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Energy Justice in Sub-Saharan Africa

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ENERGY JUSTICE IN SUB-SAHARAN AFRICA

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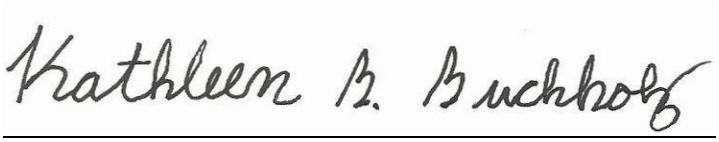
Signed: 

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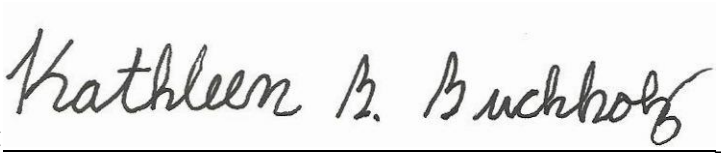
Signature: 

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Energy Justice in sub-Saharan Africa

Master of Arts in International Affairs

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Sub-Saharan Africa has the lowest rates of electrification and some of the worst education statistics worldwide. In the absence of strong infrastructure for a reliable grid system and quality universal primary schooling, the poor suffer significantly. Though substantial research has been done on both issues separately, the relationship between the two has yet to be explored. This thesis uses social justice theories to introduce the connections between energy poverty and an individual's education capabilities through a case study in Zambia. Case study research was carried out in the urban low-resource settlements of Lusaka, Zambia over a period of two months with Lifeline Energy, using methods of participant observation.

Drawing on trends discovered in survey responses, interviews and feedback from a distribution of renewable technologies, this study demonstrates that a lack of modern forms of energy detracts from education. By synthesizing the data with Martha Nussbaum's capabilities approach and Sendhil Mullainathan and Eldar Shafir's scarcity theory, the research reveals that energy poverty hinders an individual's ability to study and gain a quality education and diminishes their available cognitive capacity to learn by tunneling attention to the resource deficit. Furthermore, it supports the claim that energy poverty is not gender neutral. The research concludes that the scarcity caused by energy poverty can be lessened by the investment in and use of small-scale renewable technologies which alleviates some of the daily stress and grind of poverty. This thesis lays the groundwork to recognize energy poverty as an injustice.

Keywords: Energy Poverty, Education, Gender, Sub-Saharan Africa, Scarcity,

Capabilities Approach

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Introduction

Close to half of the world's population lives in extreme poverty, subsiding on less than two dollars and 50 cents a day.[1] Yet the highest rates of poverty worldwide are in sub-Saharan Africa, where close to half the population lives on even less, one dollar and 25 cents a day.[2] UNICEF estimates that 22,000 children die each day from poverty and that the highest rates of child mortality are in sub-Saharan Africa.[3] But poverty contributes to more than high mortality rates. Energy poverty, a lack of access to modern energy services, hinders both economic and social development.[4] Modern energy is crucial for everything from healthcare and sanitation to telecommunications and transport and the issue is growing with the population. In sub-Saharan Africa the population growth outpaces the efforts to increase energy access. 1.4 billion people, or 18 percent of the global population, live without access to electricity and the majority live in sub-Saharan Africa.[5] This is especially problematic for urban areas; approximately half the world's population now lives in cities and towns and one out of every three urban resident's lives in slum conditions.[6]

Eradicating energy poverty is not one of the United Nations Millennium Development Goals. This thesis will demonstrate how important energy poverty is to the Millennium

[1] The World Bank, *Percent of People in the World at Different Poverty Levels,* World Development Indicators, 2005.
[2] The World Bank, *Poverty headcount ratio at $1.25 a day (PPP) (% of population),* World Development Indicators, 2010.
[3] UNICEF, *Child Mortality Rates Drop a Third Since 1990,* UNICEF Press Centre, New York, 2010.
[4] International Energy Agency, *Modern Energy for All*, World Energy Outlook, IEA, Paris, 2013.
[5] International Energy Agency, *ENERGY POVERTY: How to make modern energy access universal: Special excerpt of the World Energy Outlook 2010 for the UN General Assembly on the Millennium Development Goals*, IEA, Paris, 2010.
[6] United Nations, *The Millennium Development Goals Report,* United Nations, New York, 2007.

Development Goals, in particular to goal two, achieving universal primary education and goal three, promoting gender equality and empowering women. Sub-Saharan Africa has the second lowest literacy rates by region in the world, second only to West and Central Africa.[7] The goal to achieve universal primary education cannot be met without special attention paid to the sub-Saharan. Educating children helps reduce poverty; it provides the next generation the tools to fight poverty and conquer disease.[8] Females have a distinct disadvantage in educational systems, contributing to a cycle of gender inequality. Sub-Saharan Africa has the lowest proportion of countries with gender equality in school.[9] The research for this thesis will follow the work of one non-profit in the region that uses technology to solve these issues.

Lifeline Energy

One non-profit working to provide education support and close the gender gap is Lifeline Energy. Lifeline Energy is a non-governmental organization, NGO, which provides technology solutions for off-grid learning. Operating in sub-Saharan Africa, Lifeline Energy distributes solar and wind-up media players and radios that they designed and manufactured specifically for the humanitarian sector. These durable devices provide access to learning programs on the radio or saved on the device for up to 60 people at a time. Since 1997 they have increased access to information and education for millions of people in sub-Saharan Africa including vulnerable children, refugees, women, the ill and

[7] UNICEF, Statistics by Area/Education: Literacy, ChildInfo: Monitoring the Situation of Children and Women, UNICEF, 2012.
[8] UNICEF, Statistics by Area/Education: Overview, ChildInfo: Monitoring the Situation of Children and Women, UNICEF, 2012.
[9] UNICEF, Girls Education and Gender Equality, Basic Education and Gender Equality, UNICEF, 2014.

disabled. Their main focus is to increase access to information and education though their work also provides access to radio programming on modern agriculture to increase crop yields and on health to combat HIV/AIDS and malaria. For two months the author worked as a participant observer and graduate student researcher for Lifeline Energy in Lusaka, Zambia.

Research Questions

Using a case study of the urban low-resource settlements in Lusaka, Zambia, the capital of one of sub-Saharan Africa's countries, this thesis will highlight the unexplored connections between energy poverty and education in terms of social justice. In researching energy poverty this thesis will illuminate how a lack of access to modern forms of energy affects an individual's education. It will examine the differences in access to modern energy for men and women, and their ability to gain a quality education. Then it will question whether access to solar powered technologies provides opportunities for increased capabilities. In examining these research questions, this thesis posits that energy poverty limits the educational capabilities of the poor and asserts that the scarcity caused by energy poverty can be alleviated by the investment in and use of small-scale renewable technologies.

Methodology

The questions will be examined in the context of contemporary social justice theories. First it will rely on the capabilities approach articulated by Martha Nussbaum. The capabilities approach to development attempts to explain why poverty still persists by switching the focus away from income and instead examining the abilities of an

individual.[10] Nussbaum's capabilities approach particularly focuses on women and asserts that their capabilities are limited by their surroundings. Using this framework, the case will augment the capabilities theory by testing it on a situation of energy poverty and examining the results as they pertain to education. It will then further the theory by connecting it to Mullainathan and Shafir's scarcity theory to answer the question, 'why do the poor remain poor?'

Mullainathan and Shafir's scarcity theory examines how poverty taxes the minds of the poor. It posits that scarcity is a subjective sense of having more needs than resources; this limits the available cognitive capacity to learn.[11] In combination with the capabilities approach, scarcity theory will be used to explain why the poor remain poor. It will guide the field research by framing energy poverty as a form of scarcity. Mullainathan and Shafir's scarcity theory is untested in the field of energy poverty and this case will serve as an introduction to a theory that can be used to form policies benefitting the poor. It will look at the investment in small-scale renewable technologies, solar-powered lights and radios, as tools that could decrease the effects of energy poverty. By using this framework the case study will be examined in terms of educational capabilities and scarcity and will emphasize technology.

The Case Study

The case study was completed in Lusaka, Zambia. Zambia is a landlocked country in Sub-Saharan Africa. It faces many of the same difficulties as its neighboring countries: poor

[10] Nussbaum, Martha C, Creating Capabilities: The Human Development Approach, Cumberland, RI, Harvard University Press.
[11] Mullainathan, Sendhil, Shafir, Eldar, Scarcity: Why Having Too Little Means So Much, New York, NY, Times Books, 2013, 86.

infrastructure, a lack of access to quality education, a deficit in trained teachers and an HIV/AIDS epidemic. In particular, the capital, Lusaka is typical of many in the sub-Saharan with high poverty levels, unemployment, and substandard housing for the poor. The low-income residences that the poor reside in are compounds; they are the equivalent of urban shantytowns or townships. Between 60 to 70 percent of Lusaka's population resides in these authorized and unauthorized compounds.[12] Just a fifteen-minute drive from the city center, there is little to no formal, planned infrastructure present. It is a struggle to provide children with basic quality education. The author worked as a graduate student researcher for Lifeline Energy and conducted qualitative and quantitative research in three of Lusaka's compounds Misisi, Garden, and Ng'ombe over the course of two months. This included interviews with school administrators and teachers, a comprehensive survey on energy use, and a recorded distribution of small-scale solar powered products.

Education in the compounds is mainly provided by community run schools. The community schools are run locally and without the financial support of the government, though some subsidy programs exist. There are also government schools, which are comparatively more expensive and must be tested into; the supply of government schools does not meet the demand in the compounds. The community schools charge much lower school fees, if any, than the government schools and may be staffed with volunteer teachers or poorly compensated teachers. The community schools have few resources and low budgets. With high rates of HIV/AIDS in the compounds, the schools are often burdened with providing food and waived school fees for vulnerable or orphaned children.

[12] Mulenga, Chileshe L, The Case of Lusaka, Zambia, Rep. London: University College London, 2003, 14.

The community schools populations that the author visited average between 50 to 80 percent vulnerable or orphaned children.

Through participant observation, a method of research for exploratory studies and for critically examining theories, the author studied Zambia's Interactive Radio Instruction Program, IRI.[13] IRI is a method of providing quality education to a wide audience. This particular program, *Learning at Taonga Market*, started in 2000. It assists community schools by supplementing teaching and supporting untrained teachers to manage the lessons effectively.[14] Children participating in *Learning at Taonga Market* were previously able to access quality school lessons anywhere in the country on the national radio broadcaster. Lifeline Energy's radios were distributed to community learning centers and schools across Zambia, and school was conducted over the air. Currently the *Learning at Taonga Market* Program is only broadcast on community radio stations and not by the Zambian National Broadcasting Company, ZNBC, as it previously was. This costs up to 60,000 learners a chance at a higher quality education. It leaves mentors, the Taonga Market Program teachers who are not formally trained and may only have a primary education themselves, to continue teaching unaided by the support of the radio lessons.

Thesis architecture

Chapter one will explore the connections between energy poverty and education in terms of social justice. It will build the framework for the case study using Martha Nussbaum's capabilities approach and Mullainathan and Sharif's scarcity theory. Then Chapter two

[13] Danny L. Jorgenson, *Participant Observation: Applied Social Research Methods*. Newbury Park: Sage Publications, 1989.
[14] Foster Lubinda, Fanwell Besa, *Learning at Taonga Market*. Lusaka ,Zambia: Ministry of Education, 2011.

will describe the case and will show the following five points. Through a triangulation of the research: the survey, the interviews and the results of the distribution of solar powered products the case study will show (1) that solar powered lights allow increased access to study hours, and (2) that the lights eliminate the use of candles. It will also demonstrate (3) that radios provide access to a higher quality education, (4) that they eliminate the need for batteries and (5) that the radios compensate for missed classes or an irregular class attendance.

Chapter three will synthesis the theory with the data and examine the trends from the research to elucidate how each of the points shows that energy poverty limits the educational capabilities of the poor and that the scarcity can be alleviated with small-scale renewable technologies. It will show (1) that solar powered lights allow safe access to increased study hours; which increases the educational potential of the poor. (2) That the lights are a tool that alleviates the bandwidth tax incurred by energy poverty, by eliminating the use of candles it creates slack in their budget and time. (3) That solar-powered radios allow access to higher quality education. (4) That the solar-powered radios elimination of batteries alleviates the bandwidth tax and (5) that the radios allow for slack in a way traditional methods of schooling do not. These findings will then be used to create policy recommendations to NGOs, local and national governments, and international development organizations to aid in combating energy poverty. The conclusion will then summarize the findings and conclude with an analysis of the study and open pathways for future research.

Chapter One

In examining the issues of energy poverty and its connections to education, this chapter will examine how energy poverty plays an unexplored role in the field of social justice, as energy justice. It will first provide an overview of energy poverty, the importance of education and the role of gender. It will then rely on the capabilities approach to social justice articulated by Martha Nussbaum and scarcity theory, newly postulated by Sendhil Mullainathan and Eldar Shafir. The capabilities approach to development attempts to explain why poverty still persists by switching the focus away from income to examining abilities instead. It focuses on what an individual is able to do or accomplish as opposed to what the individual possesses. Nussbaum's theory on capabilities will be extended to the field of energy poverty as an energy injustice. Yet the capabilities approach fails to explain why the poor remain poor and what the barriers to obtaining capabilities are. Sendhil Mullainathan and Eldar Shafir's scarcity theory will bridge the gap to explain that scarcity taxes individual's minds; thereby perpetuating poverty. Scarcity creates a bandwidth tax on individual's cognitive capacity, preventing them from obtaining desired capabilities and explaining why poverty still persists.

Energy Poverty

Energy poverty is a lack of access to modern energy services such as household access to electricity and clean cooking facilities.[15] Energy poverty is also present in situations where access to electricity is available yet unreliable due to widespread power outages or the

[15] International Energy Agency. *Energy Poverty.* IEA. International Energy Agency, 2014.

expense of electricity. Therefore more broadly, the term refers to the lack of sufficient choice that would give access to adequate, affordable, effective, and environmentally sustainable energy services that could support economic and human development. It encompasses situations where there is no access to modern energy services and situations where access is present yet insufficient. The African Development Bank associates energy poverty with a deprivation of adequate light to facilitate evening and nighttime choirs and leisure activities.[16] Electricity also powers household appliances and is relied on in telecommunications. Without it, access to lighting and information are limited. Some of the common alternatives to electricity include candles and matches, kerosene, charcoal and firewood. The extensive use of these biomass fuels in traditional and inefficient ways and the limited availability of modern fuels are manifestations of poverty; they restrain economic and social development.[17] They are also harmful for the environment and for health of the user. The inefficient use of biomass fuels can lead to serious health damage including respiratory diseases, obstetrical problems and heart disease.[18]

The International Energy Agency estimates that 1.4 billion people are without access to electricity and that the majority live in sub-Saharan Africa; yet access to affordable and reliable energy services is fundamental to reducing poverty.[19] The IEA predicts that the United Nations Millennium Development Goals to eradicate poverty will not be met without combatting energy poverty. The importance of eradicating energy poverty is included in the Sustainable Energy for All initiative by the UN Secretary General in 2011.

[16] African Development Bank [AfDB], Energy Sector Policy of the AFDB Group, AfDB. African Development Bank Operational Resources and Policies Department

[17] International Energy Agency, ENERGY POVERTY: How to make modern energy access universal: Special excerpt of the World Energy Outlook 2010 for the UN General Assembly on the Millennium Development Goals, IEA, Paris, 2010.

[18] Ibid.

[19] Ibid.

As achieving universal primary education is one of the UN Millennium Development Goals, this thesis will examine the unexplored connections between energy poverty and education.

Education

Education plays a key role in reducing poverty; with higher levels of education, the likelihood of being poor falls considerably.[20] Education opens the door for employment opportunities and economic growth as well as social development. The poor are much more likely to have limited access to education, lower quality education and higher drop-out rates. UNICEF reports that education ends generational cycles of poverty and that increasing women's education is a critical lever in reaching development objectives, as it addresses gender inequalities.[21] Education not only has the potential to transform lives but it is also recognized as a basic human right. The United Nations Convention on the Rights of the Child recognizes the right to a free and compulsory education and an education directed toward fulfilling the potential of each individual.[22]

Yet education in sub-Saharan Africa is not up to basic standards. It is not on track to meet the UN Millennium Development Goals and does not yet meet the criteria set by the Convention on the Rights of the Child. Sub-Saharan Africa accounts for more than half of all out-of-school children worldwide, with one in five primary school-age children never attending school or dropping out; there has been little progress in keeping children in

[20] Khandker, Shahidur; Haughton, Jonathan. Handbook on Poverty and Inequality. Herndon, VA, USA: World Bank Publications, 2009, 4.
[21] UNICEF, Basic Education and Gender Equality: The Big Picture, UNICEF, 2014.
[22] Office of the High Commissioner for Human Rights, Convention on the Rights of the Child, New York, 1990.

school.[23] UNICEF recognizes a multitude of barriers inhibiting access to education including but not limited to the cost of school fees, gender inequality, the quality of education available and the ability to relate to the content being taught.[24] Beyond primary school, the education statistics in sub-Saharan Africa become even more dire, with 38 percent of the lower secondary school age group out of school.[25] The recognized barriers for the poor to lower secondary school include cost, distance to school, labour market demand and especially for girls social, cultural and economic factors.[26]

The Role of Gender

Females have a distinct disadvantage in educational systems in poverty prone areas. An estimated 31 million girls of primary school age and 34 million girls of lower secondary school age were not enrolled in school in 2011; sub-Saharan Africa has the lowest proportion of countries with gender equality in school.[27] Gender affects enrollment in school as well as the number of years of education attained. Literacy rates for females in sub-Saharan Africa are below that of males as well.[28] Gender also disproportionately affects women in terms of energy poverty as well. Women are more likely to suffer the health effects of energy-inefficient appliances because they are the primary users of household energy.[29] The task of collecting and using these fuel sources also falls more to women; this is a daily time consuming strain on productivity. It limits the amount of time

[23] UNICEF, Basic Education and Gender Equality: Equitable Access, UNICEF, 2014.
[24] Ibid.
[25] UNESCO, Reaching the Marginalized: Regional Overview: Sub-Saharan Africa, Education for All Global Montoring Report, 2010.
[26] Ibid.
[27] UNICEF, Girls Education and Gender Equality, Basic Education and Gender Equality, UNICEF, 2014.
[28] UNICEF, Statistics by Area/Education: Literacy, ChildInfo: Monitoring the Situation of Children and Women, UNICEF, 2012.
[29] Ibid.

and energy available for other activities including learning and studying. The gender disparity inherent in energy poverty and in education prevents the achievement of United Nations Development Goal Three: to promote gender equality and empower women.

In sub-Saharan Africa energy poverty is so far unrecognized by policy makers and international institutions as a contributing factor to the inability to obtain to a higher quality education. Educations role in reducing poverty is important because education increases an individual's ability to do the things they value, which will be shown through the capabilities approach. The inequality of women in terms of energy poverty and educational capabilities must be examined and alleviated to reach the UN Millennium Development Goals and to irradiate extreme poverty.

The Capabilities Approach to Social Justice

There are many ways to examine poverty that rely on income. These economic approaches often treat the family as a basic unit, instead of a group of individuals whose goals and aspirations differ. The numbers alone can show that extreme poverty persists, but do not explain why. The tenets of the capabilities approach were founded by Amartya Sen in development economics to explain why poverty still persists. It is an approach to social justice purporting that the freedom to achieve well-being is a matter of what people are able to do and to be; it is concerned with individuals abilities to do the things they value. This is firstly significant for the person's overall freedom, and secondly in that it allows the person opportunity to have valuable outcome or increased well-being. With this is mind, Martha Nussbaum's summary of the term capabilities approach applies; it is an approach to a comparative quality of life assessment and to theorizing about basic social

justice. It holds that the key question to ask, when comparing societies and assessing them for their basic decency or justice, is, "What is each person able to do and to be?" [30]

Sen's theory distinguishes between capabilities and functionings; the latter being achieved outcomes.[31] Therefore while capabilities are the potential to do something that the individual values, the functionings are the realization of that potential. For evaluation purposes, the capability, not the function is relevant; if an individual has a capability and chooses not to exercise the ability to use it, the freedom of the individual is the same. Evaluating only functionings or outcomes can give too little information about how well people are doing. Individuals may have the capability to do something, yet actively choose not to. In this sense it is capabilities not functionings that governments should strive to improve.[32] This allows individuals the freedom to decide what to do for themselves. While the origins of the approach are owed to Sen, Nussbaum advances the theory with her notion of a threshold level of capabilities, to be strived for. Her current threshold is a list of Central Human Functioning Capabilities includes Life, Bodily Health, Bodily Integrity, Senses, Imagination and Thought, Emotions, Practical Reason, Affiliation, Other Species, Play, and Control Over One's Environment.[33] Nussbaum defines and uses the central capabilities as a threshold that individuals can demand from their governments. It can be used to examine the social inequality and injustice against members of the community, or state.

[30] Nussbaum, Martha C,. Creating Capabilities: The Human Development Approach, Cumberland, RI, Harvard University Press, 5. Sen, Amartya, Development as Freedom, NewDelhi, India, Oxford University Press, 2000, 191.
[31] Sen, Amartya, 75.
[32] Nussbaum, Martha C, 25.
[33] Ibid, 78.

Women and the Capabilities Approach

Nussbaum advances the capabilities approach by focusing on the gender inequality of women and how it affects their central human capabilities. She writes specifically on women, women's agency, and women's capabilities as being an important aspect to social justice. Literacy, primary and secondary education and learning are important, yet development for women in these area's still lags behind.[34] Literacy promotes pathways for women to acquire capabilities and goods that they are pursuing. It is a contributing factor to social development and can increase gender equality. Unfortunately, the unequal social and political circumstances women face give them unequal human capabilities.[35] Women who are illiterate are more dependent on their husbands, and are less likely to send their children to school. They are more likely to suffer abuse from their husbands and have access to other services they value.[36] This failure to reach a higher level of capability is therefore a problem of justice.[37] The differences in capabilities between men and woman also help to illustrate why the focus of the capabilities approach is not on income. The income of a family could be the same, but if there is an allocation of resources which favors males over females, than examining income will not adequately show the difference. For example, if there is a tendency to favor male children's education over female children's education, than looking at the income of the family alone will not predict the likelihood of the child to gain an education. A family may invest their resources in the study habits of a male child, neglecting the female child's ability to study in a similar

[34] Nussbaum, Martha C, 32.
[35] Nussbaum, Martha C, Women and Human Development The Capabilities Approach, New York, NY, Cambridge University Press, 2000, 80.
[36] Ibid.
[37] Ibid.

manner. Therefore while income can be a means to capabilities, the focus is not on income, but poverty, and poverty is more than a lowness of income, it is a capability deprivation.[38]

Scarcity Theory

Yet the capabilities approach to social justice fails to explain why the poor remain poor even in the face of programs designed to help gain capabilities. Sendhil Mullainathan and Eldar Shafir's theory on scarcity bridges the gap. They theorize that poverty is more than a lack of income. Scarcity is defined as a subjective sense of having more needs than resources and this has strong implications on how one thinks and acts.[39] Scarcity directs the mind toward an unfulfilled need at the cost of other concerns that might warrant attention. Mullainathan and Shafir believe scarcity to be not just a physical constraint, but a mindset that weighs on all choices.[40] Thus because the mind is focused on handling scarcity, it has less mental capacity or bandwidth available to handle everything else. This focus is so intense and yet so unconscious that it can be described as tunneling, anything outside the tunnel is neglected without thought.[41] This means there is not a conscious decision to ignore or neglect other thoughts that could be just as, if not more important to an individual. This is the bandwidth tax imposed by scarcity and it reduces an individual's ability to process new information.[42] An individual struggling with a bandwidth tax may not be able to learn as fast because their mind is preoccupied by his or her scarcity.

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[38] Sen, Amartya, 87.
[39] Mullainathan, Sendhil, Shafir, Eldar, Scarcity: Why Having Too Little Means So Much, New York, NY, Times Books, 2013,86.
[40] Ibid, 12.
[41] Ibid, 29.
[42] Ibid, 13

Mullainathan and Shafir write that if the poor lack bandwidth, they will be disadvantaged at acquiring useful skills whether it be learning new social skills or developing good spending habits because any form of skill acquisition requires bandwidth.[43] This does not indicate low intelligence, but instead an involuntary limited cognitive capacity. It follows that the poor do not necessarily have an innate low intelligence, but that they could have a limited cognitive capacity to learn because they have a taxed bandwidth.

Scarcity forces trade-off thinking while those with an abundance of resources are left with slack. Slack is important; it provides a buffer against failure because any mistakes or unforeseen costs can be absorbed. Slack can come in the form of time, of money, or of cognitative capacity. For example, an individual with more slack in their available time can schedule their day leaving extra time an emergency; an individual with extra money has available funds for an unforeseen medical fee and an individual with extra cognitive capacity can learn a new skill or trade.

Poverty is a particular kind of scarcity. It is a case of economic scarcity; it is when it is not viable for an individual to change what he or she wants or thinks he wants.[44] A person suffering from a scarcity of time could decide to give up an activity and therefore gain more time, but a person suffering from extreme poverty cannot decide to give anything up. Scarcity theory answers the question 'why do the poor fail so badly and in so many ways' by explaining that poverty, the scarcity mindset, causes failure.[45] The poor suffer from a bandwidth problem and this limits their ability to acquire skills, to learn social skills or

[43] Ibid, 162.
[44] Ibid,149.
[45] Ibid 155.

develop good spending habits.[46] Put simply, poverty limits capabilities. Precisely because the poor have a taxed bandwidth, they need more slack built into their lives, allowing for error. Bandwidth is a core resource, and the poor lack it.[47] In order to design programs that help the poor, the bandwidth tax must be accounted for and slack must be built into the program.

Mullainathan and Shafir's theory of scarcity complements the capabilities approach. It suggests that the bandwidth tax prevents the poor from gaining capabilities important to their development and points to scarcity as the culprit. In order to design programs that help the poor, the bandwidth tax must be accounted for and slack must be built into the program. Tools that alleviate the bandwidth tax could allow more energy for developing important capabilities, allowing the poor access to the things they value.

Justification of Research

At the time of this writing, energy poverty was not on the agenda of Mullainathan and Shafir, or Nussbaum. It was not on the agenda of education policy makers or international institutions either. However, as a form of poverty that affects 1.4 billion people in the world, it plays an important yet unexplored role in social justice and poverty eradication. The gender inequality that Nussbaum focuses on can be examined through research on energy poverty, but the lack of access to modern energy services affects both men and women. By examining how the alleviation of energy poverty affects the educational capabilities of the poor, the proper policies to aid in combatting the injustice and eradicating poverty can be formed.

[46] Ibid,162.
[47] Ibid, 229.

Chapter 2 Case Study

In examining energy poverty's connections to education in terms of the capabilities of individuals, the author conducted a case study in Lusaka, Zambia. For a period two months the author worked as a graduate student researcher and participant observer for Lifeline Energy, a non-governmental organization which produces and distributes technology solutions for off-grid learning. The author was based in Lusaka, Zambia and worked in the Lusaka's low-resource settlements, or compounds. The author conducted surveys and interviews, distributed Nokero solar-powered lights and radios and provided Lifeline Energy with feedback on these products. The work involved studying an Interactive Radio Instruction program, IRI, *Learning at Taonga Market*, and examining its importance to the communities in terms of the capabilities it enhanced. The case study will show (1) that solar powered lights allow increased access to study hours, and (2) that the lights eliminate the use of candles. It will also demonstrate (3) that radios provide access to a higher quality education, (4) that they eliminate the need for batteries and (5) that the radios compensate for missed classes or an irregular class attendance.

Details of the Case Study Area

The urban centers in Zambia began as places of residence for colonists in the 1930's. With the discovery of copper in the Copperbelt Province, they developed into trading routes linking Zambia to South Africa and to the West. They were not originally designed to be permanent residences for a large population. Locals required temporary residence and employment permits to work in the centers, which were typically only granted to men needed in the mining industry or women as domestic servants. Then with the booming

international demand for copper in the 1950's the need for cheap labor in mining settlements and for manufacturing drove migration into the urban centers. The population growth of Lusaka rose with the economic boom yet the availability of low-income housing did not. Informal settlements on the outskirts of town were formed, some by legal methods and some not.

As copper prices decreased in the 1970's and few improvements were made to agricultural processes or output, the Zambian Government depended on foreign aid. In 1976 the IMF attached conditions to its loans, most notably the structural adjustment programs. This included privatization, removing subsidies, and reducing government expenditures and state participation in the economy. The downsizing of the civil service and diminishing free social services such as education and health has contributed to a growing urban poor population across.

Today the urban poverty in Zambia is still increasing. Of the 4.3 million urban residents in Zambia, more than half live in poverty.[48] The low-income housing that the poor in Lusaka reside in are shantytowns called compounds. These have limited infrastructure and government support. There are both authorized 'self-help' areas of housing which may have had some structural improvements in the past twenty years and unauthorized housing where there were and continue to be little to no public services or support. This includes a lack of public transportation, limiting employment opportunities and no public waste disposal or rubbish removal, leading to sanitation problems. Between 60 to 70 percent of

[48] Beasley, Thomas W, African Political, Economic, and Security Issues: Poverty in Africa, New York, NY, Nova Science Publishers Incorporated, 2009, 177.

Lusaka's population resides in these compounds.[49] Residents reside in low grade, substandard cement homes that are built closely together, with an average of one or two feet between structures.[50] Few houses have doors; instead cloth fabric hangs down to cover the entrance. The lack of trees and irrigation systems contribute to flooding in the rainy season.[51] Houses have one or two rooms and do not have running water. Latrines are built outside and shared between houses. At night, the walk to the latrine can be dangerous; there are no street lamps so the risk of poisonous snake or spider bites as well as assault can be high. The compounds have a high prevalence of HIV/AIDS and malaria, as well as alcoholism and drug abuse. As of 2010 the national prevalence of HIV/AIDS for ages 15 to 49 was 14.3 percent yet for woman of the same age is was 16.1 percent.[52] It is common to see the informal bars in the compounds fill up by noon.[53] Unemployment is rampant at 50 percent because formal employment requires leaving the compound. [54] The informal job sector such as selling charcoal or scrap metal is large and growing. It's estimated that between 1990 and 2000 the informal sector or self-employment market increased by a margin of 11.9 percent for males and 7.7 percent for females. There are also large informal markets in the compound where the common goods include airtime, and cellphone charging stations, charcoal, and bottled soda and water. While many public services in the compounds are lacking or nonexistent, power lines can be seen from almost every angle, giving the illusion that electricity is everywhere. Yet only 52 percent of the urban population in Zambia has access to electricity for their lighting needs, 35 percent of the

[49] Mulenga, Chileshe L, The Case of Lusaka, Zambia, Rep. London: University College London, 2003, 14.
[50] See Appendix 1 and Appendix 2 for author's photos of case study area.
[51] Ibid, 13.
[52] Information and Research Branch, Gender Statistics Report 2010, Central Statistical Office, Zambia, 2012, 18.
[53] Authors field notes, 2013.
[54] Beasley, Thomas W, 178.

urban population relies on candles for lighting. [55] For cooking, only 38 percent of the urban population uses electricity, while 55 percent uses charcoal.[56] The actual cost of electricity is low but still unaffordable to the residents in the compounds. Depending on the house size and number of appliances, the cost of electricity for a month in the compounds can be between 100 and 300 kwacha, or between 18 and 54 US dollars. Many families cannot afford to buy electricity in these amounts, as it is prepaid monthly, and instead buy weekly in smaller prepaid amounts when they can. When their allotted electricity runs out for the week or month, there is no money to buy more. To compound the issue, as most residents are tenants, they might split electricity with the neighbors that they share a common wall with. So while the cost may be 100 kwacha, each family may pay 50 monthly, with no way of knowing how much electricity one or the other is using. By comparison, a candle for one night costs one kwacha or less than 20 cents. Depending on the number of candles used each night, the average family could spend 30 to 90 kwacha, five to 16 US dollars on candles each month. In this case they do not have to pay up front; they can buy candles daily from a local informal market when they have the funds.

Electricity is supplied by the Zambian Electricity Supply Company Limited (ZESCO), which is state owned and supplies the majority of power in Zambia, as well as exporting to other South African Countries. [57] It is the result of exportation and the large demand that the electricity in Zambia is unreliable; often ZESCO turns off electricity in a scheduled blackout known as load shedding, which is much more frequent in the compounds than in

[55] Central Statistical Office,2010 Census of Population and Housing Volume 11 National Descriptive Tables, Lusaka, Zambia, CSO, 331.
[56] Ibid, 339.
[57] The Times of Zambia, *Zambia: Zesco Should Address Zambia's Energy Needs.* Times of Zambia , All Africa, 2012.

the affluent areas of Lusaka.[58] In a more affluent area of Lusaka, such as the Roma Suburb, it is common to lose electricity for a few hours of one day a week, while in the compounds power can be shut off for hours of the day every day and often for the whole day a couple times a week. Because of the different grid systems, it is common for electricity to be shut off on one side of the street one day, and the other the next.[59]

The most common form of education in the compounds is the community school. The community schools are run locally and without the financial support of the government, though some subsidy programs exist. There are also government schools, which are comparatively more expensive and must be tested into. These are few and far between in the compounds. The community schools charge much lower school fees than the government schools but are not staffed as well. The schools often have little to no support from outside the compound itself. The typical community school has a dirt floor, no electricity or running water. Textbooks and writing utensils are scarce. Community schools charge nominal fees per month, though many waive the price or have a reduced price for those who cannot pay such as vulnerable children or orphans. The term 'orphans' refers to a child who has a parent that is not present or available to look after the welfare of the child. A double-orphan refers to a child who has neither parent present or available to look after a child; often the cause of death for a parent was HIV/AIDS.[60] For example, no distinction is made between a child whose father has passed away and a child whose father lives elsewhere due to alcoholism or other illness. Any orphan or double-orphan is referred to as a vulnerable child. With high rates of infection in high poverty areas, the burden to

[58] Author's field notes, 2013.
[59] Author's field notes, 2013.
[60] Dowden, Richard*, Africa Altered State, Ordinary Miracles*, New York, Public Affairs, 2009, 327.

provide food and school fees for the children left behind is high. Nationally 19.2 percent of all children under 18 years old are orphans or vulnerable children.[61] Enrolment at the community schools that the author visited averaged between 50 to 80 percent orphans and vulnerable children.

Lifeline Energy

Lifeline Energy is a nongovernmental organization which produces and distributes *technology solutions for off-grid learning*. Since 1999, Lifeline Energy has distributed more than 500,000 self-powering radios for group listening conservatively reaching 20 million listeners.[62] Lifeline Energy operates mainly in sub-Saharan Africa and designs products specifically for the poor populations that use them. Lifeline Energy has a longstanding relationship with the Ministry of Education in Zambia and has been working with them for 12 years to bring higher quality education to Zambia's vulnerable populations. The research for Lifeline Energy was undertaken with three main objectives, all related to the education in Lusaka's compounds. (1) To research the depth of energy poverty in Lusaka's compounds and (2) analyze the connection of energy poverty to education and record the effects of renewable energy products on educational capabilities. (3) Also, to demonstrate the continued need for Interactive Radio Instruction IRI programmes, such as *Learning at Taonga Market.* To reach these objectives, the author conducted qualitative and quantitative research in three of Lusaka's compounds, Garden, Misisi, and Ng'ombe over the course of two months, including interviews with school

[61] Information and Research Branch, Gender Statistcs Unit, 28.
[62] Kanani, Rahim. "Kristine Pearson on the Founding and Future of Lifeline Energy." Forbes. Forbes Magazine, 01 Nov. 2011. Web. 21 Feb. 2014.
See Appendix 3 for picture of Lifeline Energy Radio.

administrators and teachers, a comprehensive survey on energy use, and a recorded distribution of small-scale solar powered products with a follow up interview after a month long period of use.

Ministry of Education

The Zambian Ministry of Education is the governmental department committed to improving access to education. The author met with two employees of the Ministry of Education twice for interviews and updates on the progress of getting the *Learning at Taonga Market* Program back into the community. It is the Ministry who writes the content for and manages the *Learning at Taonga Market* program. The Ministry of Education has a long list of tasks to be accomplished before *Learning at Taonga* Market can proceed. It deemed the content for Taonga Market to be outdated. For example, since the programs start twelve years ago, the currency in Zambia had been re-based, lessons refer to the currency before it was re-based. Each lesson in each grade must be rewritten and the Ministry stresses the need for a strategy for redistribution. The mentors training guide would need to be reprinted and taught before the program could proceed. At the end of the author's time in Zambia, in November 2013, the process of updating the content for redeployment was making progress, albeit slowly as constrained by its budget. The Ministry of Education was still working on updating grade one. The partnership with ZNBC was at a standstill over payment issues.[63] Currently the *Learning at Taonga Market* program is only being broadcast on community radio stations and not by the Zambian

[63] Authors field notes, 2013.

National Broadcasting Company (ZNBC) as it previously was. Due to unpaid broadcasting fees, ZNBC discontinued *Learning at Taonga Market,* costing up to 60,000 learners their best chance at an education.

Learning by Radio: *Learning at Taonga Market*

As a participant observer for Lifeline Energy, the author was exposed to radio education programing. Radio education is not new. This particular program, *Learning at Taonga Market*, was started in 2000. It is a form of Interactive Radio Instruction (IRI). According to the 2006 study on the use of IRI, community schools adopted the IRI methodology to supplement teaching and assist untrained teachers to manage the lessons effectively.[64] A 2008 study by the Examination Council of Zambia showed that students' scores who participated in the program were higher than those of government schools in reading and mathematics. The IRI schools came second in mean performance only to private schools. The program also helps fill the void in the communities of trained teachers. In a 2010 study on training needs of community schools teachers in Lusaka, found that 85 percent of teachers had no formal teacher training; 65 percent indicated they were willing to upgrade their teacher qualification by enrolling into formal teacher training establishment but lack of prerequisite relevant qualification prescribed for entry into teacher training colleges.[65]

Children participating in *Learning at Taonga Market* were previously able to access quality school lessons anywhere in the country on the national radio broadcaster. Lifeline Energy's radios were distributed to community learning centers and schools across Zambia, and school was conducted over the air. These radios had a portable solar panel

[64] Lubinda, Foster, Besa, Fanwell, *Learning at Taonga Market*, Lusaka , Zambia. Ministry of Education, 2011, 8.
[65] Ibid, 9.

enabling the radio to be charged in the sun. It also had a wind-up crank on the back for charging. The schools do not require textbooks, uniforms, or traditional classrooms and with one radio, anyone listening can attend school. The mentors participated in training on how to best use the program, this is often the only training they have.[6667] In the community schools visited, there were former *Learning at Taonga Market* mentors, and former attendees of the program. Learners met in a variety of structures in their communities such as churches, community halls, homes or existing classrooms. Now that ZNBC is not broadcasting the program the community schools and learning centers using it in the compounds have been discontinued or must rely on other options to teach. The radio program taught lessons at all of the basic grade levels and gave clear instructions for both the teacher or mentor, and the students. Learners of any age or poverty level could attend school when it was convenient, and because the Lifeline Energy radios were charged by renewable technologies, they were not dependent on electricity or batteries. It was a low cost option for communities to access education and information through technology.

The Survey Methods

The author conducted surveys and interviews in the compounds, as well as distributed solar-powered lights to survey participants, the students, teachers and administrators connected with community schools in the compounds. After meeting with each schools administrator, the author chose a sample of students between the ages of 11 and 17 for the survey, as well as all of the teachers who were present at the school. The students chosen

[66] Lubinda, Foser, Besa Fanwell, 2011, 8.
[67] See Appendix 4 for example of training certificate.

had volunteered for the survey after it was explained to them by their administrator, though they were not told that they may be given a solar powered light. As word spreads rapidly in the compounds, the author suspects that some respondents knew of the lights ahead of time and could have chosen to skew their answers. In order to account for the discrepancies, the survey is not relied on as the only data. House visits allowed the author to check for accuracy, and the interviews with administrators provided an overview of the energy situation. The author recorded 67 surveys across three compounds with students and their families, teachers and administrators from thirteen community schools.[68] The compounds were Misisi, Garden, and Ng'ombe. The surveys covered a range of questions connected to energy poverty from household information, the energy and details surrounding what the respondent cooked with, lighting, study and education habits, their use of radio and cellphones, and income. Respondents that received solar-powered lights had follow up interviews a month after receiving the light. Respondents were chosen to receive the lights with the administrators help. Because the amount of lights to be distributed was limited, they were only to be given to those without electricity the majority of or all of the time, and who attended school regularly. As there was human bias in who received lights, the author recognizes that the administrators recommended that the highest achieving students were selected instead of students with a range of test scores. Because of this, the study habits of the students selected were similar.

The author began by visiting schools, teachers and mentors that Lifeline Energy had prior relations with. By doing so the author had a guide that the communities trusted and was allowed access to other community schools and students as well as into the student's

[68] See appendix 5 for survey questions

homes. On these visits a guide who also served as a translator accompanied the author. English is widely spoken in Lusaka and is an official language; however, some of the respondents and their families or guardians were more comfortable speaking in a local language, Nyanja.[69]

All of the teachers interviewed for the survey were teachers at the community schools. The majority lived in the compound that they taught at, while a few lived in surrounding compounds. None of the community teachers interviewed lived in areas or communities considered more affluent than the compounds. Some lived with their parents or families still, a few had families of their own, only one lived by himself.

The author surveyed students between ages 11 to 17. All were between grade six and grade nine. This age and grade were chosen to ensure that the students were of an age and grade where they would be assigned homework or work to review and study nightly. When surveying the students at the schools, surveys were conducted in English, with their teacher or mentor available to help them if they felt more comfortable answering in Nyanja, although almost all students chose to answer in English. A few had the questions repeated to them in Nyanja and then responded in English. The students accompanied the author to their homes to speak with parents, guardians or family members as well. This allowed time to speak with students outside of the classroom in a less formal setting. One translator and guide explained that students often fear giving the wrong answer in class and suggested that they felt the same about answering questions to the author. After speaking with family members or guardians, it was ascertained that while the students and guardians answers were similar, the students did not always know the answer to questions about their

[69] Zambia, 2010 Census of Population and Housing, Lusaka, Central Statistical Office, 2010, 1.

families' financial situations. They often gave an answer anyway out of respect. After speaking with the author's supervisor from Lifeline Energy, Kristine Pearson, the author established that the students were reluctant to admit not knowing an answer; they would say what they thought the author would want to hear. This bias was addressed by speaking with family members and examining housing situations firsthand.

Distribution of Solar-Powered Lights and Radios

The author distributed 19 Nokero N 200 solar powered lights to teachers and students connected with community schools in the compounds.[70] The lights were provided to the author by Lifeline Energy, who had received them as a donation from their lighting partner, Nokero in the USA. The author met with each participant either at the school for the teacher or at the home of the student to demonstrate and teach the participant how to operate and charge the light.[71] Each participant had also completed a survey prior to receiving a light and then had a longer discussion with the author about their use of energy and their educational goals. These longer discussions with participants allowed more of an opportunity to gain insights into what the individuals valued in life, what they aspired to do or achieve, and how they viewed well-being. It allowed respondents to openly discuss their desired capabilities. For example, students were able to elaborate on why they valued their education and what they wanted to be when they grew up, such as a teacher or doctor. This allowed for more qualitative data on how the respondents felt about their energy poverty and how they desired change. The translator and guide accompanied the author on these

[70] See appendix 6 for picture of Nokero N 200 Solar Light.
[71] See appendix 7 for photo of distribution and training process.

visits to help explain how the light worked as well and to translate questions that the participants had. The author noticed a reluctance to ask questions about how the light worked.

Eight students received the solar powered lights. All of the students who received lights were between grade 7 and grade 9 and ages 13 to 17. None of the participants had reliable electricity in their homes; the majority was without access to any form of light at night. Every participant who received a light also took the survey on energy poverty, as well as agreed to a more intensive interview session. The remaining lights were distributed to teachers and administrators of the school. Those who received lights were either still in school themselves or were studying to go back to school to get a higher degree or certificate. This was to ensure that gaining more education was an important capability to them. The teachers were often only a few years older than the students, with little to no more education than finishing grade 12. The teachers had as little electricity in their homes as the students and some also had the burden of supporting families themselves.

In addition to the lights, two Lifeline Energy radios were distributed to one of the schools the author visited in the compounds. Many of the community schools had an older model of the radios and used them to listen to *Learning at Taonga Market* when possible.[72] This provided the author the opportunity to contrast the current situation with the interviews from former *Learning at Taonga Market* mentors and teachers on how well the program worked for increasing education in the compounds. The interviews conducted with administrators and former *Learning at Taonga Market* mentors provided the bigger picture of the schools and students educational goals and opportunities as well as their challenges.

[72] See Appendix 8, 9 for photos of an old radio and newly distributed radio.

They could account for changes in attention span on days after electricity blackouts or load shedding that the students themselves could not. Administrators talked openly of patterns of attendance and concentration, and painted a bleak picture of the day to day life in the community schools.

The Feedback Process

A month after distributing the lights, the author visited the participants who received solar lights again for follow up and feedback. This feedback was critical to determining how the lights affected education related capabilities and also to determining if the lights would help alleviate poverty. One teacher had moved away within the month and was unreachable. However the school reported that she moved to attend to her own education at university level. During the feedback process the author learned that two of the lights had been stolen on the same day in one of the compounds. The lights were stolen from the same alley where they were left charging in the sun on the ground. It was of the school administrators opinion that the lights were stolen by a relative or neighbor for personal use, not to be sold as they would be the only of their kind in the local markets. All of the other lights were working properly and had not been stolen, or broken. Through the case study the survey, interviews and the distribution and feedback process support five points on the use of lights and radios relating to energy poverty and education.

Observations

(1) Solar powered lights allow a safe access to increased study hours. Fifty-three people or 79 percent of those surveyed reported having electricity, yet 52 of those reported having

extensive power cuts each week.[73] Some of this is due to load shedding by the power company ZESCO. However, most of the cuts are because the cost of electricity is too expensive when compared to the families' income. Many of those surveyed reported running out of electricity only halfway through each month or sooner; electricity is often split between multiple houses and once the power was depleted for the month, there is no money to buy more until the next month. Other respondents had such extensive power cuts that he or she had electricity only a day or two each week. 15 people, or 21 percent of those surveyed did not have any form of electricity at all.[74] None of these individuals lived alone either, including their families, more than seventy-five people the author came into contact with lived without electricity. Those without electricity were the poorest surveyed when looking at income as well. Typically the student was a double-orphaned child living with an aunt, grandmother, or cousin. These family units were not confined to a single compound, examples were found in all three of the compounds surveyed.

The survey results established that it is hard for students to study in the compounds. The students who received lights all reported that while they tried to study every day they had difficulties because of access to electricity. In in-depth interviews respondents answers varied from one hour to two hours of study time each night. There were often nights that they could not study at all or as long as they want because of their lack of electricity. The teachers surveyed and interviewed had the same issues. Before receiving the light, all respondents surveyed reported making choices each night between his or her studies, making lesson plans, and reviewing students' work. They reported that the candle would run out before they were able to finish all three and had to decide which to do, pursue their

[73] Author's survey results, 2013.
[74] Author's survey results, 2013.

own educational goals or help students pursue theirs. Through the administrator interviews, one mentor and teacher, Clement Chipili explained how the stress of not having electricity affects his daily life. He constantly makes hard choices that affect his own ability to gain an education. Studying during the day is not an option for most of the poor. The students found it hard to study during the day due to other responsibilities such as cooking and cleaning while there was sunlight. The students and teachers surveyed reported trying to start studying earlier in the afternoon, but they had other responsibilities. The girls especially were often in charge of cooking for their families before it was dark outside. At night they could not manage without a light. The work for the day, cooking and cleaning, had to be done before studying and needed to be done before nightfall because of the inconsistency of lighting. Of the students given lights, five had a textbook to study with while three had to rely on past papers and notes taken from class. They all reported studying in their houses, except one who occasionally visited a relative with working electricity. In this case the student walked home alone in the dark after studying.

Yet despite the difficulties, the data showed that education was important to the all of the students. Everyone surveyed reported how important education was, as did the individual's families or guardians. The results of the distribution were positive. All of the students who received lights reported studying longer and more consistently with the light than they were previously able to do. They reported using it to study every night. The light allowed them to do chores or cook during the day and not rush other activities to have time to study before it got dark. It allowed them to not stress about going to school the next morning without homework completed or notes studied. Students sat for yearly national exams either during the time of the study or after the study ended; all reported that they believed

having the light benefitted them in school. The teachers given lights all reported that they believed it benefitted their own education and their students as well.

(2) Solar-powered lights eliminate the use of candles. Candles are used in the compounds as an alternative when there is no electricity, or electricity is unaffordable. Even with the high number of those surveyed that had electricity to some extent, the number of those who studied or worked by night with a candle was 53, or 79 percent.[75] Those with power reported that power cuts would often happen in the evenings, leaving the respondents in the dark and forcing them to buy and rely on candles every day.

Yet access to candles is gendered. The survey showed that male students were more than twice as likely to have candles for studying as female students. In interviews with students, two of the boys reported that their fathers paid for their candles and the other boy's father allowed him to use the torchlight on his phone. None of the girl's fathers or guardians bought them candles specifically for studying. The girls reported using candles if they were left over after their family or guardians used them to cook with. The girls were more likely to run out of candles while studying or not have a candle to study with at all. The survey also asked about the cellphone use of respondents and their families. When a father or male guardian had a cellphone with torchlight on it, which was less than one third of the time male students reported sometimes using the torchlight to study. Female students only reported using torchlights to study if their mother or female guardian owned the phone. This accounted for only 3 female respondents. The torchlights on cellphones are not a reliable way to study; they do not give off enough light to see more than a line or two of a page at a time and cannot be charged without electricity.

[75] Author's survey results, 2013.

The distribution of the lights suggests that when people have access to solar-powered lights, they stop buying candles. All of the recipients of the lights reported that they and their families stopped buying candles for the entire month after they received it. This can save seven to 21 kwacha, the equivalent of about one to five US dollars, a week depending on how many candles they used a day. The disuse of candles has the potential to save lives. The indoor use of candles is dangerous; the survey demonstrated that accidents involving candles in the compounds touched almost every participant. The vast majority of participants knew of someone who had a serious burn or who had died from a candle accident.

The use of candles affects education as well. Students, teachers and administrators spoke of how their eyes hurt in school. The habitual use of candles causes' blurred vision from strained eyes. Teachers said it affected the student's concentration as well. None of the recipients of lights reported any problems with vision after use as they had previously with candles. The lights were bright enough to light up their paper or textbook brightly and provided enough light to see in an enclosed room.

(3) Radios provide access to higher quality education. The data recorded demonstrates that access to information and education is highly valued in the compounds. Respondents surveyed all reported listening to the news or education programming when they could, and would listen more if they had access. Twenty-four of those surveyed owned working televisions and 31 owned working radios. However, this group overlapped almost exclusively, with almost every individual who had a television at home also having a working radio. Those surveyed who had working radios or televisions had one or more family member working, and even then, the television only worked if the house had

electricity at the time. Even more of those surveyed had a broken radio or television at home.

The most prevalent answer in the survey for what respondents listen to when they had a radio, and also what those without a radio wanted to listen to was the news. Then in interviews, respondents frequently talked about how the desire to know what is going on around them both locally and nationally. Respondents also reported wishing their children had more educational programming. This demonstrates how important access to information and education is to the residents of Lusaka's compounds. All parents or guardians surveyed reported education as being extremely important for their children.

The solar-powered radios that Lifeline Energy distributes provide access to *Learning at Taonga Market*, when it was available. Former mentors or the program spoke of how important it was for the communities, because it provided access to higher quality education.[76] Because teachers typically do not have formal training or qualifications to teach, the quality of education they can offer students varies widely. They spoke of how they saw students improve with *Learning at Taonga Market* because it was easier for them to pay attention and learn at their own pace. All of the teachers surveyed expressed a desire for more education, and more than half wished they knew more to teach students. School administrators spoke of how the teachers did not feel confident in teaching students and that without access to the radio program, the quality of the lessons was not as high. The community schools that the author visited also self-reported a high absentee rate among teachers, in part due to low and sometimes non-existent teacher salaries. Yet the radio program offers a standard education for anyone listening regardless of the teacher's ability.

[76] See appendix 10 for quotes from *Learning at Taonga Market* Mentors .

(4) Solar-powered radios eliminate the need for batteries. Batteries are expensive and access to batteries is limited and gendered. The survey demonstrated that even when respondents or their families owned a radio, it often sat unused because the batteries had run out and there was no money to buy more. On average, a family buys batteries once a month, for a device they plan to use every day. From separate compounds guides Clement Chipili and Banda Lucas suggested that during home visits, when respondents said their radios were broken, some may have just been embarrassed to say they could not afford batteries. The data from the case suggests that men have more access to batteries than women. This was especially apparent when asking who controlled access to the radio in the home, or who chose what the respondent listened to. Male students were almost a third more likely to report choosing what they listened to on the radio than female students. Their family members or guardians reported the same gender bias, with men more likely to pick the programming. The female teachers that were surveyed and those given lights rarely reported choosing the program on the radio.

The student counselor at one school discussed how it affects students to not have access radio or working radio at home. She believes that they have lower self-esteem and have less confidence in their ability to answer questions in class than the students who listen to educational programs at home. If schools have a solar-powered radio then they don't need to buy batteries and the gender gap is lessened, at least for the children and teachers with access to the community radio. That the radios are solar powered saves money on batteries, just as the solar powered lights save money on candles. This money can be put to other things at home or for the schools can be spent on food and teacher's salaries.

(5) Radios compensate for irregular class attendance and attention in school. Teachers and administrators commonly spoke of low attendance rates and poor concentration in the classroom. Students often come to school hungry, having had nothing to eat for the day or stay home because of it. Even where there is food, it is rarely nutritional. When asked what they cook, 95 percent of respondents answered nshima. Nshima is a cornmeal product with little nutritional value; it is served with a side dish or relish of fresh or dried vegetables if available. Meat is expensive and rare. Even when students attend regularly, classes are not always taught. Volunteer teachers do not always show up to teach, or have not prepared lesson plans. But from what the teachers and administrators say, radios help to fix the problem. Using solar-powered radios in conjunction with IRI programs allows students to make up a class that they missed, and not fall behind. If a student cannot attend school at the traditional time because of chores at home, or is too hungry, sick, or tired to learn he or she can listen to the program at another time, when it is saved to the device through an mp3. The radios provide the same exact class at any time of day, with the same quality education. It doesn't matter if the teacher forgot to make a lesson plan or could not finish a plan because they did not have a candle to see by, the lesson is already prepared. Former *Learning at Taonga Market* teachers and mentors spoke of what the programs meant to them and the overwhelming response was how needed it was in the community because of the education it provided. The radio allowed them access to educational programs and the training provided with it gave confidence to the teachers. That typical community school teachers have little training means the quality of education the students receive is quite variable. *Learning at Taonga Market* takes away the inconsistency. Anytime the lesson is listened to it is the same, regardless of where the student is or when he or she is listening to

it. Because it is an interactive program the students sing and dance as they learn, which the mentors said helps them focus and keeps their attention. The radio allowed learning to happen at a pace all of the students could work at. The program could be prerecorded and then paused and repeated as necessary. The radio allows learning to happen at a rate that benefits the students.

The case study demonstrates that the bleak picture of energy poverty in Lusaka's compound negatively affects education. The details of the case study area show how the communities face severe poverty and difficult situations every day. Through triangulated data, surveys, interviews, and a distribution of products the case studies five points connect energy poverty to education through ways of studying and the quality of education available. It shows gender inequality in the energy use in the compounds and that the gender inequality also affects education in terms of studying. In the next chapter the case study will be synthesized with the capabilities approach and scarcity theory to reach conclusions and policy recommendations on how to alleviate the stresses of poverty.

Chapter 3: Synthesis of the Case Study

The case study demonstrates that energy poverty in the compounds negatively affects the ability of the poor to gain a quality education. The hardships of energy poverty impede the ability to study, to access information and education and cause stress in the daily lives of the poor. The study suggests that solar lights and radios are tools that increase an individual's access to educational capabilities. The lights and radios may change the way people live by reducing the scarcity of energy poverty. By enhancing access to valued capabilities, they provide a way out of the poverty trap. The trends shown through the five points from the case study research demonstrate this. (1) Solar-powered lights allow safe access to increased study hours; this increases the educational potential of the poor. (2) The lights are a tool that alleviates the bandwidth tax incurred by energy poverty, by eliminating the use of candles it creates slack in budgeting and time. (3) Solar-powered radios allow access to higher quality education through IRI. (4) The solar-powered radios eliminate the use of batteries, which alleviates the bandwidth tax, and (5) the radios allow for slack in a way that traditional methods of schooling do not.

(1) That solar-powered lights allow safe access to increased study hours increases the educational capabilities of the poor. Electricity is an unreliable source of energy in the compounds. Respondents could not afford to use it for all of their energy needs including lighting, charging cellphones and listening to the radio. It is also unreliable because of the load shedding that occurs regularly in the compounds. Electricity does not meet the needs of the people. It does not allow them the ability to do the things they value. For example, an individual cannot depend on electricity to study, read, access information or cook by. These are valued capabilities by the respondents and they are capabilities that are not being

met due to energy poverty. It violates Nussbaum's Central Human Functional Capabilities because an education, literacy and basic mathematical training, is necessary for the central capabilities including senses, imagination and thought.[77]

The lack of electricity prevented respondents from gaining the education they valued. The lack of electricity is a scarcity of light. This scarcity influences the way the poor go about their lives; because of it they do not have the ability to obtain a quality education. Through surveys, interviews and a distribution of solar powered lights the case demonstrated that solar powered lights increased the respondent's ability to study. The students who received lights all reported studying more often than they were previously able to. The increase in study time is something they valued for their education. Having a light decreases the daily stress of not knowing whether or not they will have electricity that night to study with. It means students will not be embarrassed or in trouble in class for not completing an assignment. Teachers who received the light had reported making choices each night between their own studies, making lesson plans, and reviewing their students work; this is a trade-off that they no longer had to make. Teachers could attend to their own educational goals and not sacrifice their student's goals, or vice versa. Having a light meant that teachers did not need to come to class without lesson plans prepared.

The case study showed that female students had less available time and fewer light sources to study by than male students. Women do the majority of the cooking and cleaning ~~in the compounds~~, and the case showed that female students had many more household chores than male students. This left female students with less time during the day to study; they

[77] Nussbaum, Martha C, *Women and Human Development The Capabilities Approach*, New York, NY, Cambridge University Press, 2000, 78.

have more to do before it gets dark at night. As Nussbaum's capabilities approach discusses, the unequal circumstances of women leave them with unequal capabilities. Yet when asked 'what do you want to be when you grow up', both male and female students responded with doctor or teacher, professions that require education. The case shows that energy poverty creates unequal conditions for men and women to study in. The scarcity of light affects women more; female students have fewer opportunities to study at night than male students and fewer opportunities to study during the day. Yet the distribution of solar lights to students changed this. With the addition of lights, the gender bias in study time was eliminated in the case study. Female students with lights were able to study as much as male students with lights. By focusing on alleviating the scarcity of light that all respondents felt, the unequal circumstances of male and female respondents lessened.

Everyone the author came across in the case valued having a safe way to study more. The recipients of lights reported that the lights helped them study for their upcoming yearly exams, helping them to feel more prepared than they would have. By providing a tool to help the poor study, their ability to gain an education was increased. Solar lights alleviate the scarcity of light incurred by energy poverty.

(2) That solar-powered lights eliminate the use of candles alleviates the bandwidth tax incurred by energy poverty and creates slack in their budget and time. Buying and using candles is a daily hindrance for escaping poverty. Candles are inexpensive yet it is daily cost. The worry that comes from not knowing whether there will be enough candles for light that night is constant and draining, as is the fear of accidents from using them. Almost all of the respondents had or knew of someone who had an accident with a candle. The survey showed it is a constant thought and worry. A fire in an enclosed space can

quickly burn through the structure and spread to the rest of the compound, devastating lives within minutes. This is just one example of the way energy poverty taxes the bandwidth of the poor. Scarcity theory explains that scarcity reduces bandwidth, or how much of a person's capacity is available for use. In the case study energy poverty reduces bandwidth in the respondents. Respondents worried about not having enough light at night to accomplish their work and their studies; they worry about not having candles and about candles running out. They worry about candles causing destruction and worry about the strain candles put on eyesight. This reduced bandwidth disadvantages respondents in school. The bandwidth tax limits the ability to process new information, yet learning requires bandwidth to process and build on new information each day. The bandwidth tax imposed on the poor by energy poverty directly prevents them from gaining the quality education that they desire.

The data from the case suggests that respondents can save seven to 21 kwacha, one to five US dollars a week by saving the money that they would have put toward candles. This extra money creates slack in their budget. Scarcity theory shows how important slack is to the poor, it provides room to fail.[78] This is essential to alleviating an overtaxed bandwidth. Slack can compensate for budgeting mistakes or unforeseen costs that would otherwise perpetuate the cycle of poverty. While the savings may not seem like much each week, it allows the respondents the opportunity to put money toward the goals that they value.

Women in particular are negatively affected by the bandwidth tax from energy poverty. In addition to the survey and interviews demonstrating that female respondents have a decreased ability to study because of their energy scarcity, it demonstrates an increase in

[78] Mullainathan and Shafir, 2013.

their stress about attending school. It was a trend in interviews with school teachers and administrators as well as one schools counselor that students feel embarrassed when they come to school unprepared, having not studied or completed their homework the night before. This bandwidth tax could be a contributing factor to the gender disparity in matriculation rates from schools. The disuse of candles in favor of solar-powered lights relieves some of the unequal resource distribution among genders and lessens the bandwidth tax particularly felt by women.

The case demonstrated that when the poor had access to a solar light, they stopped buying candles. This meant that respondents did not have to worry about whether there would be light, and whether there would be money for buying candles. That recipients of the lights did not need to worry about accidents from the candles also suggests that their daily bandwidth tax had decreased. This allows the poor to focus more of their cognitive capacity on gaining the capabilities they value such as education. Investing in solar lights can alleviate this bandwidth tax.

(3) Solar-powered radios allow access to higher quality education which can increase the educational capabilities of the poor. Only 24 of respondents surveyed, or 36 percent of respondents owned working radios. These radios were either electricity or battery dependent. The technology is useless for the respondent without a way to power it. Solar powered radios provide the ability for all learners to gain a quality education through programs such as the *Learning at Taonga Market*. The radios do not cost anything to charge and can be relied on more consistently than battery or electricity powered radios. Importantly, this is what the communities themselves expressed a desire for. Through the survey it was evident that the poor value access to information and educational programs.

The respondents valued learning and the opportunities education brings. The interviews with teachers who previously used *Learning at Taonga Market* spoke of how it helped students gain a higher quality education. Teachers saw improvements in the students' grades and ability to focus. The statistics from the 2008 study support this as well. Students' scores who participated in the program were higher than those of government schools in reading and mathematics. The IRI schools came second in mean performance only to private schools; this shows an increase in the quality of education with *Learning at Taonga Market*. The respondents in the case value the access to education and information that Lifeline Energy radios can deliver.

Using solar radios for IRI programs increases girl's access to education. In the survey, women reported a desire to listen to the news and to educational programs equally, if not more than boys. This demonstrates the respondent's desire for information and education. Yet, females are more likely to drop out of school early due to school fees than males. While community school fees are less expensive than government schools, they are still too high for some parents or guardians to afford. Just as resources are allocated differently for male and female students for lights, they are unequally distributed for school fees for education. With radio programs, the cost of sending children to community schools decreases and the access to education for females increases.

Energy poverty creates a scarcity of power, without the energy to run devices; people cannot do the things they value such as listening to educational programming. Solar

radios tackle this problem. With reliable access to the radio using Lifeline Energy radios the respondents in the case study can gain a higher quality education using the *Learning at Taonga Market* program.

(4) Solar-powered radios eliminate the use of batteries which alleviates the bandwidth tax and creates slack in budgeting. Solar-powered radios allow users access to information and education that was previously hard to acquire. The study showed that even when people owned a radio or television it rarely worked or they did not have the batteries to use it. Put another way, a lack of batteries prevented the respondents from valued capabilities, accessing information and education programs, even when they owned a radio. An investment in solar radios eliminates the need to buy batteries. The elimination of batteries is the elimination of one more constant worry for the poor. With solar-powered products the poor do not need to worry about whether they can afford to listen to the radio that day, or if the program will cut out half way through because the batteries are too old. This is another example of the way the scarcity of energy poverty taxes the bandwidth of the poor and limits their capabilities.

Female's ability to listen to the radio is limited in part because of the expense of batteries. Male students reported choosing the programming almost a third more than female students. One explanation by a guide was that because men are the ones buying the battery for the family, they decide who listens and to what. While access to batteries is gendered, listening to educational programming on a solar powered radio is not. Radios that run on solar power can be charged daily for free; the fear of depleting costly batteries is removed. Having access to solar radios increases the likelihood that a female can access IRI programs such as *Learning at Taonga Market*.

This creates a small amount of slack in the respondent's budget, as funds previously used for batteries can be allocated elsewhere. This is similar to the slack created by not buying candles. Batteries are typically purchased every month and are a substantial investment for the poor. By eliminating the use of batteries, respondents can save on money and stress and reduce the gender disparity that comes with their use.

(5) The radios allow for a non-traditional method of schooling which creates slack in how the poor manage resources and bandwidth. The poor do not have steady class attendance or concentration in school. Both students and teachers in the case study often came to school hungry and tired or sick. The children often suffer from malnourishment. The staple of their diet, nshima, does not offer them the proper nutrients to grow and learn. The teachers and administrators interviewed reported how difficult it was to learn in this environment. Their daily observations about the students suggest that students are distracted. On days after heavy load shedding, teachers reported a lack of concentration in students and lower class attendance. They theorize that students are embarrassed to come to school unprepared, having not studied or completed assignments.

The radios allow for a different form of learning. It allows the poor slack in how they learn; it allows room to fail.[79] Mullainathan and Shafir theorize that building slack into programs for the poor is necessary for a program's success.[80] In a traditional school, missing school or not paying attention one day would mean falling behind and having to catch up. Yet the rigidity of the traditional structure makes this difficult for the poor. It is more difficult to learn and gain new capabilities with a taxed bandwidth and lowered

[79] Mullainathan, Shafir, 80.
[80] Mullainathan, Shafir, 176.

cognitive capacity. Using solar radios for education means school can happen anywhere and at any time, as long as the lesson is recorded. This takes the poor's limited bandwidth into account. The structure of the radio programs, which involve singing and dancing serve to capture the attention of a taxed bandwidth. Teachers reported that students paid attention more and learned more when they had access to *Learning at Taonga Market*. Radio programming enables the poor to gain educational capabilities on their own time while taking into account their limited cognitive resources.

Addressing the scarcity issues involved with energy poverty increases the education potential of the poor. Solar lights and radios are tools that alleviate the tax of being in a constant low-resource state. The addition of these tools helps to eliminate some of the daily grind and stress of poverty, leaving the poor with more cognitive capacity to focus on gaining valued skills. When combined with IRI programs, the access to higher quality education increases in low-resources settlements. This enables the poor to learn in an environment that takes their circumstances into account.

Recommendations

This research is only the starting point for examining how energy poverty is an injustice that negatively affects the educational capabilities of the poor. However, it can be used to form policy recommendations and design programs to alleviate the scarcity caused by the injustice. The data from this thesis represents a typical urban area of one country in sub-Saharan Africa, whose statistics on poverty, education, and gender equality are typical of the region. Because of this, the data can be used at the local, regional and international level to form policies that will aid in eradicating the injustice.

Lifeline Energy, Local Nongovernmental Organizations

Monitor and evaluate programs to measure bandwidth as well as material dimensions of scarcity.

Lifeline Energy is the only NGO of its kind. It recognizes the roadblocks of energy poverty and has been working to alleviate the scarcity of light and energy and connect the poor with higher quality education by involving technology before it was on the national or international agenda. Based on the synthesis of the data with the theory, Lifeline Energy's strategies deliver access to valued capabilities to groups of vulnerable populations. The author recommends increasing the feedback loop in terms of monitoring and evaluation in order to measure the growth in cognitive capacity in the population from using the technology. Studying bandwidth can indicate productivity and predict a growth in human capital.[81] For Lifeline Energy this data could be used to convince donors and local governments that investments in small-scale renewable technologies will affect the economic development in the area as well as improve education.

This recommendation can also be implemented by any NGO working in the field to test the effectiveness of their programs. It is a multi-dimensional approach to assessing poverty reduction strategies. By combining the focus of alleviating the scarce resource with a strategy to increase the poor's bandwidth programs can have a greater impact. This allows NGO's to access why or why not their current strategies are working and would allow for a more thorough evaluation of the program.

[81] Mullainathan and Shafir, 2013, 229.

The Zambian Ministry of Education, Local and National Governments

Capitalize on IRI programs to deliver high quality education to the poor.

The author recommends that the Zambian Ministry of Education focus on and invest in IRI programs such as *Learning at Taonga Market*, and prioritize broadcasting it nationally. IRI programs such as *Learning at Taonga Market* deliver higher quality education to the poor than what would be available without. The design of the program increases educational capabilities and breaks down the gender disparity of vulnerable populations. The programs design takes the taxed bandwidth of the poor into account and helps by focus attention on learning. Scarcity theory explains that with a good program design, bandwidth can be built.[82] *Learning at Taonga Market* builds bandwidth by allowing the poor to learn at their own pace and at a time that works with their daily schedule. This increases the poor's capacity to learn new information and succeed in school as well as in life, as education helps to end generational cycles of poverty. This will also increase the likelihood of Zambia meeting the UN Development Goal of a free and compulsory education for all children.

The author recommends that local and national governments across sub-Saharan Africa develop IRI programs similar to *Learning at Taonga Market*. Because of the low education statistics across sub-Saharan Africa, IRI programs could benefit the energy poor of many sub-Saharan African countries. The case study demonstrated that IRI programs are vital to the education of the poor in Zambia. Teachers and students face a much harder time without the support of the program. The need for *Learning at Taonga Market* is great in the

[82] Mullainathan and Shafir, 176.

compounds. Schools lack trained, confident teachers and materials to teach in traditional schooling methods. They value the access to education and information that the programs bring because they live with the difficulties that come from energy poverty and the lack of access to quality education that accompanies it. The case study suggests that radio education could help other countries facing the same difficulties in education.

Invest in small-scale renewable technologies to support off-grid learning.

The author recommends that the Ministry of Education in Zambia and governments across sub-Saharan Africa invest in small-scale renewable technologies such as solar-powered lights and radios and through partnerships and distribute them to the poor for free or at subsidized costs. These technologies fill the gap that limited access to electricity has created; they reduce the effects of energy poverty. They alleviate the scarcity of energy and light while allowing the user to save money on candles and batteries. Solar radios allow a user access to information and education that previously was hard to acquire. The radios that the poor often have now are not powered by renewable energy sources. Because they depend on electricity or batteries, they cannot always be used. With solar-powered radios the ability for all learners to gain a quality education through programmes such as the *Learning at Taonga Market*, can be achieved. Importantly, this is what the communities expressed a desire for. However, the author suggests that how the technologies are distributed is vital and warns governments that in order to be successful in alleviating the gender gap, and using the technologies to best develop individual capabilities, attention must be paid to the distribution process. Attention must be paid to the community dynamics and the distribution process to ensure success.

International Development Organizations

Recognize access to modern sources of energy as a human right.

The author recommends that international development organizations develop strategies to put energy poverty on their agenda. This includes advocating across disciplines, working with multiple players in the for-profit and non-profit world and working across governments to increase awareness of the issue. By recognizing energy poverty as an injustice policy makers lay the groundwork for declaring a human right to clean and reliable energy. In doing so they would be following international precedent in establishing human rights such as the right to clean water, the rights of women, and the rights of the child.

Promote alleviating energy poverty as a strategy to reach the UN Millennium Development Goals.

The IEA already believes that until modern energy sources are widely available, the UN Millennium Development Goals will not be reached. This thesis supports that belief with a case study demonstrating energy's importance to education and gender equality. The Millennium Development Goals 1) to eradicate hunger and extreme poverty, 2) to achieve universal primary education and 3) to promote gender equality and empower women all necessitate the acquisition of modern sources of energy. Energy poverty is a form of extreme poverty in that it prevents both social and economic development. Energy poverty negatively affects education and gaining a quality primary education is difficult without modern energy sources. It disadvantages the poor. Energy poverty disproportionately

affects women. Because women are the more frequent users of household energy, they are affected more by energy poverty. The case study re-enforces the theory on this in terms of capabilities as well. By focusing policies to alleviate energy poverty, the first three UN Millennium Goals would be easier to accomplish.

Conclusion

Using social justice theories, participant observation methods and an analysis of the data, the case study of Lusaka, Zambia supports the hypothesis that energy poverty limits the educational capabilities of the poor and that the scarcity caused by energy poverty can be alleviated by the investment in and use of small-scale renewable technologies. A lack of modern forms of energy detracts from education two-fold. First the lack of resources hinders an individual's ability to study and gain a quality education. Therefore the scarcity of light and energy limits the resources available, which prevents an individual from reaching his or her potential. Second, it diminishes the available cognitive capacity to learn by tunneling attention to the resource deficit. This limited ability to learn and process new information drains educational potential as well.

Yet access to solar-powered technologies increases educational opportunities for the poor. The lights and radios eliminated the scarcity of resources and allowed individuals to do the activities they valued, including studying and gaining an education. Further, the solar-powered devices had a positive effect on the cognitive capacity of the poor. Not only did access to clean energy sources and access to educational programs increase but the lights and radios helped to alleviate some of the daily stress and grind that extreme poverty causes.

The research supports the Nussbaum's theory that circumstances create unequal capabilities. Energy poverty is not gender neutral. Women are the dominant users of household energy yet benefit from it the least. While poverty affects both men and women, women are at a disadvantage when energy resources are scarce. Fortunately, while

women's educational capabilities are hindered by energy poverty, the solar powered devices help to level the playing field. When the resources are not scarce, women's access to education increases.

Future Research

This case study serves as an introduction to research relating energy poverty to education. As a case study bound in time and scope, the author recognizes the limits of the depth of its research and recommends future research to build on this study. To strengthen the research, a longitudinal study on the effects of renewable technologies on individual's cognitive capacity is needed. A case that is monitored over a several years could show the effects of energy poverty and of solar powered technologies more strongly. This could include tracking the effects solar powered lights and radios have on the students' performance in the classroom against students who do not have the technologies. It could follow the results of their yearly examinations in school to track improvements against their own previous grades and the grades of their peers. A longer study could also measure the student's ability to focus as a way to test for improved cognitive capacity. The author suggests tracking attendance and drop-out rates to determine if renewable technologies make a difference in keeping students enrolled in schools.

A more in depth study would increase the size and diversity of the studied population. This could include children who have dropped out of or never enrolled in schools and adult education and training programs. These vulnerable sub-groups represent populations that were not included in the case study. Research could be focused on younger age populations, younger than 11, to better study the connections between energy use and primary school education. The author also recommends a study specific to women's

education in the compounds and research into how energy poverty may affect them more acutely as they age. The author believes that research on the effects of an inability to complete homework and study, from a student's point of view, is vital to research on gender disparity in schools. This could test whether there is a critical age that students need technology in order to get the most out of their education. A study for this purpose could help local officials target programming to best prevent age-specific dropout rates.

The duplication of the study in other urban areas across sub-Saharan Africa would help create valuable data for policy recommendations. It would show local officials that it is possible to alleviate energy poverty without investment in the grid system and that they could combat low education statistics at the same time as improving quality of lives. Of course the study could also be duplicated in rural areas as well. The issues surrounding energy poverty and education are not only in urban areas. Research needs to be completed on energy poverty and education in rural areas in order to argue for clean modern sources of energy as a human right. This could show that energy poverty is an injustice that affects the poor, regardless of location. A comparative study on rural and urban energy poverty could strengthen the theory that IRI would help learning across all of sub-Saharan Africa. The duplication of this case study in rural areas, and the comparison of the results are vital for gaining awareness and support for the issue.

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This study demonstrates that energy poverty is a form of scarcity that limits the education capabilities of the poor, with special regard to women. Drawing on trends found in the

research, it finds that small-scale solar powered devices can alleviate scarcity, allowing individuals the opportunity to gain skills and do the activities they were shown to value. The thesis concludes that the alleviation of energy poverty is vital to both education and gender equality. This study serves as an introduction to the field of energy justice; more research is necessary to properly identify all variables that might aid or impede in establishing a human right to modern energy sources.

Appendices

Appendix 1

Pictured: Photo by the Author. A compound in the case study area.

Appendix 2

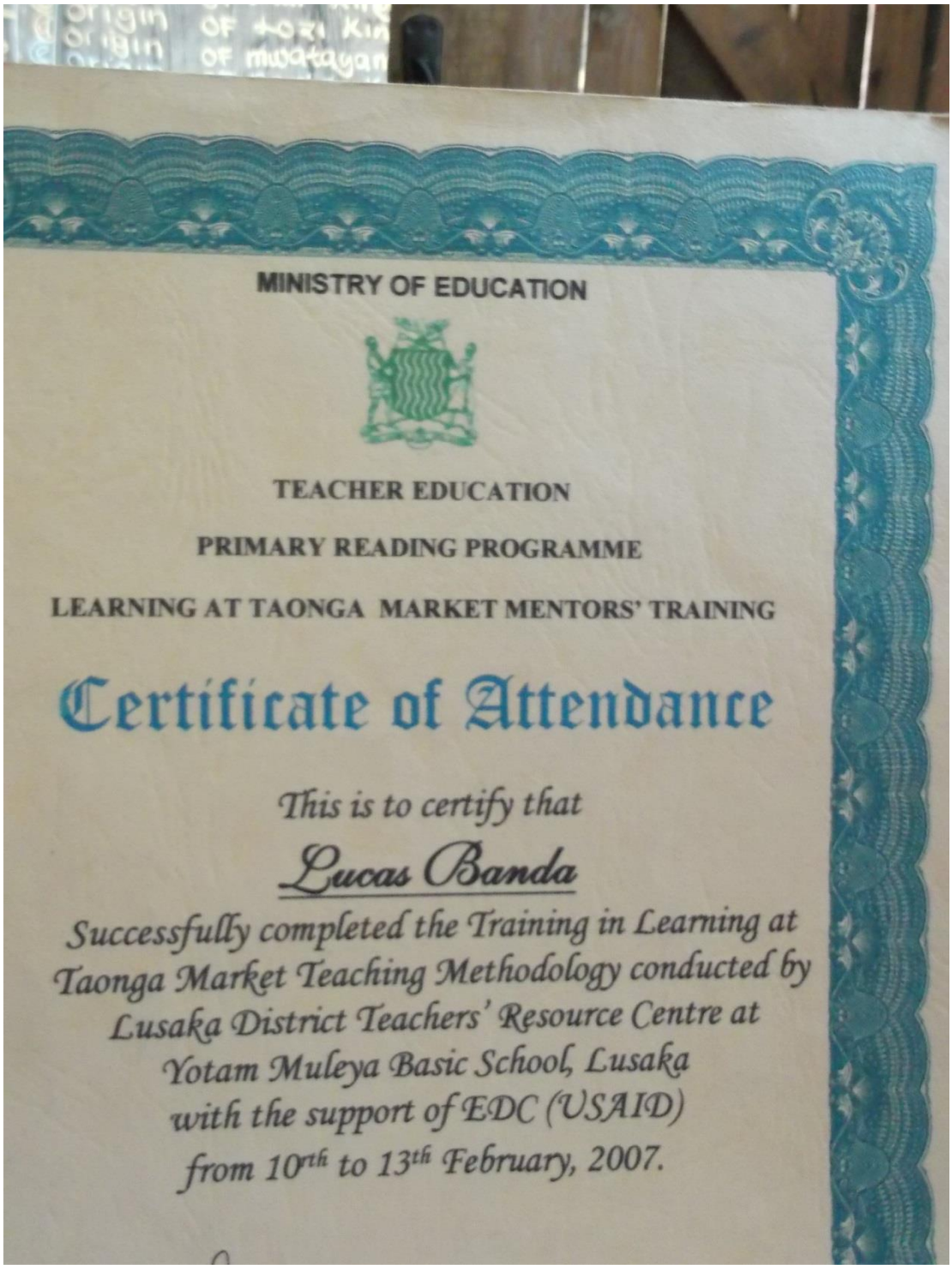
Pictured: Photo by the author. A compound in the study area.

Appendix 3

Pictured: Lifeline Energy Prime Radio, courtesy of Lifeline Energy

Appendix 4

Pictured: Photo by the author, permission given by Lucas Banda. Example of training certificate for Learning at Taonga Market Mentors



MINISTRY OF EDUCATION

TEACHER EDUCATION

PRIMARY READING PROGRAMME

LEARNING AT TAONGA MARKET MENTORS' TRAINING

Certificate of Attendance

This is to certify that

Lucas Banda

Successfully completed the Training in Learning at Taonga Market Teaching Methodology conducted by Lusaka District Teachers' Resource Centre at Yotam Muleya Basic School, Lusaka with the support of EDC (USAID) from 10th to 13th February, 2007.

Appendix 5

Survey Questions

Name_____ Location:_____ M / F Date:

Allowed to use name and location: _____

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1. Household Info

a. Who lives in the household? Ages?

What is the main source of income?

b. Type of house. How many rooms?

Notes:

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2. Cooking

a. What fuel do you use for cooking?

b. Who does the cooking?

c. How many meals do you cook per day?

d. What do you cook?

e. How often do you xx fuel it?

f. How much do you pay per day/wk?

g. Do you know where your charcoal comes from?

h. How long have you had your cookstove?

i. Where is it made, do you know?

Notes:

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3. Lighting

a. What do you usually use to light your house at night?

b. What do you use the light for mainly?

c. Specify qualities of lighting.

d. How much do you spend per day/wk

e. If you have a torch, how many batteries do you need? How long do they last? How much do they cost? How often do you buy batteries for your torch?

f. Have you ever had any accidents with candles/kerosene/firewood?

Notes:

NB: people often don't go out at night to use the toilet out of fear. You might ask casually if they go anywhere at night, how do they see

4. **Study and Education habits**

a. How many days a week do you study after school? When do you study?

b. Where do you study? What materials do you use to study? Class notes, textbooks etc.

c. What do you use to study at night?

d. Who pays for the XX? How much is spent per day / wk – do you know?

e. How long do you study for? Do you want to study for longer?

f. How often are you unable to study?

g. Do you have access to a radio at school? A computer?

h. Does your school have electricity? What do they use it for?

i. What do you want to do with your education?

j. What are the biggest challenges to getting your education?

k. How has not having access to education stopped you from doing what you value (want to do)

l. When and how do you make your lesson plans? (teachers)

Notes:

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5. **Radio**

a. Does your family own a radio? Does it work?

b. If not, how do you get your information?

c. What kind is it (solar, battery)? If no, how long did it last?

d. How often do you buy your batteries/dry cells? Where do you buy them?

e. How much do they cost?

f. What do you like to listen to most?

g. Who decides what you listen to?

h. What are the most important things that you've learned from your radio?

Notes:

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6. **Cell Phones:**

a. Do you have a cell phone? Who owns cell phones in your family?

b. How do you charge your cell phone?

c. How often do you charge your cell phone?

d. How much does it cost on average to charge your phone?

e. How often do you top up your phone? How much do you spend per top up?

f. How long do you leave your phone when its charging?

g. Do you listen to the radio on your phone?

Notes:

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7. Other:

a. What is the main source of income for the household?

Occupations?

b. Do you know how much you spend on energy per month/year? Would you like to know?

Notes:

8. Follow Up

a. Have you been using the solar light?

b. How often have you used it? What have you used it for?

c. How has it made a difference to you?

d. How has it made a difference to your education?

e. What challenges have you had with the light?

f. Has anyone other than yourself used the light?

If so, what have they used it for?

Notes:

Appendix 6

Pictured: Photo from Nokero, NokeroN200 Solar bulb.

Appendix 7

Pictured: Photo by the author. The distribution and training of Nokero N200 solar light.

Appendix 8

Pictured: Photo by the author. Community school teacher with old radio

Appendix 9

Pictured: Photo by the author. Young student with Lifeline Energy Prime Radio

Appendix 10

Quotes from *Learning at Taonga Market* Mentors

"With Taonga Market it was easy to learn and understand, they used actions like write the number one, and it was easy for that baby to then write, whether it was a boy or a girl, and if there was a storytelling, after the story was over they would share with their friends so it was easy for them to communicate to us"

"When they hear a pupil talking on Taonga Market, they would get encouraged, it made them want to be a teacher when they grew up to speak on radio programmes." "Taonga Market was so important because it made it easier for the teachers to make their lesson plans, the work was so [much] easier for us, the children enjoyed it very much. That program was a direct one, and it helped a lot of children in terms of songs and motivation for the children"

"I was a teacher at Taonga Market at Chaise Basic School. It was so important because it helped a lot of the children, they could not manage to pay for the school fees for government schools, the children's grades improved, and actually you would see them come from government schools to join Taonga Market, so it was great. Without Taonga it is difficult, we have a lot of kids in the compounds not going to schools, the schools are already full, the children want to go back to school and if we have Taonga, then it is better."

Works Cited

Works Consulted

Cathy Clark, Lillian Gu (2011) *LIFELINE ENERGY: Using Hybrid Legal Forms for Maximum Impact.* CASE at Duke University.

Jonathan Henry Haugton, Shahidur R. Khandker.(2009) Handbook on Poverty and Inequality. Washington, DC: World Bank,

Jan Bart Gewald, Marja Hinfelaar,(2008) *Afrika-Studiecentrum Series, Volume 12 : One Zambia, Many Histories : Towards a History of Post-Colonial Zambia.*Leiden, NLD, Brill.

Danny L. Jorgenson (1989) *Participant Observation: Applied Social Research Methods.* Newbury Park: Sage Publications.

Margaret E. Keck, Kathryn Sikkink (1998) *Activists Beyond Borders*. Ithica and London: Cornell University

Christopher LaMonica, (2010*) Local Government Matters: The Case of Zambia ,* Boston: Lambert Academic Publishing.

Chileshe L. Mulenga, The Case of Lusaka, Zambia. Rep. London: University College London, 2003.

Susan Perry, Celeste Schenck (2001) *Eye to Eye: Women Practising Development Across Cultures.* London and New York: Zed Books Ltd.

Bizeck Jube Phiri,(2005) *A Political History of Zambia: From the Colonial Period to the 3rd Republic* Africa Research & Publications.

John Rawls (1971) *A Theory of Justice.* Cambridge: The President and Fellows of Harvard College.

Andrew Sardonis (2003) *Africa: Another Side of the Coin: Northern Rhodesia's Final Years and Zambia's Nationhood* London: IB Tauris & Co Limited.

Thokozani Simelane, and Mohamed Abdel-Rahman. *Energy Transition in Africa*. Pretoria 0001; South Africa: Africa Institute of South Africa, 2011. Print.

Rory Stear, Kristine Pearson (2009) *Power Play: Freeplay Energy and the Freeplay Foundation Expand Access to Energy, Information, and Education.* Innovations: MIT Press Journal, 60-70.

Thomas Tufte, Paolo Mefalopulos (2009) *Participatory Communication: A Practical Guide.* Washington D.C.: The International Bank for Reconstruction and Development/The World Bank.

Bunker Roy (2009) *Empowering the Rural Poor to Help Themselves*: *The Barefoot Approach*. Innovations: MIT Press Journal, 71-80.

Rangaswamy Vedavalli,. Energy for Development: Twenty-first Century Challenges of Reform and Liberalization in Developing Countries. London [u.a.: Anthem, 2007.

Nicholas H. Wolfinger (2002) *On Writing Fieldnotes: Collection Strategies and Background Expectancies.* London: Sage Publications

International and Regional Instruments and Publications

The Case of Lusaka, Zambia (2003) London: University College London, Chileshe L. Mulenga.

2010 Census of Population and Housing: Volume 11 National Descriptive Tables (2012) Lusaka, Zambia: Central Statistical Office.

Child Mortality Rates Drop a Third Since 1990,(2010) UNICEF Press Centre, New York, UNICEF.

Convention on the Rights of the Child (1990) New York: Office of the High Commissioner for Human Rights.

Energy for All: Financing access for the poor: Special early excerpt of the World Energy Outlook 2011 (2011) Paris: International Energy Agency.

Energy for a Sustainable Future (2010) New York: The Secretary-General's Advisory Group on Energy and Climate Change Summary Report and Recommendations.

Energy Poverty (2014) Paris: International Energy Agency.

Energy Poverty- How to make modern energy access universal? (2010) Paris: Special excerpt for World Energy Outlook 2010, United Nations General Assembly on the Millennium Development Goals.

Energy Sector Policy of the AFDB Group (2012) African Development Bank: Operational Resources and Policies Department.

Environment Statistics in Zambia: Energy Statistics (2010) Lusaka, Zambia: Central Statistical Office.

Gender Statistics Report 2010 (2012) Lusaka, Zambia: Central Statistical Office, Information and Research Branch, Gender Unit.

Girls Education and Gender Equality, Basic Education and Gender Equality (2014) UNICEF.

Kristine Pearson on the Founding and Future of Lifeline Energy (2011) Forbes, Rahim Kanani.

Learning at Taonga Market (2011) Lusaka, Zambia: Ministry of Education, Foster Lubinda, Fanwell Besa.

The Millennium Development Goals Report (2007) New York: United Nations.

Modern Energy for All: World Energy Outlook (2013) Paris, International Energy Agency.

Percent of People in the World at Different Poverty Levels (2005) World Development Indicators, The World Bank.

Poverty headcount ratio at $1.25 a day (PPP) (% of population),(2010) World Development Indicators, The World Bank.

Publication of Population and Housing (2010) Lusaka, Zambia: Central Statistical Office.
Renewables 2011 Global Status Report (2011) Paris: Renewable Energy Policy Network for the 21st Century (REN21).

Statistics by Area/Education: Literacy, ChildInfo: Monitoring the Situation of Children and Women, (2012) UNICEF.

World Energy Outlook. (2010) Paris, International Energy Agency, OECD/IEA.

Zambia: Zesco Should Address Zambia's Energy Needs (2013) Zambia: AllAfrica, The Times of Zambia.

Books and Journals

Abhijit Banerjee, Esther Duflo (2011) *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. New York, Public Affairs.

Thomas W. Beasley, (2009) *African Political, Economic, and Security Issues: Poverty in Africa.* New York, NY, Nova Science Publishers Incorporated.

Ruchiti Beri, Uttam Kumar Sinha (2009) *Africa and Energy Security Global Issues, Local Responses.* New Delhi, Academic Foundation, Institute of Defence Studies and Analyses.

Richard Dowden (2009) *Africa Altered States, Ordinary Miracles.* New York: Public Affairs.

Amartya Sen (1999) *Commodities and Capabilities*. Oxford: Oxford University Press.

Amartya Sen (1999) *Development as Freedom*. New York: Alfred A. Knopf Inc.

Amartya Sen (2011) *The Idea of Justice.* Cambridge: The Belknap Press of Harvard University Press

Kirsten Majgarrd, Alain Mingat (2012) *Education in Sub-Saharan Africa: A Comparative Analysis.* Herndon VA: World Bank Publications.

Sendhil Mullainathan, Eldar Shafir (2013) *Scarcity: Why Having Too Little Means So Much.* New York NY, Times Books Henry Holt and Company LLC.

Martha Nussbaum (2001) *Women and Human Development: The Capabilities Approach.* New York: Cambridge University Press.

Martha Nussbaum (2011) *Creating Capabilities: The Human Development Approach*. US: Martha C. Nussbaum.

Sridhar Venkatapuram (2011) Health Justice: An Argument from the Capabilities Approach. Cambridge: Polity Press.