

THE SOCIAL IMPACTS OF THE GREAT GREEN WALL IN RURAL, SENEGALESE VILLAGES

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ABSTRACT

The Great Green Wall (GGW) is a reforestation effort aimed at restoring degraded land conditions throughout the Sahelian region of Africa. Senegal has been leading the initiative, planting trees officially since 2008. As these trees grow, so too will the region's environmental stability. Variability in land-surface temperatures will decrease and new wildlife habitats will be created. The trees will also increase access to fruits and fodder for both humans and animals. The GGW will increase environmental security in the area. As with most sustainable development projects, its successes are intrinsically tied to the way it impacts the daily lives of the people it is aiming to protect. This paper is a review of that relationship and those impacts. As a top-down approach to natural resource management, an in-progress assessment is necessary in order to qualify and prioritize the issues surrounding the GGW, and thus ensure its long-term environmental benefits.

Keywords: Africa, desertification, Great Green Wall, Water Resources, Arid Environments

BACKGROUND

The north-central region of Senegal is home to the Great Green Wall (GGW)—a reforestation project aimed at restoring decades-old, degraded land conditions by establishing tree belts and community gardens throughout 11 Sahelian countries. It is a massive undertaking, of which Senegal has been at the forefront. In Senegal, the GGW is housed under the government's Eaux et Forêts (water and forests) division. With over two million trees planted each year, the local landscape and social institutions governing the lives of the people in this region have drastically changed.

A primary goal of the GGW is to improve the living conditions of the people of the Sahel, and reduce their vulnerability to climate change, climate variability, and drought (FAO-EU Partnership, 2011). After 5 years, what changes has the GGW brought to the daily lives of the local population? This study uses semi-structured interviews and personal observations to provide an in-progress assessment of the GGW impacts on local, social constructs.

Information obtained during these interviews demonstrates that the effects of the GGW on the daily lives of the people it aims to protect are varied. Gardening and economic components of the GGW seem to have made the most positive differences in the villages, increasing access to nutrient-rich foods on a regular basis and allowing for small entrepreneurs the opportunity to expand their businesses. Decreased availabilities of water and grazing areas, however, have prompted negative perspectives and feelings of marginalization by most village-level stakeholders. While these GGW naysayers have not formed any kind of collective-action coalition to protect their interests, they are typically the most vocal entities in the villages—indicating a sense of power at the local level, but an incapacity when dealing with such top-down approaches of development that directly affect them.

Historically, development projects that do not include the voices of the people they aim to help have been unsustainable—failing without continued support and influx of resources to the area. This in-progress assessment of the GGW is important in that its long-term successes are intrinsically tied to issues it brings to the local population. Once funding and/or project leadership leave the area, it will be up to the villagers to protect the millions of trees that were planted. If certain issues go unaddressed, the customary institutions governing the way the village stakeholders live (in terms of passing land down from generation to generation and accessing water for religious, livelihood, and survival reasons) have the capacity to undermine the longevity of the environmental impacts the GGW aims to instill, by cutting down the GGW trees for firewood or overgrazing cattle. For these reasons, the voices of the marginalized cannot and should not be ignored.

Introduction

Sahelian Environment and Land Degradation

As a semi-arid zone of climatic and environmental transition separating the Sahara desert of northern Africa and the rainforests in the continent's equatorial region, the Sahel is a fragile and dynamic ecosystem, highly dependent upon the amount of rainfall in a year as well as dramatically influenced by anthropogenic pressures. Drought-tolerant trees and shrubs dot the landscape, and vegetation is green only in the short rainy seasons.

The United Nations Environmental Programme (UNEP) formally defines land degradation as a significant, temporary, or permanent loss of ecosystem function or biodiversity. Anthropogenic pressures, such as agricultural and grazing practices; deforestation and poor resource management; climatic factors, such as droughts or floods; and combinations of both drive ecosystem degradation (UNEP, 1992). In semi-arid and arid ecosystems like the Sahel, land degradation can lead to desertification, an irreversible state of degradation in soil health (on a human time scale), due to climatic factors and/or human pressures (UNCCD, 2013).

Land degradation in the Sahel can be traced to historical socio-political change. Traditionally, nomadic pastoralists roamed the area to find water. This mobility distributed the environmental impact of their lifestyles across a broad expanse of land. Colonial powers altered this way of life by drawing national borders and limiting nomadic movement, concentrating the environmental impact of local people onto smaller spaces. Herders began settling, forming villages in the region. Their agricultural practices exhausted the soil of its nutrients, and overgrazing decreased the area's vegetal cover. As sedentary populations grew, so did demands for firewood, agricultural land, and fodder; subsequently, trees were cut down, further depleting soil health and productivity (Stewart, 2008).

Societies of subsistence farming and pastoralism still exist, although often influenced by colonialism and economic development prospects. The people of the Sahel are prime examples of such societies. Many are subsistence farmers growing millet, peanuts, and sorghum for their family's food for the year. Others are agro-, nomadic, or transhumant pastoralists, raising sheep, goats, and cows. Their livelihoods are directly tied to the productivity of the land, making degradation and desertification serious problems. Most do not make enough money to save for the future. Instead they rely on their animals as bank accounts, selling one when a family member gets sick or is married. When land does not produce sufficiently to keep these animals alive, the financial security of these people is detrimentally affected. Should the effects of a changing or highly variable climate destroy their natural landscape through drought, desertification, or flood, the economic and social security of these people would be indescribably jeopardized. Sustainable means of mitigating the effects of a highly variable climate, especially as it affects land productivity, are necessary to protect these vulnerable populations.

Great Green Wall Initiative

In 2005, the Nigerian president, Olusegun Obasanjo, introduced his vision of ecological restoration to combat desertification of the Sahel region. He proposed the development of a green wall of trees (Figure 1) to span the continent of Africa (15 km wide, 7,600 km long). The former president of Senegal, Abdoulaye Wade, was the first major proponent of the Great Green Wall (GGW), and is credited with its name. Starting the official

tree-planting phase in 2008, the country of Senegal has led the initiative into action. As of 2011, Senegal has planted 20,234 hectares (50,000 acres) of trees, roughly equating to 2 million trees each year. At the time of this study (summer 2013), the

project was currently taking place in the Lagbar, Mbar Toubab, Tessekere, and Widou villages, located in the Louga region of Senegal (northwest portion of the country) (Hertsgaard, 2011).

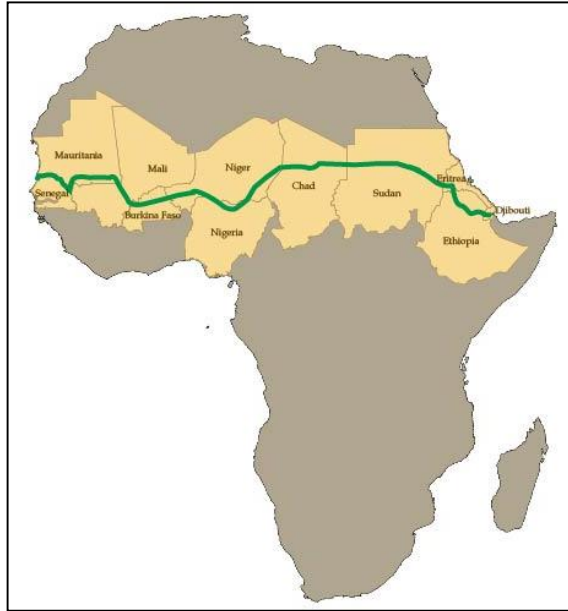


Figure 1: Proposed location (green line) of GGW through the Sahel.

In Senegal, two vital factors determine which trees are planted within the GGW. The first involves choosing trees adapted to the harsh climatic conditions of the region. Located in the northern interior region of Senegal, the project area is subject to high temperatures, which drive high rates of evaporation. The second factor affecting tree choice is the consideration of the inherent value of the trees to the local population. Villagers living and working near the GGW need incentives to not cut down the trees. In other words, the trees themselves must be more useful to or offer some kind of financial incentive for the villagers over the prospect of firewood or fodder for their herds of cattle and goats. For these reasons, the GGW leaders in Senegal have chosen several indigenous and naturalized species to be planted as part of the initiative. The most common species being planted are *Acacia senegal*, *Balanites aegyptiaca* and *Ziziphus mauritiana*. Each produces products such as fruits, berries, or gum useful to the local populations and their economies. Additionally, each tree chosen is relatively fast growing and drought tolerant.

The trees of the GGW are prepared and cared for in a large tree nursery within the confines of each participating village. Hundreds of thousands of polyurethane bags are prepared with soil, seeds, and water until it is time to transplant the seedlings into the ground. This tree preparation process occurs during the hot season months (March–July) and requires massive amounts of water to keep the seedlings alive in the hot climate. The project gets water from the community water basin at night and in the early morning in order to avoid direct competition with the local population, which obtains water from the borehole during the day.

The primary aim of this research project was to highlight the perceptions by the local population of GGW impact onto their daily lives in order to qualify and prioritize any issues that should be addressed to ensure the sustainability of the project. To guide this assessment, the author interviewed village-level stakeholders with questions that revolved around four common themes: water access and allocation, grazing areas and patterns, community garden impacts and participation, and the impacts felt by the local economy.

Materials and Methods

This research project took place in the Louga region of Senegal (Figure 2), with additional interviews occurring with the administration of the GGW in Dakar. The villages in the GGW-impacted region are predominantly Pulaar, although many of the GGW workers come from other areas in the country and are of other ethnicities, such as Wolof or Sereer. Community members are practicing Muslims, and most consider themselves transhumant pastoralists.

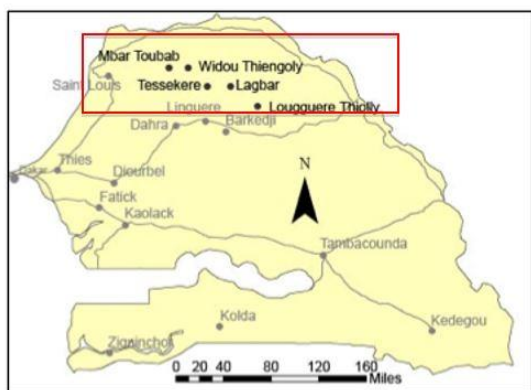


Figure 2: Map of Senegal, showing GGW villages in this study.

To determine whether and/or how the GGW has affected daily lives, conversations were held with stakeholders at all levels, including project administrators, GGW workers, NGO consultants, university researchers, and villagers. At the village level, interviews were informal, semi-structured conversations. All village-level interviews were conducted with confidentiality, and the names of the interviewees are respectfully withheld. Quantifying the exact number of interviewees at the village level was difficult due to cultural norms in the area. An interview that began with 1–3 people would draw a crowd (10–20) over the course of a few minutes (initially shocked that an outsider was speaking Pulaar)¹. Usually crowd sentiment would be in agreement with most if not all members, reaffirming the same viewpoints. Interviews with the administration in Dakar were more formal, and no confidentiality agreement existed at this stakeholder level, as these men were GGW officials. Each

¹ The author had previously lived in a Senegalese, Pulaar-speaking village, and can speak the language.

conversation was tailored to its particular audience, although some similar questions were asked at each stakeholder level. Interviews with most villagers and GGW workers were conducted in Pulaar, the local language.

In Widou Thiengoly, the author lived within the confines of the Eaux et Forêts (Water and Forests, the governing branch of Senegal's protection of water and forests), thus having easy access to the workers directly involved with GGW. Working in the tree nursery to help GGW workers plant or prepare seeds gave the author ample opportunity to see the productivity of their labor as well as the functionality of the project as a whole. It also proved to be a good time to informally ask questions about the project. Living in this center also gave her access to NGO staff and other contract workers who came to the village to investigate the progress of the project.

One lesser-known aspect of GGW is the project's implementation of community gardens to enhance nutrition in the area. Per Senegalese culture, it is rare for women to voice their own sentiments in community meetings open to both sexes. For this reason, the author had hoped that the community garden might prove to be a safe space, in which village women would feel comfortable expressing how the GGW had shaped their daily lives. The author spent many hours in the community garden, working with the women, talking to them, and asking questions. To get other perspectives, she walked to various villagers' homes and shops and spent time at the community water basin, making personal observations and conversing with the people obtaining water.

With Widou as a base, the author visited three other villages in the region (Mbar Toubab, Loughere Thiolly, and Lagbar) directly involved in the project, meaning they were the central locations for the project in their surrounding areas and housed the tree nurseries. In each village, she interviewed the director of the project for that village as well as ground-level workers of various jobs (i.e. tree nursery worker, women's garden manager). She also made an effort to speak to village-level politicians, such as village chiefs and local water managers, but travel between villages was difficult and time-consuming, limiting interview time in each village.

Results

The findings presented here represent the views of different levels of stakeholders and are subject to interpretation, as most are stakeholder opinions obtained from interviews conducted in the Pulaar language. Most conversations started with just a few persons (2–5) and quickly attracted several others who wanted to share their sentiments (+10 persons). In conversations with increased audiences, the attitudes shared by one speaker (positive or negative) were reiterated several times by the majority of members of the group. The resulting conceptual themes are most representative of Widou Thiengoly, given the author's time and experience in this one place. Questions and conversations posed in separate villages offered very similar results, however, making it easy to generalize the social effects from Widou to the surrounding villages.

Water

Water was the cornerstone of about 70% of conversations within each GGW village. Out of 50–65 conversations with village stakeholders, water was a major topic in 35–45. It was of special concern during the study because of the time of year. Water is pumped into a large aboveground basin. To get water for their families and animals, men climb up the basin and siphon the

water back down to their family members below, who then give it to their animals before filling up their own cisterns. The hot season yields no other opportunities or sources for villagers to get water outside of the borehole (community well) system. Additionally, water demands for domestic and animal needs (drinking, bathing etc.) increase during the hot season due to the extremely warm temperatures. The tree seedlings within the GGW tree nursery must also receive adequate amounts of water to survive the hot season. According to the Sergeant in Widou (in each village, the Eaux et Forets is run by a formerly trained man of the military, typically a Sergeant), the forage (water tower) pumps water directly to the Eaux et Forets campus for 2–3 hours every two nights. The pumping occurs at night so as to avoid competition with the population. The Eaux et Forets then pays for the water by providing gas for the pump. The forage manager in Mbar Toubab reported that payment for water amounts to about 800 liters of gas per week. When direct access to water via a pipe from the forage was not available or was not working, GGW workers instead went to the borehole every few days to get water by truck which they then delivered to the gardens, tree nurseries, and Eaux et Forets campuses for domestic use.

The quantities of water being sent to the Eaux et Forets were so great that the water pump oftentimes could not refill its cistern in time for the local people and their animals. This lag time in refilling the overland basin greatly affected daily life for the villagers. Because the borehole was the single water source for all the people and animals within a several kilometer radius (Widou’s borehole in particular was a watering point for everyone within a 16-km radius), the presence of the GGW had greatly increased competition for this scarce natural resource (Figure 3).



Figure 3: Villages getting water from the community water basin in Widou Thiengoly, Senegal. Photo taken June 2013 by the author.

Many villagers (approximately 20–30) claimed that they or someone they were close to had spent up to three days waiting to get water. One villager from 7 km away from Widou had been in the village for two days and had yet to get water. He said as

soon as he filled his basins he would return home where he would get one day of rest and then return to Widou to wait for more water. When doing so, he would leave approximately 40 liters of water at home for all domestic and animal needs until he returned.

Another village respondent was especially passionate on the matter saying, *we did not create climate change or poverty, yet the gesse (tree nursery), takes lots of water and leaves little for the population* (personal interview English/Pulaar/French). He went on to mention that the people of the Eaux et Forets themselves do not have to struggle for water, as water for the compound is obtained as an official act of the GGW. Other villagers expressed similar concerns: *The biggest difference in the village since the incoming of GGW is it brought problems with water, GGW is only problems, GGW has decreased the strength of the village, and the only problem here is water* (interviews, translated from Pulaar). These interviews indicate that the access and allocation of water in the area have been limited due to the presence of the GGW.

This struggle for water has left most villagers feeling hydrologically marginalized. One village stakeholder explained community sentiments with a simple story (translated from Pulaar):

Imagine you have 2,000 CFA (approximately \$4 US) to buy rice and vegetables for your family for dinner. Then imagine you unexpectedly have several guests arrive. You are excited to see them, but still know that you only have 2,000 CFA to use for dinner. You do what you can with the money, but you know that no one will be full. Then, those guests never leave. Your resources must be spread out over a greater number of people day in and day out. This is how GGW operates in terms of water. We like GGW, we like the project, but we still only have 2,000 CFA to spend on dinner.

Another village stakeholder expressed similar sentiments, highlighting that the GGW is taking their local resources, but that the project is not transparent and he is unsure of the overall purpose of the GGW.

There are currently plans to convert one GGW parcel planted in 2008 (halfway between Widou and Tessekere) into a nature reserve, complete with animals. According to a groundwater engineer contracted by the government, a new borehole would be built within the confines of the parcel to supply water to the animals within the reserve. Director of Technical Operations for the GGW, Papa Sarr, confirmed this plan, adding that there is potential to connect the new water source to the nearest village, Tessekere, to help alleviate some water problems there. At the time of this study, there were no other plans to alleviate water problems in other villages.

Gardens

The development of community gardens is a smaller initiative associated with the GGW. Each GGW village has a community garden, each of which is quite large and built with GGW money. They are run by garden managers, usually trained professionals from other parts of the country. This manager lives within the Eaux et Forets center. Under the manager, there are democratically elected garden officials (president, vice president, secretary, and treasurer: all usually female) who facilitate the selling of the garden's produce in the market. In rural, Senegalese culture, women are usually in charge of garden plots

(men are in charge of the fields). An estimated 692 women are involved in the current five community gardens (information from Papa Sarr, Director of Technical Operations for GGW).

In Widou, pipes, installed from the water tower to the garden, connect with a drip irrigation system to water the crops. These lines were not working during the study period, so women came each morning to water the plants by hand, collecting water from uncovered cisterns within the garden.

Unlike many community gardens in Senegal, which are without reliable access to a water source, water for these gardens is obtained as an official act of the GGW initiative, allowing them the capability of producing vegetables throughout the year. Depending on the season, the gardens can grow lime and mango trees, beans, eggplant, onions, tomatoes, and hibiscus, among a variety of other crops. Before the implementation of the garden, vegetables were only available at the weekly market. Now, women can take home produce much more regularly in exchange for a few hours of labor each week.

Women are in charge of garden maintenance—watering, weeding, planting, and harvesting. They are divided into groups. Each group comes on a certain day to water whatever crops are in the ground, harvest what is ready, and discuss what is needed for the garden with the garden manager. Meetings with all the women are held once a month to speak of upcoming plans and changes to the working schedule. Each garden the author visited was quite large and was fenced to keep roaming animals from trampling on the crops. The garden in Widou Thiengoly covered 7.5 hectares, and most of the gardens in other villages were of comparable size.

The garden in Loughere Thiolly was different. It had been established before GGW entered the area. Instead of community plots, each woman owned her own plot and was active as much as she wanted to be. What she produced on her own space was hers and she could use it how she wished. Participation in the garden was struggling as it did not have direct access to water and was 0.5 km away from a water source. Many women in Loughere Thiolly had given up gardening outside of the rainy season.

When the community-managed garden is harvested, each woman takes home a share of what is produced, while a share is sold in the weekly market (Figure 4). Profit from what is sold at market goes into the garden's funds. These gardens are important resources for villages, as they provide for increased nutrition year-round, as well as for leadership and educational opportunities for women outside of the home.



Figure 4: Women splitting the crop of onions for each woman's share. Photo taken in Widou Thiengoly, Senegal in July 2013 by the author.

The estimated productivity of the five community gardens from 2008 to 2011 can be seen in Table 1. Although equating to only 32 hectares total, the garden spaces have proved quite productive, generating an estimated revenue of almost 5,000,000 CFA (approximately \$10,380 US) between 2008 and 2011.

Table 1: Productivity of the community gardens affiliated with the GGW in the studied Senegalese villages, 2008-2011. Data are from information given to the author in June 2013 by Papa Sarr. Currency is in local CFA (556 CFA is approximately 1 USD).

Activity	2008	2009	2010	2011	Total
Village gardens (# of gardens and # of hectares)	N/A		3 gardens 17 ha	2 gardens 115 ha	5 gardens 32 ha
Number of fruit trees in place	N/A		2,370 trees	2,080 trees	4,450 trees
Vegetable production (in tons)	N/A		12,250 tons		12,250 tons
Revenue from garden (in FCFA)	400,000 CFA		1,430,000 CFA	3,055,000 CFA	4,885,000 CFA

Grazing

Another social aspect of the GGW is its impact on the quantity of land available for grazing surrounding the villages. Each parcel of the GGW is fenced and guarded daily, usually by a villager with a machete. The fences, which are meant to be removed from the parcels once the trees reach maturity, are to exclude animals and humans from trampling on the young trees. In an area where most of the population is transhumant pastoralists, such fenced-in places severely limit the amount of area a herder can take his cattle or goats for grass.

As of June 2013, seven villages were participating in GGW in Senegal. Workers of the Eaux et Forets in each village spend the year preparing the seedlings for transplant into the GGW. They also develop the lands surrounding the village to become the parcels in which these seedlings will be planted. Each parcel ranges in size from a few hundred to several thousand hectares. Parcel size depends upon how much money has been allocated to that particular village in that particular year. The Sergeant in charge of operations in Loughere Thiolly mentioned they had originally planned for 4,000 hectares to be planted in 2013. The administration then cut back on finances to this region of the GGW, and the parcel size decreased to only 500 hectares. According to Papa Sarr, the GGW in Senegal will eventually cover a total area of approximately 817,000 hectares.

Although the parcels for GGW are fenced off to exclude animal and human pressures, GGW has set up a system in which villagers can apply for a permit to retrieve grass for their animals from inside the parcels. They cannot bring their herds into the GGW land, but may bring in a horse and a cart to remove and collect the grass. According to the Sergeant in charge of in the village of Mbar Toubab, “if a villager needs grass, he can come into the parcel and get grass for free. He must get paper from me, but I am fair with the papers. I ask no bribes, no money, etc. I am here for the people” (interview done in English). The villagers, however, spoke passionately against this system—fuming that the land was taken from them (although no one officially owned it). When speaking to villagers on this issue, the author did not come across anyone who partook in the permit system to get grass for his herd.

A prominent village stakeholder, however, noted the reduction of grass and space available for animals to graze as one of the fundamental issues the GGW brought to the village (in his opinion, second to water issues). Another man mentioned that his herd had once been able to roam for 10 km to forage for grass and now they are contained to less than 5 km. He mentioned that, should someone’s animals roam into the parcel, without the owner having a permit, the owner would receive a ticket from the guard, which must be paid by bribe.

Economic effects of the GGW in participating villages

The GGW has increased economic opportunity in the villages in which it is based in three distinct ways: 1) job creation, 2) tourist revenue, and 3) the possible emergence of cell phone service in the region. In each village, the GGW has created 40–50 jobs. Many of these jobs are in the tree nursery—planting and caring for the seedlings—but other jobs include cleaners and cooks for the Eaux et Forets center, the garden manager, parcel guards, drivers, mechanics, and caretakers of Eaux et Forets animals.

The GGW employs both men and women, although job characteristics are highly dependent on gender. In Senegalese society, women usually serve as cooks and cleaners, but in the GGW they also work in the tree nursery (*pepiniere*). Their roles in the *pepiniere* are slightly different from the men’s roles. Women prepare and plant the seeds, while the men prepare the soil for the seedling bags and water the existing plants. Men are also responsible for building the fences to be placed around new GGW parcels. These jobs have increased, at the villager level, the amount of disposable income in the local economy (Table 2).

Table.2: Great Green Wall–related jobs and respective monthly incomes.

Parcel Guard	\$35,000 CFA/month (approx \$70 US)
Cleaning Lady	\$50,000 CFA/month (approx \$100 US)
Tree Nursery Workers	\$54,000 CFA/month (approx \$108 US)

A complaint that emerged from about 30% of villager conversations is the demographic of people who are getting these jobs. One of the most steadfast respondents claimed: *GGW is a family project*, implying that only friends and family of the Director General of the GGW can get the jobs that have been created by the GGW (interview, translated from English/French/Pulaar). Another village stakeholder said, *I don't have a friend in the forests* [Eaux et Forets], *so I don't have the work* (interview translated from Pulaar). A prominent man in the village said, *they must develop the locality* in order for the project to be successful, meaning that the GGW should use more of the local labor force. He continued, saying *I am a development agent in the village, and yet there is no collaboration with the local people* (translated from English/French/Pulaar). In Widou Thiengoly, approximately half of the workers involved with GGW were from the village itself.

Most of the GGW workers live in the Eaux et Forets compound, which gives them unique benefits. Those who live in the Eaux et Forets do not have to go to the borehole to obtain water for their domestic needs. Rather, water is either brought into the compound through direct piping or in large trucks. Additionally, their meals are prepared by the Eaux et Forets cook. Each resident pays 14,000 CFA (approximately \$28 US) per month for food. When visitors come to the GGW area, fancier meals are made for everyone in the Eaux et Forets compound for no additional charge.

The GGW is an internationally recognized initiative, and it brings hundreds of visitors to the area to study, record, and promote its endeavors. Visitors include government contractors, GGW contracted mechanics, and NGO workers. During the study period, the NGO, World Vision, held a conference in Widou for hundreds of Senegalese farmers to tour the GGW in the area. They came from all over Senegal and were in the area for three days, staying in large tents and sleeping on cots. When visitors came to Widou, meals were prepared by GGW staff, which usually employed a few more women than just the regular cook. Meals were a little fancier when guests arrived, almost always serving meat dishes paired with bread. These subtle acts inherently increase the overall demand for these products in the market, greatly boosting the incomes of villagers who sell them.

Travelers would go into the local shops to buy snacks, tea, phone credit, and hygiene items for the duration of their stay in the area, pumping revenue into the local economy. Additionally, souvenirs are an important aspect of Senegalese culture. When a family member takes a trip outside of the village, it is customary for that person to bring something back to the family. Often it is something small, like tea and sugar. It is not unusual, however, for a visitor to buy something larger when they go out into the bush, like a goat or sheep, as prices in rural areas are usually markedly less than prices for these same commodities in the cities. Although this study did not quantify the impacts of visitors on the local economy, a substantial amount of monetary exchange between visitors and local business owners was noticed during the study period.

An economic impact felt daily by the villagers themselves revolves around the emergence of cell phones. Cell phone service entered the area in 2011. There are multiple cell phone companies within Senegal, but at the time of this study the only company to serve the region was Orange. Some people, mainly the GGW workers, explained that cell phone service was instituted in the area because of the GGW. One of these workers (not a native villager) stated that people like him would come into the village to work for the GGW, but would not be able to call their families or the administration in Dakar to let them know how things were progressing. Other villagers disregarded this idea. One villager passionately said, *Cell phone service is not here because of GGW, but because there are CLIENTS willing to buy it here* (translated from Pulaar).

Discussion

Water

There is a Pulaar saying that, “a man cannot speak his mind until his herd has drunk water.” In a land dominated by meager and highly variable rainfall, and where pastoralism equates to livelihood, water is the primary concern of daily life. It is the driving force behind herd movements and it has influenced the recent sedentarization of nomadic lifestyles.

Historically, water was “open access” for nomadic pastoralists (Tisdell, 2003). They would come upon a watering point, take what they needed, and move on. Until the mid 1950s, pastoralists would only visit the northern-central region of Senegal (commonly referred to as the Ferlo or the Ferlo Desert) in the rainy season due to lack of permanent watering points (Valenza, 1975). Boreholes began being built in 1954, and by 1955, 50 wells could be found along the major herding routes throughout the Ferlo (Thompson and Adloff, 1958). Nomadic pastoralists could then expect year-round access to water in the region and many began settling around the new boreholes (Valenza, 1975).

At this point, water was still deemed “open access”—free for anyone to use however he/she needed it. To help prevent conflict between settlers and nomads, the government declared that all subterranean water should be state property and also should be free (UNDP, 2013; Thompson and Adloff, 1958). This declaration compelled the government to pay for all the fuel, repairs and staff required for each borehole, but it also equalized all users’ rights to water access.

Water management has since changed dramatically in rural Senegal, especially in the Ferlo region. By the 1980s there were over 180 wells, and the national government could not finance all their operations. It then handed control of water to local communities who created committees to manage the water system (Thompson and Adloff, 1958). Users began to be charged for their water consumption to help cover the costs of borehole maintenance and operation. This system is more or less still governing water distribution in Widou Thiengoly. In November 2013, the government announced that it would turn to private industry for maintenance and management of the rural borehole system (PEPAM, 2013). Implications of this new policy in the region are not yet known.

Instituted within this more formalized agreement among water users is customary law based on the norms and traditions of an Islamic, pastoralist society. Cows, goats and sheep are like bank accounts. All efforts to allow these assets to survive are taken. In the rainy season they drink from seasonal lakes. In the hot season, the herd is taken directly to the borehole to be watered. Here, family members distribute water to the herd before filling their own basins.

Many of these customs vary temporally, based on the season. During the rains, alternative access points for water are quite common. There are rainy-season lakes from which to withdraw water for laundry and water animals. It is also not as hot in this season, so animals and humans require less drinking water. Most households also practice rain catchment for domestic use whenever possible. Such practices alleviate pressures on the borehole system. During the hot season, everything needs more water and no alternative to the borehole system exists, creating increased pressure on the resource. Certain adaptations take place in order to accommodate this more stressful acquisition of water. Animals drink only every few days. Laundry is done less often. In many communities where water is difficult to obtain, gardening gets postponed until the rainy season. There is no written law mandating these practices, but this particular society recognizes their importance in order to ensure equity in water access for the religious and livelihood needs of all people.

Existing customary institutions are influenced when ‘newcomers’ enter the system (Meinzen-Dick and Nkonya, 2005). The dynamics of the new system will depend on power relationships. If the incoming entity enters an area with more power than the existing institutions, the system as a whole will change. If the incoming entity comes into the system with less power than the existing institutions, the system as a whole will stay intact.

Because GGW is a top-down approach to natural resource management and is run through the government of Senegal, it entered the area with much more power than the existing, traditional institutions. Because it held more money and influence, GGW was capable of shifting the power over water away from village-level needs in order to ensure its own success. The U.N. Human Development Report (UNDP, 2006) explained that, in times of water scarcity, it is the people who do not have a voice in the allocation decisions who first feel the effects of reduced supplies. Multiple community members, including village chiefs, showed evidence of this theory and spoke about the lack of transparency in the project: *I don't know what it (GGW) is doing or why it is happening. It needs to be transparent but it is not. It is taking our resources* (interview with a village chief, translated from Pulaar). The village leaders had no part in this decision-making process. GGW was sent to them without consultation. They accepted its presence, and have consequently been water stressed by its existence.

Access to a resource includes the ability to secure a minimum amount based on need (Gupta and Lebel, 2010). For international reporting purposes, access to water is defined as “at least 20 L/day of clean water from a source less than one kilometer from home” (UNDP, 2006). This definition already declares the thousands of villagers that live multiple kilometers from a borehole to have limited access to water. GGW has drastically altered this access for many others by taking massive amounts of water out of the borehole system at Widou Thiengoly to care for the seedlings in the tree nursery. The pump cannot keep pace with demand. The competition between the trees, humans, and animals is now too steep to fulfill all needs. Consequently, many families must wait up to three days to fill their cisterns and provide drink for their animals—most negatively impacting those families who come from several kilometers away to get water.

Such a change in access is extremely dramatic, forcing villagers to get less water less often. Doing so not only compromises families and herd’s health, but also entire livelihoods. During water scarce times, families often furlough certain domestic duties that are also considered preventative health measures, such as proper hygiene. This behavior pattern creates more pathways for sickness and disease. Sick animals rear less money in the market, jeopardizing families’ incomes.

Water allocation refers to the sharing of water as a resource, including its burdens and risks (Gupta and Lebel, 2010). GGW has affected this landscape in multiple ways. It has diminished the overall quantity of the resource to be shared, leaving less for the general population, and has unevenly distributed allocation difficulties onto the village population. Because villagers are spending more time waiting for water, typical daily activities are delayed, creating a sense of “time poverty.” “Time poverty” refers to the limitations and consequences of the time demand it takes to do labor activities that are essential for daily life (UNDP, 2006). By spending more time getting water, children and teachers are out of school longer and economic activities are delayed, linking time poverty to income poverty. Currently there is no formal contestation by the villagers towards the administration of the GGW. When asked about their hard times getting water, most villagers (including those who were most passionate against the GGW) merely claimed, *ko aduna tan* (that is the world or that is how things work). Although quite vocal about the problem, they do not seem to be actively protesting the presence of the GGW or its power over the water system.

Alternatively, because the GGW project is on the ground in this area and because it must have water to be successful, the government is more invested in the area than it was before and it shows a greater interest in keeping the water system functioning. Should something in the water system malfunction or break, there is likely to be unfettered governmental support, ensuring a quicker response to getting the system fixed.

Gardens

The women who worked in the gardens seemed quite proud of their work. The presidents of the groups of women gardeners in both Widou Thiengoly and Loughere Thiolly spoke of enjoying their work within the garden. The president in Widou comes in from two kilometers away to participate in the garden functions, and the president in Loughere Thiolly continued to be active in her garden plot, despite its distance from the water source. Such viewpoints seem to indicate a general desire to have and to be active in this part of GGW. Each day the author spent in the garden at Widou, as many as 20 women would come to water the plants and harvest its crops, spending at least 1–2 hours there. In this culture, women rarely have jobs outside the home. Their days typically consist of cooking, getting water, and taking care of family members—they rarely have free time. That women are spending these hours every week at the garden is an indication of the positive impact this aspect of GGW is having on the villages. Women are willing to take on the extra work of gardening for the prospect of better food for their families.

It also allows for them to have experiences leading and managing resources in a new way, outside the home. According to these women, the role of the GGW in the village was the garden and thus spoke positively of the GGW and its presence in the area, indicating a high potential for continuation of the garden after GGW officials leave the area. Their husbands and fathers, however, typically related the problems with water access and grazing areas to the implementation of the GGW to the area.

Grazing

Village perception about how much land is now closed to public access is relative, based on the person answering the question. It was difficult for villagers to quantify (in Western terms such as hectares or square meters) how much land they no longer had access to when I asked them how their grazing patterns had changed.

In regard to the lack of village participation in the permit system, the author made several observations. One day, she became lost in an unfamiliar parcel. In trying to make her way back to the study sites, she noticed several downed fences, spanning many meters. Such open access would make secret grass-grabbing quite easy. It cannot be said if this happened, as no villager admitted to doing so, but the possibility did exist. Another possible explanation is that the information about the permit system is not well known in the village. Certain parts of the population may not be privy to its existence. The people with whom the author did speak were knowledgeable yet extremely unenthusiastic about it. She did not speak, however, to the entire village population about this issue.

A more likely explanation for the lack of use of the permit system is the deliberate disregard by the villagers who choose to ignore the opportunity the system presents. Reasons for this disregard can be varied. This system was imposed upon these pastoralists; it was not planned *with* them, effectively leaving them feeling disempowered. In pastoralist culture, land, along with other natural resources such as water and wood, is typically considered open access. [Agro-pastoralist society is a little different in that herds are typically kept off of producing cropland.] In a Senegalese pastoralist society, however, a herd takes what it needs, and there is no exchange or payment necessary to a landowner. The visiting herd's manure helps to fertilize the field for the following rainy season. Typically, ownership of land in rural Senegal is not decreed by a legal document or title, but, instead, village elders decree it in a patriarchal fashion, making "ownership" more of a relative term rather than a legal contract.

Exclosed spaces not only severely limit the prospect of finding grass nearer to the village, but the system as a whole changes the very culture in which Senegalese pastoralists operate. It challenges the tradition-based ideologies behind land ownership and open access to natural resources, resulting in a population that feels marginalized by the presence of the GGW in its space. For these reasons, this issue, if not directly addressed, will cause the most problems to the long-term environmental successes of the GGW. When fences and guards are removed, cultural institutions will be reinstated. GGW lands will be requisitioned by the local populations. The needs for fires and building materials will prevail, and the trees will likely be cut down. To ensure sustainability, more participatory methods should be utilized when acquiring lands that will be exclosed to the public for tree stands. The GGW should also work to be more transparent with the local populations as well as educate them to the science behind planting trees as a means for soil remediation. At the time of this study, only a few villagers not directly involved with the GGW knew why the trees were being planted.

Economics

The GGW has pumped money and resources into the local markets since it entered the area. It has created and maintained jobs, while also increasing demand for local products. While not every employee is a native to the region, many are, keeping a good portion of that income in the villages. Additionally, the project brings in hundreds of visitors to the area each year, not only increasing demand for items, but also allowing for increased opportunities for cultural and intellectual exchanges.

The argument that the GGW workers brought cell phone service to the area is plausible, but not undeniable. The author did not have a chance to meet with an employee of Orange to ask why the company had entered the area. It is possible that the GGW administration in Dakar helped to influence Orange's arrival to the area, but cell phone reception is still a growing market in Senegal. Even today, it has not reached all villages, but it has grown tremendously in the recent past, making cell phone reception quite common throughout the country. Widou Thiengoly is the location of the area's weekly market and medical services. Phone companies often place cell phone towers in these kinds of villages. The continual influx of visitors to the markets and health posts is an indicator of a strong and dynamic customer base. This case has proven true in Widou Thiengoly and the surrounding villages, as most of the villagers (men and women) have cell phones and most shops sell cell-phone credit.

When the GGW leaves a village, economic influxes will decrease. Visitors will come less often, decreasing the demand for select items. Jobs will inevitably be lost, most negatively impacting the local villagers lucky enough to get a job with the GGW. It is the idea of the GGW administration that the local population will use the fruits and fodder provided by the trees to sell in local markets, increasing individual economies. Per Senegalese culture, most villagers do not actually buy these types of commodities; to them, bush-tree produce is a common good and they go out and collect them. If a villager did indeed decide to take up this economic opportunity, he would have to take these items to cities, whose populations would be more likely to buy them. The nearest road town to Widou Thiengoly is approximately 90 kilometers away on a rough bush-road, making such entrepreneurship timely and costly.

Conclusions

The social ramifications of the GGW can be seen in changes to daily life for the villagers. These changes especially revolve around participation in the community garden, increased economic opportunities, changes in grazing patterns for animals, and changes in water accessibility. Some of these changes – most notably, access to water and grazing lands – have the power to undermine the longevity of the environmental benefits the GGW aims to achieve. Addressing these changes is a vital step in ensuring the project's long-term success.

Lack of access to water was a central theme in all the villager conversations in Widou Thiengoly. In the hot season, GGW removes great amounts of water from the one water source in the village. The pump is not capable of keeping up with demand from the project as well as with demands from the population and their animals. Because the GGW comes from the government, its needs from the water system take precedence over the demands from the population. In doing so, it has effectively hydrologically marginalized the village population, instigating a sense of time poverty by elongating their quest for water and diminishing time for other potentially economically beneficial pursuits, such as education, business, or improved health. This

change in daily life was passionately touted as the major problem of the GGW presence in the area. Such inequities in access to water and the effects that that limited access brings to local households is not indicative of a sustainable means of development. It, in fact, threatens the very security of the local population.

The presence of the garden, however, allows for improved nutrition as well as increased economic opportunities for women. It also proves to be a place for women to take and experience leadership roles outside the home. Most women do not correlate issues with water to the presence of the GGW, but instead view the garden as its major impact. The opportunities it provides proves to be especially empowering for the women, ensuring long-term benefits past the age of the GGW.

Grazing patterns have changed due to decreased available land surrounding the villages. It is possible to get a permit to remove grass from within a GGW parcel, but this permit is either fictional, not well publicized, given nepotitiously, or ignored by the villagers. The acquisition and fencing of these formerly, publically used spaces is a direct slight against the cultural institutions governing the social constructs for land-use and land-ownership in the area. Village men tout that the exclosed spaces serving as the tree stands for the GGW are the second biggest problem the initiative has brought into the area (behind lack of access to water). These exclosed spaces will eventually open back up, and cultural norms will most likely fall back into place. Firewood and fodder will be gathered from these parcels like they always were. At the time of this study, there were no official coalitions or organizations formed to fight for villager rights to regional natural resources (water and land-space).

Economic opportunities have increased since the GGW has been implemented on the ground, although quantifying these impacts was difficult in only a short time in the study area. Added jobs include tree nursery workers, maintenance men, cooks, and cleaners. Once the GGW leaves the area, however, these economic influxes will likely diminish. Cell phone reception is new to the area (since 2011) and has brought increased phone usage as well as the sale of pay-as-you-go minutes to the area's businesses. Perceptions on why the cell phone company entered the area differ depending on the level of stakeholder. People working for the GGW believe that their presence in the area influenced the company to come, while other stakeholders believe that it was a matter of having clients in the region. Either way, its entrance to the region has dramatically altered the forms and methods of communication for these people.

Future research is encouraged on these social effects of the GGW, with an emphasis on how they change throughout the year. Water problems have the potential to be alleviated during the rainy season, as seasonal lakes offer a secondary source of water for animal needs and other domestic uses, such as laundry and cooler temperatures decrease the amount of water needed for drinking. Additionally, once the older parcels have trees mature enough to remove the enclosing fences, grazing lands will increase, allowing pastoralists easier access to grasses for their herds. With improvement in these problems, local perspectives on the presence of GGW may change, possibly ensuring the long-term benefits the GGW aims to achieve – villagers may even forgo cutting these trees for firewood, but only time and transparent communication between the GGW administration and village-level stakeholders will influence that story.

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