A Descriptive Analysis of a Micro-Market Pre-Electrification:

Yele, Sierra Leone

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Abstract

This paper aims to provide a descriptive analysis of the micro-market, Yele, Sierra Leone, pre-electrification. It will do so through descriptive statistics and visual representations with the intention of providing recommendations to ensure the success of market growth post-electrification. My original work aimed to provide an analysis both before and after electrification. However, due to political unrest and lack of capital the hydroelectric power plant is still not live at the time of this paper. To start, I will introduce my previous work in Yele and the hydroelectric power plant that the Lion Heart Foundation is building. Then I will discuss descriptive statistics which include, returns to education, business sector make up, and capital measures. I provide visual representations of these various dynamics and give my policy recommendations for when electricity goes live. In general, my concerns are the location and regulation of those with lower education levels. I offer two predictions on what will happen to the shops in the service sector. First, I believe there will be an expansion of those businesses in the service sector. This will be followed by a consolidation of shops that are of the same nature. Lastly, I present my intentions for future studies in product diversification. I predict that product diversification will follow as similar patter to the shops in the service sector.

Introduction

Every year billions of dollars are spent on international aid and development. How best to spend this money is highly debated and is the focus of a great deal of economic research. Through extensive research there is a growing realization that electricity is a necessary condition for rural development, however, it has yet to be proven to be sufficient by itself to bring about the desired socioeconomic impact. Rural electrification is the generation and distribution of electricity through decentralized power grids to people in rural areas. Evidence on the topic of rural electrification is scarce. In general, authors agree rural electrification is important. However, there is little agreement on the overall effectiveness. Due to previous relations with eLuma, CBO., I was granted access to a micro-market, Yele, Sierra Leone, undergoing the process of electrification. PowerNed, a Dutch NGO, aimed to refurbish a hydroelectric power plant in Yele damaged during a civil war. The culmination of efforts planned to launch with the full operation of the hydroelectric power plant in November 2012. My main research goal is to conduct an economic analysis of the market impact of the deployment of a rural electrification project in the micro-market of Yele, Sierra Leone. While my original research goals were to conduct an economic analysis of the market before and after the launch of electricity, third party factors interfered with the collection of my second round of data. To date, due to political unrest and lack of capital the hydroelectric power plant has not gone live for a consistent amount of time. However, in the opportunity that presented itself I found significance in a descriptive analysis of Yele pre-electrification.

In this paper, I will provide a descriptive analysis of the micro-market pre-electrification and potential forthcomings of the electrification project. This paper will introduce my previous work in Yele, Sierra Leone. Then it will discuss the development of the survey used to capture the data used for this paper. Next, I will discuss the dynamics of the market and my projections for the success of the rural electrification project. I will examine education, business sector, and capital. Then I will provide visual representation of the market in its current state by mapping various demographics. Most importantly, my paper will offer potential policy implications to increase the effectiveness of the electrification project.

My original research intentions were to monitor the change in product differentiation and diversity post electricity in regards to the development and dynamics of an emerging market. However, due to the unforeseen difficulties, I will return to this at the end of my paper a proposal for further research.

Background

Sierra Leone is a small coastal country located in Western Africa. From 1991 to 2002 Sierra Leone was ravaged by a civil war. The war destroyed infrastructure, markets, and many daily business practices. After the war, Sierra Leone became a central focus on international aid programs as well as many governments.

My research for this project took place in Yele, a small chiefdom in the geographic center of Sierra Leone. Yele is the capital of the Gbonkeleken District, a relatively prosperous region. Prior to the civil war, Yele was a booming economic center while post- war Yele lacks infrastructure, resources, and market structure. There are currently around 5,000 residents in Yele, many of which are living below the poverty line. Many of the businesses in Yele were dislocated during the civil war and most existing micro-enterprises lack the resources to grow due to the widespread loss of wealth and poor economic conditions. However, Yele's strategic location still holds great potential for commercial and economic growth.

Prior to the war, in the late 1980's construction was started on a 250kW hydroelectric power plant located on the river, intended to bring electricity to the immediate Yele area. During the war, the infrastructure was badly damaged and for many years the hydro was rendered a lost cause. However, over the past decade Yele has slowly rebuilt itself and has drawn attention from the international NGO, The LionHeart Foundation. Starting in 2007, The LionHeart Foundation started rehabilitation on the hydro and the hydro went live temporarily in October of 2012. With the start of electricity, pre-paid boxes were made available to the residents of Yele for a subsidized price. Unfortunately, due to technical difficulties, political unrest in the area, and the financial situation of the Lion Heart Foundation the hydro has not been able to work at full capacity or for a consistent period of time. As of February 2013 the hydro is no longer working and will require extensive repair.

eLuma

My specific connection to Yele, Sierra Leone is through eLuma, CBO. eLuma is a community based organization that focuses on helping entrepreneurs use electricity for productive uses in emerging micro-markets such as Yele. While The Lion Heart Foundation is rebuilding the power plant, an opportunity to transform electricity into a productive resource presented itself. eLuma is tackling this endeavor, bringing electricity and economic empowerment to the community. As a budding organization eLuma noted that instead of simply being used for household tasks and recreation, electricity has the power - along with adequate infrastructure, financial services, and business coaching - to transform Yele as a model for growth. In a nutshell, eLuma is a multiphase supported market place that will work with select entrepreneurs to introduce electricity in to daily business practices. The development center will be a marketplace for disseminating the above services. Working alongside the community, we hope that the project will be a place for exchanging goods, services, and ideas.

Specifically, during phase one of eLuma's roll out plan we have selected 10 entrepreneurs to receive coaching and banking services. Upon the completion of the phase one building these 10 shop owners will relocate into the eLuma facility where they will receive a shop and pre-paid electricity box in return for a small monthly rent. These 10 shop owners will continue to go through extensive training as they adjust their business practice to the introduction of electricity.

My goal is to provide a qualitative analysis of Yele pre-electrification, with the intention of further benefiting The LionHeart Foundation and the eLuma project as a forefront of international development. Furthermore, I aim to impact the development projects to more effectively benefit the entrepreneurs in Yele.

Literature Review

My research focuses on two important aspects of economic analysis. They are the impact of rural electrification on development and product diversification in an emerging market.

The literature on the impact of rural electrification on economic development is scarce and diverse. Bernard (2010) examines rural electrification by the increase in consumption, from data sets across sub-Saharan Africa. Dinkelman (2011) compares the impact of rural electrification on employment rates. These papers fall short in understanding the extent that electricity interacts with other social factors. Cabraal, Barnes, and Agarwalg (2005) overcome this shortcoming by focusing on the productive uses of rural electrification. Productive uses are any activity that creates economic growth, increases income, and reduces migration to urban areas. While Cabraal, Barnes, and Agarwalg (2005) are closer to understanding the relationship between rural electrification and economic growth they still fail to consider the impact of other development factors that increase economic growth. Failure to also include such factors will result in failure to understand the importance of rural electrification. My research will look at the dynamics and demographics of a micro-market pre-electrification. Additionally, I will present a proposal for future studies in understanding the impact of rural electrification on micro-markets through product diversification. I chose product diversification because it will provide a more tactical measure of how the market place is growing.

The literature on product differentiation is greatly varied and is extremely scarce in developing markets. Luo (2002) focuses on product diversification in regards to international joint ventures (IJVs) within emerging markets. Lou stresses environmental change in emerging markets and its effect on determining product diversification. However, Lou does his analysis with respect to political factors and focuses less on technological change. Iacobucci and Rosa (2004) say that diversification stems from one entrepreneur diversifying his own set of skills and this development leads to market expansion. In the present study expansion could prove to be very important as prominent business owners can expand their products within existing shops. This paper most closely emulates Hidalgo and Hausman (2008) who make an interesting and relevant point that "poor countries specialize in goods that are relatively intensive in labor and land, while richer countries specialize in goods that use more infrastructure and institutions." While Hausman's work focuses on the macroeconomic level the point may shed light on the future development of Yele. This paper suggests that as infrastructure, namely electricity, is implemented into a market the nature of the goods specialized in will change. Hausman states that it is important to consider product diversification as a measure of economic development because it is multidimensional and "as nations develop, different industries and products are

born." My proposed paper will take into account the ideas presented in Hausman's paper and apply them to a single developing micro-market. It is important to note that the research presented in this paper in not meant to compete with traditional measures of economics such as output and wages in the labor market. Rather, it is meant to compliment previous work and provide a more holistic view of micro-market development.

Methods

Originally, I set out to capture the change in product diversification before and after electricity using a two round survey. The survey was administered before the initial launch of the grid in the September 2012, with the intentions to do a second round survey over Christmas. However, due to previously discussed reasons the second survey was never completed. Most importantly, the hydroelectric power plant whose impact was supposed to be measured suffered serious damages and was shut down. The loss in capital for the LionHeart Foundation caused the NGO to shut down other local entities and the survey was unable to be completed. At this time the hydro is still inactive and the political and economic situation of Yele is very unstable.

To collect my data I did an exhaustive survey of the shops in Yele so that I could gather the largest number of observations possible. After gathering the survey data, I then mapped each shop in the market to visually represent different dynamics of the market. With the second round of data, these maps would expand and shed light on the changing dynamic of the market. Through the first round of my survey I was able to shed light on many valuable aspects such as education, capital, and sector break down.

Data

For the data discussed in this paper, I used data from an original field survey collected from Yele, Sierra Leone. The data was collected on September 6th, 2012 by ELRA, Inc. I developed the survey with the help of Assistant Professor Rebecca Lessem. The survey was designed to conduct an economic analysis of the market impact of the introduction of electricity. ELRA, Inc. surveyed a total of 98 shop owners. (See Appendix A to view the complete survey). To be qualified for the survey the shop owner and enterprise had to fit the following criteria:

- The enterprise is creating some source of economic value for the person. i.e. They have products or services that are sold or traded.
- The enterprise has some form of structure: Shop, stand, market

Each survey correspondent participated on a voluntary basis. In exchange for participation the shop owner received a card worth 50 units of cellphone "top up", which is the equivalent to cellphone minutes. "Top up" is a necessity for most living in Yele and a highly valued commodity.

Due to my previous relationship with the area as well as ELRA it is it fair to say that this was a trusted interaction. The selection of surveyors was highly influenced by a desire to represent the majority of those surveyed. Thus, to avoid drawing additional attention drawn to the process and promote honest answers the surveyor had to be Sierra Leonean and fluent in the local dialect on Timne.

The survey covers a series of basic demographic questions, including education, and then focuses on the products/services available in the market and their origins. I used basic items such as cars, bikes, motorcycles, and rice, as a measure of capital. In developing markets such as Yele, where banking is not commonplace, measuring wealth in terms of income and liquid wealth can be difficult. By gathering a baseline level of capital I am able to determine if wealth increases by seeing if capital increases. I split the nature of business between products and services to capture if the dynamic of the market changes after the introduction of electricity because businesses in the service sector may further benefit from electricity.

Some shortcomings of my data set are the limited number of observations and the presences of missing data points. Because the survey was collected in an area with a very high illiteracy rate even when the surveyor speaks the local dialect the questions are not always comprehended. The instability of the market made it near impossible to gather data on certain characteristics. For example, when trying to gather information on the prices of goods the surveyors found that there was no stable price. Prices varied drastically depending on the relationship the shop owner and the buyer.

Descriptive Statistics

First I will provide a basic set of descriptive statistics on the data, focusing mainly on gender and family demographics. There are 98 observations of small and micro enterprises. Of those surveyed, 68.3 percent were owned by males. The average population age was 40 years with a standard deviation of 11.8 years. The median age was 38.5 years. The average age for males was 40.8 years with a median of 39 years. The average age for females was 38.1 years with a median of 32 years. Below, Table 1 shows the descriptive statistics of family structure.

	Mean	Std. Dev.	Min	Max
Married	0.9673913	0.1785834	0	1
# Wives	1.28125	0.5185067	1	3
#Children	5.120879	3.675248	0	21
# Dependents	8.309524	5.501317	0	25

***Table 1**: Table 1 displays the descriptive statistics of family demographics. As you can see here, 96 percent of all shop owners surveyed are married, with a mean of 1.3 wives per male shop owner. The mean number of children is 5.12 children per shop owner with a mean of 8.3 dependents.*

As seen in Table 1, 96 percent of the shop interviews are married with an average number of 1.3 wives. The number of wives is greater than one due to the religious demographic of Yele. The shop owners have an average of 5.12 children with a standard deviation of 3.68 children. An important statistic in emerging markets is the number of dependents in a family because this may not be the same as the number of children. Due to the high rate of teenage pregnancy it is very likely that a household will have additional dependents per bread winner. We see exactly this is in Yele where the average number of dependents is 8.31 dependents with a standard deviation of 5.5 dependents. The max number of dependents is 25. The observation can be considered an outlier. However, it is still very important to consider the implications of such household dynamics.

Returns to Education

One important aspect of the market I was able to explore was the distribution of education across the shop owners. Education levels amongst shop owners may provide various levels of understanding to the potential use of electricity. Shop owners who are illiterate will have difficulties reading the material and completing the forms necessary to purchase electricity.

Additionally, it can be assumed that illiterate shop owners would have a harder time grasping the concept of electricity overall. Below, Table 2 shows the descriptive statistics of education.

Education	Frequency	Percent	Cum.
Illiterate	31	32.29	32.29
Elementary	17	17.71	50
Middle School	18	18.75	68.75
High School +	24	25	93.75
Quranic	6	6.25	100
Total	96	100	

Table 2: *Table 2 represents the descriptive statistics for education within the shop owner population. As seen a significant part of the population is illiterate, with 32.3 percent of shop owners have no education. Additionally, 68.75 percent of the population has received less than a high school diploma. Six shop owners have received a Quranic education.*

Above we can see that 32 percent of the population of is illiterate. Not surprisingly, 68.75 percent of the surveyed shop owners have received a less than a high school education. In contrast, in the "high school +" category there are 3 shop owners who have received a graduate degree. Due to the areas religious demographic it was not surprising to see that 6.25 percent of the population has received strictly Quranic education. One thing to remember about those who have received a Quranic education is that they are literate. If the second survey were completed, I wouldn't expect to see a drastic change in the education breakdown. However, if I could continue this study for an extended period of time I would predict that education level would go up as electricity became more available because light would provide more opportunities throughout the day for children to study while also working for their family. Additionally, with the introduction of electricity comes the opportunity for more advanced technologies to enter the market requiring a higher level of education to understand them.

Lastly, with respect to education I looked at the gender distribution within shop owners. Below Table 3 represents the educational breakdown by gender.

	Gender		
Education	**Female**	**Male**	**Total**
Illiterate	15 48.39	16 51.61	31 100
Elementary	8 47.06	9 52.94	17 100
Middle School	4 22.22	14 77.78	18 100
High School +	3 12.5	21 87.5	24 100
Quranic	0 0	6 100	6 100
Total	30 31.25	66 68.75	96 100

Key
Frequency
Row Percentage

Table 3: *Table 3 shows education with respect to gender. After Junior Secondary school, education becomes male dominated. Note: The last row, Quranic Studies, is male dominated by law.*

Here we see that after Junior Secondary School education becomes male dominated with 87.5 percent of those who had an education level of high school or higher being male. Many factors could be lead to the gender gap in education, including the lack of available funds to send girls to school, early pregnancy, and gender stereotypes. I believe that the introduction of electricity may adjust for some of the gender bias but I do not know if it will be able to fully correct it.

Products vs. Services

Next, I look at the enterprises with respect to business sector. This is an important market dynamic to take into consideration because electricity may affect businesses in each sector differently. There are 69 product based businesses and 37 service based businesses. Of these 7 are hybrids, meaning they both provide a service and sell a product. For example, one of the tailors sells school uniforms and has a garment repair business. Below, Table 3 shows the distribution of business in each sector by education level.

	Sector		
Education	Service	Product	Total
Illiterate	3	27	30
	10	90	100
Elementary	3	12	15
	20	80	100
Middle School	8	7	15
	53.33	46.67	100
High School +	11	9	20
	55	45	100
Quranic	2	4	6
	33.33	66.67	100
Total	27	59	86
	31.4	68.6	100

Key
Frequency
Row Percentage

.***Table 4:*** *Table 4 represents the business sector by education levels. Illiterate shop owners are heavily concentrated in the product sector. As education increases more shop owners move towards the service sector with 55 percent of shop owners with a high school education or higher being in the service sector.*

Here we observe that shop owners are overwhelmingly in the product sector when they have lower levels of education. As shown, 90 percent of the illiterate show owners have businesses of the product nature. As the education levels increase, shop owners are more favorably in the service sector with 100 percent of those having graduate degrees working in the service sector. I think business sector by education is an interesting comparison because having a business in the service sector may require more technical skills that are not necessarily linked to the material taught in school. Additionally, businesses in the service sector may better benefit from electricity such as a carpenter or hair dresser. With the introduction of electricity it will be interesting to observe how the education level of shop owners and the business sector dynamics develop.

Capital

Another important measure I was able to capture was capital by using rice, bicycles, motorcycles, and cars as basic forms of capital. I chose these four assets as measures of capital because they hold various levels of importance within the community. Rice is often stockpiled as

a form of food security. Bicycles are a less expensive form of transportation. Motorcycles and cars are both traditional types of capital that signify a high level of wealth. In Yele, I was unable to use land as a measure for capital because all of the land is technically rented from a group of elders. This group ownership is not uncommon in micro-markets like Yele. Below, Table 5 displays the mean ownership of each measure of capital amongst shop owners.

	Capital			
	Rice	**Bike**	**Motorcycle**	**Car**
Mean	0.58	0.09	0.24	0.11

Table 5: *Table 5 displays the means of measures of capital. Of shop owners interviewed, 58 percent have extra rice stored for food security. Surprisingly, almost a quarter of shop owners have motorcycles.*

The above table shows that 58 percent of shop owners had extra rice stocked in their shops. Food security is a dire issue in micro markets and hopefully, with the introduction of electricity, an increase in income generation will allow more shop owners to store food. Next, only 9 percent of shop owners owned a bike. Surprisingly, 24 percent of shop owners owned a motorcycle which is a more expensive form of capital than a bicycle. Lastly, only 11 percent of shop owners owned a car. While 11 percent may seem very low this is still remarkably high for an area as impoverished as Yele. Next, to add context to the measurements of capital I look at them with respect to education and gender in tables 6 and 7, respectively.

		Capital		
Education	**Rice**	**Bike**	**Motorcycle**	**Car**
Illiterate	0.58	0.13	0.26	0.10
Elementary	0.53	0.18	0.29	0.12
Middle School	0.56	0.06	0.22	0.06
High School +	0.58	0.04	0.25	0.17
Quranic	0.67	0.00	0.17	0.00
Total	0.57	0.09	0.25	0.10

Table 6*: Table 6 shows the breakdown of capital with respect to education levels within the shop owners. There does not appear to be any noticeable pattern between capital and education levels. It is surprising that 67 percent of those with Quranic education have rice stockpiled but this may be due to small sample size.*

		Capital		
Gender	**Rice**	**Bike**	**Motorcycle**	**Car**
Female	0.74	0.16	0.16	0.19
male	0.51	0.06	0.28	0.07
Total	0.58	0.09	0.24	0.11

Table7: *Table 7 shows the breakdown of capital by the gender of the show owner. Female shop owner have a larger proportion for 3 out of the 4 measured capital categories.*

In Table 6, where capital is tabulated with respect to education levels, there is not anything very interesting to gather. For the most part, capital is not specific to education levels. The one statistic that stands out is that those with a Quranic education are above average in stock piling rice. Where 57 percent of the shop owners interviewed had extra rice, a surprising 67 percent of those with Quranic education had rice stock piled. This may be a result of the small sample size.

In Table 7, a larger proportion of women than men own capital in three out of the four categories. For rice, 74 percent of female shop owners had a supply of rice compared to 51 percent of male shop owners. Additionally, 19 percent of female shop owners had cars in comparison to the 7 percent of male shop owners. When the market begins to develop and various different aid programs are developing, this could be an important factor to consider because this shows that female shop owners are focused on long term investments. In a market as volatile as Yele, long term investments are important because they provide stability and both food and income security in this case.

Mapping these Demographics

After finding the above statistics I mapped the shop owners with respect to various demographics in relation the electricity grid in hopes of visually representing what Yele will look like as a market once electricity goes live. In the images the royal blue dots represent the electricity grid. More specifically these are telephone poles capable of creating electricity connections to the shop owners. Additionally, each image will have a key describing the markers. With these images I will present possible policy options that I foresee helping the success of the hydroelectric power plant as well as income generation throughout the market.

First I looked at the market with respect to education. It is important to note where in respect to the grid the most educated people live because the higher a shop owner's education level the more likely they are to understand the concept of electricity. Below, Figure 1 shows the location of the illiterate population, the most dominate portion of the shop owners. Figure 2, shows the educational spread of the entire market and Figure 3 shows an up close look at the economic center of Yele, also known as "Junction". Junction is the meeting point of the three main roads which run through Yele. It is important to note that there are street lights in Junction provided by the Lion Heart Foundation that turn on at sun down and off at sun rise. As a public good the street lights create a positive externality especially for those who are not unable to afford electricity specifically in their shop. While an entrepreneur may not purchase electricity they can still benefit from longer business hours by strategically locating themselves in Junction. We see this below with the illiterate shop owners.

Figure 1: *Figure 1 is a visual representation of the illiterate shop owners in Yele. Here we can see that illiterate shop owners are heavily concentrated around junction.*

In Figure 1, we see that the illiterate shop owners are heavily concentrated around junction. These shop owners may have chosen junction because this location receives the most traffic and in turn will lead to larger sales, especially because the majority of illiterate shop owners sell products, as we learned earlier. Additionally, it can be assumed that the illiterate shop owners are less likely to be able to afford electricity so they will benefit greatly from the street lights. With respect to the grid elsewhere, there is no observable pattern of the illiterate shop owners' location.

With the illiterate shop owners represented so densely in Junction there are two main policy recommendations I propose. First, I propose that there should be a form of registry in Junction for shop owners which limits the number of stands allowed. Many of the illiterate shop owners sell the same items. If Junction becomes over developed it will become an eye sore for the nicer shops and make it difficult to establish solid electricity connections. Next, I would propose people with higher levels of education be offered pre-paid boxes first because there are a limited number of boxes initially available. To gain access, the shop owner may need to move but this should be explained early enough in advance to make it a viable option.

Next, I mapped all of the shop owners by education level. As shown below in figure 2, the main concentration of shops is still in junction. There is no pattern present for those with elementary education. If you look closely in Figure 3, in addition to the illiterate shop owners there are higher number of those shop owners with middle school education in junction. Here, I have marked four shops that will not have access to electricity because they are too far away from the grid. Of these four, two of the shop owners contain graduate degrees. I do not feel that it is beneficial to the market for its highest educated shop owners to not have access to the In general, I recommend that shop owners with higher levels of education better position themselves in relation to the grid. One policy recommendation that I have is specific to eLuma. With promised connection to the grid, eLuma should focus on selecting the entrepreneurs based on education level. With these shop owners having a better chance of succeeding, Yele is more likely to experience the benefits of the positive externalities of education, such as increased economic productivity.

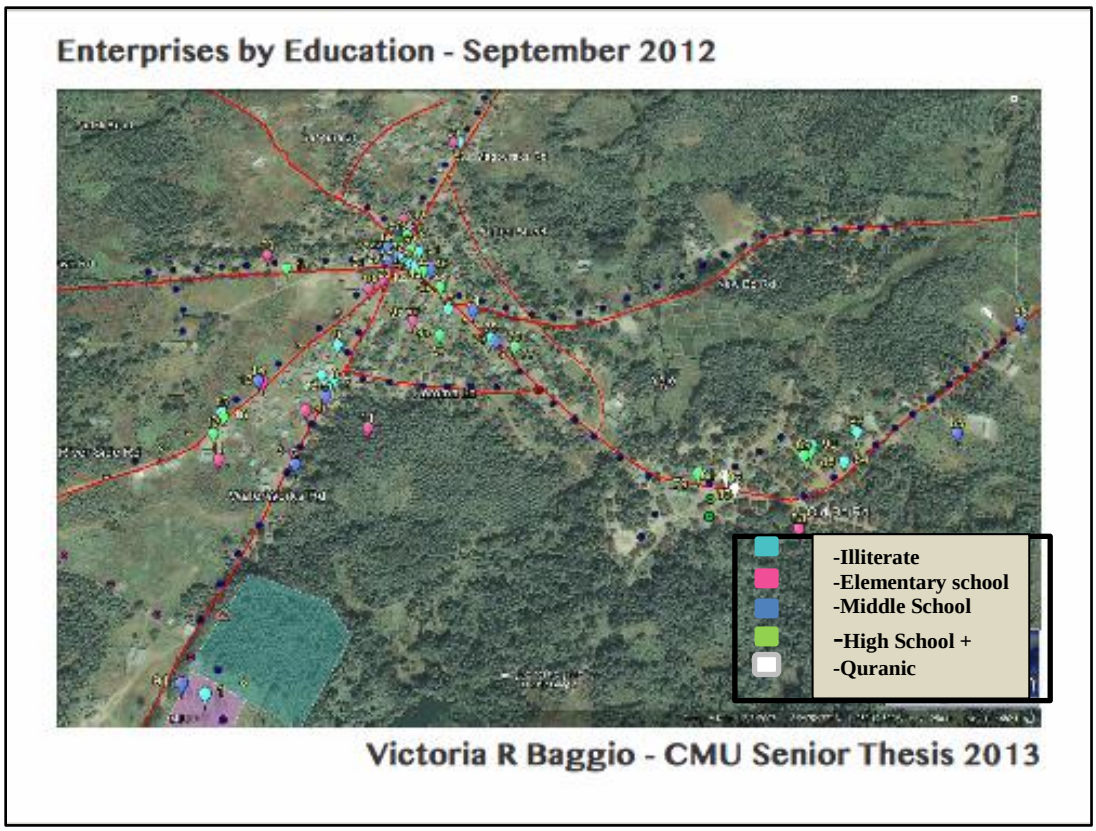


***Figure 2**: Figure 2 shows the educational break down for the shop owners.*

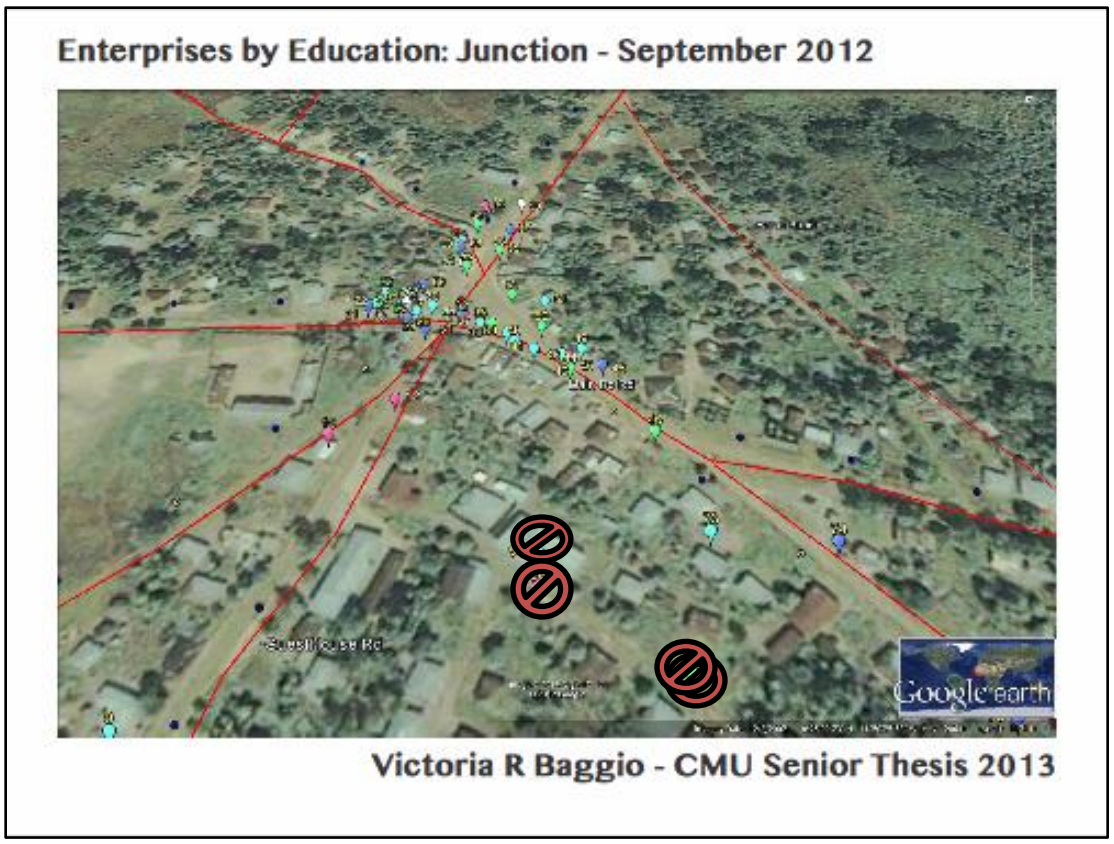


Figure 3*: Figure 3 shows a closer version of the educational break down of shop owners. Here we see that there are 4 shop owners who will not be able to receive electricity, two of which have graduate degrees.*

Next, in Figure 4, I mapped the shops that were in the service sector. As I stated earlier, I believe that businesses in the service sector will be more likely to benefit from electricity. Below you can see that I have marked five houses that are unable to receive elctricity because they are too far away from the grid for a connection as determined by the Lion Heart Foundation.

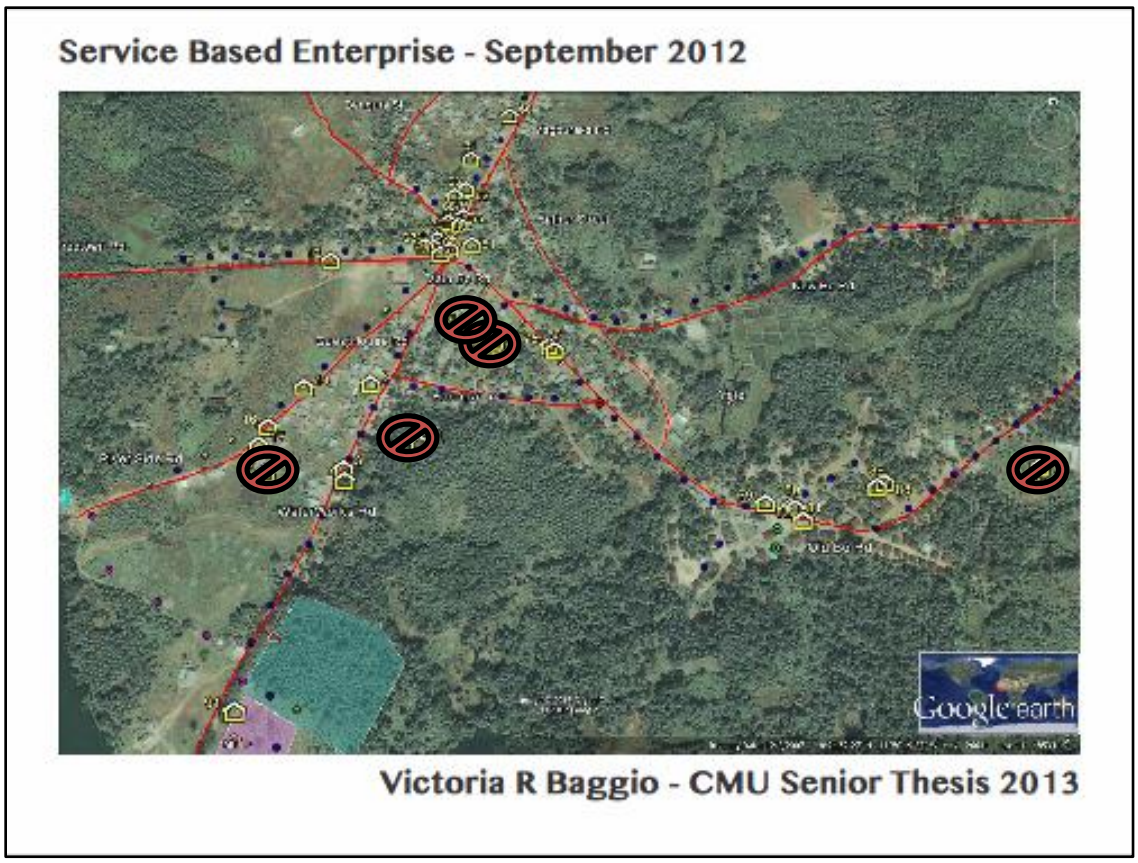


Figure 4: *Figure 4 shows the service sector of Yele. Of this demographic there are 5 shop owners who will not be able to receive education.*

For the service sector I do not have any direct policy recommendations but rather two predictions. First, I think that with the introduction of electricity we would see an increase in the number of shops that are service focused. Second, I think that contradticingly we would see a consolidation and streamlining of the services avaialable. For example, there are currently 5 different tailor shops in Yele. I predict that once electricity in up and running the tailor shops will either consolidate into one service or that one tailor will be able to expand their business enough to put the other tailors out of business.

Lastly, in Figure 5, I mapped show owners that I deemed would benefit from electricity. These were mainly the shops in the service sector with the addition of some shops selling medicines and food products. The shops range from a cinema run off of a

generator and a cell phone charging shop to tailors and pharmacies. A full page version of this picture is available in appendix B for better viewing.

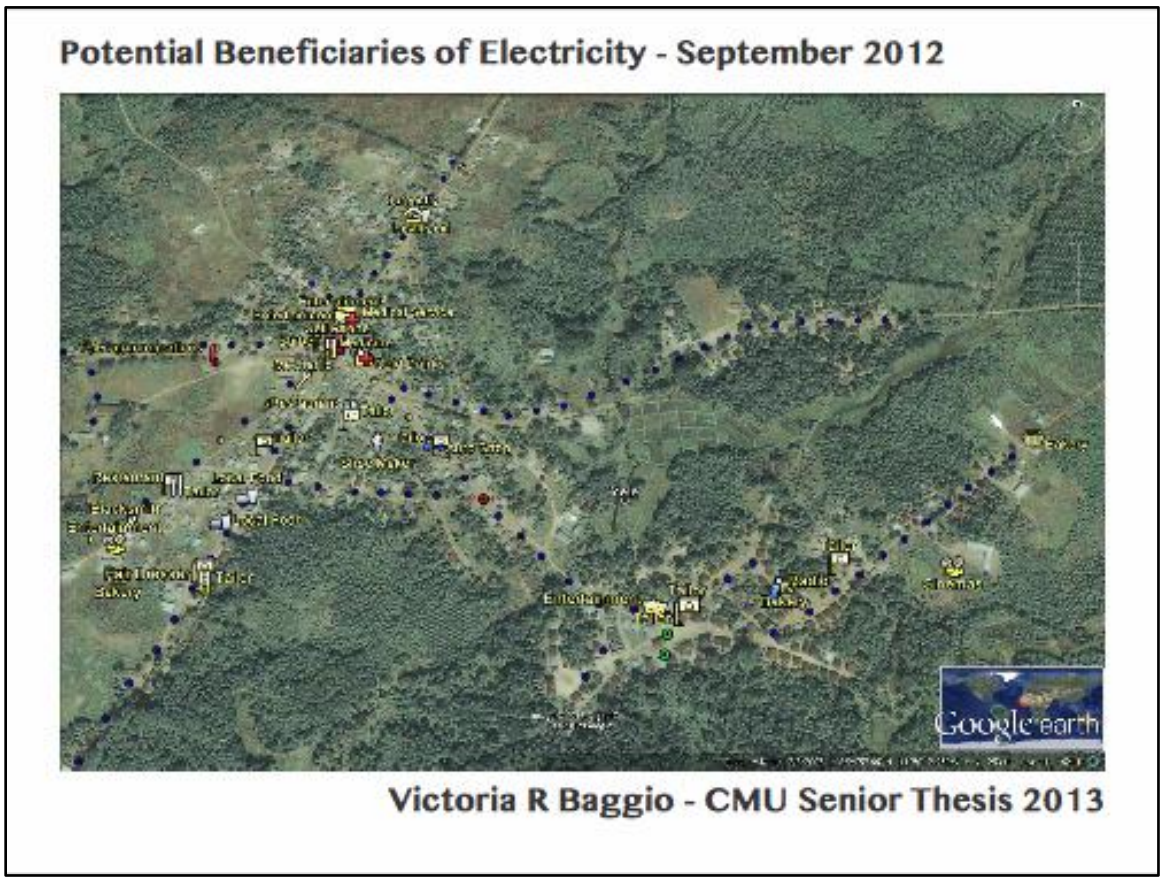


Figure 5*: Figure 5 shows the potential beneficiaries from electricity. I considered a shop to benefit from electricity if there were some aspect of their business that would be able to utilize electricity for an income generating purpose, apart from the introduction of light. These shops contain a variety of businesses such as, a cinema, a pharmacy, a tailor, etc.*

Of the 98 shops a total, I dictated that 48 shops would benefit from electricity. I considered a shop to benefit from electricity if there were some aspect of their business that would be able to utilize electricity for an income generating purpose. It is assumed that all of the shop owners will benefit from longer store hours due to the introduction of light. Of these 48 shops, 5 will not be able to obtain access to the grid for the first stage of roll out because of location. My largest concerns from this break down are that the hydro will not receive enough activity during the day to become profitable. This is one of the issues the eLuma aims to tackle. Additionally, apart from eLuma I feel that there needs to be a better explanation of how electricity can improve business.

Further Studies

If I were to continue this study I would first focus on my original research endeavors. My main research goal would be to conduct an economic analysis of the market impact of the deployment of a rural electrification project as seen through the change in product diversification. I would do this by tracking the evolution of product diversity and product differentiation within Yele, Sierra Leone. Product diversification and differentiation are significant indicators of market growth and fluctuations. My research question would be, "How does the presence and deployment of a rural electrification project affect a rural market as seen through product diversification and differentiation?" In documenting the different available products and uses of products over time I will be able to better understand the impact of such development projects. I would map the various products available in the first round of the survey and then create time lapsed pictures with the products from the second round of surveys. I believe this innovative way of mapping the available products in an emerging market could led to further policy recommendations.

What I Expect to Find

I expect to find that as electricity is introduced to Yele the number of products available will drastically increase. I expect to see this in two ways. First, in the development of new shops and enterprises and second, in diversification within an entrepreneurs current business. Then, as the market adapts to the use of the new technology over time the number products will level off and reach equilibrium. See Figure X for a concept image of this idea.

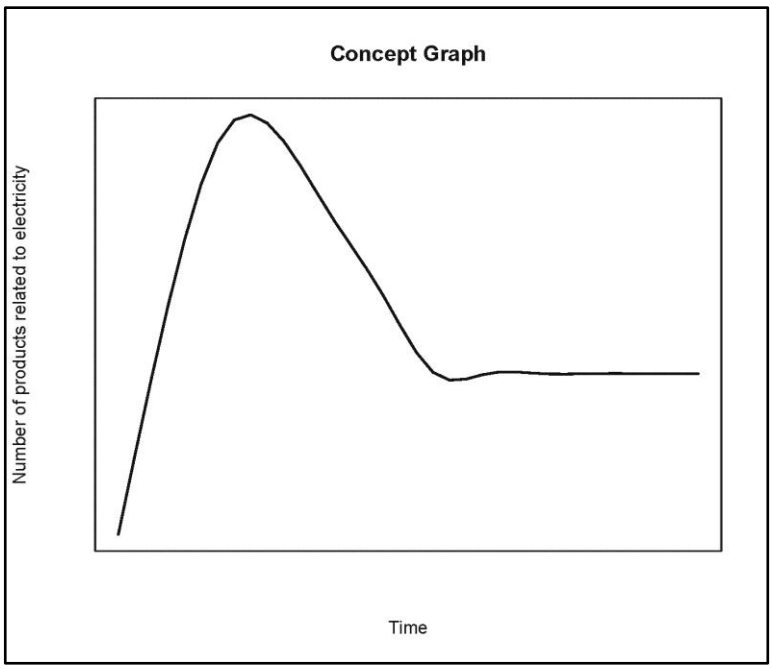


Figure 6: *Figure 6 is a model developed to capture my prediction of product diversification over time. Initially, I think that the number of products will spike and then as time goes on they will reduce and level of to an equilibrium number of products.*

Furthermore, if I were able to continue this research across the introduction of a clean water source and other development products, I believe that this pattern would develop for each sector of products.

Appendix A

Survey Number:
GPS Location:

OWNER INFORMATION			
Owner(s) Name:		_____	
Gender:		Male	Female
Age:		_____	
Education:		None Some K-12 K-12 Some High School High School Some College College Graduate	
Married:		Yes	No
If yes (married), # of Wives:		_____	
	Children:	_____	
	Dependents:	_____	
Do you own	**a Bike:**	Yes	No
	Car:	Yes	No
	Motorcycle:	Yes	No
	Home:	Yes	No
	Rice:	Yes	No
	Other:		

Survey Number:
GPS Location:

SHOP INFORMATION

Shop is:
Self-Owned
Rented
Other:

Employees: **# Male:** _____
 # Female: _____

Material Shop is made of:
Mud
Wood
Cement
Tin

SECTOR:
Product
Services

IF PRODUCT

What Products do you sell?
_____
_____
_____
_____

Are products:
Handmade
imported
Other:

If imported, where do you get your products?
Makeni
Freetown
Bo
Other:

Please List Other Products Below:
_____
_____
_____
_____

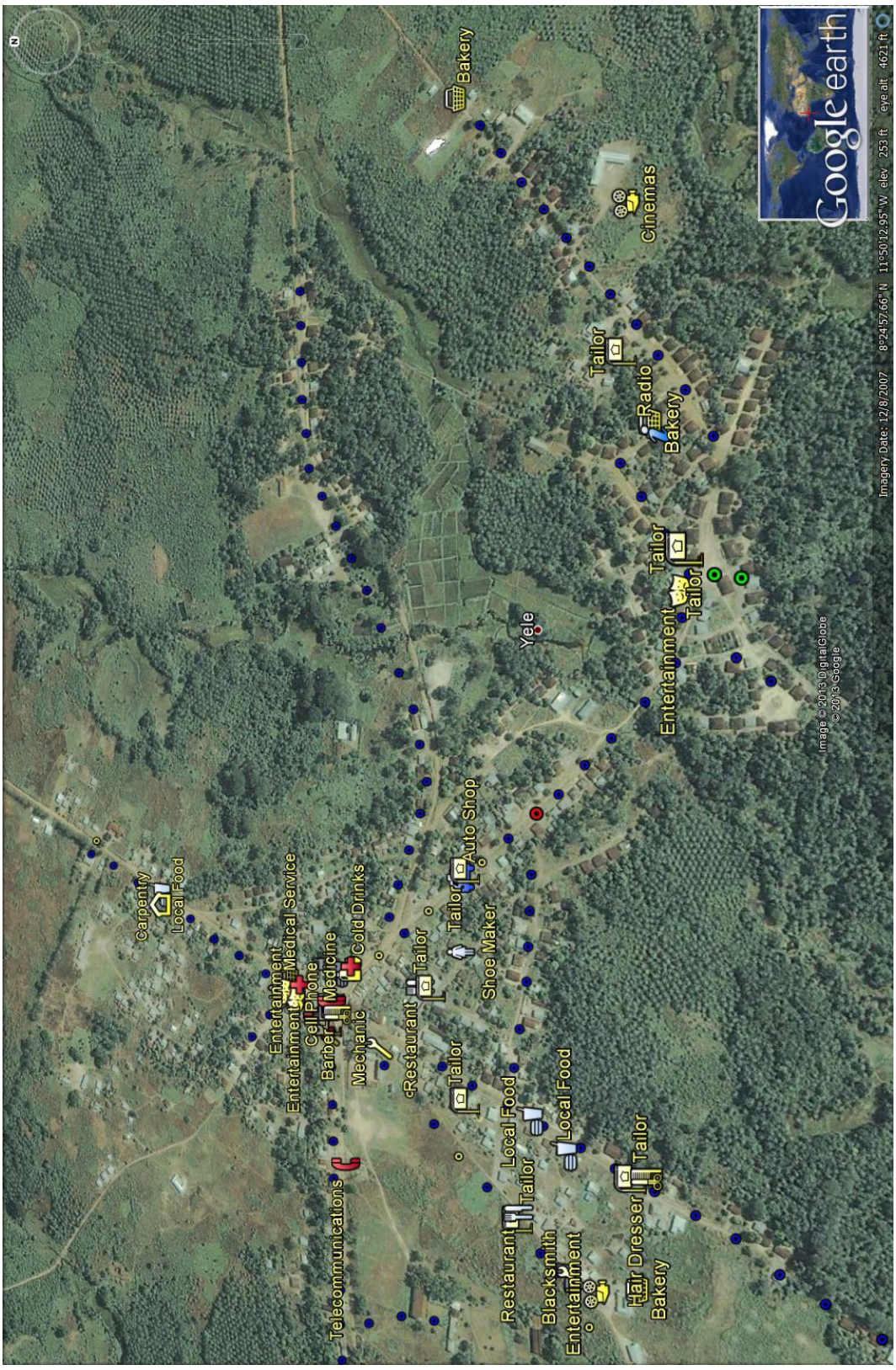
IF SERVICE

What is the nature of your service:

Do you require supplies from somewhere else?

if so, where?

Appendix B


Bakery
Cinemas
Tailor
Radio
Bakery
Tailor
Entertainment
Tailor
Yele
Auto Shop
Shoe Maker
Tailor
Restaurant
Tailor
Cold Drinks
Medicine
Cell Phone
Medical Service
Entertainment
Entertainment
Barber
Mechanic
Telecommunications
Carpentry
Local Food
Restaurant
Tailor
Local Food
Local Food
Blacksmith
Entertainment
Hair Dresser
Tailor
Bakery
Google earth
Image © 2015 DigitalGlobe
© 2015 Google
Imagery Date: 12/8/2007 8°24'57.66"N 11°50'12.95"W elev 253 ft eye alt 4621 ft

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