6%
Customers from outside the village, same district	84.2%	83.7%	**49.0%**	**39.4%**
Customers from outside district in same country	52.6%	48.3%	**6.9%**	**0.8%**
Customers from outside country	9.5%	11.6%	1.0%	0.0%

Qualitative data from Myanmar shows that women's businesses tend to be home-based, and with no employees. Furthermore, under the same conditions, men are paid more than women as labourers, often explained by their strength or capacity to do the 'hard work'. A key informant from a CSO mentioned 'Men are still earning more than women. There still is less job opportunities for women than men', and a female from Kan Gyi Taw explained 'Men need to use more physical strength. They do hard stuff while women's work is easier. So, they earn more".

In summary, men enterprises have higher average earnings than women's, and male employees earn more than female employees in the three country studies. Ghana's enterprises show lower gender differences. Both men and women's enterprises display similar business practices in terms of registration, accounting practices, and openness to external markets. In Tanzania, however, women are behind men in these three indicators.

4.2.2. Differences in access to capital and skills

Women's lower access and control over resources is a potential reason for their lower business performance. Our data shows gender differences in access to finance, skills, education, and a variety of other resources such as land, vehicles, appliances or cattle.

Tanzanian enterprises show lower and more unequal access to financial services than their Ghanaian counterparts. More than 75% of enterprises in Ghana have bank accounts and close to 40% have requested loans, most of which were granted. However, only 35% of enterprises in Tanzania have bank accounts and 19% have requested loans, most of which were granted as well. In Ghana, women hold significantly more bank accounts than men, while the opposite is the case in Tanzania. However, in both countries women have more frequently requested loans but the difference with men is not statistically significant. In both countries, men's enterprises enjoy higher starting capital, but the difference is only statistically significant in Tanzania.

Table 15- Access to capital and financial services by gender

	Ghana			Tanzania		
	All	Male	Female	All	Male	Female
Starting capital (USD)	669	739	550	**709**	**947**	**312**
Own Bank account	**76%**	**73%**	**82%**	**34.7%**	**43%**	**22%**
Requested loan	38%	36%	43%	19%	17%	22%
Loan Granted	93%	94%	92%	84%	90%	76%

Asset ownership or availability figures show again the higher empowerment of Ghanaian female entrepreneurs. They enjoy land and buildings for their businesses as much as men and only have lower ownership of cars. On the other hand, female entrepreneurs in Tanzania show significantly less valuable assets than men.

Table 16- Asset availability in businesses by gender

	Ghana		Tanzania	
	Male	Female	Male	Female
Land plot/farm	66.8%	62.6%	**54.9%**	**35.4%**
Buildings	53.4%	46.9%	**57.4%**	**43.3%**
Car	**24.9%**	**8.8%**	**2.5%**	**0.0%**
Motorcycle	0.4%	0.7%	**12.3%**	**4.7%**
Boat	-	-	**4.4%**	**0.8%**
Bicycle	66.8%	62.6%	**16.7%**	**7.1%**

Access to capital was the most important constraint to business for enterprises in both countries, regardless of gender. In Tanzania, some interviewees highlighted women's difficulties to raise capital for business. For example, a male entrepreneur said "men are well privileged to undertake business as they can acquire loans much easier than women", a female guesthouse owner agreed with the view that "men can easily acquire loans and are trusted more than women". This opinion was seconded by many of our key informants. For example, a female accountant from hydro-power plant LUMAMA indicated that "women depend more heavily on agriculture, their income is very seasonal

and dependent on the availability of markets for their products. This makes them not creditworthy". In a similar manner, TANESCO's representative in Ukerewe said that "Women do not venture in the opportunities created by electricity mostly due to lack of capital". Sambi's (male) Village Executive Officer added: "because Sambi community is strongly patriarchal, sometimes women don't have the right to take credit. Most credit schemes require collateral and women don't have the right to own land". Women often get involved in informal savings groups or village banks to overcome this constraint.

In Ghana, women working in traditionally male trades referred specifically to the difficulties faced in raising the finance required to buy appliances and land:

> "If they want females to be engaged in male activities, the government must support the females with machines. The machines help and you don't need your physical energy to cut wood. When you don't have machines the work is so difficult. But before you need to look for land and set up a shop. So when women consider all these, they just settle for hairdressing...you can even operate from your veranda." Woman carpenter, Techiman.

Men also face similar challenges to raise finance to buy equipment, but they can more easily use their physical strength in place of it, for example:

> "If I had money, I would have purchased a lot more tools. Because the cash inflow is inconsistent, we are unable to save money to buy better machines. I really need an electric machine and a grinding machine. No matter how good you are at the job, without the tools, there is nothing you can do. (…) but if you don't have machines, you can hire them" Male straighter from Techiman.

Contradicting previous research (de Mel, McKenzie, & Woodruff, 2009) some respondents said men's business profits are more likely captured by household needs than women's profits:

> "Female businesses are the ones that usually grow faster than those of men. The reason is that, if she is a married woman, she doesn't spend her revenue on anything. She is always reinvesting it back into the business but for a married man, you are responsible for the household expenses. She can say she doesn't have money but you can't. You have to manage for the business to survive as well as bring something home. This is why businesses of men do not grow as fast as those of women." (Male welder from Berekum).

> "When women come for a service they put it into the right place, but men sometimes divert the funds. When women get support for their businesses, they look and their families look happier." Head of the Business Advisory Centre of Techiman.

It seems, therefore, as if women have lower access to capital to start with, but then they are more able to save and reinvest in their businesses to make them grow: "when a man decides to take up this job, he easily expands because of the bigger start-up capital, but for the females they start from somewhere and grow into a bigger business."

Qualitative data from Myanmar showed that ownership of assets tends to be under the men's name, as the head of the household, making it difficult for women to access capital or other resources. This lower access and control over resources means that, for women that want to start a new business, they tend to require men's permission to do so. A KII from the Government indicated that "Only one member from one household is given a loan and this is typically the head of household, who is a man. Women may be doing all the work in a business but the store will be under the husband's name".

In all three countries participatory FGD to understand gender differences in access to and control over resources were run. In these discussions, access was defined as the opportunity to use a resource, while control represented the full authority to make decisions about the use of a resource (i.e. buy, sell or modify it). In all cases men displayed higher access and control over most resources, with the exception of cooking fuels and appliances[7]. In Ghana, women controlled more resources than in other countries, including electric appliances such as fridges and televisions, the latter also controlled by women in Myanmar. The most valuable assets such as land, buildings, vehicles, heavy machinery, furniture and livestock are controlled by men. In farms, women control low value animals like poultry and low value crops like sweet potatoes and tomatoes. Access to and control over fishing related assets in Tanzania and Myanmar are exclusive to men, and in Tanzania it is even taboo for women to use or repair fishing boats or equipment. On the other hand, women, who dominate subsistence agriculture do not have the decision making power to sell some crops to gain additional income. If they do it, this must be while their husbands are unaware of it. According to a female farmer from Sambi (Tanzania): "after harvesting and storing crops at home, we do not have power to make decisions about selling them". This unequal distribution of resources was attributed to the patriarchal system that rules society. For instance, one women in Bwisya (Tanzania) said "men have all the power for decision making". However, women acknowledge in all countries that they have control over the income earn in their own businesses.

Skills are another important resource for starting and operating businesses. Gendered data on education presented in Table 22 show that Ghana is heading to equality in education, but gender differences persist in Tanzania. Overall, Ghana also shows higher educational attainment, with the majority of respondents having at least secondary education, while most have only primary in Tanzania.

Progress towards equality in education was validated in our interviews to workers and key informants in Ghana:

> "Things have changed drastically as far as the education of the Ghanaian children. Gone are the days when education was restricted to the boys alone here in Berekum" Berekum Municipal Chief Executive (male)

> "when it comes to school enrolment you have gender disaggregated data showing that the ratio is almost 1 to 1" Techiman Municipal Planning office (male)

Tanzania's interviewees, instead, evidenced that education is still biased in favour of men:

[7] Scores given in the three countries during this exercise are included as an annex.

"most women are not exposed to entrepreneurship training, because they have to remain at home taking care of children" (male entrepreneur from Murutunguru). A female accountant from LUMAMA hydropower project indicated that she is the only female employee in a team of 10 staff. Even if the job advert was open to everyone, she was the only woman who applied. She was then trained for over a year and provided with a good job. Bwisya Ward Officer referred to a problem of women's confidence, as they don't think they will be able to do some jobs successfully, and hence don't apply for them. Most women interviewed acquired the skills to do their job by observing relatives or other workers, and by learning by doing sometimes working for free with some relative, not through formal education. In the words of Bwisya Village Chairman "Women do not have plans on what they want to do. Often they just copy and paste from what their fellows do". Learning by doing, and replication of relatives jobs was also the case for most of the men interviewed.

Formal education levels are low for both men and women interviewed in Myanmar. Those that have higher education end up going to the city to look for a job. Traditional skills for certain businesses (tailor, carpenter) are passed on to by older generations or provided by NGOs or the Government.

Table 17- Education of business owner, ANOVA by gender

	Ghana			Tanzania		
	All	**Male**	**Female**	**All**	**Male**	**Female**
None	15.8%	16.6%	14.3%	4.2%	3.9%	4.7%
Primary	10.5%	11.1%	9.5%	**71.6%**	**65.7%**	**81.1%**
Secondary	52.5%	50.6%	55.8%	**18.1%**	**22.1%**	**11.8%**
High School	13.5%	15.4%	10.2%	1.2%	1.5%	0.8%
Vocational	4.0%	3.2%	5.4%	2.1%	2.9%	0.8%
University Degree	3.8%	3.2%	4.8 %	**2.7%**	**3.9%**	**0.8%**

Several trades in Ghana organise apprenticeship schemes to support young people to gain the necessary skills to open their own businesses or be employed in existing ones. Apprenticeship programmes in male businesses such as auto mechanics appear longer and more expensive than those in female trades like tailoring or hairdressing, implying lower barriers of entry for female trades. However, chairmen of these associations worry that even after their apprenticeships these youngsters will not be able to work due to lack of capital to open their businesses.

4.2.3. Differences in care responsibilities

Unbalanced care responsibilities are one of the reasons why women operate in smaller survivalist enterprises, closer to home or home-based, according to previous literature (Kabeer, Mahmud, & Tasneem, 2011; Nordman & Vaillant, 2014; Razavi, 2007). In our sample, however, when requested to identify the two most important constraints for the growth of their business, very few women respondents highlighted care responsibilities, with most pointing at financial constraints. On the other hand, women in all countries more frequently operate from their home, and more frequently indicate the need to be close to home as the rationale for their business location, as presented in Tables 17 and 18. Women in Tanzania appear more attached to their home responsibilities, more frequently working from home or nearby to be able to attend their families. However, a

majority of women, like men, operate from a permanent building outside of their home, and have chosen their location with the view to attract customers.

Table 18- Business characteristics- Location and physical structure by gender

	Ghana		Tanzania	
	Male	Female	Male	Female
Home-based enterprise (in our outside the home)	**3.2%**	**12.9%**	13.7%	20.5%
No structure (i.e. blanket or mobile display) in a public space	0.4%	1.4%	4.9%	7.9%
Mobile stand or structure in a public space (i.e. cart, trolley, etc.)	18.2%	23.1%	5.4%	9.4%
Permanent building structure (shop)	**78.3%**	**62.6 %**	**76.0%**	**62.2%**

Table 19- Reasons for the selection of business location

	Ghana		Tanzania	
	Male	Female	Male	Female
It is close to home so I can combine work with caring for my family	**4.3%**	**16.3%**	**14.5%**	**29.0%**
It is a good place to attract customers	45.9%	42.2%	**69.1%**	**51.6%**
I was told to take this location (i.e. allocated by municipality)	3.2%	0.7%	2.4%	3.2%
Available for hire	**34.8%**	**19.0%**	6.3%	6.5%
Inherited this location	**4.7%**	**9.5%**	2.9%	4.0%
Had no alternative	**4.7%**	**10.2%**	3.9%	3.2%
Other	2.4%	2.0%	1.0%	2.4%

In both African countries, as well, women operate significantly shorter hours than men (approximately 1 hour less every day), which could be due to their higher care responsibilities.

Qualitative data offered further insights about the care burden of women in the region as compared to men, and its impact on paid work opportunities. Across all countries and field sites, the social organisation of care was women's role. Women's responsibility for care was naturalised, with women considering themselves better for the job and men acknowledging that they could not do it. Men's responsibility instead is to provide for the family, hence becoming the naturalised breadwinner. Women are responsible for collecting firewood and fetching water, caring and feeding the children, cleaning the house, washing clothes and dishes, cooking, planting crops, feeding and caring for animals. In rural settings, men also support in farming for family consumption and cattle rearing. In Myanmar, when men were asked about the benefits of energy use for women, they constantly referred to women as caretakers, not to women as workers: "at the moment [after electricity] it is better for women as there is light in the house. Before they had to wake up early to make fire and cook, now some women can prepare it in advance in the rice cooker". Participants in rural Tanzania and Myanmar followed more closely traditional gender norms, whereas in urban Ghana there were many instances in which these were being challenged.

In Ghana, the most advanced site with regards to gender equality, men engage in more household activities than in the other two countries, such as ironing, looking after the

children or cleaning the house. What is more, many men expressed dissatisfaction about the burden of being the only one responsible to provide for their families, but some women contested that view, indicating that they contribute as much as men to their household's finance.

> "In this era, both men and women contribute financially to housekeeping" (Female petty trader from Techiman, mother of three)

> "Things have greatly changed in our time. It is no longer the way it used to be where women depend on men. Now women are equally sharing in the household financial responsibilities." (Female hairdresser, mother of one, from Techiman)

> "A woman will do as much as the man. If a man does not have money, as a mother you need to use whatever means to ensure that the children eat. Both men and women work very hard to be financially responsible for their households so the men cannot say they are under pressure. Women in Ghana are more concerned about their children than men." (56 years old woman, operating a chop bar in Techiman, mother of six and looking after grandchildren.)

> "You men after marrying will go for "side chicks" or other women apart from their wives, so if they say they are under pressure, who put them under pressure? It is their own doing. They should stop lamenting." Same as previous female respondent

> "I don't agree with him because household chores are not for just the wife or children. If the woman has difficulties, the man can help the woman" (Female seamstress from Berekum)

In any case, it was clear than even when women worked, they still had responsibility for caring activities at the household. For them to reduce this burden, they had to earn enough to pay for help. The Ghanaian case also showed that even when attitudes to household responsibilities changed, some specific activities remained distinctively female, particularly washing clothes and cooking:

> "For women most of our time is used on food preparation. If a woman is in church and the pastor is preaching, a woman will be counting down to get home to prepare food for the family." (56 year old woman, operating chop bar in Techiman, mother of 6).

> "What I can't do is washing my wife and children's' clothes (…) For someone who is married, washing is not my work. Besides, when the neighbours see you washing, they will talk. They will say my wife has fooled me and I am now washing for her" (41 year old man, father of 3, working on electronics in Berekum)

> "Washing, especially washing for men is not very easy". (Female petty trader from Techiman)

> "Because I am a married woman, I have to wash my husband's things so by the time I am done the time to go to work will be all gone". (Female sprayer)

In Myanmar, the concept that women's job is less important than men's came across very often. For example, a woman from Oak Pho explained "after I finished my school, I wanted to attend sewing training but my father refused, as there was nobody to do housework".

Interestingly, the use of electric appliances could switch gender roles for household tasks, with some men in Ghana indicating that they are now in charge of ironing. Also, experiencing the hardship of household chores could persuade men to purchase time-saving appliances:

> "My wife got boils on her hand and washing was very difficult. I live with just my wife so I had to do the washing. I didn't like it, so I had to buy a washing machine." (41 year old man, father of 3, working on electronics in Berekum)

A clear message from the discussions was the importance of exposure for gender norms to change:

> "I know a bank manager at Sunyani, who will wake up in the morning, wash his baby and wife's clothing while his wife stays in the kitchen preparing breakfast. When he is done, he dresses up and goes to work. This makes it easier for both of them to go to work early. The men are supposed to help in household chores." (Female petty trader from Techiman)

> "Today's discussion has opened my understanding on how I can be of help to my wife at home so we can all live peacefully and grow together. I will also like to urge my fellow men to assist their wives in domestic chores in order enhance the welfare of both men and women." (Male worker from Techiman)

> "From what we have done today, I have realized men can help women in their work. So we are going to tell the men who are home to help the women to develop." (34 years old female automechanic, Berekum.)

4.2.4. Differences in motivations

Previous literature has pointed at the different motivations that men and women have for running business as a cause for differences in their performance (Banerjee, Duflo, Glennerster, & Kinnan, 2015; Minniti, 2010; Nagler & Naudé, 2014). Hence, women would typically run survivalist enterprises aiming at meeting daily household needs, whereas men would be more ambitious driven and growth-oriented. Table 20 shows that this hypothesis seems correct in Tanzania, where in their responses about motivations to run enterprises men appear more ambition driven and women more necessity driven. However, it is refuted in the case of Ghana, where men and women exhibit similar motivations. In Myanmar entrepreneur motivations were to continue the family business; follow a personal interest; and convenience. Those following a personal interest were mostly men (carpenter, builder, photographer) and those choosing convenience were mostly women, working from their own homes so they could earn an extra income and take care of the children at the same time.

Table 20- Motivations for running a business. Share of enterprises by gender.

	Ghana		Tanzania	
	Male	Female	Male	Female
Affording daily food needs	21.7%	18.4%	**18.4%**	**32.3%**
Contribute to home expenses	15.8%	16.3%	**14.5%**	**26.6%**
Needs for children	9.1%	14.3%	8.2%	12.9%
Independence	13.8%	11.6%	11.1%	9.7%
To have something to do	14.2%	13.6%	4.3%	8.1%
It was my ambition	24.1%	25.2%	**30.9%**	**5.6%**
I could not find another job	1.2%	0.7%	5.3%	1.6%

In Tanzania, it emerged that most men and women working in food preparation, a typically female activity, had chosen this business as a last resort, not having many other alternatives. Food preparation has very low barriers of entry with low capital and skill requirements.

In Ghana, preconceptions of women as risk averse were challenged: "Market women take a lot of risks, they travel long distances taking their products and when they get to their destination towns they might end up even sleeping in the stations. Some of these women are raped in those lorry stations and some of the goods they sell are perishable but still they take the risk to go and bring it". Ministry of Gender, Child and Social Protection Officer for Brong Ahafo region (female).

In both countries, nearly all businesses declared their desire to grow, whether male or female run. Their ideas on how to achieve this show some differences in Ghana, but are widely similar in Tanzania. Expanding the products offered is the preferred option in Tanzania, whereas the most popular options in Ghana are typically more capital intensive, such as purchasing new equipment or moving to a better space.

Table 21- Growth ideas (% of enterprises)

	Ghana		Tanzania	
	Male	Female	Male	Female
Expand the range of products on offer	**50.2%**	**31.3%**	29.2%	32.0%
Increase production	54.2%	58.5%	22.6%	25.6%
Invest in new equipment	57.7%	54.4%	18.5%	18.4%
Improve to a better or bigger space	54.9%	62.6%	12.8%	12.0%
Hire more staff	25.3%	29.3%	0.5%	0.0%
Open another enterprise in the area	**22.5%**	**11.6%**	15.4%	11.2%
Don't know	2.8%	1.4%	1.0%	0.8%

There was no shortage of precise growth ideas in our sites, which men and women explained in detail during interviews, but all respondents pointed at the lack of capital as the reason why they had not materialised.

4.2.5. Gendered occupational segregation

The last and all important reason why men and women display different energy use patterns at work is occupational segregation. Gender norms determine the types of

sectors where men and women operate and the roles that they play within sectors. There were a lot of commonalities in the "appropriate" jobs for women across countries. In rural contexts, men dominate the key sources of agricultural income, such as fishin and cultivation of cash crops. Women instead are heavily involved in subsistence agriculture. In the services sector women work in small retail, tailoring, hairdressing or food preparation. Men instead operate across a wider range of activities in services and manufacture, often involving physical energy, which can be replaced with electricity or diesel engines. Some of these male dominated, energy intensive, activities include milling, carpentry, metal works or vehicle repair and maintenance. In rural settings, however, we also observe non-physical activities such as money-transfer services, or video halls or guest houses are mainly run by men.

Figure 4 shows the distribution of men's and women's enterprises across sectors in Tanzania, evidencing women's role in just a handful of sectors.

Figure 4- Number of enterprises per owner's gender and sector of activity in Tanzania

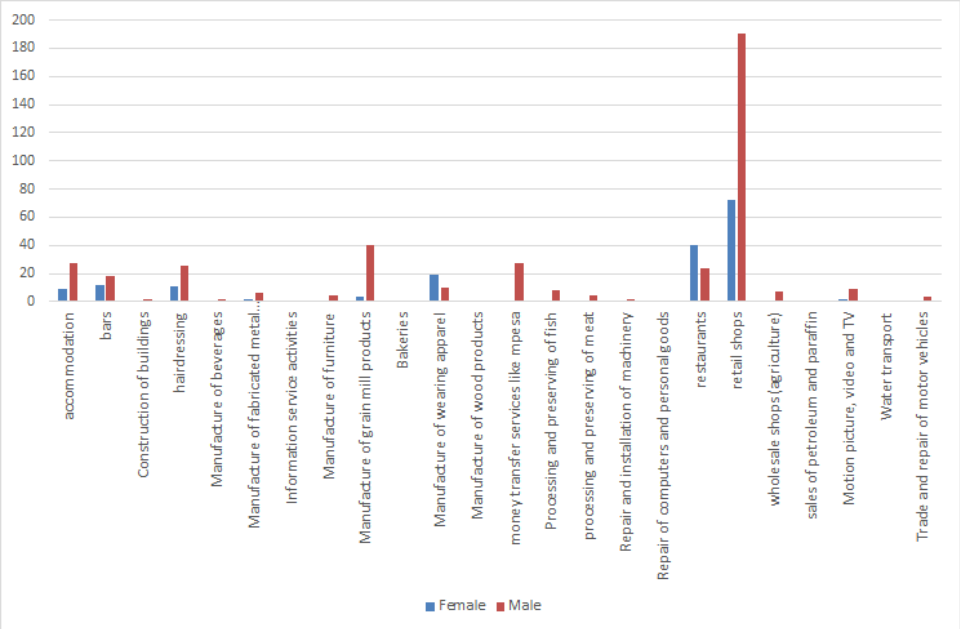
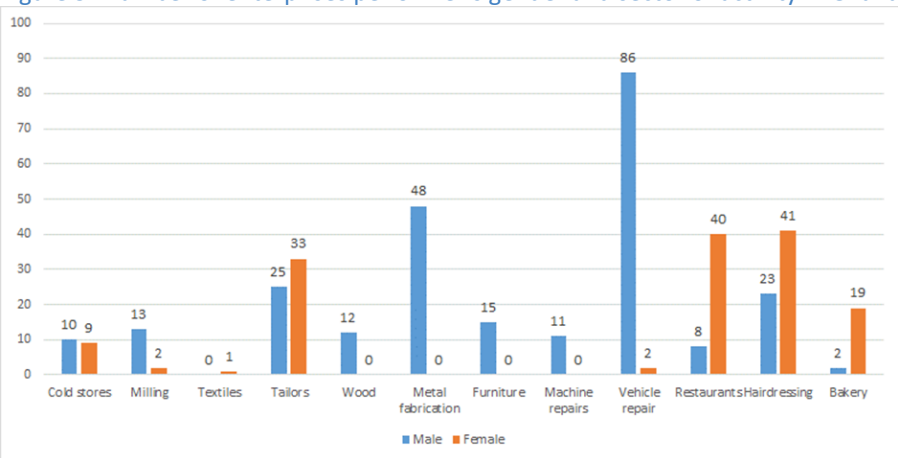


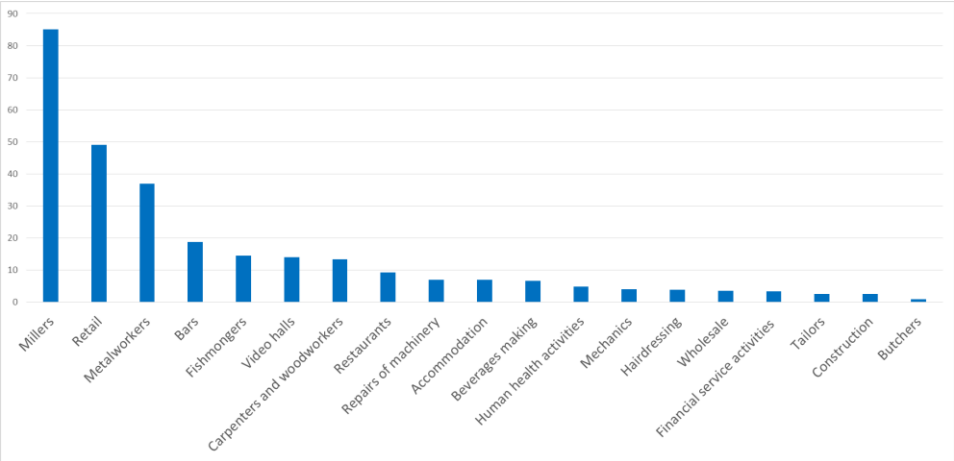
Figure 5 shows a similar pattern in a more sophisticated urban economy, in which only 11 sectors were selected as part of our sample. Like in Tanzania's rural economies, women dominate restaurants and tailoring, in addition to hairdressing.

Figure 5- Number of enterprises per owner's gender and sector of activity in Ghana



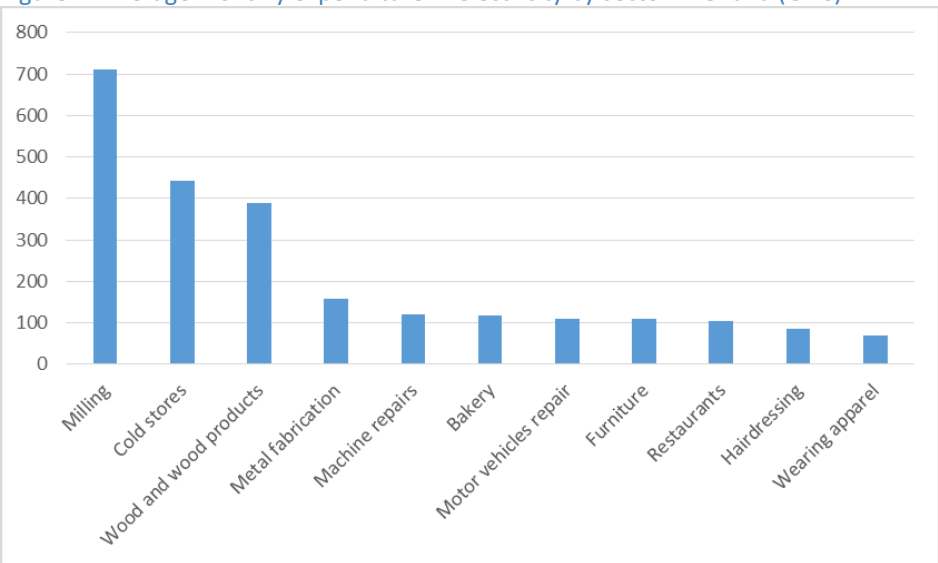
Sectoral segregation is important from an energy consumption point of view, because the type of fuel and amount consumed is in great part determined by the sector of operation. Figure 6 shows that men dominated trades such as milling and metal works, top the largest energy consumers in Tanzanian villages.

Figure 6- Average weekly expenditure in electricity by sector in Tanzania ('000 TSH)



In Ghana, milling, cold stores, woodworks and metal fabrication are among the top consumers, as per Figure 6. Only cold stores have significant female representation.

Figure 7- Average monthly expenditure in electricity by sector in Ghana (GHC)



This gender pattern disappears when we consider total energy consumption, and female run businesses such as restaurants, or bakeries, alternate with male ones like milling and carpentry.

Within sectors, women typically earn less than men. For example, they occupy the least profitable activities in the value chain of fishing and milling, the two key sectors of Lake Victoria islands' economy. In Myanmar villages the idea that male labourers in the agriculture sector should earn more than women was also widespread. Salaries of male labourers were almost 50% more than the salary of female labourers. One man

mentioned 'of course, here women cannot earn as much as the men earn. They earn 2000 for working one morning, but men earn 3000'. This is also the case in the formal sector, where women's role is still secondary:

> "In formal settings most women are in junior staff positions such as secretaries, cleaners, labourers …, at that level they don't take decisions, they just obey instructions. So, if you go to heads of department meetings you end up being the only female. In informal settings women are mostly engaged in hairdressing, dressmaking sweepers, cleaners, petty trading and the likes. They are also into farming but not into cash crops, only into peppers, onions, tomatoes… those small crops that can be grown around the house and don't fetch much. The cashew and the cocoa are male dominated and even if you see women, they are supporting their husbands". Female Ministry of Gender, Child and Social Protection Officer, Sunyani, Ghana.

Occupational segregation derives from socially constructed as well as biological differences between men and women. According to respondents, men are physically strong, while women are "weak" and have to stop working during pregnancy and after childbirth. Women were also seen to be better at cooking and cleaning than men, and less able to understand how to operate machinery. Other factors came also into play when for the choice of activity in Tanzania, such as the risk of sexual harassment when working after sunset, mobility restrictions to engage with suppliers and clients outside the hometown or village, or the social stigma of working around men.

Promisingly, some changes in gender norms were starting to show in the traditional societies of Lake Victoria:

> "When you compare the previous years and now, I see women being recognised and appreciated because now there are families depending on women's income. Before women were recognised only because their parents paid a dowry, but now educated women support families and the community has realised that." Sambi Village Executive Officer

> "Now women are more aware of their rights. For example, there are several women who come to my office claiming their rights if the father of their children is not providing for them." Bwisya Ward Executive Officer

> "There are some traditions that say that women should not do some kind of activities but now days they are changing. For example some of my family members did not agree with me to work in the barber industry. They thought that is not for women but men. But now they see the improvement." Female barber in Nabweko

> "I have heard that now women are joining engineering work so it may happen that in the future there will be women who will be investing in this work." Male welder and miller in Bugolola.

In Ghana, these changes were more evident. Ghanaian market women had a reputation of strong traders and were a key referent of women's important role in society. Furthermore, with education and globalisation, interviewees had been exposed to several

instances of women surpassing their traditional roles. This was seen with admiration and respect, rather than as a threat.

> "Recently when I went to Accra, the VIP bus I boarded was driven by a woman. I was surprised initially when the woman came into the steering wheel. I nearly went down. Psychologically I was not comfortable, how can a woman drive me to Kumasi? But she was doing very well, she was very careful too and the zeal she was putting, I mean I was clapping! So when I dropped down I said: Mama God bless you (chief development planning office, male Techiman)

> "When I went to the school for monitoring the headmaster of our programme on building and construction, he was full of praise for one of the trainee ladies. He couldn't imagine that she could lift blocks and start building by herself. He was so amazed. When the girl started performing, the boys saw that girls too can do it. They had to see to believe." Ministry of Gender, Child and Social Protection Officer (female)

> "There are female technicians that are able to climb up to transformer level, they come and check the faultiness of meters, perform meter calibrations and they're working very well. It was in the olden days that people didn't like or women didn't like pursuing technical programs and science courses but now you can see they dominate in many of these courses" NEDCO representative in Berekum.

> "If the women do the carpentry work, they can do it and do it better. Because at certain times, it does not need much strength, it needs skills." Male carpenter in Berekum

> "I think both men and women have the same brain, so if you put your mind to it you can do it, except when it comes to strength." Male straighter, Techiman

> "When I was in Kumasi, three of the masters were females and were giving instructions to male and female apprentices, but men did the lifting work" Male straighter in Techiman.

> "When you come to the political arena gone are the days when politics was purely reserved for men. At the moment we have women becoming MPs, women becoming even Chief Justice" Chief Executive Officer of Berekum

There was a feeling of pride among women doing male jobs, because they had been able to show that they could do it:

> "Some people come to see you doing that job and they become happy and give you more work because you are a female [...] everyone is happy that this sister is doing this work. I am happy if someone says something good about it." (Female auto-mechanic)

> "I enjoy the work much because you wouldn't see many women into it. People sometimes asked me why I am into this job as a woman but I usually say to myself that these people do not know what they ae saying." (Female sprayer)

> "You are happy because you can also say you are the one who did it." (Female sprayer)
> "I really feel proud of my job. People even call me by the name of my business (…) at the beginning men were surprised and some came to check me out. I believe women can also do men related work and even do it better than them" (female miller, Berekum)
>
> "When some people see you in the working gear, they like you and even give you money. It motivates me to work. Sometimes when I am by a car working you won't see that I am tired. When you see me working on the car, you wouldn't even think it is me. When someone comes to see you doing the job, they are marvelled because I am a female doing this kind of work. The work is nice and it is beautiful when a female is doing it." Female sprayer
>
> "[When you walk around Techiman Township and people who know you as a female carpenter look at you, do you feel shy?] No, I don't feel shy. I feel proud. I'm excited about the work. Even my family members are excited about my work. They even say that "my sister is the one doing carpentry here". Female carpenter in Techiman.

Many men agreed that they would prefer to pay a woman over a man doing car services or carpentry: "One advantage the women have is, over here the females don't like learning a vocation so, if one of them is able to go through and she opens her shop, men prefer patronizing their services." Male sprayer in Berekum. "Women will get more customers. When a woman does something, men like to go there. If a woman owns a bar, men usually go there." (Male carpenter in Berekum). But the same happened with men venturing into female jobs: "When the males learn (hairdressing) they get a lot of customers because it is not common so it helps them." (Woman hairdresser).

A common element in most women who had crossed over to male dominated sectors, was the influence of male role models, or exposure to the sector from family and friends:

> "I used to sell yams alongside this milling business inherited from my father but fully resorted to the milling after the death of my father (…) I had a customer at Kumasi Magazine who died a month ago; he taught me how to assemble the station because I was been cheated by repairers (…) I took inspiration from a man who came for a funeral in this town. After I had discussed with him my interest in milling, he promised to give me the machine to start the business. He lavishes praises on me anytime he comes around. I can say it is that motor which coined the whole business." (Female corn miller)
>
> "I was one day chatting with a friend and she told me that her father said someone has sprayed her motorcycle. A female had sprayed his motor cycle! And when she completed it was very nice. So her father said he will let her train as a sprayer. At that time I didn't know about the spraying vocation. I didn't know what it entails but I took a decision that I will also do that thing. So when I completed school and my parents told me that there was no money, I told myself I will learn this job" Female sprayer

> "A woman trader came to our village. We were chatting and she said that her daughter was going to train as a sprayer. So when she said that, I said wow, this woman has spoken about this job and made me happy. I said that if her daughter is going to learn spraying, then I will also learn spraying." Female sprayer

> "What motivated me is that, my male sibling came to do it and I came after him." Female sprayer

> "I had a teacher of Social Studies called Mr. Sulley. Now he teaches at Techiman Secondary. He taught me freely. He had wished to support me financially to further my education, but that did not happen. So when he realised that I was learning a male job, he was the only one who came to the workplace and visited me and encouraged me. He said that if I worked hard I would be equal to my colleagues furthering their education." Female carpenter

In summary, gender norms that determine appropriate productive activities for men and women are a key determinant of energy consumption patterns. These norms are strongly rooted in the communities, and take long to change. However, some communities are showing that through education or exposure to role models, women can crossover to male dominated sectors or occupy positions of higher responsibility in mixed sectors.

4.3. Summary of modelling results in Ghana and Tanzania

This section compares the results for Ghana and Tanzania of the model specified in equation 1, section 3, with monthly profit, energy expenditure and electricity expenditure as dependent variables. Results for other variables (opening hours, sales, number of customers, business expenditure, number of hours of electricity use) are included in the annex.

Dependent variables are expressed in natural logarithm, hence coefficients of the independent variables in the subsequent tables have to be multiplied times 100, and be interpreted as percentage change in the outcome variable when continuous variables increase by one, or when the value of dummy variables is 1, ceteris paribus. Results are presented for all the sample, and then separately for just male owned enterprises and just female owned enterprises, to identify gender differences in the impact of variables. To rule out the presence of collinearity in explanatory variables, their correlation coefficients were looked at, without finding any high value.

We begin by discussing the results of business economic performance indicators. Results for monthly profits are presented in tables 22 (Ghana) and 23 (Tanzania), in the first column for the whole sample, and in the other two columns separately for only male owned and female owned enterprises. In both Ghana and Tanzania, our variable of interest "being a female owner" has a negative effect on profits, but it is only statistically significant in Ghana. In both countries, businesses using electricity obtain significantly higher profits than those that don't. In Ghana, being inside a LIZ was another variable of interest, and it shows a negative and significant coefficient, that becomes even more negative for female owned businesses. In Tanzania, the intervention of interest took place in Bwisya, where we observe a higher positive impact of electricity than in other regions.

We do not observe similar results with regards to the impact of individual characteristics on profits. In Ghana, older, married, and migrant owners, holding bank accounts obtain significantly higher profits. In Tanzania, more educated, not married owners do so. The number of children has a positive impact on profits in Tanzania, driven by male entrepreneurs. However, in Ghana, the number of children is negatively correlated with profits. Being formally registered is in both countries positively and significantly correlated with profits. Keeping accounting books has a positive coefficient in both countries, but is only statistically significant for Tanzania. Finally, enterprises with higher starting capital obtain more profits in Ghana, but their impact is not significant in Tanzania. Fixed effects indicate that restaurants perform better than most other sectors ceteris paribus. Hence this predominantly female sector does not display worse profits than the rest, when all other factors are taken into account.

Table 22- OLS Results- LN last month profit Ghana

	(2)	(2.1)	(2.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.055***	0.058***	0.055***
	(0.008)	(0.013)	(0.008)
No Education/Primary Education	-0.017	0.151	-0.285
	(0.146)	(0.193)	(0.222)
Migrant	0.304**	0.415**	0.053
	(0.135)	(0.181)	(0.198)
Married	0.304**	0.242	0.404**
	(0.153)	(0.267)	(0.195)
Bank Account	0.955***	0.933***	0.686***
	(0.149)	(0.201)	(0.244)
Requested loan	0.215	0.329	-0.040
	(0.150)	(0.201)	(0.204)
	Household Characteristics		
Number Children	-0.150***	-0.227***	-0.051
	(0.049)	(0.076)	(0.044)
Number of Elder	0.008	-0.007	0.021
	(0.023)	(0.054)	(0.024)
	Business Characteristics		
Female Owner	**-0.333***		
	(0.199)		
Electricity	**0.623*****	**0.498****	**0.701*****
	(0.146)	**(0.230)**	**(0.208)**
Industrial Zone	**-0.588*****	**-0.444***	**-1.014****
	(0.194)	**(0.236)**	**(0.417)**
Member of Association	0.167	0.252	0.011
	(0.154)	(0.228)	(0.190)
Registered Business	0.356**	0.339	0.304
	(0.180)	(0.236)	(0.236)
Starting Capital ('000th)	0.003**	0.002	0.005**
	(0.001)	(0.001)	(0.002)
Permanent Structure	0.422**	0.375	0.575***
	(0.163)	(0.229)	(0.219)
Keep Book	0.238	0.395	0.093
	(0.204)	(0.292)	(0.276)
Number of Workers	-0.010	0.068	-0.043
	(0.030)	(0.049)	(0.038)
Observations	393	248	145
R-squared	0.963	0.960	0.976
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 23- OLS Results- LN last month profit Tanzania

	(1)	(1.1)	(1.2)
	All Sample	**Male**	**Female**
Individual characteristics			
Age	-0.006	-0.010	-0.008
	(0.005)	(0.008)	(0.007)
No Education/Primary Education	-0.347**	-0.360**	-0.237
	(0.138)	(0.157)	(0.290)
Migrant	-0.159	-0.295	0.202
	(0.144)	(0.198)	(0.233)
Married	-0.257*	-0.330*	-0.105
	(0.153)	(0.191)	(0.249)
Bank Account	-0.024	0.016	0.126
	(0.185)	(0.241)	(0.296)
Household characteristics			
Number Children	0.033*	0.045**	0.067
	(0.019)	(0.023)	(0.049)
Number of Elder	-0.002	0.028	-0.049
	(0.035)	(0.040)	(0.056)
Business characteristics			
Female Owner	**-0.167**		
	(0.163)		
Electricity	**0.312****	0.338*	0.305
	(0.147)	(0.198)	(0.334)
Member of Association	-0.010	-0.058	0.020
	(0.161)	(0.246)	(0.288)
Registered Business	0.371***	0.391**	0.357
	(0.139)	(0.181)	(0.233)
Starting Capital ('000th)	0.001	0.001	0.000
	(0.001)	(0.002)	(0.002)
Permanent Structure	-0.115	-0.128	-0.146
	(0.148)	(0.193)	(0.281)
Keep Book	0.334**	0.568***	-0.230
	(0.160)	(0.201)	(0.355)
Number of Workers	0.199*	0.237	0.020
	(0.108)	(0.143)	(0.145)
Observations	328	201	127
R-squared	0.340	0.344	0.468
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Results for other business performance variables are presented in the annex, but we summarise here their differences and similarities. In both countries, using electricity is always positively correlated to performance indicators such as opening hours, sales and customers, and statistically significant in most cases. The sign for female ownership, however, varies, and is not statistically significant in most cases, showing that when women face disadvantages, these are already taken into account by other explanatory variables. In Ghana, businesses located in LIZ always show worse results than other firms, and the negative impact is statistically significant in most cases. In Tanzania, being a female owner carries more positive effect in Bwisya than in other regions, showing the positive effect of gender mainstreaming interventions in the village.

Among control variables, in Ghana, age, migrant and married status, holding bank accounts, business formal registration and starting capital have consistently positive impacts on business performance indicators other than profit. The number of children and elderly in the household, which are proxies for care burden, also display negative signs, and in most cases statistically significant for children. In Tanzania, the sign of the different variables remains consistently positive and sometimes statistically significant for migrants, bank account holders, registered, with high starting capital, operating from a permanent structure and keeping accounting books.

We now focus on results for energy consumption variables, including: energy expenditure, electricity expenditure and number of hours of use of electricity. Results for energy consumption display opposite signs for our variable of interest "using electricity" in Ghana and Tanzania. Whereas in Ghana, using electricity is positively and significantly correlated with energy bills, in Tanzania, businesses that use electricity have significantly lower energy bills, more so in villages served by the cheaper main grid, but also in villages supplied with mini-grids and solar home systems. This opposite effect is not due to the higher cost of electricity in Ghana. It must, therefore be due to the more intensive use of electricity, with more electric appliances in Ghana. This assumption is backed with data about appliances ownership, which is considerably higher among Ghanaian enterprises. Thus, in Tanzania using electricity appears to have cost reducing effects for businesses that have been using it for a relatively short time. In Ghana, instead, where businesses have been using electricity for over a decade, it has cost increasing effects because it is used more intensively with more appliances. This cost increasing effect is larger for male owned businesses. But as seen in the previous results, using electricity also significantly increases profits, sales and other business performance indicators. Among other variables of interest "female ownership" has a negative, but not significant impact on energy expenditure in both countries, and location in industrial zones within Ghana has no significant impact on energy consumption either.

Younger entrepreneurs, registered businesses, and businesses with higher starting capital display significantly higher energy expenditure in Tanzania. In Ghana instead, older entrepreneurs and enterprises with a higher number of workers present higher energy expenditure. Sectoral fixed effects capture some of the variation in energy expenditure.

Table 24- OLS results Total energy expenditure Ghana

	(2)	(2.1)	(2.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.017**	-0.003	0.041***
	(0.007)	(0.009)	(0.011)
No Education/Primary Education	0.023	0.405**	-0.015
	(0.162)	(0.201)	(0.235)
Migrant	-0.073	-0.161	-0.042
	(0.148)	(0.173)	(0.254)
Married	0.088	0.307	-0.107
	(0.157)	(0.210)	(0.216)
Bank Account	-0.101	-0.020	0.082
	(0.186)	(0.211)	(0.332)
	Household Characteristics		
Number Children	0.016	0.032	-0.009
	(0.044)	(0.057)	(0.071)
Number of Elder	-0.019	0.038	-0.004
	(0.030)	(0.056)	(0.026)
	Business Characteristics		
Female Owner	**-0.202**		
	(0.198)		
Electricity	**2.365*** **	**3.289*** **	**1.386*** **
	(0.198)	**(0.264)**	**(0.302)**
Industrial Zone	**0.143**	**-0.049**	**0.725***
	(0.234)	**(0.258)**	**(0.406)**
Member of Association	-0.149	-0.233	0.259
	(0.161)	(0.217)	(0.214)
Registered Business	0.156	0.341	-0.352
	(0.197)	(0.226)	(0.289)
Starting Capital ('000th)	-0.000	-0.001	0.001
	(0.001)	(0.002)	(0.002)
Requested loan	0.083	0.148	-0.038
	(0.151)	(0.175)	(0.250)
Permanent Structure	-0.080	0.034	0.126
	(0.186)	(0.228)	(0.299)
Keep Book	0.110	0.131	0.259
	(0.218)	(0.228)	(0.367)
Number of Workers	0.075**	0.088	0.020
	(0.032)	(0.056)	(0.039)
Observations	396	250	146
R-squared	0.908	0.922	0.933
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 25- OLS Results- Total Energy Expenditure in Tanzania

	(2)	(2.1)	(2.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	-0.023***	-0.024*	-0.013
	(0.008)	(0.013)	(0.013)
No Education/Primary Education	0.029	0.024	-0.133
	(0.248)	(0.296)	(0.441)
Migrant	-0.245	-0.643**	0.388
	(0.231)	(0.299)	(0.405)
Married	-0.025	0.245	-0.363
	(0.256)	(0.411)	(0.353)
Bank Account	0.116	0.140	-0.101
	(0.246)	(0.308)	(0.441)
	Household Characteristics		
Number Children	0.023	-0.015	0.014
	(0.030)	(0.036)	(0.063)
Number of Elder	-0.053	-0.059	-0.090
	(0.066)	(0.085)	(0.107)
	Business Characteristics		
Female Owner	-0.234		
	(0.262)		
Electricity	-1.440***	-1.238***	-1.909***
	(0.241)	(0.340)	(0.405)
Member of Association	0.022	0.383	0.022
	(0.234)	(0.339)	(0.234)
Registered Business	0.572**	0.491	0.572**
	(0.229)	(0.301)	(0.229)
Starting Capital ('000th)	0.003*	0.003	0.001
	(0.002)	(0.002)	(0.003)
Permanent Structure	-0.219	-0.115	-0.304
	(0.229)	(0.293)	(0.384)
Keep Book	-0.161	-0.335	0.374
	(0.216)	(0.278)	(0.402)
Number of Workers	0.115	0.108	0.033
	(0.153)	(0.154)	(0.283)
Observations	328	201	127
R-squared	0.673	0.682	0.723
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, results for electricity expenditure as dependent variable are presented in Tables 25 and 26. In both Tanzania and Ghana, being a female owner is negatively correlated with expenditure in electricity, but the relationship is only statistically significant in Tanzania. Other control variables display the expected positive sign in both countries, but are not statistically significant, for example having a bank account, being member of an association (statistically significant for women in Ghana), and being a formally registered business. In other cases, signs are contradictory. For example, having a high starting capital as a positive effect on electricity expenditure in Ghana, which is statistically

significant for the sub-sample of female businesses. However, starting capital displays a negative impact in Tanzania, which is statistically significant for the men subsample, and turns into a positive impact for the female only sample. Sectoral fixed effects account for a significant variation in electricity expenditure in both countries.

Table 26- OLS results- LN Total Expenditure in Electricity, Ghana

	(3)	(3.1)	(3.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.037***	0.023	0.044**
	(0.011)	(0.015)	(0.017)
No Education/Primary Education	0.043	0.114	0.335
	(0.183)	(0.195)	(0.370)
Migrant	0.071	-0.062	0.079
	(0.167)	(0.184)	(0.304)
Married	0.237	0.464*	0.237
	(0.197)	(0.260)	(0.285)
Bank Account	0.203	-0.061	1.316**
	(0.192)	(0.218)	(0.506)
	Household Characteristics		
Number Children	0.003	-0.042	0.030
	(0.049)	(0.076)	(0.064)
Number of Elder	0.019	0.137**	-0.022
	(0.048)	(0.059)	(0.039)
	Business Characteristics		
Female Owner	**-0.194**		
	(0.279)		
Industrial Zone	**-0.325**	**-0.190**	**-0.207**
	(0.214)	**(0.251)**	**(0.441)**
Member of Association	0.270	0.168	0.758**
	(0.175)	(0.220)	(0.330)
Registered Business	0.183	0.326	-0.056
	(0.223)	(0.272)	(0.332)
Starting Capital ('000th)	0.001	0.001	0.004**
	(0.002)	(0.001)	(0.002)
Requested loan	0.137	0.189	0.177
	(0.170)	(0.185)	(0.316)
Permanent Structure	-0.016	-0.131	0.410
	(0.216)	(0.270)	(0.344)
Keep Book	0.308	0.206	0.529
	(0.225)	(0.266)	(0.319)
Number of Workers	0.012	0.040	-0.056
	(0.037)	(0.055)	(0.051)
Observations	270	183	87
R-squared	0.932	0.950	0.933
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 27- OLS Results LN Total Expenditure in Electricity, Tanzania

	(5)	(5.1)	(5.2)
	All Sample	**Male**	**Female**
Individual characteristics			
Age	-0.049***	-0.065***	-0.052**
	(0.012)	(0.015)	(0.020)
No Education	-0.273	-0.294	-1.099*
	(0.284)	(0.347)	(0.641)
Migrant	-0.310	-0.257	-0.266
	(0.290)	(0.350)	(0.768)
Married	0.405	1.054**	0.082
	(0.299)	(0.438)	(0.482)
Bank Account	0.155	0.527	-0.816
	(0.284)	(0.345)	(0.648)
Household characteristics			
Number Children	0.031	-0.005	0.235***
	(0.044)	(0.042)	(0.082)
Number of Elder	-0.136	-0.099	-0.213
	(0.091)	(0.115)	(0.159)
Business characteristics			
Female Owner	-0.660*		
	(0.339)		
Member of Association	0.409	0.355	0.830
	(0.300)	(0.444)	(0.552)
Registered Business	0.341	0.216	0.383
	(0.273)	(0.321)	(0.625)
Starting Capital ('000th)	-0.001	-0.788**	0.209
	(0.002)	(0.332)	(0.698)
Permanent Structure	-0.387	-0.242	-0.481
	(0.293)	(0.313)	(0.523)
Keep Book	-0.239	0.106	-0.102
	(0.276)	(0.196)	(0.341)
Number of Workers	0.126	0.355	0.830
	(0.158)	(0.444)	(0.552)
Observations	216	146	70
R-squared	0.749	0.753	0.801
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, while not presented here, OLS regressions with hours of electricity consumption per day as dependent variable showed women owners in Ghana using electricity for significantly more hours than men, but no significant differences in Tanzania. In both countries, starting capital was positively and significantly correlated with hours of electricity.

In summary, the comparison of modelling results shows some consistent messages. These include the positive relationship between electricity use and business economic performance. Female owners, on the other hand, do not consistently perform worse than their male counterparts, when all other variables are kept equal. With regards to the impact of interventions, location in LIZ in Ghana is linked to lower business performance, but location in Bwisya, in Tanzania, is linked to better business performance for women

than in other regions, and higher impacts of electricity on business performance. Some of the indicators where women typically perform worse than men are also correlated with better business performance, such as: formality, starting capital, or accounting practices. Results for energy expenditure indicate that electricity use reduces energy bills in Tanzania, but increases them in Ghana, probably due to the more intense use of electricity with appliances in the latter. Also, being a female owner is in all cases correlated with lower energy and electricity consumption, but it is only significant for electricity consumption in Tanzania.

5. DISCUSSSION AND MESSAGES FOR POLICY PRACTICE

Evidence from our three case studies shows that, in the absence of gender interventions, men entrepreneurs benefit more from the promotion of productive uses of energy, when it focuses on electricity as the energy carrier. For example, Light Industrial Zones in Ghana improved electricity supply mainly for male owned enterprises in the auto mechanics sector. Only 13% of enterprises in these zones are owned by women, and women employees are a minority. In Tanzania, most enterprises in our sample are owned by men and employ other men. Besides, men´s enterprises are usually more profitable than women´s and more frequently use electricity. Given the lower electricity consumption levels of women´s enterprises, even those connected would obtain lower benefits. The less important role of women as electricity consumers could make them less interesting for private sector suppliers. For example, one of the Directors of the mini-grid supplier in Bwisya indicated that their two priority sectors to act as anchor loads in the island are fishing and milling, both male dominated. Evidence from Myanmar also showed that men benefit more and more rapidly from productive uses of electricity.

Men and women in the three countries analysed show differences and similarities in how they consume energy at work. For example, electricity is the most frequently used type of energy for both men and women, even if a significantly higher share of male enterprises uses it. On the other hand, women dominate the use of cooking fuels, whether gas, charcoal or firewood. Among these, charcoal is the most prevalent cooking fuel. Gas was unavailable in Tanzanian islands visited, but was used by almost a quarter of female entrepreneurs in Ghana. Diesel is also more frequently used by men than by women in their enterprises. When total energy expenditure is taken into account, no significant differences are observed between men and women in Ghana or Tanzania, as lower expenditure in electricity is compensated with higher expenditure in cooking fuels.

The Ghanaian case study showed, that improving supply of electricity for men's enterprises necessarily mean that women are disadvantaged. For example, Ghana's progressive tariff scheme, by which higher consuming commercial clients pay more per kWh than those consuming less, creates a cross subsidy from more electricity intensive male enterprises to lower electricity consuming female enterprises. Furthermore, there was no evidence that enterprises in the LIZ were performing better than female enterprises in the region. On the contrary, increased competition in industrial clusters, and distance from the town centre appeared to have had a destructive effect. In fact, the predominantly male enterprises located in LIZ displayed lower profits than their

counterparts outside these zones. This brings to the fore the importance of careful planning of PUE. As previously demonstrated in the literature, energy alone cannot create economic growth and other enabling factors need to be in place when planning these interventions. PUE interventions also need to go beyond electricity to target women. For example, interventions related to cooking fuels, such as Ghana's LPG promotion programme would therefore have benefitted women rather than men entrepreneurs.

In spite of the different ways in which women's productivity could benefit from existing energy policies, all countries showed women's gaps in profits, salaries and electricity consumption. Several reasons accounted for these. First, women typically specialise in sectors with low average electricity (not energy) consumption. These include hairdressing, tailoring, restaurants, and bakeries. They are often less profitable and less power intensive than men dominated activities. However, when men and women operate in the same sector, their performance is not different. In rural economies, men dominated the most profitable activities along the value chain of fishing and agriculture. For example, in Tanzania men were involved in selling agricultural crops and cultivation of cash crops. Women instead were involved in subsistence crop cultivation for household consumption. Sectoral segregation is on one hand due to gender norms that determine the "appropriate" income generation activities for women. On the other hand, women's lower access to capital and other resources also makes them more likely to specialise in the sectors above.

In addition to, and related to sectoral segregation, women are disadvantaged in their access to skills, financial and physical resources to start businesses. In rural economies women's educational attainment is lower than that of men, but this was not the case in urban Ghana. Access to capital was repeatedly mentioned as a key constraint for both men and women, but women had a smaller capital to start with. Women also showed lower ownership of high wattage electric appliances, and lower ownership of land and buildings which could be used as collateral for loan applications. Lack of equipment was particularly mentioned by women in Ghana as constraint for them to crossover to male dominated sectors. There was also some evidence showing care responsibilities limiting women's performance at work. For example, women work shorter hours than men, and run their businesses from home or nearby to attend household responsibilities. Urban Ghana displayed a more gender equal society than rural Tanzania and Myanmar. Men had taken over some typically female responsibilities such as ironing and child rearing. However cooking and washing remained distinctively in women's domain.

The relatively more equal Ghanaian society showed encouraging progress in some respects. Education was helping both men and women to challenge gender stereotypes about household responsibilities and the types of businesses that men and women can/should do. More women were getting into desirable formal employment in banks, civil service or as school teachers, for example. And more of them were getting into STEM professions. Even if women displayed a lower starting capital, they showed significant economic empowerment, holding bank accounts more frequently than men, and being able to save and reinvest their business profits without diversion to the household. In this respect, the cultural norms of the region made men responsible to provide for the household, and men more often complained of being unable to save for their business after meeting family needs. Furthermore, facilitated by globalisation and exposure to new role models, more men and women were challenging traditional gender roles. Women in

traditionally male businesses showed pride in what they do, and in having been able to demonstrate that they can do as good a job as men. Many men appreciated women venturing into traditional male jobs and showed delight when their preconceptions are proved wrong.

We provide policy recommendations that take into account the diversity of our target regions, and draw from their prevailing gaps and achievements towards gender equality in the PUE. These are classified in two groups: first PUE interventions that support the activities that men and women currently do and leave no one behind. Second PUE interventions that transcend traditional sectoral segregation as well as segregation within sectors, moving towards equity in the use of energy at work.

The following actions would support men and women's PUE in their current roles:

1. **Access to finance and equipment**. Finance was identified by both men and women as their most pressing constraint to growth. However, different strategies for finance provision are required for men and women to match their particular needs. For example, finance was more likely to be captured by household needs when given to men in Ghana. However, in Tanzania key informants recommended that women receive in kind, rather than cash transfers to avoid displacement to the household.

2. **Energy management training.** Many businesses both in Ghana and Tanzania displayed a total lack of understanding about how electricity bills are calculated and a distrust about whether meter readings were legitimate. In Ghana, there was in many cases resistance to prepaid meters, which should allow businesses to better control their bills. Further understanding of energy bills, and how to achieve savings could support both male and female businesses to improve energy efficiency and derive higher benefits from their productive use of energy.

3. **Reliability improvements.** The poor reliability of grid electricity supply was highlighted by both men and women entrepreneurs as a key constraint to their businesses. Poor reliability causes delays in production, lost customers, lower sales, and damaged equipment. As a result, those who can afford it were turning to individual generators or solar home systems to bypass the grid. This has significant consequences for the power utility, starting a vicious cycle in which higher consumers abandon the grid, hence reducing the revenues of the power utility and its ability to invest to improve reliability.

4. **Support to traditionally female trades with high quality, affordable energy, and not only electricity.** Interventions to improve the cost and quality of cooking fuels, and to support small commercial consumers of electricity, or improve energy supply for subsistence agriculture are more likely to target women. Cooking fuels interventions include the promotion of LPG, with lower impacts for women health, or improved cookstoves using charcoal more efficiently. Interventions to support small electricity consumers include progressive electricity tariffs, where large consumers subsidise smaller ones, like is the case in Ghana. This system however requires good quality of service to avoid the wealthier electricity consumers to leave the grid in favour of self-generation. Interventions promoting women in agriculture include irrigation

with pressure pumps. Support to small or subsistence based women's activities may not appeal to private oriented investors, though. For example, a Director of the mini-grid supplier in Tanzania was of the view that "the promotion of women's activities is more expensive than the revenues these entrepreneurs get because they are involved in micro-activities. They need to scale up." Therefore, there is a gap that the public sector needs to fill in this respect.

5. **Support traditionally male trades with improved high quality, affordable energy as well as new technologies, but taking into account other business constraints.** Predominantly male heavy consumers of electricity have benefitted from improved supply when they have moved to LIZ in our target region. However, LIZ based businesses face other challenges that keep their profits low, such as inability to invest in equipment, destructive competition in industrial clusters, and distance to the town centre, which discourages potential customers. Men in our sample use their own physical strength as their only energy source more often than women. Inability to purchase equipment is one of the key reasons for this, and should be one of the key areas targeted for further support to PUE by men. Furthermore, many women are not attracted to typically male sectors due to their reliance on physical strength. Support for businesses in these sectors to upgrade with new technologies could make it easier for women to crossover, as apprentices, workers and entrepreneurs. Another area would involve supporting men to get more advanced skills to move up the more crowded occupations where competition is the highest.

The following actions would support men and women to transcend their traditional roles and move towards gender equity in the PUE:

6. **Education.** Gender equality in education is behind changing attitudes with regards to what men and women can do at work and at the household. Higher education is allowing women to enter formal occupations that can bring stability and higher income. A new role for women at the workplace can also reduce the pressure that men feel due to cultural norms that make them fully responsible to provide for the household. The sharing of household and financial responsibilities can support both men and women to feel professionally accomplished, save and reinvest in their business, and enjoy time for leisure. In our case study of Tanzania, for example, the Kara culture dominating Bwisya island prevented men from allowing their wives to engage in business. However, after a gender mainstreaming intervention, women started to engage in business and men started to support their wives. Men were willing to undertake family care work on behalf of their wives during training courses for 2 to 4 months, which deeply challenged traditional norms.

7. **Soft skills and exposure to new role models.** Even if women are increasingly entering the formal market thanks to education, they are still relegated to secondary positions with no decision making power. Those in the informal sector operate at smaller scale than men, and using less machinery. Our interviews clearly conveyed that stereotypes can be broken when men and women are exposed to others transcending gender roles and showing that it is possible. Confidence building for women venturing to male trades had often come with the encouragement of male role models. Policies to increase the level of exposure to women in decision making positions, or women in highly capitalised sectors could be very effective to erode the persisting occupational segregation. Some examples of these interventions are affirmative action to

include women quotas in training programmes and apprenticeships; mentoring programmes where women in powerful positions or running businesses in male trades counsel younger women; or associations where women in male dominated sectors or occupying positions of responsibility share their challenges and support each other.

8. **Support women to scale up.** The small scale character of women´s businesses acts as a drag for growth and keeps them as small electricity consumers. Women can be supported to join forces in associations to target customers together, access supplies at a lower cost, or increasing their bargaining power with the Government.

9. **Access to equipment that replaces physical energy with electric power.** Women in Ghana who had crossover to male dominated sectors indicated that physical strength was one barrier preventing them from doing male jobs, but this could easily be replaced with equipment, for example in the carpentry or milling sectors.

The choice of policy depends on the particular circumstances of the target region. For example, the first set of recommendations, targeting men and women´s current roles, is expected to achieve faster success, and particularly so in more traditional societies. The second set requires transformations at the community level but will lead to longer lasting improvements. In the case of Bwisya, Tanzania, transformational interventions were already showing some initial successes. Women had started new electricity consuming businesses after being exposed to training and awareness activities, as well as access to loans. Some men, on the other hand, were starting to change attitudes towards women's involvement in enterprises. In Ghana, there was also clear evidence that gender roles could change with time, education, and exposure. In any case, a lot remained to be done in all settings, as deep-rooted preconceptions were still widespread. Furthermore, as traditional norms erode, women could face new vulnerabilities perpetuating their poverty, as proved by the rise of fathers escaping financial responsibilities towards their children in the absence of official marriage deeds in Ghana.

6. CONCLUSIONS

As countries progress towards the goal of universal access to modern energy, productive uses are becoming a key factor for the financial sustainability of electricity supply, in particular. Accordingly, electricity suppliers, national governments and international development partners, are interested in promoting these to facilitate the success of electrification efforts. Because men and women use energy differently at work, the promotion of PUE is likely to deliver different benefits for them.

This paper gathers evidence on how men and women benefit differently from the productive use of energy, what explains those differences, and what kinds of interventions could be implemented to improve gender equity of PUE efforts. We draw from the experience of three countries: Ghana, Tanzania and Myanmar. In the first we analysed urban areas that had been provided with improved electricity supply in Light

Industrial Zones. In the second, we looked at fishing villages in three islands. One of the islands had access to electricity from mini-grids and had benefitted from a programme to promote PUE among women. The other two islands had not been exposed to gender mainstreaming programs for energy. One of them had electricity from the main grid, and the other only from individual solar home systems. In Myanmar, we look at rural areas, some of which had recently received electricity from mini-grids, while others remained without access.

A multi-method approach is used, combining quantitative research- involving descriptive statistics and OLS regressions- and qualitative research, involving key informant interviews, semi-structured interviews and focus group discussions. Research in Myanmar, however, was only qualitative. Results from different tools are triangulated to validate the statements made, and we complement quantitative insights with qualitative detail about people's perceptions, motivations and aspirations.

Results show that men and women use energy differently at work. Men are more heavily involved in rural enterprises, owning a larger percentage of them. They also dominate the most profitable sectors of agriculture, like cash crops and large fish. In both rural and urban areas, they operate in sectors that typically consume more electricity or diesel. Women instead are mainly in charge of food preparation and more heavily consume cooking fuels like charcoal, firewood and gas. Women's productive use of electricity is also widespread, but in smaller quantities. Data on energy consumption as a whole, and energy intensity measured as the share of energy expenditure in total expenditures and total profits, is not significantly different across genders. Finally, poor electricity reliability is a drag for both men and women businesses. However, women in Ghana were more affected as the distribution network is weaker outside industrial zones.

Gender differences in energy consumption patterns for productive uses can be explained by the lower capitalisation of women´s enterprises, lower profits, higher care responsibilities, and the segregation of men and women in different trades. In Tanzania women have lower education and skills, have different motivations to run businesses tha men, and their markets are limited to their village. On the other hand, there are many signs of gender equality in education, ability to export, and motivations to run businesses in Ghana. In both settings, but more so in Ghana, there were instances in which both men and women were challenging traditional norms about the distribution of tasks at work and the household, even if many norms still prevailed.

Results from the regression model show that electricity is consistently associated with better outcomes for businesses in all countries, while being female is associated with lower profits, and lower electricity consumption. LIZ interventions in Ghana targeted at male dominated enterprises had not had the intended effect of benefiting business outcomes. However, there are some encouraging results with regards to the mini-grids and gender interventions in Bwisya, where entrepreneurs seem to benefit more from access to energy than in other regions. However, we observe significantly higher costs than for consumers of electricity from the main grid. The high cost discourages users to use more electricity. The main grid instead shows low costs but an unreliable service and some users aspire to get solar systems as a back up to avoid disruption to their business.

The paper concludes offering policy recommendations to improve implementation of rural electrification programmes by promoting the gender equity of PUE interventions. Two approaches are proposed. First, targeting men and women in their current productive roles with improved finance, energy management education, improvements in reliability of electricity supply, targeted supply of improved cooking fuels and affordable electricity for female businesses, and targeted supply of equipment and higher specialisation for male businesses. Second, transforming current gender roles with further education, exposure to role models, and associations to scale up small female businesses. Whereas the first approach could be less attractive for profit-seeking private electricity suppliers, given the smaller consumption of female activities, it could achieve faster and more direct benefits. The second approach instead could contribute to improve women's economic empowerment as well as create more demand for electricity services, however it requires the transformation of social norms, and the acceptance by all the community. Results are hence expected in the longer term.

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ANNEX 1 – FGD ACCESS TO AND CONTROL OVER RESOURCES

Table 28- Access and control of resources by men and women- Averages for Techiman and Berekum, Ghana

	ACCESS		CONTROL	
	Men	Women	Men	Women
Water	8	2	0	10
Firewood	0	10	2	8
Microwave	6	4	2	8
Woman's income	3	7	2	8
Gas (LPG)	5	5	3	7
Fridge	6	4	4	7
Television	6	4	4	7
Other elec. appliances	4	6	4	6
Utensils for cooking	2	9	4	6
Charcoal	0	10	5	5
Electricity	7	3	5	5
Fan	9	1	5	5
Mobile phones	7	3	7	4
Motorbike	9	2	7	4
Radio	8	2	7	4
Cash	7	3	7	3
Computers	9	2	7	3
Iron	7	3	7	3
Livestock	7	3	7	3
Furniture	8	3	8	3
House	8	2	8	2
Lands	9	2	9	2
Car	9	1	9	1
Man's income	7	3	9	1
Petrol/Diesel	9	1	9	1
Total Average	**6.3**	**3.7**	**5.5**	**4.5**

Table 29- Access and control of resources by men and women- Averages for Bwisya and Sambi, Tanzania

	ACCESS		CONTROL	
	Men	Women	Men	Women
Land/Farm	4	7	8	2
Land/Plot	7	3	8	2
House	5	5	7	3
Trees for Timber	8	2	9	2
Fruit trees	5	5	6	4
Cattle	7	3	8	2
Goats	7	4	8	2
Poultry	3	7	4	7
Pigs	8	2	8	2
Radio/TV	5	5	8	2
Lamp/lantern	5	5	7	4
Mobile phone	5	5	5	5
Furniture	5	5	8	3
Kitchen utensils	2	9	1	9
Savings	6	5	6	4
Salary	6	5	5	5
Income from agriculture	4	6	5	5
Income from business	8	3	7	3
Fishing nets	10	0	9	1
Food crops	5	5	4	6
Village Community Bank	5	5	5	5
Canoe	10	0	8	3
Motorcycle	6	4	8	2
Bicycle	5	5	8	2
Labourers	5	5	5	5
Total Average	**6**	**4**	**7**	**3**

Access and control of resources by men and women in Kenti, Myanmar

Energy uses and resources	**Access**		**Control**	
	Male	**Female**	**Male**	**Female**
Motorcycle	5	3	6	2
TV/ Video	2	6	2	6
Farm	3	4	7	1
Pet	1	7	8	-
Meter Box	4	4	8	-
Music Box	5	3	5	3
Sewing machine	-	8	4	4
Home-used (solar)	4	4	4	4
Phone	4	4	6	2
Solar lantern	1	7	-	8
Savings account	3	5	2	6
Motor boat	6	2	8	-

ANNEX 2 – OLS REGRESSIONS RESULTS

2.1 Ghana

Table 29 - OLS Results – Opening Hours

	(7)	(7.1)	(7.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.085***	0.100***	0.081***
	(0.015)	(0.020)	(0.026)
No Education/Primary Education	-0.131	-0.129	-0.336
	(0.297)	(0.299)	(0.606)
Migrant	0.640**	0.440*	0.773
	(0.251)	(0.256)	(0.517)
Married	0.369	0.011	0.796
	(0.335)	(0.371)	(0.601)
Bank Account	1.427***	1.062***	1.583**
	(0.294)	(0.329)	(0.715)
	Household Characteristics		
Number Children	-0.245**	-0.224**	-0.376
	(0.095)	(0.090)	(0.234)
Number of Elder	-0.009	0.019	-0.052
	(0.045)	(0.077)	(0.064)
	Business Characteristics		
Female Owner	**-0.254**		
	(0.450)		
Electricity	**1.025*** **	**0.272**	**1.692*** **
	(0.292)	**(0.348)**	**(0.528)**
Industrial Zone	**-1.034*** **	**-0.704** **	**-0.668**
	(0.336)	**(0.326)**	**(1.239)**
Member of Association	-0.273	-0.314	-0.333
	(0.295)	(0.295)	(0.570)
Registered Business	0.784**	0.713*	0.692
	(0.339)	(0.404)	(0.624)
Starting Capital ('000th)	0.003**	0.002*	0.007**
	(0.001)	(0.001)	(0.003)
Requested loan	0.624**	0.367	1.121**
	(0.285)	(0.321)	(0.535)
Permanent Structure	1.039***	0.360	1.868***
	(0.334)	(0.389)	(0.641)
Keep Book	0.139	-0.168	0.650
	(0.356)	(0.404)	(0.710)
Number of Workers	-0.127**	-0.013	-0.168**
	(0.050)	(0.081)	(0.080)
Observations	395	250	145
R-squared	0.954	0.969	0.944
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 30 - OLS Results – LN Sales High Season

	(8)	(8.1)	(8.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.062***	0.062***	0.062***
	(0.009)	(0.013)	(0.012)
No Education/Primary Education	0.126	0.070	0.168
	(0.141)	(0.169)	(0.244)
Migrant	0.386***	0.451***	0.221
	(0.125)	(0.158)	(0.242)
Married	0.223	-0.051	0.623***
	(0.165)	(0.250)	(0.221)
Bank Account	1.083***	1.002***	1.358***
	(0.152)	(0.178)	(0.323)
	Household Characteristics		
Number Children	-0.097**	-0.167***	0.022
	(0.043)	(0.054)	(0.052)
Number of Elder	-0.004	-0.004	0.011
	(0.024)	(0.043)	(0.032)
Female Owner	**0.246**		
	(0.214)		
Electricity	**0.692*** **	**0.523*** **	**0.589** **
	(0.145)	**(0.196)**	**(0.281)**
Industrial Zone	**-0.504*** **	**-0.479** **	**-0.390**
	(0.189)	**(0.221)**	**(0.423)**
Member of Association	0.048	0.121	-0.028
	(0.140)	(0.176)	(0.225)
Registered Business	0.319*	0.369*	0.059
	(0.174)	(0.200)	(0.317)
Starting Capital ('000th)	0.003**	0.003*	0.004**
	(0.001)	(0.002)	(0.002)
Requested loan	0.356**	0.325*	0.295
	(0.146)	(0.191)	(0.248)
Permanent Structure	0.620***	0.772***	0.609**
	(0.161)	(0.211)	(0.307)
Keep Book	-0.020	0.145	-0.253
	(0.177)	(0.222)	(0.299)
Number of Workers	0.001	0.077*	0.000
	(0.029)	(0.042)	(0.039)
Observations	396	250	146
R-squared	0.969	0.971	0.972
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 31 - OLS Results – LN Sales Low Season

	(9)	(9.1)	(9.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.049***	0.042***	0.057***
	(0.009)	(0.013)	(0.012)
No Education/Primary Education	-0.042	-0.019	0.159
	(0.196)	(0.282)	(0.253)
Migrant	0.291	0.332	0.036
	(0.183)	(0.259)	(0.247)
Married	0.511**	0.677**	0.605**
	(0.203)	(0.320)	(0.234)
Bank Account	1.267***	1.371***	1.001***
	(0.229)	(0.317)	(0.322)
	Household Characteristics		
Number Children	-0.159**	-0.300***	0.052
	(0.071)	(0.087)	(0.056)
Number of Elder	0.017	0.071	0.001
	(0.032)	(0.071)	(0.032)
	Business Characteristics		
Female Owner	**0.140**		
	(0.226)		
Electricity	**0.691*** **	**0.871** **	**0.296**
	(0.200)	**(0.339)**	**(0.290)**
Industrial Zone	**-0.016**	**0.106**	**-0.645**
	(0.315)	**(0.400)**	**(0.474)**
Member of Association	0.061	0.215	-0.170
	(0.217)	(0.339)	(0.240)
Registered Business	0.135	0.196	-0.171
	(0.252)	(0.335)	(0.342)
Starting Capital ('000th)	0.003**	0.002	0.004*
	(0.001)	(0.001)	(0.002)
Requested loan	0.375**	0.350	0.244
	(0.177)	(0.270)	(0.241)
Permanent Structure	0.497**	0.722**	0.401
	(0.215)	(0.341)	(0.322)
Keep Book	0.018	0.242	-0.205
	(0.216)	(0.261)	(0.348)
Number of Workers	0.028	0.063	0.058
	(0.034)	(0.065)	(0.045)
Observations	396	250	146
R-squared	0.908	0.885	0.958
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 32 - OLS Results – Customers High Season

	(10)	(10.1)	(10.2)
	All Sample	**Male**	**Female**

	Individual Characteristics		
Age	0.038***	0.035***	0.039***
	(0.006)	(0.009)	(0.009)
No Education/Primary Education	0.260*	0.208	0.246
	(0.153)	(0.183)	(0.216)
Migrant	0.409***	0.408***	0.146
	(0.127)	(0.151)	(0.211)
Married	0.256*	0.066	0.569***
	(0.137)	(0.185)	(0.188)
Bank Account	0.742***	0.594***	0.799***
	(0.140)	(0.170)	(0.244)
	Household Characteristics		
Number Children	-0.027	-0.015	-0.006
	(0.035)	(0.050)	(0.051)
Number of Elder	-0.053**	-0.005	-0.050*
	(0.021)	(0.040)	(0.030)
	Business Characteristics		
Female Owner	**-0.520****		
	(0.204)		
Electricity	**0.336****	**-0.126**	**0.206**
	(0.144)	**(0.203)**	**(0.231)**
Industrial Zone	**-0.472*****	**-0.364***	**-0.771***
	(0.176)	**(0.197)**	**(0.410)**
Member of Association	-0.266*	-0.218	-0.184
	(0.142)	(0.170)	(0.205)
Registered Business	0.289*	0.284	0.239
	(0.173)	(0.185)	(0.286)
Starting Capital ('000th)	0.000	-0.001	0.002
	(0.001)	(0.001)	(0.002)
Requested loan	0.270*	0.213	0.287
	(0.140)	(0.173)	(0.212)
Permanent Structure	0.059	0.097	0.405
	(0.163)	(0.206)	(0.264)
Keep Book	0.169	0.275	-0.058
	(0.179)	(0.193)	(0.303)
Number of Workers	0.017	0.069	0.032
	(0.028)	(0.044)	(0.036)
Observations	368	222	146
R-squared	0.904	0.915	0.932
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 33 - OLS Results – Customers Low Season

	(11)	(11.1)	(11.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.035***	0.029***	0.041***
	(0.006)	(0.009)	(0.008)

No Education/Primary Education	0.173	0.120	0.232
	(0.155)	(0.194)	(0.223)
Migrant	0.332**	0.331**	0.056
	(0.131)	(0.159)	(0.220)
Married	0.318**	0.243	0.580***
	(0.136)	(0.187)	(0.197)
Bank Account	0.690***	0.541***	0.719***
	(0.142)	(0.178)	(0.249)
Household Characteristics			
Number Children	-0.099**	-0.093	-0.089*
	(0.039)	(0.058)	(0.050)
Number of Elder	-0.063***	-0.043	-0.042
	(0.022)	(0.042)	(0.029)
Business Characteristics			
Female Owner	**-0.515****		
	(0.208)		
Electricity	**0.395*****	**0.201**	**0.128**
	(0.139)	**(0.206)**	**(0.214)**
Industrial Zone	**-0.425****	**-0.369***	**-0.682***
	(0.182)	**(0.212)**	**(0.366)**
Member of Association	-0.149	-0.019	-0.142
	(0.147)	(0.188)	(0.210)
Registered Business	0.201	0.157	0.141
	(0.181)	(0.190)	(0.311)
Starting Capital ('000th)	0.000	-0.001**	0.002
	(0.001)	(0.001)	(0.002)
Requested loan	0.249*	0.249	0.223
	(0.141)	(0.179)	(0.216)
Permanent Structure	0.106	0.094	0.383
	(0.161)	(0.217)	(0.257)
Keep Book	0.101	0.150	-0.033
	(0.184)	(0.201)	(0.335)
Number of Workers	0.042	0.085*	0.049
	(0.028)	(0.045)	(0.038)
Observations	378	232	146
R-squared	0.843	0.828	0.901
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 34 - OLS Results – LN Annual Profit

	(14)	(14.1)	(14.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.073***	0.072***	0.081***
	(0.011)	(0.017)	(0.012)
No Education/Primary Education	0.226	0.424*	-0.004
	(0.188)	(0.250)	(0.296)
Migrant	0.618***	0.726***	0.301
	(0.189)	(0.253)	(0.269)
Married	0.539**	0.348	0.934***
	(0.210)	(0.335)	(0.300)
Bank Account	1.161***	1.062***	1.229***
	(0.196)	(0.266)	(0.354)
	Household Characteristics		
Number Children	-0.184***	-0.269***	-0.070
	(0.064)	(0.097)	(0.058)
Number of Elder	0.008	0.008	0.028
	(0.029)	(0.066)	(0.030)
	Business Characteristics		
Female Owner	**0.298**		
	(0.296)		
Electricity	**0.728*** **	**0.698** **	**0.608* **
	(0.202)	**(0.328)**	**(0.329)**
Industrial Zone	**-0.724*** **	**-0.614** **	**-1.056* **
	(0.237)	**(0.283)**	**(0.536)**
Member of Association	0.060	0.247	-0.242
	(0.209)	(0.303)	(0.279)
Registered Business	0.270	0.233	0.055
	(0.266)	(0.349)	(0.378)
Starting Capital ('000th)	0.004***	0.003*	0.007***
	(0.001)	(0.002)	(0.002)
Requested loan	0.260	0.306	0.141
	(0.201)	(0.265)	(0.306)
Permanent Structure	0.531**	0.546*	0.695**
	(0.205)	(0.296)	(0.327)
Keep Book	0.304	0.505	0.107
	(0.250)	(0.352)	(0.388)
Number of Workers	-0.053	0.044	-0.090
	(0.039)	(0.057)	(0.055)
Observations	396	250	146
R-squared	0.963	0.961	0.972
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 35 - OLS Results – LN Total Expenditure

	(15)	(15.1)	(15.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.066***	0.049***	0.091***
	(0.008)	(0.014)	(0.011)
No Education/Primary Education	-0.096	-0.033	-0.072
	(0.182)	(0.211)	(0.247)
Migrant	0.401***	0.382**	0.321
	(0.135)	(0.163)	(0.262)
Married	0.448***	0.390	0.533**
	(0.170)	(0.259)	(0.235)
Bank Account	1.060***	0.945***	1.311***
	(0.174)	(0.213)	(0.361)
Number Children	-0.097***	-0.096*	-0.121**
	(0.036)	(0.050)	(0.057)
Number of Elder	-0.007	0.048	-0.013
	(0.027)	(0.050)	(0.027)
	Business Characteristics		
Female Owner	**0.005**		
	(0.243)		
Electricity	**0.394****	**0.457***	**0.156**
	(0.176)	**(0.249)**	**(0.329)**
Industrial Zone	**-0.507****	**-0.522****	**-0.290**
	(0.205)	**(0.229)**	**(0.522)**
Member of Association	-0.164	-0.002	-0.317
	(0.154)	(0.193)	(0.233)
Registered Business	0.533***	0.662***	0.066
	(0.202)	(0.236)	(0.343)
Starting Capital ('000th)	0.003***	0.003**	0.005*
	(0.001)	(0.001)	(0.003)
Requested loan	0.558***	0.492**	0.516*
	(0.162)	(0.219)	(0.266)
Permanent Structure	0.618***	0.627***	0.759**
	(0.179)	(0.234)	(0.350)
Keep Book	0.105	0.026	0.211
	(0.244)	(0.328)	(0.303)
Number of Workers	0.029	0.152***	-0.053
	(0.035)	(0.049)	(0.043)
Observations	396	250	146
R-squared	0.965	0.968	0.972
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 36 - OLS Results – LN Total Hours Electricity Used

	(3)	(3.1)	(3.2)
	All Sample	**Male**	**Female**
	Individual Characteristics		
Age	0.020***	0.018**	0.022***
	(0.004)	(0.007)	(0.007)
No Education/Primary Education	0.063	0.071	0.051
	(0.085)	(0.106)	(0.129)
Migrant	0.053	0.006	0.107
	(0.077)	(0.089)	(0.145)
Married	0.115	0.003	0.231*
	(0.087)	(0.131)	(0.134)
Bank Account	0.121	0.071	0.580***
	(0.096)	(0.116)	(0.194)
	Household Characteristics		
Number Children	-0.020	-0.015	-0.034
	(0.017)	(0.028)	(0.027)
Number of Elder	0.012	0.033	-0.003
	(0.010)	(0.024)	(0.013)
	Business Characteristics		
Female Owner	**0.325*** **		
	(0.111)		
Industrial Zone	**-0.146**	**0.104**	**-1.145** **
	(0.130)	**(0.135)**	**(0.518)**
Member of Association	0.011	-0.112	0.130
	(0.087)	(0.127)	(0.126)
Registered Business	0.184**	0.218**	0.089
	(0.086)	(0.106)	(0.126)
Starting Capital ('000th)	0.001***	0.001**	0.001
	(0.000)	(0.001)	(0.001)
Requested loan	0.067	0.100	0.130
	(0.077)	(0.091)	(0.135)
Permanent Structure	0.077	-0.051	0.356***
	(0.094)	(0.131)	(0.121)
Keep Book	0.096	0.079	0.152
	(0.112)	(0.144)	(0.172)
Number of Workers	-0.025*	-0.004	-0.041*
	(0.013)	(0.024)	(0.023)
Observations	270	183	87
R-squared	0.937	0.936	0.961
Region Fixed Effect	Yes	Yes	Yes
Sector Fixed Effect	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

2.2 Tanzania

Table 37- OLS Results – Customers High Season (ln)

	(2)	(2.1)	(2.2)	(2.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	0.024***	0.031**	0.055***	0.012
	(0.007)	(0.015)	(0.010)	(0.013)
No Education/Primary Education	0.368*	0.116	0.190	0.788*
	(0.201)	(0.507)	(0.390)	(0.398)
Migrant	0.517***	0.692*	0.604**	1.502***
	(0.188)	(0.381)	(0.304)	(0.425)
Married	0.442**	1.177*	0.057	0.441
	(0.197)	(0.664)	(0.329)	(0.289)
Bank Account	0.315	0.573	0.002	0.505
	(0.203)	(0.497)	(0.396)	(0.376)
Household Characteristics				
Number Children	-0.018	-0.245**	-0.037	0.023
	(0.030)	(0.107)	(0.039)	(0.053)
Number of Elder	0.001	0.092	-0.013	0.038
	(0.044)	(0.071)	(0.069)	(0.104)
Business Characteristics				
Female Owner	0.127	1.365**	-0.090	-0.238
	(0.210)	(0.653)	(0.345)	(0.344)
Electricity	0.502***	-0.183	0.247	0.612*
	(0.169)	(0.572)	(0.284)	(0.365)
Member of Association	0.076	0.022	0.317	-0.010
	(0.196)	(0.621)	(0.321)	(0.367)
Registered Business	0.151	0.499	0.363	-0.128
	(0.192)	(0.631)	(0.348)	(0.385)
Starting Capital ('000th)	0.001	0.002	0.005	0.001
	(0.002)	(0.005)	(0.010)	(0.004)
Permanent Structure	0.483***	0.554	0.224	0.586
	(0.185)	(0.490)	(0.278)	(0.458)
Keep Book	0.268	0.177	0.569	0.465
	(0.191)	(0.479)	(0.424)	(0.315)
Number of Workers	0.075	0.132	-0.244	0.455**
	(0.140)	(0.278)	(0.263)	(0.227)
Observations	328	66	140	122
R-squared	0.896	0.924	0.895	0.919
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 38- OLS Results – Customers Low Season (ln)

	(3)	(3.1)	(3.2)	(3.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	0.017**	0.019	0.037***	0.006
	(0.007)	(0.014)	(0.014)	(0.012)
No Education/Primary Education	0.391**	0.038	0.389	0.841**
	(0.187)	(0.434)	(0.350)	(0.384)
Migrant	0.218	0.257	0.251	1.131***
	(0.181)	(0.317)	(0.304)	(0.349)
Married	0.319*	0.924	0.258	0.167
	(0.183)	(0.549)	(0.374)	(0.270)
Bank Account	0.079	0.343	0.027	0.149
	(0.198)	(0.444)	(0.380)	(0.381)
Household Characteristics				
Number Children	-0.035	-0.152	-0.073	0.011
	(0.034)	(0.091)	(0.048)	(0.050)
Number of Elder	-0.022	0.034	-0.036	0.074
	(0.035)	(0.056)	(0.070)	(0.096)
Business Characteristics				
Female Owner	-0.038	0.860	-0.321	-0.361
	(0.210)	(0.530)	(0.397)	(0.337)
Electricity	0.494***	0.255	0.393	0.469
	(0.167)	(0.546)	(0.361)	(0.352)
Member of Association	0.048	0.119	0.431	-0.272
	(0.205)	(0.551)	(0.344)	(0.353)
Registered Business	0.056	0.185	0.102	0.088
	(0.179)	(0.502)	(0.350)	(0.357)
Starting Capital ('000th)	0.002	-0.001	0.011	0.001
	(0.002)	(0.004)	(0.011)	(0.003)
Permanent Structure	0.323*	0.156	0.053	0.390
	(0.174)	(0.401)	(0.301)	(0.373)
Keep Book	0.475**	0.422	0.753*	0.646**
	(0.184)	(0.369)	(0.423)	(0.281)
Number of Workers	0.029	0.108	-0.385	0.420**
	(0.127)	(0.311)	(0.254)	(0.190)
Observations	328	66	140	122
R-squared	0.834	0.885	0.818	0.881
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 39- OLS Results – Opening Hours

	(6)	(6.1)	(6.2)	(6.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	0.148***	0.113**	0.150***	0.161***
	(0.018)	(0.045)	(0.026)	(0.036)
No Education/Primary Education	0.609	1.747	-1.015	2.133**
	(0.540)	(1.486)	(0.802)	(0.991)
Migrant	1.888***	1.555	1.357*	3.464***
	(0.487)	(1.259)	(0.692)	(1.058)
Married	1.297**	3.952**	1.439*	0.528
	(0.560)	(1.549)	(0.794)	(1.130)
Bank Account	-0.104	1.323	-0.095	-0.913
	(0.570)	(1.761)	(0.863)	(1.054)
Household Characteristics				
Number Children	-0.230***	-0.420	-0.102	-0.207
	(0.069)	(0.278)	(0.089)	(0.150)
Number of Elder	0.161	0.129	0.442**	0.009
	(0.127)	(0.224)	(0.175)	(0.331)
Business Characteristics				
Female Owner	0.411	1.771	0.966	-1.182
	(0.597)	(1.651)	(0.758)	(1.096)
Member of Association	-0.956*	-0.505	-1.406*	-0.401
	(0.518)	(1.686)	(0.718)	(0.905)
Registered Business	0.705	1.554	-0.279	0.668
	(0.526)	(1.766)	(0.804)	(0.913)
Starting Capital ('000th)	0.012**	0.003	0.013	0.010
	(0.005)	(0.015)	(0.021)	(0.010)
Permanent Structure	1.214**	1.947	1.995***	-0.713
	(0.498)	(1.631)	(0.687)	(0.964)
Keep Book	0.429	-1.148	1.666*	0.456
	(0.514)	(1.504)	(0.884)	(0.831)
Electricity	1.989***	1.139	1.478**	2.080**
	(0.546)	(2.026)	(0.735)	(0.835)
Number of Workers	-0.579*	-0.668	-0.456	-0.582
	(0.336)	(0.925)	(0.506)	(0.595)
Observations	328	66	140	122
R-squared	0.915	0.939	0.924	0.930
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 40- OLS Results – Sales High Season (ln '000th TZS)

	(7)	(7.1)	(7.2)	(7.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	-0.016**	-0.035**	0.007	-0.013
	(0.006)	(0.013)	(0.011)	(0.009)
No Education/Primary Education	0.003	0.443	0.040	0.067
	(0.164)	(0.483)	(0.271)	(0.277)
Migrant	0.165	-0.251	0.207	0.404
	(0.155)	(0.363)	(0.213)	(0.331)
Married	-0.031	0.453	-0.482	0.145
	(0.159)	(0.483)	(0.313)	(0.226)
Bank Account	0.388**	0.665	0.283	0.628**
	(0.156)	(0.440)	(0.270)	(0.272)
Household Characteristics				
Number Children	0.032	0.016	0.026	-0.003
	(0.023)	(0.074)	(0.032)	(0.040)
Number of Elder	0.016	-0.019	-0.068	0.061
	(0.047)	(0.097)	(0.067)	(0.061)
Business Characteristics				
Female Owner	0.102	0.744	-0.428	0.270
	(0.161)	(0.573)	(0.300)	(0.273)
Member of Association	0.112	-0.099	0.275	0.169
	(0.157)	(0.461)	(0.237)	(0.246)
Registered Business	0.408***	0.910**	0.480*	-0.031
	(0.146)	(0.437)	(0.249)	(0.232)
Starting Capital ('000th)	0.001	0.001	0.014*	-0.003
	(0.002)	(0.003)	(0.008)	(0.002)
Permanent Structure	-0.067	-0.229	-0.482**	0.440
	(0.154)	(0.392)	(0.205)	(0.333)
Keep Book	0.351**	0.780*	0.649**	0.207
	(0.147)	(0.402)	(0.260)	(0.213)
Electricity	0.072	-0.731	-0.176	0.121
	(0.141)	(0.509)	(0.273)	(0.248)
Number of Workers	0.405***	0.069	0.400**	0.439***
	(0.104)	(0.269)	(0.185)	(0.158)
Observations	328	66	140	122
R-squared	0.523	0.790	0.561	0.580
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 41- OLS Results – Sales Low Season (ln '000th TZS)

	(8)	(8.1)	(8.2)	(8.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	-0.019***	-0.045***	-0.005	-0.015

	(0.007)	(0.017)	(0.010)	(0.012)
No Education/Primary Education	-0.305	0.423	0.019	-0.337
	(0.210)	(0.490)	(0.329)	(0.392)
Migrant	0.030	-0.693*	-0.112	0.471
	(0.252)	(0.399)	(0.287)	(0.801)
Married	-0.258	0.231	-1.088***	0.204
	(0.203)	(0.506)	(0.328)	(0.325)
Bank Account	0.023	-0.088	-0.169	0.304
	(0.216)	(0.498)	(0.345)	(0.384)
Household Characteristics				
Number Children	0.061**	0.148*	0.084**	-0.031
	(0.025)	(0.083)	(0.040)	(0.053)
Number of Elder	-0.187**	-0.475***	-0.217***	-0.054
	(0.081)	(0.102)	(0.080)	(0.110)
Business Characteristics				
Female Owner	0.170	0.410	-0.458	0.318
	(0.228)	(0.516)	(0.316)	(0.481)
Member of Association	-0.190	-0.599	0.164	-0.133
	(0.203)	(0.589)	(0.322)	(0.353)
Registered Business	0.220	0.487	0.445	-0.372
	(0.193)	(0.462)	(0.327)	(0.300)
Starting Capital ('000th)	0.004	0.002	0.016*	-0.001
	(0.003)	(0.004)	(0.009)	(0.003)
Permanent Structure	-0.146	-0.259	-0.557*	-0.009
	(0.190)	(0.520)	(0.298)	(0.447)
Keep Book	0.322	0.774*	0.966***	-0.099
	(0.208)	(0.452)	(0.365)	(0.288)
Electricity	0.225	0.137	-0.213	0.417
	(0.221)	(0.538)	(0.339)	(0.390)
Number of Workers	0.420***	0.270	0.618***	0.371**
	(0.123)	(0.441)	(0.226)	(0.164)
Observations	328	66	140	122
R-squared	0.476	0.771	0.629	0.344
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 42- OLS Results – Annual Profit (ln '000th TZS)

	(9)	(9.1)	(9.2)	(9.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	0.015	-0.012	0.013	0.017
	(0.009)	(0.018)	(0.010)	(0.021)
No Education	-0.203	0.517	-0.380	-0.490
	(0.226)	(0.688)	(0.412)	(0.509)
Migrant	0.353	0.652	-0.263	1.784**
	(0.283)	(0.484)	(0.286)	(0.870)

Married	-0.173	0.747	0.448	-0.796*
	(0.250)	(0.487)	(0.271)	(0.473)
Bank Account	0.307	0.890	0.184	0.170
	(0.297)	(0.685)	(0.338)	(0.717)
Household Characteristics				
Number Children	0.015	-0.039	0.028	-0.015
	(0.028)	(0.099)	(0.034)	(0.074)
Number of Elder	0.067	-0.021	-0.027	0.287**
	(0.051)	(0.138)	(0.064)	(0.113)
Business Characteristics				
Female Owner	0.029	0.668	0.308	-0.679
	(0.283)	(0.649)	(0.330)	(0.662)
Member of Association	-0.127	0.457	-0.330	-0.245
	(0.235)	(0.490)	(0.326)	(0.499)
Registered Business	0.175	1.264**	0.700***	-0.438
	(0.210)	(0.614)	(0.255)	(0.410)
Starting Capital ('000th)	0.010***	0.006	0.029***	0.013***
	(0.003)	(0.006)	(0.008)	(0.005)
Permanent Structure	0.019	-0.890*	-0.085	-0.218
	(0.185)	(0.496)	(0.224)	(0.541)
Keep Book	0.061	0.325	-0.107	0.118
	(0.262)	(0.581)	(0.311)	(0.491)
Electricity	0.204	-0.635	0.372	0.285
	(0.197)	(0.716)	(0.225)	(0.390)
Number of Workers	-0.134	-0.133	-0.433*	-0.063
	(0.241)	(0.351)	(0.226)	(0.523)
Observations	327	66	140	121
R-squared	0.546	0.752	0.687	0.549
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 43- OLS Results – Total Expenditure (ln '000th TZS)

	(10)	(10.1)	(10.2)	(10.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	-0.018***	-0.020*	-0.023**	-0.023***
	(0.005)	(0.011)	(0.011)	(0.008)
No Education	-0.066	-0.381	-0.097	0.438
	(0.146)	(0.389)	(0.281)	(0.275)
Migrant	0.118	0.631*	-0.042	0.191
	(0.142)	(0.348)	(0.243)	(0.226)
Married	0.094	-0.371	0.059	0.275
	(0.149)	(0.298)	(0.308)	(0.228)
Bank Account	0.178	0.825**	0.195	-0.331
	(0.151)	(0.370)	(0.279)	(0.283)
Household Characteristics				

Number Children	0.029	0.091	0.047	-0.031
	(0.020)	(0.057)	(0.036)	(0.032)
Number of Elder	-0.042	-0.026	-0.081	0.026
	(0.033)	(0.056)	(0.058)	(0.069)
Business Characteristics				
Female Owner	-0.124	-0.508*	-0.044	-0.587**
	(0.157)	(0.276)	(0.290)	(0.260)
Member of Association	0.146	0.527	0.113	0.308
	(0.159)	(0.315)	(0.259)	(0.234)
Registered Business	0.292**	0.733*	0.363	-0.130
	(0.147)	(0.428)	(0.280)	(0.255)
Starting Capital ('000th)	0.003*	0.004	0.014*	0.000
	(0.001)	(0.003)	(0.007)	(0.002)
Permanent Structure	-0.071	-0.701*	-0.197	-0.065
	(0.153)	(0.348)	(0.279)	(0.257)
Keep Book	0.218	0.251	0.273	0.244
	(0.138)	(0.364)	(0.283)	(0.209)
Electricity	0.296**	-0.221	0.157	0.326
	(0.136)	(0.377)	(0.276)	(0.210)
Number of Workers	0.253**	0.239	0.402**	0.293
	(0.098)	(0.229)	(0.170)	(0.229)
Observations	328	66	140	122
R-squared	0.420	0.742	0.502	0.397
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Regressions Other Energy Performance Indicators

Table 44- OLS Results – Total hours of energy used (ln)

	(11)	(11.1)	(11.2)	(11.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	0.014***	0.032***	0.013**	0.002
	(0.004)	(0.007)	(0.006)	(0.009)
No Education	0.107	-0.069	-0.056	0.222
	(0.108)	(0.298)	(0.168)	(0.273)
Migrant	0.014	-0.086	0.030	0.294
	(0.107)	(0.248)	(0.157)	(0.219)
Married	-0.013	-0.371	0.127	-0.070
	(0.119)	(0.274)	(0.197)	(0.179)
Bank Account	0.051	0.034	-0.157	0.290
	(0.124)	(0.284)	(0.222)	(0.217)
Household Characteristics				
Number Children	-0.009	-0.124**	0.039*	0.002

	(0.017)	(0.050)	(0.023)	(0.031)
Number of Elder	-0.006	0.070*	-0.055	0.071
	(0.026)	(0.038)	(0.045)	(0.052)
Business Characteristics				
Female Owner	-0.220*	-0.801*	-0.054	-0.075
	(0.128)	(0.402)	(0.196)	(0.226)
Member of Association	-0.019	0.279	-0.188	-0.168
	(0.118)	(0.345)	(0.193)	(0.200)
Registered Business	0.022	-0.141	-0.070	0.329*
	(0.116)	(0.298)	(0.198)	(0.193)
Starting Capital ('000th)	0.001	0.001	0.002	0.001
	(0.001)	(0.002)	(0.005)	(0.002)
Permanent Structure	-0.075	0.144	-0.176	-0.073
	(0.103)	(0.259)	(0.145)	(0.240)
Keep Book	0.099	0.599*	0.166	0.110
	(0.119)	(0.302)	(0.202)	(0.189)
Electricity	1.447***	1.119***	1.625***	1.310***
	(0.113)	(0.265)	(0.185)	(0.211)
Number of Workers	-0.036	-0.162	-0.066	0.080
	(0.072)	(0.166)	(0.120)	(0.124)
Observations	328	66	140	122
R-squared	0.872	0.941	0.881	0.887
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 45- OLS Results – Total hours of electricity used (ln)

	(12)	(12.1)	(12.2)	(12.3)
	All Sample	**Bwisya**	**Murutunguru**	**Irugwa**
Individual Characteristics				
Age	0.034***	0.049***	0.049***	0.022*
	(0.005)	(0.016)	(0.010)	(0.011)
No Education	0.053	-0.380	0.052	0.347
	(0.138)	(0.416)	(0.248)	(0.375)
Migrant	0.052	0.122	0.018	0.472*
	(0.146)	(0.338)	(0.242)	(0.258)
Married	0.067	0.114	0.079	0.081
	(0.146)	(0.432)	(0.318)	(0.216)
Bank Account	0.174	0.657*	-0.065	0.144
	(0.157)	(0.361)	(0.339)	(0.300)
Household Characteristics				
Number Children	-0.036	-0.163**	-0.001	-0.026
	(0.023)	(0.076)	(0.034)	(0.027)
Number of Elder	0.012	0.111	-0.057	0.049
	(0.033)	(0.070)	(0.060)	(0.058)
Business Characteristics				
Female Owner	-0.077	-0.315	0.014	-0.112
	(0.181)	(0.713)	(0.315)	(0.287)
Member of Association	-0.201	0.029	-0.516*	0.230

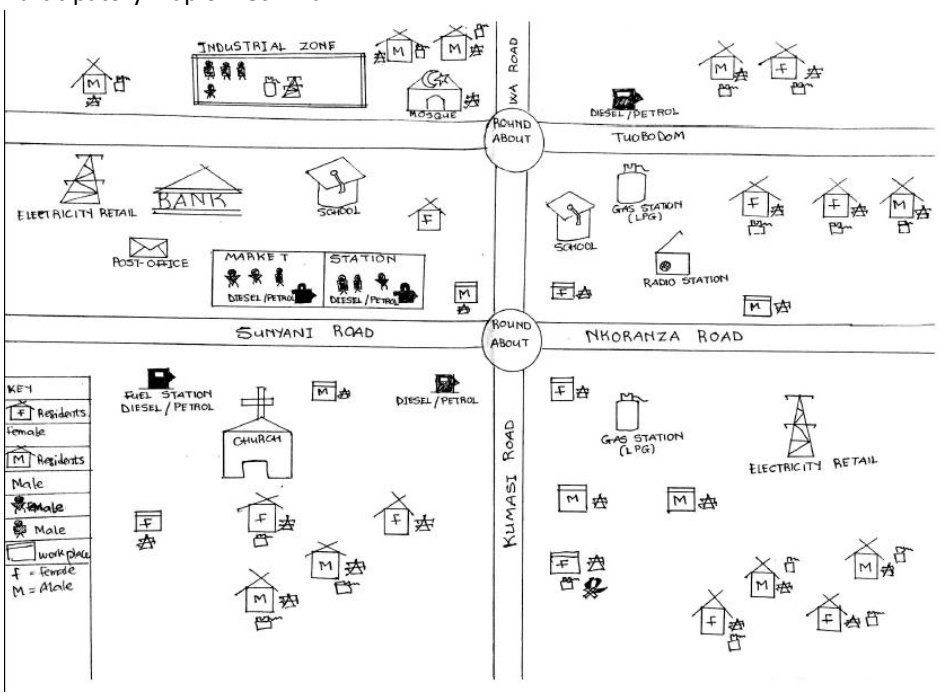
	(0.163)	(0.460)	(0.296)	(0.296)
Registered Business	0.155	-0.365	0.060	0.273
	(0.140)	(0.364)	(0.246)	(0.228)
Starting Capital ('000th)	0.002***	0.005	-0.002	0.002
	(0.001)	(0.003)	(0.008)	(0.002)
Permanent Structure	0.110	0.513	0.058	0.156
	(0.139)	(0.375)	(0.228)	(0.323)
Keep Book	-0.041	0.054	0.233	-0.092
	(0.141)	(0.414)	(0.286)	(0.207)
Number of Workers	-0.152	-0.512**	-0.257	-0.081
	(0.092)	(0.190)	(0.276)	(0.189)
Observations	216	47	89	80
R-squared	0.885	0.931	0.880	0.918
Region Fixed Effect	Yes			
Sector Fixed Effect	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

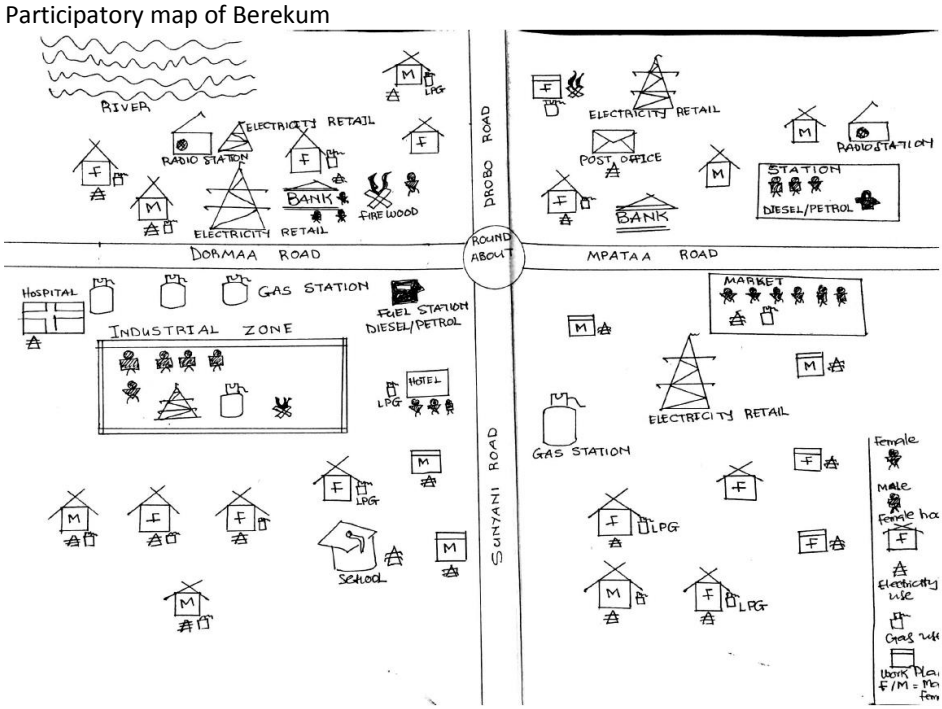
ANNEX 3 PICTURES

3.1 Ghana

Participatory map of Techiman



Participatory map of Berekum



Woodworks gender value chain FGD in Berekum

Wearing apparel gender value chain FGD in Berekum

Activity mapping Berekum

Community mapping Berekum

FGD Access to and control over resources, Berekum

Interview to the chairwoman of Berekum's hairdressers association

Interview with female auto-mechanic (right) in Berekum

Interview with female corn miller in Berekum

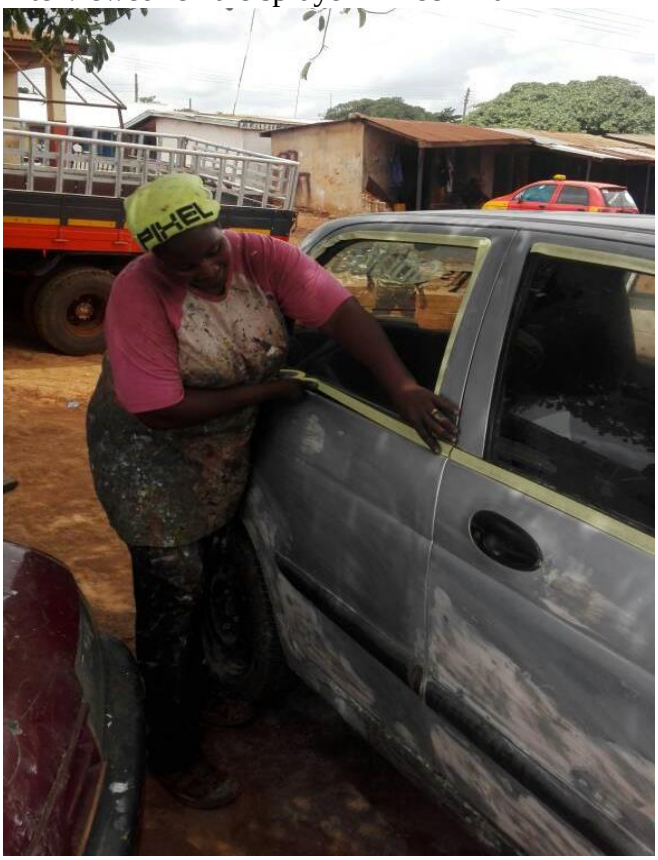
Plate 17 Male metal fabricator in Techiman

FGD access to and control over resources in Techiman

Activity mapping Techiman

Interviewed metal oven fabricator in Techiman

Interviewed female sprayer in Techiman



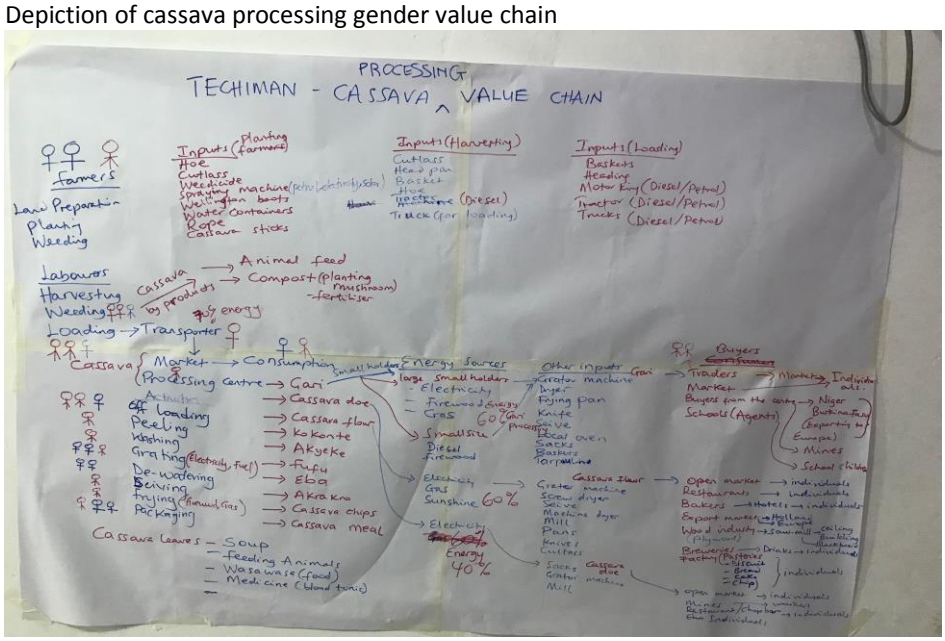
Interviewed male welder in Techiman

Interviewed female carpenter in Techiman

FGD metal fabrication value chain in Techiman

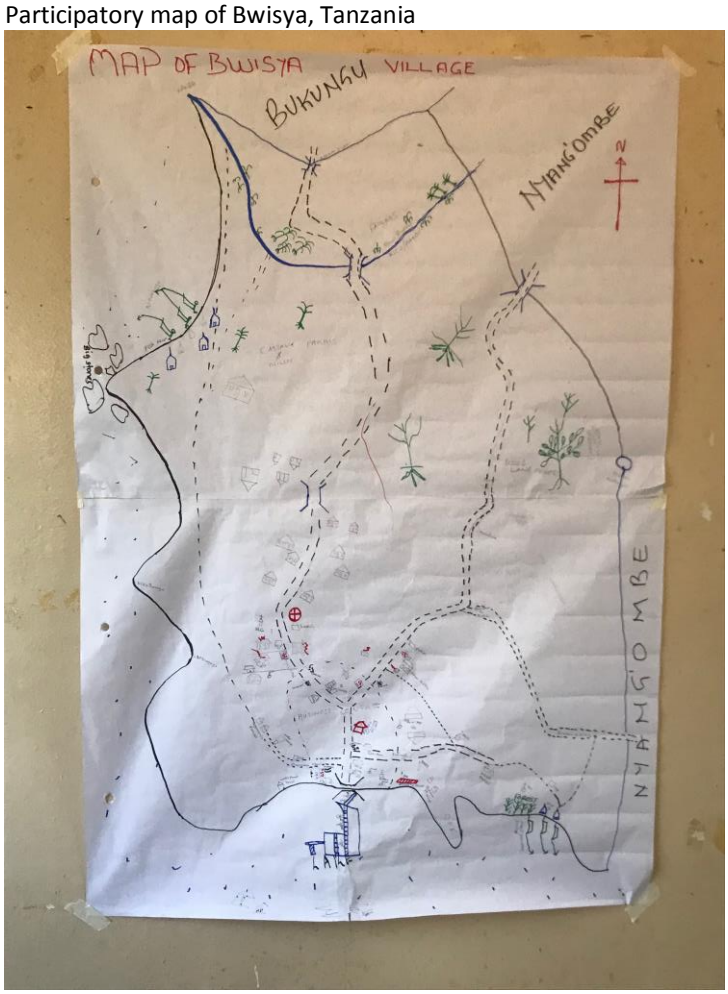
Interview with female soap maker in Techiman

Depiction of cassava processing gender value chain



3.2 Tanzania

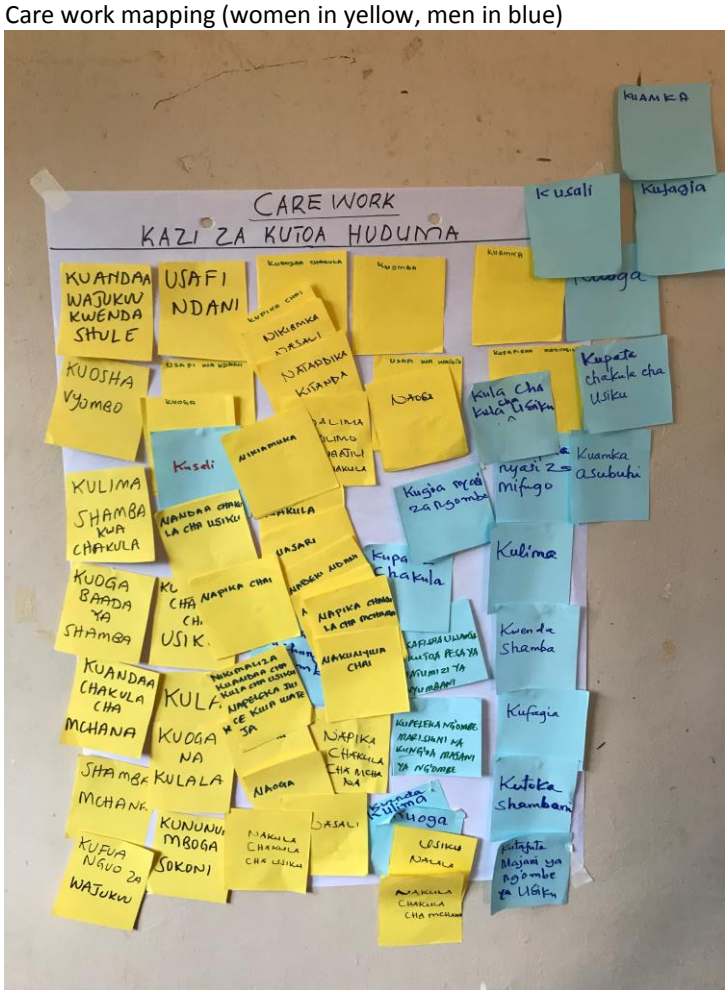
Participatory map of Bwisya, Tanzania



Discussion with women about the map

Activity mapping, Bwisya

Care work mapping (women in yellow, men in blue)



Women bakers in Bwisya

Fishermen in Sambi

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