

A Sustainable Solution for Water Scarcity to Empower Women:

Climate Change Adaptation in Turkana County, Kenya

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Preface

As a senior, graduating this spring with a B.E. in biomedical engineering with a concentration in cellular and molecular specialization and a minor in writing and rhetoric, I became interested in learning and writing about women's health in the developing world. In fact, my next plan -- to attend SUNY Downstate Medical Center's MD/MPH program and pursue a pediatric residency, hopefully with an oncology/hematology fellowship -- was, in part, influenced by wanting to help women who suffer from physical and emotional stress as a result of congenital birth defects, stillbirths, and intrauterine growth restriction.

I've always been interested in public health and the work of nongovernmental organizations (NGOs). I fell in love with the field when I studied abroad in Tanzania as a freshman in the summer of 2017. There, I started a sustainable reusable menstrual pad incentive. My friend and I went to the local market in Maji ya Chai and prototyped affordable pads out of blankets and tablecloths. We then taught over forty women how to make these pads at the United African Alliance Center. We were able to actually make an impact, which is something that I have always wanted to do. Thus, when I received an email from Dr. Robert Kaplan about doing independent research on women's empowerment in a community sustainable water storage system in India for a spring symposium at Stony Brook University under Professor Peg Christoff, I jumped at the opportunity.

Conducting research on the Bhungroo irrigation technology in Gujarat was particularly interesting to me because my parents come from an agricultural background in India. Both my paternal and maternal grandfathers were farmers in northern Haryana, owned acres of land, and were successful in the business. I was startled to realize that Gujarat has a very different ecosystem than northern Haryana. Where they have a monsoon season and drought, we have a larger temperature range and consistent rainfall. Furthermore, the spices grown in Gujarat would probably die in Haryana's cooler weather.

Every time I went to India to visit my grandparents, we would always host a free lunch, and collect donations for the local shelter; thus, I gained a sense of what it was like to work on behalf of the poor, which is how I became interested in doing volunteer work in Maji ya Chai. It turns out that Maji ya Chai in Tanzania and rural Gujarat in India have similar levels of poverty, which peaked my interest in doing independent research for the SBU spring symposium. When I was in Tanzania in 2017 and stayed with the Maasai, an indigenous, nomadic, pastoralist community, I reflected upon what it would take to raise their standard of living to be sustainable over the long term.

My family's background gave me insight into the overall process and enabled me to develop appropriate questions for my interview with Trupti Jain, co-founder of the social enterprise that developed the Bhungroo irrigation technology for poor farmers in Gujarat. Furthermore, as an engineering major, I had the technical knowledge to ask about the design of the Bhungroo technology and analyze the sketches and description on the Naireeta Services' website.

At first, I tried to approach my research on the Bhungroo climate change adaptation program, which claimed to place women in leadership positions, with a medical mindset. I researched the negative biological impacts of climate change for men and women, which clearly

indicated that women, more than men, were significantly negatively impacted by climate change. I soon learned that not a single research paper stated otherwise. [Please see the Appendix for details.] Thus, while I wanted to tailor my paper for the SBU symposium to describe this disproportionality, I decided to change direction to try to understand how to help the women.

This is when I started doing deep research on the Bhungroo irrigation technology developed by Trupti Jain and Biplab Paul through their social enterprise, Naireeta Services. I combed through the website and the United Nations Framework Convention on Climate Change's (UNFCCC's) website to learn how this technology worked. As I researched, I became in awe of this simple yet impactful technology. India is a patriarchal society where very few women own land, but by only letting women own this technology, the Bhungroo system actually gave women power. A lot of the papers I was researching for climate change solutions advocated for placing women in positions of power and having them become the voices for the disparities that women face in India. As nice as this sounds, I doubted that this would work. As a woman with roots in India, where I attended school, I was not allowed to voice my opinion simply because I'm a woman. And I lived close to big cities that are known to be progressive! How could women in rural communities possibly be allowed to voice their opinions?

That's why I liked the Bhungroo technology so much. It did not ask the women to change their lifestyle, become educated at the risk of their families lives, and then join the government. It understood the cultural boundaries of Indian society and gave them power as they are. If women are in control of a reliable water source for the farming community people HAVE to come to them. People HAVE to show them respect to try to get water. Through this technology women are able to earn an income while earning the communities respect while continuing their everyday lifestyle. It was ingenious.

While the Bhungroo technology is a wonderful idea, it comes at a cost. Over time, this cost may seem miniscule as it is usually paid for within the first three years of implementation; still, it is a hefty upfront cost. In the course of our weekly meetings, I asked Dr. Christoff if there was a way to offset the cost. There is grant money through the Naireeta Services, but I wondered if there was a way to offset the cost completely. This technology is only offered to poverty-stricken populations, why should we have them pay? That's when Dr. Christoff told me about another financial initiative that also had gained recognition through the UNFCCC -- Wocan's W+ points.

The W+ points are a way for individuals, companies, and corporations to buy points toward a project that empowers women in one of four categories: renewable energy technologies, time and labor saving devices, forest and agriculture activities, and employment opportunities. It is measured by six domains: time, income and assets, health, leadership, education and knowledge, and food security. The W+ program trains a project coordinator who is committed to ensuring the success of the project. After learning about this, I wondered whether W+ could sponsor the installation of the Bhungroo technology. The Bhungroo technology would fit into the forest and agriculture category. It would also save time and labor as women do not need to travel long distances at the expense of their health, or need to barter the little that they have for a water source as the Bhungroo technology itself becomes a water source. It would also be in the domains of health, time, and food security, making it eligible to be sponsored by Wocan and its W+ program. I understood that the Naireeta Services already had a grant system, but by having it also be sponsored by Wocan so that W+ points can be purchased for it, the technology would be made accessible to even more people.

After studying and researching a few more organizations through the UNFCCC and interviewing both Jeannette Gurung of Wocan and Trupti Jain of Naireeta Services, I decided

that combining their two programs would help women combat the disparities they face in climate change. When I told this to Dr. Christoff, she asked if I believed it could help areas such as Turkana County in Africa, which is near where I lived in the summer of 2017 and where Stony Brook University has a research institute. I thought about what I know of the area and the people from my experience in Tanzania and responded, “Yes. I think this could really help them.” That’s how the last part of my paper came to fruition. What was also exciting was that, prior to COVID-19, Dr. Christoff was planning to travel to the SBU’s Turkana Basin Institute (TBI) to see if my idea could work..

Upon learning that this could actually be tested, I wanted to make sure 100% that this idea was plausible in Turkana County. Naireeta Services has a strict criteria -- including seven steps that I describe later in this paper -- before the Bhungroo irrigation technology could be installed. This prompted me to interview Acacia Leaky, Technical Director of the Turkana Basin Institute (TBI) and Professor Kamazima Lwiza in the School of Marine and Atmospheric Sciences (SoMAS) at Stony Brook. After analyzing their responses, I realized that, due to the water shortage in Turkana County, the Bhungroo technology would be beneficial for the area if it was modified to fit the lifestyle of pastoralists.

The Bhungroo technology is tailored to poor farming communities. It’s basically a large water storage tank that is used for irrigation. After interviewing Acacia Leakey and Professor Lwiza, and learning that the people of Turkana County are pastoralists and very few of them own land (beyond a few acres), I had to determine whether there was a way to modify the Bhungroo technology system to a pastoralist lifestyle.

Change always has backlash. It’s simply not plausible to assume everyone in the community is going to want to change, and it’s not our place to force them to do anything. However, it turns out that Naireeta Services had developed seventeen versions of the Bhungroo

technology to adapt to a range of climates, which led me to propose a version that fits the climate of the Turkana County to include a more sophisticated filtration system so that the water stored is viable drinking water for humans and animals alike. Already, the water from the technology is drinkable, but as the water may be sitting in the tank for a while, a more sophisticated filtration system is needed. This would be extremely beneficial to the people of Turkana County because the nearby Turkana Lake is too alkaline to provide viable drinking water.

The Bhungroo technology would provide a consistent water source for the people and, because it can only be owned by women, African women finally would be able to have a position of power in their communities. They will need to be consulted on anything water related, increasing the respect the community has for them. Finally, people will start listening to their grievances and give women a platform to voice what needs to be done in order to combat climate change. This is a sustainable solution that does not require the women to do any more work than they are already doing, and it would not be a financial strain on their families. They will be able to finally have a say and have an opportunity to be respected in the community without additional costs.

As confident as I am in this project, I am curious to see how the people in Turkana County will react to it. I also wonder if the land is geologically viable for the Bhungroo technology to be implemented. My biggest fear is that the men of Turkana County would not let the women be in a position of power. According to Dr. Lwiza, “Women have no power. It is a male-dominated society. Widows are married/inherited by the husband’s brothers or paternal cousins” (Lwiza Interview). There is also the factor of inter-tribal fights that occur in the area. I’m not sure if the Bhungroo technology would raise or ease those tensions; and any type of vandalism to the technology due to this conflict will be very detrimental to the entire project. All of this would need to be discussed when a Bhungroo representative goes to the area to explain

the technology. A native leader should also be informed of all of this beforehand, so there is no language barrier, and so any concerns that could be brought up can be ironed out. We cannot control everything, but by having someone the people can relate to on our side can only help the progress of the project.

This research project expanded my knowledge in terms of how increased heat as a result of climate change affects the biologies of women. I knew that everyone was adversely affected by climate change; but I never realized that women, as child bearers, have more challenges adapting. In addition to the biologies, one scholar pinpointed institutional inequities: “Women in the South will be affected more by climate change than men in those countries; and men in the North pollute more than women,” (Arora-Jonsson, 2011). That is, men make up the majority of the polluters, but it is the women who suffer the most. In the course of my research, I also learned how to bring different types of information sources together -- including interviews, NGO websites, and academic research ---and propose an “optimal” solution. It was exciting and intellectually stimulating to combine the Bhungroo technology from Naireeta Services with the W+ points from the Wocan to create a sustainable cost-free method to benefit women facing water scarcity in rural communities; and then apply that to Turkana County in Kenya. I benefited from interviewing **Acacia Leakey** at the Turkana Basin Institute; **Kamazima Lwiza** who has conducted field research in the region; **Jeanette Gurung** who founded and established Wocan as a 501(c) 3 organization; and **Trupti Jain** who co-founded Naireeta Services with her husband, Biplab Paul, and developed the Bhungroo technology. From these individuals, I was able to reflect upon the project’s feasibility, and the impact that a 501(c) 3 could have in implementing a climate change adaptation program.

My research paper is intended for three specific audiences: the people of the Turkana County, NGO’s, and medical personnel. This idea is tailored to the community of Turkana

County, so this paper would be used to educate necessary authorities for approval of the project. It would also be used to explain to the Turkana people about the proposed project, which requires cooperation of the community.

Secondly, gaining the support of the many NGOs that advocate for gender equity and environmental sustainability would provide global incentives to spread this idea to other areas with water scarcity, and empower women all over the world.

Third, the medical community needs to have a greater understanding of how climate change affects the health and well being of people at all levels. New diseases and diagnoses are discovered often because our bodies are not used to the changing environment. I knew that climate change has adverse side effects, but I was horrified to read just how debilitating it is for child bearers. Medical personnel need to be educated on such topics, and researchers in the field should look for practical solutions to create a better tomorrow for women.

Introduction to the Research Project

While climate change is a global problem affecting all, research has shown that it negatively impacts women more than men, especially in rural communities (Arora-Jonsson, 2011). According to the World Health Organization, “Globally, a total of 1.3 billion people in low- and middle-income countries live below the poverty line, 70% of whom are female” (WHO, 2002). This is due to the lifestyles of rural women, who regularly use wood-burning cookstoves, and the biologies of women, as their bodies are not built to adapt to climate change. One example of this difficult adaptation is that women dissipate less heat through sweating than men, which causes conditions such as stillbirth and congenital birth defects, along with hypertension.

Scholars, governments, and organizations such as the National Communications and National Adaptations Program of Action attempt to address this problem by advocating for placing women in leadership positions (Preet et al. 2010). However, according to one authority in the field, Jeannette Gurung, poor, rural women are frustrated by the apparent disregard for the work they already do, and respond as follows: “Don’t even talk to us about taking on something else. Don’t talk to us about income-generating projects because we do not have a single minute left in the day” (Christoff and Sommer 2019). In essence, the investment of time and energy is too large, and families would not survive a vast re-ordering of women’s roles. Also, According to Trupti Jain, co-founder of a climate-change NGO that focuses on empowering women in India, traditional societies are slow to change:

The 70th Amendment is saying that at least 33% of the seats for the Penjyad (the village governing body) are reserved for women only. What *was* happening was that the dummy candidates had been put on the Penjyad because men don’t know that the seats were reserved for women; and, even if they did know, they don’t know how to work it out and make the decisions. So, in the name of the women, only men were always working in the Penjyad (Christoff and Sommer, 2012).

In addition, women would not speak out against their male counterparts, because they lack formal education and do not have the skills -- or access to training -- to enable them to take on leadership roles..

Even though scholars, governments, and communities would like to place women in leadership positions, success stories design work plans that fit into work that women are already comfortable doing. In this paper, in order to lay the foundation for understanding how to implement successful programs that would be realistic and empowering for women in Turkana County, Kenya, I first review the scholarly literature that combines women’s vulnerability in

climate change and their roles as agents for social change. Then I discuss and analyze two successful initiatives that were showcased in the United Nations Framework Convention on Climate Change's (UNFCCC's) *Women for Results* program. The first initiative, Bhungroo, is an irrigation technology developed in rural India; and the second initiative, W+, was developed in Nepal to pay women for using environmentally-friendly technologies. By combining both the Bhungroo technology and the W+incentive system, I propose ways to address the situation of rural women in Turkana County to empower them to become community leaders and improve the living conditions of their families; and present a "model" to address the problems faced by women in rural Kenya.

Literature Review

Climate change has a grave impact on the human population, more so on women than men. This is not to say that men are not negatively impacted by climate change; but women are simply impacted to a greater extent, especially poor, rural women. As Arora-Jonsson put it, in India, "the women in the south are affected the most [by] the men in the north that pollute the most" (2011). The men who are able to work in urban areas and capitalize off of factories and other pollution-inducing industries do not know or care about the repercussions of their actions. It is making them money now, and that is what they are focusing on to survive. They do not realize that they are adding to a women's daily health struggle, because it is a means of life or death for them. What they do not realize is the true cost of this lifestyle. According to the World Bank Group, "economic gains have been coupled with a near doubling of CO₂ emissions per capita, and the benefits of industrialization have been unequally distributed among the population (2018a, 2018b). The net result of these changes is that women, especially those in poverty, are at a higher risk of enduring negative health consequences associated with

wide-spread impacts from emissions of heat trapping greenhouse gasses (GHGs), now and in the future (Sorenson, 2018). No one is pursuing action against industrialism because the negative effect is not immediate, it is simply detrimental in the long run. This is a topic that has only begun to recently gain interest, as the negative effects of industrialization and the climate change that comes from it are affecting the environment to an extent that is becoming harder to ignore. It has been found that climate change specifically has a greater negative effect on women than men in India, as it pertains to heat impact, air quality, disaster-related impacts, food insecurity and malnutrition, water scarcity and water-borne diseases, and vector-borne diseases (Sorenson et al., 2018).

In terms of heat impact, the average annual temperature in India by 2030 is projected to increase between 1.7-2.2 compared to the average temperature in 1970. Women have a biological vulnerability here where they are unable to dissipate heat as well as men do. This leads to a higher metabolic rate and decreased radioactive cooling caused by having a thicker subcutaneous layer (Duncan, 2006). For a pregnant woman, prolonged exposure to higher temperatures is associated with, “still birth, congenital birth defects, and preterm delivery regardless of maternal ethnicity or age, with younger mothers having an even higher risk of negative outcomes,” (Balbus & Malina, 2009; Basu et al., 2016; Ha et al., 2017; Strand et al., 2011; Van Zutphen et al., 2012). It is also associated with gestational hypertension, preeclampsia, and poor neonatal outcomes (Kakkad et al., 2014; Makhseed et al., 1999).

Poor air quality can cause endothelial cell dysfunction and oxidative injury, aggravating cardiopulmonary disease, leading to cell death. When the pulmonary deposition of inhaled particles was analyzed, several experiments showed that the negative health effect is greater on women than men. The intima media thickness of arteries in women was studied and found to

significantly correlate with ambient levels of PM_{2.5}, whereas it did not for men, showing that women are at a higher risk for cardiovascular complications (Künzli et al., 2005). Women also have higher rates of anemia which can lead to women being more, “hematologically sensitive to the toxicologic influences of airborne pollution,” than men (Sorensen et al., 2003). Women are usually exposed to more air pollution than men, as they cook over an open fire, or use a biomass in their homes. This is especially true in rural areas where resources are strained. This increased ambient air pollution that women are disproportionately exposed to has been linked to issues with pregnancy, It has been linked to congenital birth defects, stillbirths, and intrauterine growth restriction, which is thought to be caused by placental hypoxia or the toxicity of air pollutants. (Glinianaia et al., 2004; Ritz et al., 2002; Šrám et al., 2005).

In India alone, researchers have determined that “shifting rainfall patterns, increased rates of evaporation, and population growth are projected to result in an additional 1–4 billion individuals exposed to drought by the end of the century” (Watts et al., 2017). According to a 2015 study, only 62% of urban communities and 28% of rural communities have access to improved sanitation (World Bank Group, 2018a). This disproportionately affects the chance of a woman contracting a water-borne disease, as traditionally women have the role of providing water for the family. This is particularly detrimental when a woman is pregnant or menstruating, as an increased standard of hygiene is necessary at the time, especially because women are then more susceptible to diseases (Birch et al., 2012). When water is scarce, it is estimated that at least thirty percent of a woman's daily energy is spent on harvesting water (WHO, 2014). The manual labor involved in harvesting water can cause chronic skeletal pain from repeated damage to the neck and spine. This is exacerbated the farther the woman needs to travel to actually obtain the water. It also, “increases exposure to heat stress and heat stroke,” and increases the chance of a violent crime happening to the woman (Jalees, 2005). There are many proposed solutions to fix

this water scarcity and sanitation issue. One that has a direct impact in the rural community where it is implemented is the Bhungroo technology. [For further information on the medical ramifications of climate change on women's health, see the Appendix at the end of this paper.]

Bhungroo Irrigation System (Technological Solution)

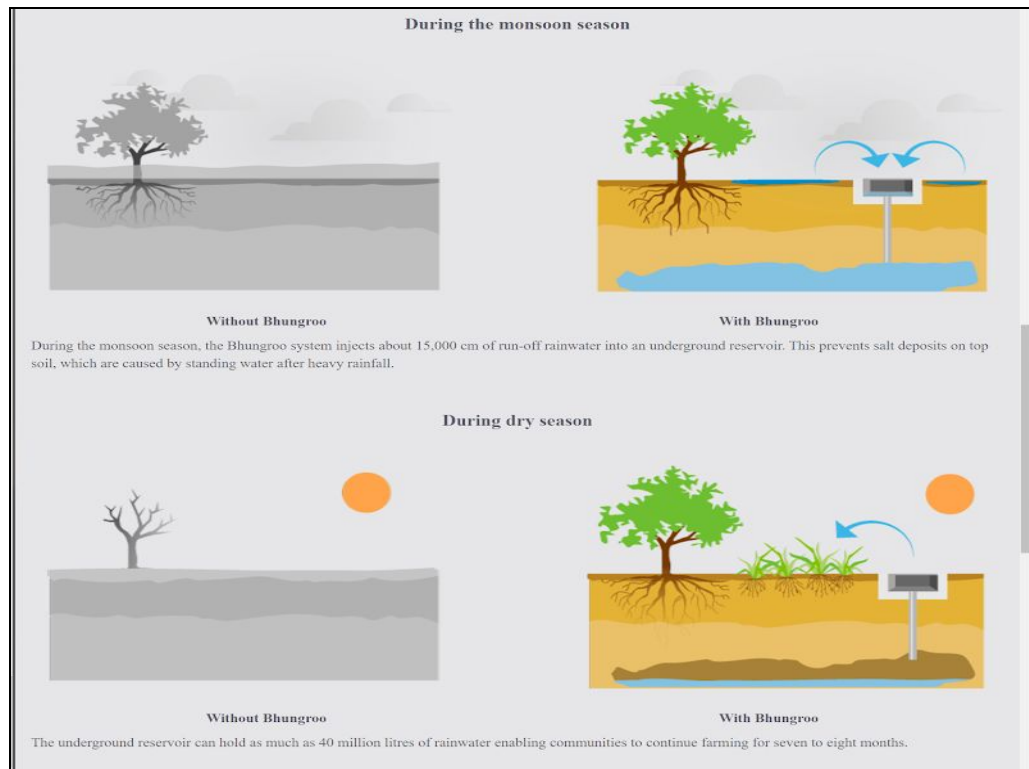


Figure 1: The Effect of the Bhungroo technology during monsoon season and dry season unfccc.int/mfc2014/lighthouse-activities/women-for-results/bhungroo/

The Bhungroo technology is an innovative water conservation technology that filters, injects, and stores excess farm water or stormwater underground for usage in lean periods (Jain and Paul, 2020). This is ideal for areas where rainfall is unpredictable, as up to 4 million liters of water can be stored during monsoon season/excessive rainfall, and then saved for drought season. As shown in Figure 1, the water stored from the excessive rainfall allows the farmland to become more viable and fertile during the dry season.

There are seventeen designs of this technology to best adapt to an area's needs, and all of the designs have a zero water footprint (Jain and Paul, 2020; Bhungroo: India, 2020). Each design guarantees productivity for over twenty-five acres of land per year, allowing the owner to pay off the cost of the device in less than two years after installation. The application process, represented in Figure 2, is a seven-step process. Co-founder Trupti Jain describes the process likewise:

It is actually a pretty long process to assess and install the Bhungroo technology. Our team then assesses the farm land presented, to see if the Bhungroo technology can even be installed in the land. DPL or APL and how the farmers are living is the second screening. We basically must see if they need this technology and can use it based on their lifestyle. The third screening is a more intensive survey of the Bhungroo facility. The fourth screening is a geological screening of the farmland presented. After that, the standard operating protocol is gone over, and the town officials must sign off on agreeing to have this system installed. Then we must ensure land ownership, and after that we go through and require a lot of documentation for the technology (Jain Interview)

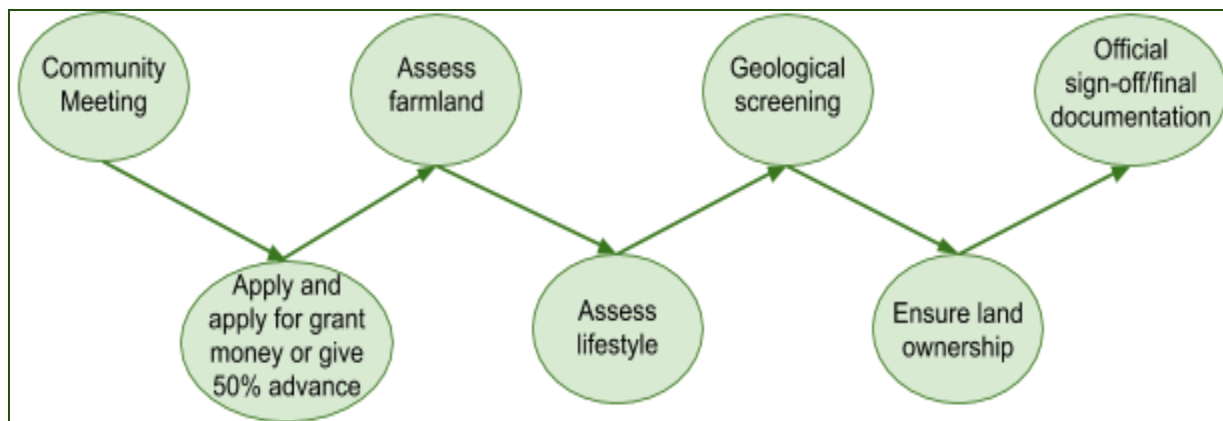


Figure 2: The seven steps it takes to get the Bhungroo technology installed in the area

Initial payment is only accepted after this process is complete to ensure the viability of the technology in the area. If the area cannot afford the technology, grant money is available through the social enterprise, Naireeta Services.

Over 50% of the farming community is constituted by southeast Asia and Africa, which is the intended audience for the Bhungroo technology (Jain and Paul, 2020). The first Bhungroo device was installed in 2007 in Gujarat, India. In Gujarat, as in many places, women cannot purchase land in their name. Co-founder Trupti Jain describes this in the following manner:

Women actually cannot have land in their name. In Gujarat, actually in all of India, very few have fought against the mold too. Only 3% of women in Gujarat own land in their own name and only 3-13% of women in all of India own land in their name. The local governing body simply won't give land in the name of a woman in Gujarat. That's why we made Bhungroo only available to be owned by women. Women are the only people that can have the water rights of the Bhungroo project. (Christoff and Sommer 2018)

In times of water scarcity, villagers come to the women who are official leaders. This increases the income of the women as the water is usually bartered for a share of crop, as most of these villages are bartering communities. This also earns them dignity and respect in the agriculture community, and the village as a whole. Although the land these women are cultivating is in the name of their husband/brother/father-in-law, the women themselves gain credibility and become significant: The village understands that these women are sometimes the only means of water. For this reason, men listen to women's concerns and are considering their opinions in decisions, where they would disregard them before. Women can use this to voice their opinions on ailments against women due to climate change.

Table 1 shows that the project's advantages outweigh its disadvantages. Although it may be difficult to bring five women together, this project helps five different families almost triple their annual income. The technology also guarantees crops for two seasons of the year for the next thirty years, which brings great relief to farmers in environments with unpredictable levels of rainfall. Women may not be able to own land in every country; but only poor women can own the Bhungroo technology, which serves to empower them in their communities. This technology

is supposed to be an investment but, without grant money, the installation price may be unattainable for many farmers. Because of this initial expense, another program needs to provide a structural foundation as a financial incentive to support the women. This is the reason Wocan’s W+ is a vital part of the proposed model in this paper.

Advantages	Disadvantages
Sustainable	Only for rural communities
Increases income from 210USD to 700USD	Must have some rainfall
Fully women driven	Breakeven in 3 years/ is expensive to implement
Tank holds 40 million liters	Can’t pass off to sons because only women can own it
Only for the poor	Only for the poor (what if deserves it but doesn’t make the cut)
Helps 5 women per system	Need group of 5 women for system
Guarantees cropping for two seasons of the year for the next 30 years	Women must have own land (unlikely) or cooperation of husband/brother as land is in the man’s name
Tailored to extreme monsoon/drought environments	Have to trade share of water or crops for seeds if bartering community
	Depends on the agreement and cooperation of the men in the community
	Long, intensive seven-step application process

Table 1: Advantages and Disadvantages of the Bhungroo technology

Wocan W+ Standard (Financial Incentive)

The Wocan W+ Standard works around the patriarchy by endorsing projects by women “that create and increase social and economic benefits for women participating in economic development or environment projects, including those that provide renewable energy technologies, time and labor saving devices, forest and agriculture activities, and employment opportunities” (Gurung, 2020). These endorsements are sponsored by companies from around

the world who are looking to combat climate change and are relatively cheap. The cost per W+ unit (minimum donation) varies per project, as each project has a different cost for implementation but for current projects it is approximately three dollars (WOCAN, 2019). This gives women both the resources they need to combat climate change and the capital to make a sustainable, long-lasting difference. Women's empowerment is measured by the W+ in six domains: time, income and assets, health, leadership, education and knowledge, and food security (Gurung, 2020). Because the model proposed in this paper focuses on the African continent, Wocan's Solafrica Bokpoort SCP Programme in South Africa is particularly relevant because it includes water supply systems. According to Wocan's project description, Solafrica Bokpoort is in the process of implementing, "a series of activities benefiting women, including water supply systems, solar lightning, soup kitchens and feeding groups, training and counseling on primary healthcare, substance abuse, gender-based violence and reproductive health, and an incubator for women-owned SMEs" (WOCAN, 2019). This project, which is similar to the one proposed for Turkana County, becomes certified after a trained project developer produces tangible results.

As shown in Table 2, the Wocan network is extensive and provides a great jumping off for the W+ points. Currently the W+ program is sponsoring projects in six countries: Vietnam, Indonesia, Morocco, Nepal, South Africa, Sri Lanka, Laos, Honduras, and Cambodia. All of these programs have relatively cheap units, approximately three dollars, that people can purchase to donate. To be approved as a W+ program, the project proposal for the initiative must be submitted by an organization, such as Naireeta Services. There is a cost to become a part of the W+ network, but it is the job of the organization to pay that cost, not the people in need. There is a main project developer for each W+ endorsed project that must send regular reports on the ongoing results of the initiative to ensure optimal success.

While the Bhungroo irrigation technology empowers women by teaching them how to farm their own land, the W+ Standard works around the patriarchy by endorsing projects by women that, according to the Wocan’s founder, Jeannette Gurung, “creates and increases social and economic benefits for women participating in economic development or environment projects.” (Gurung, 2020)

Advantages	Disadvantages
Incorporates six domains: time, income/assets, health, leadership, education/knowledge and food security	Didn’t mention a tangible incentive to buy points <ul style="list-style-type: none"> • Can write off on taxes, but no prize or anything like that
Buyers buy W+ points = money that goes towards women empowerment projects	Must be an organization to have a project proposal which can then be sponsored by W+
Has current certified projects in Vietnam, Indonesia, Morocco, and Nepal Has current registered projects in South Africa, Sri Lanka, Laos, Honduras, Cambodia, and Morocco	Not all of the money from the points goes to the women “at least 20%” <ul style="list-style-type: none"> • The rest of the money goes to the project developer to measure the success of the project and to pay for the activities for the women
Units are relatively cheap (\$3) <ul style="list-style-type: none"> • differs per project 	Initial cost: <ul style="list-style-type: none"> • \$2000 registration fee • \$1000 per applicable domains • \$1600 for the methodology approval process
109 countries involved, 1100+ women <ul style="list-style-type: none"> • wocan network not where W+ has been used • Lots of connections in this organization 	Doesn’t explain how they find groups/projects to fund/criteria <ul style="list-style-type: none"> • There is an application that is very detailed
Lots of literature/publicity, and was started in 2004	

Table 2: Some of the positive and negative aspects of Wocan’s W+ Program

Application to Turkana County

Combining the above two incentives allows women to bypass policy, as they themselves become the agents of social change, making it a more sustainable and more successful option to combat the negative effects of climate change on women in rural communities such as in Turkana County. As indicated in Figure 3, Turkana County has an arid climate that is very dry with little rain. Most people that live in the basin are pastoralists due to excessive water shortages. Most of the rain comes in April (approximately 50mm), but very little comes in September (approximately 2mm). There is a large lake in the area, but its water is alkaline and unusable (Lwiza). River water is one of the only sources of water for the over 50,000km² that make up the area (Leakey). As a result, most of the people there are pastoralists; and the few who own land grow crops such as corn, cotton, okra, sorghum, and cowpeas. According to Dr. Lwiza, “[the farmers] usually have very small plots, most cases an acre or less, but some go to 5 acres,” (Lwiza). Water scarcity dissuades residents from maintaining an agricultural lifestyle, which is one of the reasons farmers make up only a small portion of the population and pastoralists dominate.

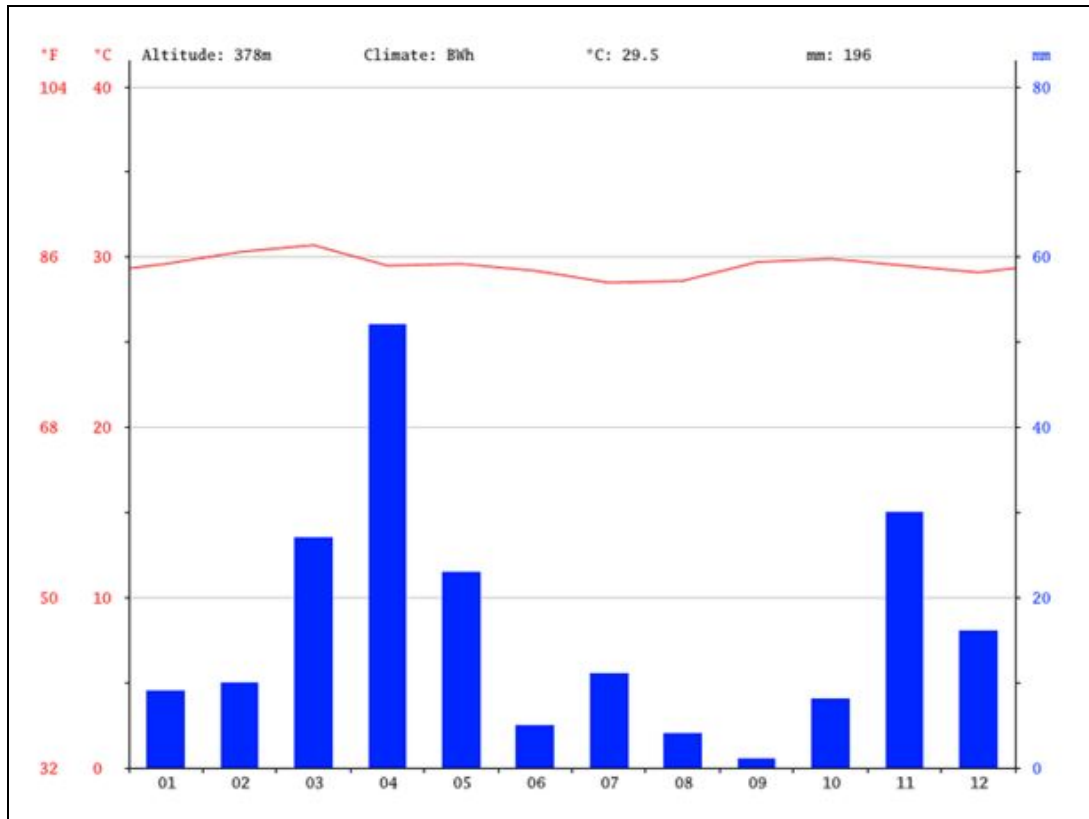


Figure 3: Average rainfall and temperature in Turkana County, Kenya per month, measured by millimeters and degrees Celsius and Fahrenheit respectively.

Most inhabitants of the region are nomadic pastoralists, such as the Maasai, Boran, and Rendille, who domesticate animals such as sheep and cattle (Fratkin and Elliot, 2001). While they rely on their livestock for everyday needs, these pastoralists face more demands in their lifestyle than ever before. Ever since the 1973 drought, pastoralism has been a life of poverty and dependence due to an increasing process of proletarianization in the countryside (Hogg, 1986). Pastoralists are losing herding lands to, “farmers, ranchers, game parks, and urban growth. (Fratkin and Elliot, 2001). This loss is magnified by, “increased commoditization of the livestock economy, out-migration by poor pastoralists, and dislocations brought about by drought, famine, and civil war,” (Fratkin and Elliot, 2001). As the Kenyan government pushes for privatization and individuation through international government programs, these problems only intensify. An

idea that relies on community, an idea like the Bhungroo project seems to be needed now more than ever before.

Plan for Implementation

The Bhungroo technology could be very beneficial to Turkana County in two ways. First, it could help current farmers irrigate their land, and, second, it can provide a stable water source for pastoralists and their livestock. The Bhungroo project is tailored to farming communities that need the technology for irrigation. It can be installed as is for their farmers. The Kenyan government has tried teaching irrigation methods in the area since its colonial days, the one thing that must be different in the way the Bhungroo technology is implemented is the communication. According to Acacia Leakey, other ideas have failed because of cost and lack of local support (Leakey interview). Furthermore, those interventions prescribed solutions to pastoralists and farmers alike, “without involving the recipients they intended to serve” (Akabwai, 1992).

That’s where the Bhungroo technology is different. Under Biblap Paul, the program management staff of Naireeta Services is involved in each area that the technology is installed. Their very first step is to have a community meeting to explain the technology and ask any questions (See Figure 1 above). They make sure everyone is on the same page before proceeding to the next step of the process (Jain interview). As for the financial incentives, Wocan could either debrief one of Bhungroo’s representatives, or send their own program managers to explain why there is no cost to the community, to show full transparency. The combination of these two ideas will give Turkana farmers a much-needed stable water source. It will also allow members of the community to work together to bring water to their small plots of land. The Bhungroo

project can only be owned by five women, so it is entirely possible that five families could work together and support one another through their agricultural journeys (Jain interview).

It's not practical to consider the possibility of converting a pastoral community into a farming community because of the stress it will cause to social cohesion, and the community overall. One way to utilize the success of previously established Bhungroo technology with the W+ program is to combine them and adapt the methods to a pastoralist society. The Bhungroo technology can be implemented as a water filtration tank rather than used as an irrigation system reservoir. This would allow the technology to adapt to the pastoralist lifestyle, and provide a steady water source for their families and livestock. The water tank may need to be modified with a better filtration system as the primary use of this would be drinking water. This would improve the quality of life for the pastoralists. They could also trade or sell the water. This would help fight the notion that, "poverty and dependence is becoming a permanent way to life to many pastoralists," (Hogg, 1986). By having their own water source for the community, the pastoralists would become independent from the cowboys and town-based elite that they currently succumb to. They would also have healthier livestock, improving their price and the owner's income, and they could trade or sell the water itself. Although this specific idea is novel, it could be extremely beneficial to the pastoralists of Turkana County.

In order to implement these ideas, it will be important to interview the women, their husbands and town officials for agricultural farmers and pastoralists alike. For optimal results, the community needs to be educated on the technology and how the process works. The husband and wife especially, need to reach a similar understanding of the project for the idea to work. If a husband doesn't support her wife or the town official tries to loot the families it won't work. As this is the first implementation of such a technology in the Basin, someone should stay to oversee

it for a year. This will help work out any potential oversights. The W+ required progress reports will also be very helpful here in keeping track of the effectiveness and timeliness of the project. Dr. Christoff will be travelling to Turkana County soon to propose this project. Upon approval the project can start its implementation process and the first trial can commence.

Conclusion

While increasing temperatures, decreased air quality, and water scarcity are debilitating problems for all, women experience pregnancy complications and negative cardiopulmonary health, and are at increased risk for water-borne diseases. Scientific studies indicate that “poverty, gender inequality, insecure land rights, heavy reliance on agriculture, less access to education and information are among the principal reasons for their [women’s] vulnerability to climate change” (Yadev and Lal, 2018). The push for industrialization causes a rise in climate change, and women are increasingly susceptible to these negative effects, as their bodies cannot adapt to the changes as well as men can. To decrease the impact of these adverse effects, an immediate solution is required.

Naireeta Services and Wocan have been working hard for a solution to both empower women and address climate change. Naireeta Services developed the Bhungroo technology, which is a water storage system that can only be owned by women and is primarily for irrigation purposes for water-stricken areas. The Wocan W+ points is a pathway for projects to be directly sponsored by corporations looking to reduce their carbon footprint by endorsing female-centered climate change initiatives. Independent of each other, these organizations have made positive impacts all over the world, and are recognized by the United Nations for their work. The W+ project has helped 7,200 women in Nepal by providing biogas digesters, saving the women 2.2 hours per day (UNFCCC, “W+ Standard: Nepal”). The Bhungroo technology has provided a

sustainable livelihood with food security for over 18,000 marginal farmers with over 96,000 dependents collectively in India (UNFCCC, “Bhungroo: India”). Although effective, both of these programs have a price tag that can seem unrealistic for poverty-stricken, rural villagers. This price tag could be mediated by combining the two initiatives. That is, W+ points can be accumulated to pay off the price of the Bhungroo technology. Specifically, organizations or corporations, for example, the LienVietPost Bank, could pay Wocan’s fees to initiate the project and, in turn, other sponsoring groups -- perhaps even college student groups -- could buy the W+ points to pay for the project (WOCAN). This two-step financial scheme would allow villagers to utilize the Bhungroo technology that empowers women by bringing their voices into local communities.

This idea is to be tested in Turkana County, where water scarcity is a major issue. The Turkana community is composed of farmers and pastoralists. While the farmers can use the technology as is, the pastoralists would need a modified version of the Bhungroo technology. They would primarily use the water tank to provide water to their families and their livestock, rather than for irrigation purposes. For this reason, a modified water filter may need to be installed with this water tank. The Bhungroo technology already filters water, but a new filter may need to be developed to accommodate for the alkaline water in the area.

By bringing together Bhungroo and W+ -- that is, the technological and financial initiatives -- the quality of life in Turkana County will improve. Women finally will have a say in their community. They are the only people who can own the Bhungroo technology, so people must come to them for water. They have an opportunity to earn respect in their community. The Bhungroo technology gives not only a platform to speak and earn respect, but also to earn for their families, to be in a position of power. Their usual duties of finding water will also be

decreased as they will have ownership of a water source. It is empowering for them, and it benefits their health. According to Trupti Jain:

Women took the lead not only in *Bhungroo* but also put efforts in negotiating with local government machinery to find and implement the appropriate government program within the village viz, the government programs focus on pond-digging work but the villagers know that that is not the right solution. So lots of money has been wasted. The women have seen this and now say that if they are in the panchayat, they can stop these kinds of things and work on what is needed” (Trupti Jain Interview).

This is the solution needed to start combating the adversities that women face because of climate change. It is sustainable, impactful, cheap, and can be modified to areas all over the world. With this idea, women around the world will not have to experience the adverse effects of climate change. We can save lives: Working hard today will make a safer tomorrow for women and the world.

Stony Brook Symposium

The power of a university community is unparalleled. When students from around the world band together on university campuses, they can cause a ripple effect and inspire action throughout the state, country, and world. The power of having a symposium on campus gives SBU an opportunity to attract the leaders of tomorrow that can inspire this ripple effect to help women who are crippled by climate change. Stony Brook is filled with a number of student groups that are passionate about this cause, as I learned when I reached out to them about attending the symposium that was to occur in mid-April before the COVID-19 pandemic hit. These groups included cultural groups such as the *South Asian Student Alliance* and the *African Student Union* that want to see their home countries prosper. Medical organizations such as *Doctors without Borders* and *Phi Delta Epsilon’s International Medical Fraternity* also are interested in decreasing the adverse health effects of climate change on women. Service clubs

and greek organizations such as the *Community Service Club* and *Iota Nu Delta Fraternity* on campus are eager to volunteer their time and raise awareness. The above-mentioned groups also can raise grant money for this project in conjunction with the NGOs at the symposium. By bringing people together from all over the world, student organizations have the power to lessen the global ramifications of climate change on women, and help make a safer world for them tomorrow.

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Appendix 1: Biological Effects by Category

My literature review relating to women and climate change initially started with charting the biological pathways in which women are negatively impacted by climate change events; the projected changes in the climate that presents challenges in India; the projected effects of these changes on women; and the enduring socio-economic vulnerabilities women will confront. This enabled me to consider on-the-ground solutions to the health adversities caused by climate change.

1. EXPOSURE PATHWAY
Increasing frequency of extreme heat events and rising average seasonal temperatures
Poor air quality from combustion of fossil fuels; increased ground-level O ₃ from elevated temperatures
Increasing frequency of climate-related disasters, including hurricanes, flooding and wildfires (Watts et al., 2017)
Shifting rainfall and temperature patterns impair crop, livestock and fishery yields, contributing to food insecurity
Water insecurity and increased risk of waterborne disease
Changes in temperature, precipitation and ecology are altering the geographic distribution of vector-borne diseases

2. CLIMATE CHANGE PROJECTIONS AND IMPACTS IN INDIA
Annual temperatures in India in 2030, compared to 1970, are projected to increase between 1.7 and 2.2 °C (Barros et al., 2014) resulting in more individuals exposed to extreme temperatures.
In India, there has been a 150% rise in air pollution related deaths over the past 20 years (Health Effects Institute, 2017). Without concerted efforts to reduce GHG emissions and other sources of air pollution, safe levels of ambient pollutants will not be achieved by 2030 (Dholakia et al., 2013).

Projected increased intensity of tropical cyclones along coastal regions of India, affecting highly vulnerable districts with poor infrastructure and high population density (Barros et al., 2014)

India is projected to experience increases in extreme precipitation as well as decreases in seasonal rainfall resulting in extended periods of drought (Barros et al., 2014)

Based on 2015 estimates, only 62% of urban communities and 28% of rural communities in India have access to improved sanitation. (World Bank Group, 2018a) Future impacts of heavy precipitation and drought (Barros et al., 2014) may worsen these conditions.

In India, several climate-sensitive VBDs are endemic, including Malaria, Dengue, Chikungunya and Japanese Encephalitis. Projected changes in climatic conditions are likely to alter the distribution and prevalence of these diseases (GOI, 2008)

3. WOMEN'S HEALTH VULNERABILITIES

Increased morbidity and mortality

Adverse reproductive outcomes including preterm delivery (Kuehn & McCormick, 2017), congenital defects (Van Zutphen et al., 2012), gestational hypertension, and preeclampsia (Makhseed et al., 1999)

Respiratory and cardiovascular disease (Beggs & Bambrick, 2006)

Adverse reproductive outcomes (Glinianaia et al., 2004; Pope et al., 2010; Šrám et al., 2005)

Women experience greater deposition of inhaled particles in their lungs (Beggs & Bambrick, 2006)

Secondary to higher prevalence of anemia women are more sensitive to toxicological exposure (Chen et al., 2005)

Women suffer disproportionate mortality and decreased life expectancy after during disasters (Kuehn & McCormick, 2017; Van Zutphen et al., 2012)

Women and girls are at high risk of physical and sexual violence, especially those belonging to marginalized sectors of society (International Federation of the Red Cross and Red Crescent, 2007)

Women giving birth in the time period following disasters have an increased risk of complications including preeclampsia, bleeding and low birthweight infants (Tong et al., 2011)

Women suffer higher rates of macro and micro nutrient deficiencies

Women are inherently sensitive to the effects of food insecurity and resulting nutritional deficiencies due to increased needs during menstruation, pregnancy and nursing.

Malnutrition leads to poor neonatal outcomes including intrauterine growth restriction and perinatal mortality (FAO, 2013)

Water scarcity forces provision from sources that may be biologically and toxicologically contaminated, resulting in bacterial, viral and protozoan infections as well as toxin exposure (Duncan, 2006)

Traveling long distances to procure water increases exposure to heat (Shiva & Jalees, 2005)

Lack of access to water and sanitation creates unsafe conditions for women, especially during reproductive times (Birch et al., 2012)

Infection during pregnancy can result in anemia and diminished trans-placental nutrient transport resulting in intrauterine growth restriction and increased vulnerability of the mother to hemorrhagic complications of delivery¹

Pregnant women have a risk of severe malaria that is three times as high as that of nonpregnant women (Steketee et al., 1996)

Dengue virus is associated with increased risk of cesarean delivery, eclampsia and growth restriction (Pouliot et al., 2010)

4. CULTURAL AND SOCIOECONOMIC VULNERABILITIES

Poor access to healthcare and cooling facilities due to personal safety concerns and lack of access to personal transportation.

Lack of communication and awareness of women's vulnerabilities to heat among local, national and even global decision makers and health care personnel

Dearth of gender disaggregated heat-related health data, unknown critical exposure windows

Culturally prescribed heavy clothing garments

Traditional indoor stoves for cooking and heating utilize biomass, which produces carbon monoxide, hydrocarbons and particulate matter and accounts for nearly 24% of ambient air pollution from PM2.5 (Health Effects Institute, 2018).

Women spend more time in the home and thus are disproportionately affected.

Women have unequal access to basic social goods and mortality is worsened when women have a lower socioeconomic status (Moosa & Tuana, 2014; WHO, 2014)

Women are often homebound caring for children and elderly while waiting for relatives to return prior to evacuation

Poor, single, elderly women, adolescent girls, and women with disabilities are often at greatest risk for abuse because they have fewer personal, family, economic, and educational resources from which to draw protection, assistance and support

Women suffer disproportionate job loss and stagnant personal economic recovery following disasters (Tobin-Gurley et al., 2010)

Poor access to obstetric care during and after disasters

Nutritional scarcity can be intensified by cultural practices that prioritize food provision to children and adult males.

In low-income countries, women produce between 60–80% of all food-livelihoods, as well as nutritional status are threatened when climatic conditions negatively impact agricultural yields (FAO, 2013)

Less than 10% of female farmers are landowners, and barely 2% have proper paperwork for their land (GDI, 2017)

Women suffer on account of their relative lack of control over farmlands and nutritional security

Traditionally, women have the household role of providing water for the family. Water scarcity equates to more time spent harvesting water and less time spent on other activities of livelihood such as economic gain

In some regions carrying water may use up to 85% of a woman's daily energy intake (Duncan, 2006)

Traveling long distances to collect water places women at risk for physical abuse and harm

Women spend more time around the house performing domestic tasks, which places them in close proximity to domestic standing water and mosquito breeding sites

Lack of access to prenatal obstetric care and assisted deliveries places women with infections at risk of postpartum hemorrhage and poor maternal outcomes, including death