

Abstract

In Kenya, only 19% of urban residents have access to proper sanitation, while 87% of the population use cell phones on a daily basis. The stark divide between the availability of technology services and basic needs is characteristic of many emerging economies. With cheap imports providing Kenyans with access to modern technology, and the government's increasing inefficiency, social enterprises are taking matters into their own hands. These enterprises are leveraging available technology to address the needs of the community and solving social problems in the most efficient way possible. For this research, I focused on three enterprises: Sanergy, SHOFCO and BURN and evaluated how technology has enabled them to rise above the crowd and maximize their impact in Nairobi, Kenya.

Keywords

Sanitation, social enterprises, Kenya, SHOFCO, Sanergy, BURN

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Introduction

On September 2015, at a historic United Nations Summit, world leaders officially adopted the 17 Sustainable Development Goals (SDGs). The SDGs are a call for action in countries at all stages of development and aim to build on the work of the Millennium Development Goals of eliminating all forms of poverty. Among these SDGs is the provision of sanitation to all people. By 2030, the United Nations aims to achieve access to adequate and equitable sanitation and hygiene for all.

However, we are a long way from achieving this goal. According to UN statistics, 2.4 billion people lack access to basic sanitation services, such as toilets or latrines. And across the world, at least 892 million people continue to practice open defecation. Access to clean water is also an important part of sanitation, but between 1990 and 2015, the proportion of the global population using water from improved sources only increased by 14%. This is even though water scarcity affects more than 40% of the global population and is expected to rise. This lack of sanitation and access to clean water results in the death of nearly 1,000 children each day due to preventable sanitation-related diseases.

In Kenya, where this research was conducted, only 19% of urban residents have access to proper sanitation, while 87% of the population uses cell phones on a daily basis. This statistic is indicative of a larger divide between the availability of technology, and basic needs goods in the developing world. With this research, I will be looking at how this divide has been leveraged by enterprises seeking to solve some of the most pressing issues their communities face. I will focus on the context of Nairobi, Kenya with a special emphasis on three innovative companies that have adopted technology to battle a diverse range of sanitation issues.

Research Overview

When conducting this research, my primary aim was to gain a better understanding of how technology influences the operations of sanitation focused social enterprises in Kenya. To accomplish this, I had to define what sanitation would mean in this context, as well as choose specific enterprises to focus on.

Sanitation is usually used to refer to public health conditions that are related to the availability of clean water and the appropriate treatment or disposal of human and non-human waste. Since sanitation can refer to a broad spectrum of wastes and their treatment, I have tried to reflect this in the companies I chose to research on.

The first company is a human waste treatment enterprise that operates throughout the urban expanse of Nairobi, Kenya. Sanergy provides sanitation units that are similar to the portable toilets we see all across the world. However, Sanergy's "Fresh Life" toilets are different in that they are franchised units that are built into the ground and serviced regularly by professional waste collectors from Sanergy. The technological component comes into play when they transport the collected waste to a centralized facility where they convert it into valuable end products such as organic fertilizer and insect-based animal feed. They also use digital mapping and mobile technology to facilitate waste collection and choose strategic locations to maximize the impact of Fresh Life toilets. Founded in 2009 by three MIT graduates and launched in 2011, Sanergy utilizes a full value chain approach to address a widespread sanitation epidemic and provide a sustainable solution for urban slums.

Although Sanergy's Fresh Life toilets are mainly meant to tackle a sanitation problem in Nairobi, they are also believed to have a positive effect on female school attendance. While boys

can urinate publicly in open areas or walk distances to use a toilet, girls often are unable to do so out of risk of public shame or fear of assault. Additionally, girls that menstruate also have trouble finding closed bathrooms to wash their reusable pads, or bins to dispose of sanitary napkins, which has caused women to drop out of secondary and tertiary levels of school. Sanergy combats this problem by strategically placing its toilets near or inside schools and providing girls with a sanitary alternative. Furthermore, as the Fresh Life toilets are franchised units, they have created an employment opportunity for the entrepreneurial spirits in the slums. By franchising these toilets and charging locals for their use, many have been able to create a constant income stream and lift themselves out of absolute poverty.

The second company is called Shining Hope for Communities (SHOFCO) which is a non-profit organization operating out of the Kibera slum of Nairobi. Kibera is the largest urban slum in Africa and is home to 60% of Nairobi's population on just 6% of the land. It is home to a plethora of urban ails including crime, lack of health facilities, clean water and electricity, inadequate housing and unemployment. However, the lack of a central authority in the slum has given rise to creative and independent people that continue to strive. One of which is Kennedy Odede, who founded SHOFCO after receiving his education at Wesleyan University. SHOFCO combats urban poverty and gender inequality through advocacy and programs focused on providing critical services for the community, with an emphasis on women and girls.

For my research, I studied their WASH (Water, Sanitation, and Hygiene) program, which addresses sanitation and hygiene in Kibera. Through WASH, SHOFCO launched its aerial water piping system which transfers filtered water to 24 water kiosks throughout the slum. This innovative system has allowed them to reach thousands of residents. It is especially important

because, given the structure of Kibera, the conventional method of planting pipes underground would require the uprooting of hundreds of households and would make the pipes vulnerable to those who may want to tap into them illegally. Furthermore, since SHOFCO is a non-profit, the kiosks provide water at a more affordable price and ensure that those who collect water regularly don't have to travel far or for long periods of time to get clean water. One externality of SHOFCO's water distribution is that it allows women and girls – who are often those collecting water every day – to spend their time on more productive activities and enables families to save more money. I will explore this in more detail.

The last company on my list was BURN, a for-profit company that manufactures and sells fuel-efficient stoves throughout East Africa. Kenyan women are traditionally in charge of cooking for their families, but often do so using charcoal stoves that produce toxic gases and have grave implications for their health. This includes severe dizziness, headaches, and cough attacks which require women to spend large amounts of time recovering from exhaustion and health implications. BURN's stoves combat this problem providing fuel-efficient stoves that produce fewer toxic gases and use less charcoal. These uniquely designed stoves result in several positive externalities such as reduced health care and fuel costs as well as more productive time for household members. The positive effects of BURN stoves are especially pronounced on the women of the household because they are the most exposed to the harms of toxic gases.

I chose these three companies because I believed that their combination was a good representation of the broad definition of sanitation and because they all utilize technology to achieve their goals. Furthermore, all three have positive externalities in society and/or the people

that use them. This is especially important because most of these positive externalities affect women, a commonly disadvantaged group in this context.

With this research, I hope to address the impactful aspects of incorporating technology into the enterprises listed above. To be more specific: how does incorporating technology make social enterprises better? Secondly, I will address the many positive externalities that are said to be caused by these companies and attempt to flesh out which ones are the most significant. I will answer this secondary question with an emphasis on women and girls as they are the most vulnerable social group in this context.

SHINING HOPE FOR COMMUNITIES

As I mentioned in the research overview, SHOFCO is a non-profit organization that operates in Africa's largest slum, Kibera. For this research, I am focusing on their aerial water pipe system by which they deliver clean water to Kibera's residents. SHOFCO sources the water from a local well, after which it is filtered and chlorinated twice. Their filtration system is capable of purifying 14 liters of water per hour and operates by generator. This is necessary because they don't have access to sufficient electricity in the slums. In addition, residents often tap into the grid to access electricity illegally, and this leads to an unreliable availability of power. From there, the water is stored in three large tanks throughout the slums. The tanks in turn supply water to the 24 water kiosks in the slums. The water distribution happens via a network of aerial pipes that connect the filtration system to the main tanks, and the main tanks to the water kiosks. This is important for several reasons: firstly, because of the informal design of Kibera and the lack of a strong central authority, uprooting houses and families to lay pipes in the ground would be virtually impossible. Secondly, the pipes are suspended high enough in the

air that those who may wish to tap into the way illegally are unable to do so without being in full view of the community. They are also made of a strong PVC plastic that makes them very hard to cut into.

The three large tanks have a capacity of 100,000 liters and the kiosks have their own tanks capable of carrying 5,000 liters of water. Residents collect the water from the kiosks using jerry cans which are capable of carrying around 20 liters of water each. Each jerrycan of water costs about 2 Kenyan Shillings, which is equivalent to \$0.02 while a jerrycan of water from the cartels can cost anywhere between \$0.03 to \$0.05 – more often on the higher end than not. Table 1 below contains more information about how much water is consumer per household and other relevant details.

Number of water kiosks in Kibera	24
Average size of a household in Kibera	7
Average number of households served per-day by one water kiosk	50
Average number of jerrycans purchased per household	5
Average size of jerrycan or water container used by households (liters)	20lt
Average amount of water sold to Kibera households per-day (liters/day)	120,000lt
Average amount of water sold to Kibera residents per-day (liters/day)	840,000lt

Table 1: Kibera water consumption estimates and SHOFCO capacity

SHOFCO has given members of the Kibera community a consistent source of clean water at an affordable price. Furthermore, since the 24 water kiosks are spread throughout the slum, they have managed to reduce the average amount of time a person travels to purchase water. In short, they help people save time and money, and access clean water.

To test the assumption that residents will direct the saved money and time towards productive or income-generating activities, we conducted a survey of 34 residents in different areas of Kibera about how they spend the time and money saved by purchasing water from SHOFCO. In addition, the survey also required them to rank (in terms of importance) the benefits of buying water from SHOFCO.

Saving money was ranked as the most important reason for switching to SHOFCO by 59% of the residents and access to cleaner water was second in line with 35% of the respondents. Only 2 out of the 34 respondents to the survey (6%) ranked saving time as the most important reason. In fact, a majority 62% of the respondents ranked it as the least important benefit of the three. I have listed the results of the survey in more detail below.

	First Priority	Second Priority	Third Priority
Money count	59%	38%	3%
Time count	6%	32%	62%
Water count	35%	29%	35%

Table 2: SHOFCO survey results

When asked about how they use the money they saved by using SHOFCO, we received a variety of responses. Some said that they used the money to buy items to improve their lifestyle (buying household items, kitchen appliances, adding variety to the household diet, etc.). Others mentioned more productive, income-generating activities (savings, paying for their children's school fees, or investing it in their small business). A small proportion of the respondents also said that they use the money they save to buy more soap because the water from SHOFCO was often salty and did not lather as easily as normal water. Among the respondents, only 24% (8 out of 34) reported using the money for productive reasons. Therefore, while SHOFCO's WASH

program has been enormously helpful in terms of helping residents save money by up to 60%, not everyone is using the money they save to maximize their long-term benefits.

As for the time saved from using SHOFCO's kiosk, we've already found that not many people see it as an important reason for buying water from SHOFCO. However, we found that a higher percentage of people – 29% – reported using the time they save towards productive activities like running their small businesses whereas the rest reported using the time for rest and leisure. Of course, an important consideration for this is that since most respondents don't save much time, they don't redirect what little time they have towards their businesses.

As for the cleanliness of the water, 62% of respondents reported that they have felt improved effects on their health, or simply that they have not contracted any water-borne diseases since they started buying water from the kiosks. However, as mentioned above, a few respondents did report that the water was sometimes too salty, but they did not say that it affected their health. In addition to carefully filtering the water it distributes, SHOFCO closely monitors the cleanliness of the water by cross-referencing the customers that use the kiosks with those that report having water-borne diseases at one of the local SHOFCO health clinics. They are able to do this because in order to use any of SHOFCO's services – be it the water kiosks or health clinics – Kibera residents are issued SHOFCO IDs through which the organization is able to keep better track of their health and development.

While these results may be unexpected for some, it's important to realize that they are most likely affected by the context as well. For instance, people in the slums don't have much access to formal banking institutions, which may be the reason for the low savings rate observed in the survey results. In fact, most savings from people in Kibera happens in the form of

“biashara”, a traditional savings method involving a group of people coming together to pool their money and awarding it to one member every month or so, according to lottery or a predetermined order. Regardless, SHOFCO has managed to help the community in such a way that they would have been unable to do so without technology. This is evident in both SHOFCO’s use of the filtration system and aerial piping, but also in its monitoring of the water and record-keeping of those using its services.

Sanergy

Sanergy was established with the aim of developing a solution to a poverty challenge faced by over 1 billion people across the world: sanitation. For the purpose of this research, I have tried to illuminate how Sanergy has utilized innovation in different parts of its value chain. Firstly, Sanergy uses digital mapping to decide where to place their Fresh Life toilets based on where they are needed the most and whether they will be able to be serviced efficiently. After the toilets have been installed and franchised, they also use mobile technology to monitor the toilet’s fill levels and communicate with franchisees for customer service purposes. And lastly, they use technology to turn the waste they collect into organic fertilizer and pet food.

Since Sanergy mostly operates inside slums and other densely populated areas, there is never a shortage of demand for their Fresh Life toilets. However, the lack of formal infrastructure in those areas makes it important to consider how accessible the toilets will be to the waste collectors after they have been placed somewhere. In addition to this, to have a genuine impact on the sanitation of an area, toilets need to be available in abundance since people are unlikely to travel long distances to use a toilet when they are accustomed to pit latrines or “flying toilets”. Because of this, Sanergy utilizes digital mapping to expand with a density-based

approach, which means they are focused on increasing their density within specific areas instead of spreading sparse coverage over a larger area. So far, they have the capability of serving 113,000 residents per day and they intend to install over 2,000 new toilets throughout 2019.

When asked about the most important reason for Sanergy's rapid expansion, the company representative emphasized that Sanergy's acceptance by the communities it serves has contributed greatly to its success. The design of the toilets, including the color and extra amenities – such as mirrors and coat hangers – were all included because of input from the community. In addition, once the toilets are franchised, they continue to collect feedback from the franchisees. They do this through the Unstructured Supplementary Service Data (USSD) gateway, which is a protocol used by GSM phones to communicate with the service provider's computers. It is similar to texting, but with a computer on the other end. Franchisees also use this system to report any issues with the toilets, which Sanergy promptly responds to. Because of their community-inclusive approach and efficient customer service, Sanergy has managed to make a good name for itself and maximize its impact.

Because Sanergy's toilets have a myriad of positive externalities, their expansion serves to combat several other social ills as well. For instance, since the toilets are franchised to community residents, their expansion has served as a source of employment for several community residents. There are those who franchise the toilets and charge people for using them, and there are also those recruited and trained by Sanergy as waste managers. This contributes to raising the employment level in those areas and improving the standard of living. Furthermore, many of the Fresh Life toilets are placed nearby, or even inside the compounds of local community school. This is important because the availability of adequate sanitation is an

important determinant of school attendance for girls. According to the World Health Organization (WHO), 11% more girls attend school when sanitation is available. This is the case because it is unsafe for girls to relieve themselves in the open like boys, and the lack of toilets makes menstrual hygiene inaccessible to them.

In fact, the first Fresh Life toilet was tested in a community school in the Mukuru slums. The school received the first Fresh Life toilet in 2006, before the official launch of the Sanergy. Prior to the introduction of the toilets, the students and faculty used pit latrines to relieve themselves. Now they have two Fresh Life toilets for girls and boys. While initially reluctant to speak much about menstruation, most of the girls we spoke to confirmed that they felt more comfortable coming to school when they knew they had access to clean toilets. The headmistress also confirmed that the number of girls enrolled in her school had increased since the introduction of the toilets. Since 2006, the school size grew from around 120 students to over 350 students because parents were more enthusiastic about the school when they saw their sanitation facilities.

BURN Stoves

BURN is a for-profit company that manufactures and sells the most durable and fuel-efficient stoves throughout East Africa. Its products are innovatively designed to provide more heat for less fuel (charcoal or firewood). BURN stoves dramatically reduce harmful indoor smoke emissions and help save money, fuel, and natural resources. It two main products:

- **Jikokoa:** Kenya's top-selling, most fuel-efficient charcoal cookstove.
- **Kuniokoa:** A fuel-efficient natural draft wood stove. It offers families a safe, clean and economical alternative to cooking with wood.

For this research, I traveled to BURN HQ where they design and manufacture their products. Most of the information came from speaking with company representatives and understanding their perspective about the market they cater to. Since BURN distributes its stoves all over the country, and internationally to some extent, it was not feasible to conduct surveys for the users of their products. However, we managed to acquire reports by the United Nations and other reputable sources about the importance of emission-reducing stoves and BURN's role in that landscape.

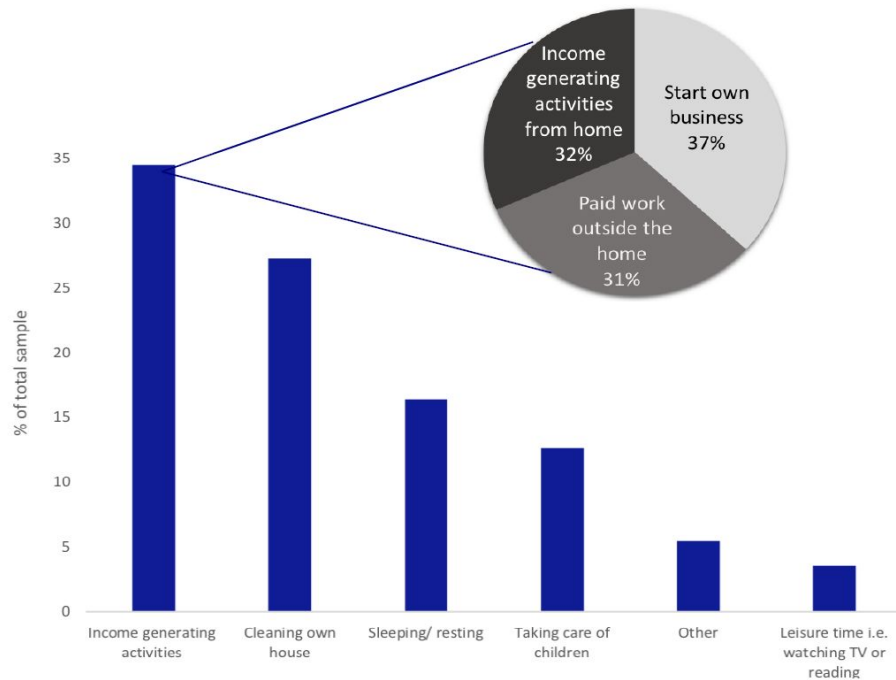
With more than 90% of the population lacking access to modern energy and clean cooking facilities, charcoal is nothing short of a household essential in Kenya. According to a 2002 study conducted by the Ministry of Energy, charcoal is the principal fuel that provides energy for 82% of urban Kenyan households. This situation is similar in neighboring countries where urban charcoal dependence is 80% in Tanzania and 70% in Ethiopia. Because of this, BURN is operating a market that is large enough to make it profitable, but also important enough to make a significant impact.

While BURN has established quite a name for itself internationally and in urban Kenya, the benefits of BURN are most noticeable in the lives of women in rural Kenya. Using BURN stoves reduces the amount of wood needed to cook, thereby reducing the total amount of time women spend collecting firewood. This is important because according to a survey by the Berkeley Air Monitoring Group, women in rural Kenya spend an average 12 hours/week collecting fuel. Furthermore, 75% describe the practice as somewhat dangerous, and 65% do not like anything about it. When asked **'If you had more time available, how would you like to spend it?'** around 35% stated that they would spend it on income-generating activities. Often,

those collecting firewood are also young girls who are still in school. The amount of time BURN stoves save means that these girls have more time to focus on their studies after school. BURN stoves also have a shorter cooking time. In an analysis of the mean cooking times of a BURN stove and traditional wood stove, the Berkeley Group found that the traditional stoves are lit for an average of 320 minutes per day. This is drastically different from the BURN stove's average usage time of 63 minutes per day. The graphs below provide a more concrete image of the amount of time firewood collection takes up compared to other activities.

Collecting and preparing wood fuel.	15.9
Agricultural work and caring for animals	14.9
Cooking (preparing food and/or drinks)	9.8
Washing and bathing	7.5
Reading and watching TV	6.9
Household chores	6.8
Caring for children and/or elderly	6.5
Eating and drinking	6.1
Collecting water	5.4
Sleeping/ resting	5.4
Sanitation, including time spent defecating	4.0
Paid work outside the home.	3.8
Meetings (school, religious, <i>charma</i>)	3.0
Going to the market and/ stores.	2.0
Income generating activities in the home	2.0
Total	100

Table 3: Average proportions (%) of time allocated to various tasks throughout the day, on days when the participants do collect wood fuel (% of total time awake). Sourced from the Berkeley Air Monitoring Group



**Figure 1: Responses to ‘If you had more time available, how would you like to spend it?’
(Source: Berkeley Air Monitoring Group)**

It is worth noting that most of the above results relate to BURN’s Kunioka stove, which uses firewood. However, BURN’s most successful model is the Jikokoa, which is powered by charcoal. Apart from charcoal being a more common source of energy than firewood, this is also because BURN’s customers care more about saving money than time. In Nairobi alone, residents use 700 tons of charcoal per day. But by using a Jikokoa stove, households can save up to \$250 per year. Because of this, most customers who buy BURN stoves are able to recoup their investment in just 4.5 weeks. This means BURN’s stoves have the potential for immense cost-savings.

All in all, BURN has managed to provide value for millions of people and has the potential to reach millions more. Since its foundation in 2003, BURN has helped save an estimated 3 million tons of wood, prevented the emission of 5.3 million tons of harmful carbon dioxide, and helped around 3.1 million people save over \$178 on fuel costs.

Final Remarks

During my time in Nairobi, I learned a lot about how technology can help provide unconventional solutions to age-old problems. I have tried to express how this is the case throughout this research paper, but the process of garnering this information was not without its challenges. For instance, after surveying multiple girls learning at a school with a Fresh Life toilet, we found the results of the survey biased and unusable. This was because the girls were not comfortable answering questions about how sanitation and menstruation affected their performance at school. Similar cultural obstacles were commonplace during the research. Because of the more relaxed perception of time in the professional community, communication with company representatives and making appointments was challenging at times. However, through trial and error, we were able to navigate the cultural landscape and find what we needed.

That being said, I believe the research has yielded fairly interesting results. When I first went to Kenya, I intended to seek out the most important aspect of incorporating technology into social enterprises. I found, however, that the results differ based on the perspective adopted. From the company's perspective, the ability to scale faster is the most attractive aspect that technology can bring. In SHOFCO's case, without the aerial pipes, reaching that many people in the slums would not be possible. As for Sanergy and BURN, the connection may not be as clear but is no less impactful. Digital mapping and the USSD customer service system are essential components of Sanergy's rapid expansion. Similarly, BURN's stove designs are the primary reasons for their effectiveness and subsequent success.

From the customer's perspective, however, the story is quite different. Well over half of SHOFCO's surveyed customers confirmed that saving money was their first priority. Sanergy's biggest growth came about when they stopped selling their toilets and instead began to franchise them and only charge maintenance fees, thereby providing a cheaper alternative for those wishing to adopt a toilet. In line with this, BURN's biggest selling point is also its long-term cost-saving potential.

Regardless of this divide, it is evident that technology is a powerful tool for scaling positive impact. Although the scope of this paper is fairly limited in terms of its regional and topical focus, I hope it illuminates how technology can be leveraged in different situations for the benefit of the larger community.

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