



# Feasibility of Water Distribution using a Bamboo Piping System in Matènwa, Haiti

An Interactive Qualifying Project submitted to Zanmite and the Faculty of Worcester  
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# Abstract

Retrieving fresh water in the village of Matènwa, Haiti is a daily challenge for its people. The villagers must travel for hours in order to retrieve water from a cistern. Providing a means of accessing readily available water in Matènwa, without onerous labor, is the goal of this project. Bamboo grows on the island and has been used elsewhere globally to help collect and transport water, so possibilities for cultivation were investigated and a development and implementation plan was proposed for the villagers.

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# Executive Summary

In the underdeveloped village of Matènwa, Haiti, residents must undergo daily hardships in order to survive. One of these hardships includes traveling for hours to retrieve for their families drinkable water from a cistern located miles away from the village. Typically women and children make the onerous trip with large jugs of water that they must transport, which is not only a difficult task to do on a daily basis but it also takes time when they could be focusing on improving their lives. Because traveling to obtain clean water is such a long and arduous daily task, a group of students from Worcester Polytechnic Institute (WPI) decided to see what can be done in order to help ameliorate the situation.

Bamboo grows on the island of La Gonave and we decided that it would be a good idea to look into the possibility of a bamboo piping system that would transport the water from the cistern. However Matènwa is higher in elevation than the location of the cistern, which would mean that the water would have to be pumped uphill in order for the villagers to be able to use it in Matènwa. Without a pump at the cistern it would be impossible for the village to obtain drinkable water from this source, however costs for a pump, among other considerations, made this option an impossibility for villagers who are without monetary resources. Other areas of the world have been documented to use roof-top catchment systems to collect potable water, thus we thought that a bamboo gutter system, constructed on the houses of Matènwa, is a much more feasible idea. With this system, individual homes would have their own rooftop catchment system made of bamboo, which would then lead the water through bamboo piping to either central or individual catchment.

Implementing any idea that is new to a culture is a very sensitive and difficult process. It is important to remember that the proposed bamboo piping system should only be suggested to

the people of Matènwa. The idea must be presented to them in a way that shows the benefits that they would gain from such a system, including children having the time to go to school and women to engage in micro-enterprises, and the villagers themselves should decide as a community how to implement it. Since the implementation of a water catchment system made of bamboo can produce numerous benefits for the people of Matènwa and knowing that water is such an important part of human survival, we feel that we are morally obliged to assist our neighbors in the Caribbean.

# Introduction

Off the western coast of Haiti sits the small island of La Gonave, home to about 120,000 people living in densely populated rural villages (*We Care for the Poor*, 2010). Due to overpopulation on an island that is only 287 square miles, La Gonave currently suffers from a multitude of problems that affect daily life, one of which is the scarcity of clean, drinkable water (*Earth From Space*, 2010). This particular problem is very well known in the village of Matènwa (see Figure 1 below), where some villagers must currently travel for hours in order to retrieve fresh water from a cistern located miles away. Given that on the island bamboo is already growing, there is a possibility of using the plant to help ameliorate water transfer by constructing a bamboo piping system to facilitate both water collection and distribution. Other water collection and conveyance innovations, rather than hand carrying the water from the cistern, should also be considered to alleviate the water problem. This project team considered both the use of pumps and the use of roof-top collection of rain water. We will recommend in this study that the village of Matènwa implement a system involving roof-top collection of rain water.

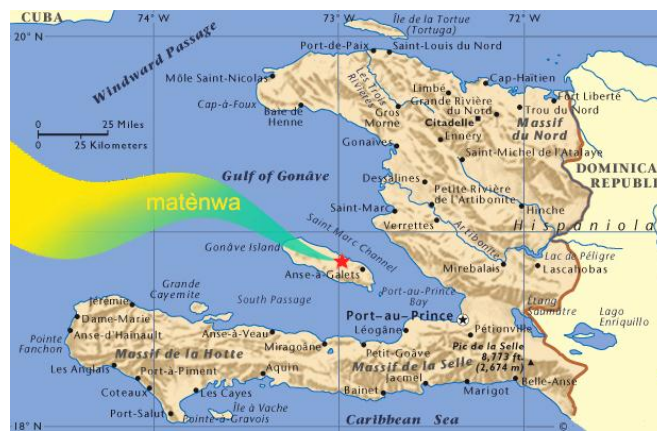


Figure 1: Map of Matènwa, La Gonave, Haiti (courtesy of [www.artmatenwa.org/links.html](http://www.artmatenwa.org/links.html))

The water distribution problem in Matènwa was brought to light by the Mangrove Fund and Zanmite, two organizations based in Portland, OR and Cape Cod, MA respectively. The Mangrove Fund and Zanmite have joined together in an effort to assist development in Haiti. The Mangrove Fund's mission is to help other organizations reach their goals of providing social and economic support to Haiti. Together these two organizations have assisted in the building and maintenance of the community center located in Matènwa, which is named Zanmite Sant Atizana, Creole for "The Zanmite Artists' Center" (The Mangrove Fund, 2010). Ellen LeBow and Lisa Brown from Cape Cod, MA assist in maintaining this center by traveling annually to Matènwa to aid local women in the production of unique painted artwork, such as silk scarves (The Mangrove Fund, 2010). Through their visits to Matènwa these women realized that the village faces many problems. In the spring of 2010, Brown presented a summary of the problems at Worcester Polytechnic Institute (WPI) in hopes that a WPI project team could propose a solution for one of the most pressing issues, the acquisition and distribution of clean drinking water. Some villagers must walk for miles in order to retrieve fresh water. Brown's photos from past trips to La Gonave suggest that the island is rich with uncultivated bamboo and due to this apparent abundance, we decided to study how bamboo may be cultivated and used for collecting fresh water from roof-top drainage systems with subsequent distribution of that water through bamboo piping.

Engineering and developmental projects must take into consideration the culture and society of the peoples they are to aid. It is important to focus on the empowerment of local people when developing such a project because that will give them the chance to develop their own ideas and desires into such a project. Because they are the residents of Matènwa, it is of course the right thing to allow these people to choose for themselves the solutions to their own



problems since whatever is decided will affect their daily lives. Moreover, water is a precious resource and disputes about its distribution can easily arise in any part of the world. There is the possibility of such disputes arising among people in Matènwa and also among villages on La Gonave with the implementation of any new water distribution system in Matènwa. Without encouraging local participation the introduction of a new way of doing things in their daily lives and culture raises the possibility that the people of Matènwa would feel as though they are being imposed upon, changing their lifestyle without their input. Examination of Haitian culture and society suggests ways of recommending innovations without having the people of Matènwa feel forced to abandon valued customs and practices. In order to sustain such a project after introducing it to the village of Matènwa, it is important to make sure that the villagers understand the project's benefits to the community. If the people of Matènwa choose to accept this project as a part of their daily life and integrate new water collection practices into their lives, it is more likely that they will work together to build and sustain a bamboo piping system. Likewise, the piping system's effect on surrounding villages should be carefully considered in regards to legal and ethical concerns involving the water rights and needs of other inhabitants living in other villages.

Research shows that a bamboo piping system is an idea that has already been implemented in other parts of the world, including a bamboo water distribution system in Orissa, India (Panda, 2008) and bamboo irrigation systems in Meghalaya, India (Water Harvesting). The fact that other parts of the developing world have already implemented the use of bamboo as a piping system suggests that such a system might work in Matènwa.

If nothing is done to help the people of Matènwa, then the water problem for the villagers will progressively get worse. With the problem of obtaining clean water continuing to worsen,

there could be an increase in the village mortality rate. If the people in Matènwa find no solution to this problem, they will consume the few water resources that remain until the island becomes depleted of fresh water. The proposed piping system constructed entirely out of bamboo can potentially ameliorate the hardships that the villagers of Matènwa must undergo on a daily basis in order to access fresh water. Giving the villagers the ability to remain close to home and still have easy access to fresh water can drastically change their lives by saving time with arduous daily chores. These benefits include, but are not limited to, allowing more children to attend school during the day and giving women more time to participate in small handicraft industries, such as those at the Zanmite community center.

We believe that given a chance to help those in need we are ethically obligated to assist these people. With so many suffering from unsafe living conditions and lack of clean water in Haiti, we as Americans, both individually and collectively, who no longer have to face these threats to good health, must not abandon those who still encounter these daily hardships. Many Americans do not realize that their easy access to clean water is a privilege and instead use an excessive amount of water every day, much of it going to waste. It is important to remember that not everyone is fortunate enough to live a lifestyle that most enjoy in the United States, thus highlighting the need to be more mindful with our own water use and at the same time help others who may lack access to a clean water supply. Therefore we hope that this project will aid the village of Matènwa to construct a bamboo piping system to collect water.

# Background

There are many features of a bamboo piping system that must be understood in order to make the proposed water collection and distribution plan in Matènwa possible. These include fundamentals about clean water and its conservation, different types of bamboo and their requirements for cultivation, key characteristics of different bamboo species that may or may not make them suitable for use in piping systems, Haitian history, culture and society, and professional practices among non-governmental agencies that promote the empowerment of rural communities. All of these diverse factors will play an important role in the sustainable development of this project.

## *Development & Political Failure: History of Haiti*

French and Spanish colonization of Haiti, as well as U.S. occupation and economic exploitation, contributed greatly to the lack of development of Haiti and to some extent the repeated political failures of the island. All of these great powers were more concerned with their national interests rather than the development of Haiti. Like in other Caribbean nations, the Europeans and Americans sought only to convert the land into profitable cash crops, such as sugar cane and tobacco, thereby destroying agricultural lands that could have produced crops for Haitians. They did not create an agrarian economy that would benefit all Haitians, but instead created profits that fell into the hands of elites who were closely allied with the economic structures imposed by the French and Americans.

A mixture of people infused with many cultures currently inhabits Haiti, a rural country that was first colonized by the French, who also transported thousands of Africans to the island

as slaves. European conquest began in the year 1492, when Christopher Columbus sailed to this small island in the center of the Caribbean and it became known as Hispaniola. Hispaniola was declared a French colony in the 1690s and was often used as a safe haven for pirates on the run in the Caribbean. Many early explorers considered this land to be capable of sustaining agriculture for both personal and commercial purposes, and major income developed on the island from tobacco and sugar. The Spanish also shared the island, for they settled in the eastern territory known as the Dominican Republic. Because of the overcrowding of the two colonies on Hispaniola, the French and the Spanish were often at war on the island, which finally ended with the Treaty of Ryswick in 1697. This treaty resulted in the French taking ownership of the western third of the island, which is now known as Haiti (Facts About Haiti And The Haitian Culture).

As news traveled about the potential profit that could be made in Haiti, many French colonists began to populate the land. By 1789 there was thought to be around 30,000-40,000 Europeans and Africans in Haiti. By the 1790s Haiti became the richest French colony in the New World, with business in the sugar, coffee, and indigo dye industries. As the wealth of the island increased, the need for slaves became more pressing; the first documented slaves in Hispaniola were in the 1500s (Haiti TimeLine). In the 1790s more slaves were being brought to Haiti and were habitually treated cruelly in accordance with the Black Code, which removed all rights from the slaves and made them the communities' property according to Articles 44 through 46 (The Code Noir [The Black Code]).

With news of the French Revolution arriving in 1789, the slaves also began to want equal rights and freedom, revolting completely against the Black Code (French Revolution). By 1791 the tension between slaves and their masters was at an extreme level and a bloody revolution

took place; the Haitian Revolution lasted for the next thirteen years (The Haitian Revolution). The slaves rose up against French colonists in a rebellion led heroically by a former slave named Toussaint l'Ouverture, which led to the removal of Spanish power on the western side of the island and the removal of the residing British colonists. L'Ouverture continued to fight the French and Spanish invaders who tried to regain power on the island until he was exiled and was followed in command by Jean Jacques Dessalines, who later became the first ruler of a newly independent Haiti (Jean Jacques Dessalines).

In April 1825 France recognized Haiti's independence. As a free country Haiti's status as the "Pearl of the Antilles" diminished into a troubled country with frequent economic and political instabilities (Brioché). Peasant society, where the peasants controlled their own land and produced crops for their own subsistence, quickly took over the island and still affects the land today, including on the island of La Gonave. In the early 1900s Haiti depended on its fertile land for economic prosperity and food, but as the population began to grow deforestation hit the island and resulted in about 70-90% of vegetation loss (Picariello). In the 20<sup>th</sup> century other countries began exploitatively intervening into a nation that was once considered the richest in the Caribbean. From 1915 until 1934 the United States occupied Haiti in an effort to stop political developments that it disagreed with that were arising in the country. Democratically no stronger after American occupation, and suffering from many political coups, Haiti fell in 1957 under the dictatorship of the Duvalier family, which many knowledgeable Haitians argue was a catastrophe from which it has not recovered (Haiti). Haiti has gone from one of the richest lands to the poorest country in the whole western hemisphere (Haiti North America) and it is currently overpopulated and suffering from the effects of its unfortunate past. For an island that is close in

size to the state of Maryland, which has a population of about five million people, Haiti's current population is 9,035,536 (Central America and Caribbean: Haiti).

In 2004 tropical storm Jeanne hit the coast of Haiti leaving about 3,000 people dead (Hurricane Jeane Over Haiti, 2004). While still in a state of shock and with limited funds or aid, Haiti began the process of rebuilding after the storm shook the whole country. After continuously suffering from political coups and economic instability and hardships, in 2006 Haiti elected René Préval to be the next president.

In January 2010 Haiti was hit by a major earthquake with a magnitude of 7.0 on the Richter scale, which leveled the whole country (Fast Facts: Haiti Earthquake). After the death of hundreds of thousands, hours of aftershock, and miles of devastation, Haiti is still in a continuing state of distress while rebuilding. Though the relief fund for Haiti is around one billion dollars, many parts of Haiti still need help (Evans). However, Haiti has been in desperate need of help for a long time prior to the earthquake disaster.

An area in Haitian territory that has served as a refuge for many Haitians, who can no longer reside in their native cities due to political unrest or natural disasters, or from fear of either, is located on an island off the coast of western Haiti in the Gulf of Gonave. This island is known as La Gonave, which is an area that is underdeveloped and suffers all the hardships typical of a poverty-stricken society. Before the 2010 earthquake hit, the population on the island of La Gonave was considerably less than what it currently is. The reason behind this population spike is related to the fact that the earthquake did less damage to La Gonave due to its distance from the epicenter. After the earthquake, many fled from their homes to the safety that they thought they would find on La Gonave (Haiti: Thousands flee to La Gonave to seek food and shelter). The island is home to about 120,000 people in rural villages located in a densely

populated location (Facts About Haiti). La Gonave currently suffers from a multitude of problems including overpopulation, which has also impacted the scarcity of clean, potable water.

Matènwa, one of several villages on La Gonave, suffers from the lack of water and a lack of economic stability (Topography). On the island the minimum wage amounts to about \$1.70 a day, where generally the men work to support large families; some men stay on the island to work while others fish or work in the city. The way that the people eat and drink in Matènwa is considered very unhealthy for any person, but this is not by choice. To get potable water the women of the village must travel roughly two miles to a well – distance varies depending on the house – to fill up sacks and buckets with water and carry them back to the village for their families.

### *Haitian Identity: Kreyol Culture*

Haiti is an island enriched with culture, community, and various symbols of unity. Understanding the bond of the Haitian community and its various types of allegiances is essential in doing any type of developmental work in Haiti. Haitians are proud, freedom-loving people who have survived repeated violations of the independence throughout their existence. The flag of Haiti (see below, Figure 2) contains a coat of arms depicting a royal palm tree topped with the cap of liberty representing freedom and independence. The palm is surrounded by an arsenal of weapons ready to defend that freedom and independence, although unfortunately other countries at different points in history have silenced this proud tradition of independence and political failure has sometimes let to violent divisions in the ideal of national unity. Under the arsenal read the only words on the flag and are very likely the most important words a Haitian can say:

“*L’Union Fait La Force*,” which translates to “Unity Makes Strength.” Despite failure and facing overwhelming odds, Haitian people continue to be a proud and resilient people.



Figure 2: Haitian Flag (courtesy of [www.cia.gov](http://www.cia.gov))

Haitian culture and society have distinct traditions in cuisine, music, dance, dress, ritual, and religion (Inc, Advameg, 2011). An important element in Haitian culture is the food that a Haitian family eats on a daily basis. A traditional Haitian meal consists of a large use of black pepper and spices, which is what sets it apart from other cuisines. The average Haitian diet contains a large amount of carbohydrates and starch, and includes rice, corn, beans, peas, and vegetables (Inc, Advameg, 2007). Like other nations, Haiti has its own customary meals that are only native to the island and its inhabitants; they are nutritious and considered very delicious when properly prepared. Most Haitian people don't have the proper food sources and materials to prepare the meals the way they should prepare them. The people of Haiti tend to suffer from nutritional deficits due to poverty, generally eating only two meals a day, including a light breakfast and a hearty dinner.





Figure 3: Tanbou Drum (courtesy of [www.haitiforever.com](http://www.haitiforever.com))

Music and other forms of art are a large part of Haitian culture. Music is listened to and practiced by all, including children and adults that have immigrated to many different countries. Many successful Haitian musicians travel the world to perform for popular audiences, mostly Montreal, Toronto, Boston, New York, and Miami. Haitian traditional music has been melded into three different types of music that is now globally popular: *Zouk*, *Kompa*, and *Kanaval*. Artists take their pick in which category they want to sing a certain song and then sing in Haitian Creole (Kreyol) or French while mixing in phrases in Spanish and English. *Zouk*, the R&B of Haitian music, is slower and more lyrical, often singing of love and emotional issues, whereas *Kompa*, the Hip-Hop of Haitian music, is more upbeat and usually sung in Creole. Many Haitian artists sing songs of life in Haiti and the hardships they had to endure to get to where they are in life. They traditionally try to empower the listener to overcome their troubles and to help the country during times of hardship. In many songs the artists refer to Haiti as their first love or the love of their lives. *Kanaval* music is the most upbeat music that Haitian people produce, which is usually heavily publicized during *Kanaval* season and mostly listened to by teens due to the fast beat and explicit lyrics. Some of the well-known groups that still make music today are T-Vice,

Carimi, Harmonik, Nu Look, and Djakout Mizik. The music was once known only by its use of the “Haitian Drum” called the *tanbou* (see above, Figure 3), which is still heard in all Haitian music, except the music is also fused with the bass guitar, saxophone, and the electric keyboard. *Kompa*, which was initially not embraced by all Haitians, has grown and shaped Haitian culture (Elveus, 2007). “Today, whether it's at a club, a wedding or simply a house party, *compas* (spelled *Kompa* in Haitian Creole) is the main style of music played by Haitians. It is so instilled in some people that they sit out and do not dance to any other types of music and wait patiently for the drum-driven melody they call their own” (Elveus, 2007). Music has a strong presence in Haitian religion and rituals, for it is used in church for worship and in rituals to contact spirits. Haitian artworks such as paintings are an empowering expression of emotion and thoughts, which can be seen in the art center in Matènwa where the women in the village work allowing them to create, display, and sell these artworks (see below, Figure 4).



Figure 4: *Atis Fanm* in Matènwa working on a piece of art (courtesy of [www.artmatenwa.org](http://www.artmatenwa.org))

Religion also plays a very large role in Haitian culture and society. There are three main types of religion on the island: Roman Catholicism, Protestant, and Voodoo. About 80% of the

country is Roman Catholic, but about 50% of the people practice voodoo (CIA). Roman Catholicism is the official religion of Haiti although some Haitians also practice voodoo and in some cases believe that voodoo can coincide with Catholicism (Haggerty, 1989). The voodoo that is depicted by television and in popular stereotypes today is of sorcery and witchcraft, but this isn't the same type of voodoo practiced in Haiti, which is usually more family-oriented (Daly, 2001). In Haitian culture it is not rare to find generations upon generations that all practice the same religion. Catholicism has greatly impacted the lives of many on the island, ranging from the names of children to the type of education a child would receive if the family could afford to send the child to school. Many children are named after people from the Bible, such as boys being given the name Jean and girls being given the name Marie. In Haiti most spiritual leaders are men, though there are a few women that are spiritual healers and herbal practitioners (Country Studies Program, 2011). In most small communities the church plays a large leadership role and with the support of the local church, mobilization for a water harvesting project by the community of Matènwa might be successfully accomplished.

### *Development in a Rural Community: Haitian Society*

Just as in many developing countries gender plays a large role in Haitian society. In rural Haiti, men are primarily responsible for farming and most of the heavy work, while women are responsible for weeding and harvesting as well as overseeing the rural, domestic economy. One of the most important daily chores, for the women in Matènwa as elsewhere is to gather water for the family. Studies in the developing world indicate that the earnings of women, often in micro-enterprises, such as the art center in Matènwa, are most likely to return home for domestic use.

Haitian culture does, in fact, value a woman's role in economics (Country Studies Program, 2011). Jobs that are usually occupied by men and women differ in terms of labor and status. Men usually take the more arduous and skilled and top paying jobs, thus they work as jewelers, construction workers, general laborers, mechanics, and chauffeurs. In the past the only doctors were also men, but presently there are increasingly more women practicing medicine. Women are mostly known for handling domestic activities, and they are responsible for cooking, cleaning, hand washing clothes, securing firewood, and walking for miles to secure water. Haitian feminist journalist Mirlene Joanis states, "Women make the country 'rich'" (Inc, Advameg, 2011).



Figure 5: Painting of Haitian Women in the Marketplace (courtesy of [www.masterjules.net](http://www.masterjules.net))

Haiti is currently \$1.7 billion in debt due to its lack of development, and the country struggles to pay back this debt. The global banking institutions, the World Bank and the IMF, impose heavy austerity measures on countries that take loans and there are often defaults;

austerity measures reduce the capacity for educational and social development in the country. Half of the residents in Haiti live on less than a dollar a day and about 80% live on less than two dollars a day; the gini coefficient, which measures wealth distribution, for Haiti is 0.65, the worst in the Caribbean. Due to trade policies, trade conditions, and deforestation, Haiti's primary industry, agriculture, can no longer thrive. Agriculture also struggles due to environmental conditions; Haiti is overpopulated resulting in deforestation and poor soil, which are necessities for large agricultural production. Countries such as the United States have created a global marketing system whereby Haitian agricultural products are more expensive than the imported products, which hurts the development of the Haitian domestic economy. Political instability has caused Haiti to suffer from trade embargos in 2000, but a recent lift of a U.S. Arms and Embargo tariff in 2006 allowed a short-lived time of economic growth (Momaya, 2009).

Haiti has not progressed in the twentieth and twenty-first centuries and is in much need of an effective developmental plan, for it suffers from deforestation, a lack of political development, and a weak, disorganized economy. The country struggles to develop economically and stabilizes itself politically; Haiti suffers from a lack of modern technological and social infrastructure. A prime example of this structural insufficiency is that the United States has working rights and laws that protect its economy and its workers, where Haiti does not. Some people believe the country needs to economically progress before anything else can get better, while some believe the country needs to develop its human resources and human capital in terms of their education and welfare before any progress is possible. In the 1950s, about 3% of the people in Haiti were considered the elite and at that time the country could not afford to do without those as they directed industries that were profitable to foreign investors (Friedmann). During a period of development all groups, including the elite, urban, rural, and the poor, would

need to develop to their highest potential and capabilities, but this has proven to be harder than some thought. The problem with this plan is that poor Haitians expected certain things, such as an immediate improvement, and the elite of Haiti expected a speedy progression for personal benefits instead of development (Friedmann). A successful program of economic development has to accommodate all classes. Development in Haiti has faced problems such as language barriers, the willingness of some rural Haitians to participate in urban-based economic growth, as well as the failure of foreign investors to understand local culture. With a better understanding of the people and the culture of Haiti previous development initiatives might have had better success. Progress has been restricted due to the lack of available skills and knowledge. Friedmann (1955) writes, “it is quite obvious that the Haitian government is in no position to carry out more than a very small number of these policies.” Over the past 56 years the Haitian government has still not put itself in a position to carry out more than a small number of development initiatives. Lundahi (1991) also argues that the underdevelopment of Haiti is not only because of the economy or the lack of an economy, but also because of the failures of the government.

During the early 20<sup>th</sup> century, 1915-1934, the United States occupied Haiti due to civil disturbance and instability and unrest in the Haitian government. At the beginning of the occupation there were times of unrest in opposition to the American presence, which cost some of the participants their lives. Many of the marines that had occupied Haiti had insisted on imposing Jim Crow laws that would make them more important and higher than the native Haitian people (Global Security, 2005). Imposing order on the nation was done mostly by the white foreigners, whose prejudices against Blacks prevented Haitians being allowed to run their own country. However, to be fair, the occupation also had some positive impact that greatly

improved Haiti's underdeveloped technological infrastructure, such as the putting up of telephone poles, allowing a telephone system to work for the first time in the country. Some towns were also able to have clean running water and construction was on the rise, which provided jobs. Public health in Haiti was also improved and the country made their foreign debt payments on time. The people of Haiti, however, had mixed feelings about being controlled by a foreign power. Under the order of President Roosevelt, in 1934 the U.S. marines were taken out of Haiti and power was transferred to the *Garde*, the Haitian *Garde*, is the military forces of the republic. Some historians argue that the U.S. left prematurely while others argue that the U.S. should not have entered at all. Unfortunately, the U.S. was neither able nor willing to provide everything that the country needed. After the departure of the United States there was still a lack of infrastructural development and both the economy and democracy suffered from this lack of development. The lack of clean water was still a primary issue throughout Haiti because not all of the island had been provided with clean water when the U.S. left.

### *The Importance of Clean Water*

Water is one of the most abundant compounds found on the earth's surface and it is essential for life, ranging from its fundamental contribution to all living organisms to its use in agriculture and industry. Agriculture is the largest consumer of the fresh water present on earth using approximately 70%. However, about 884 million people throughout the world lack access to a safe, clean water supply (Water.org, 2010). In Haiti this lack of clean water contributes to about half of all children being underweight, a sure sign of the malnutrition that plagues the country, without clean water the ability to grow food is very tough (Poor, 2010). With Haiti

being a country that has a long history of extensive dependence on agriculture, water is a necessity.

Along with Matènwa there are many villages on the island of La Gonave that suffer greatly from a lack of water. Most of this labor is done for supposed “clean” water that most likely would not even meet FDA standards in the United States.

Prior to the January 2010 earthquake, the population of La Gonave was about 100,000 people. Because the quake did not affect La Gonave directly, Haitians living on the main island fled their homes hoping to find safety on the small island; the recently calculated population is closer to 140,000 people (Blaise). The increased population on La Gonave has further exacerbated the problem of inadequate supply of clean water. With a higher population, the use and contamination levels of the water will proportionally increase, as there is no water treatment facility for clean water distribution among the inhabitants of the overpopulated island (Children of Lagonave, 2010). In addition, there is no piping or channel system to transport water from the few water sources that do exist to specific destinations.

Because each person consists of approximately 55% to 78% water, this essential compound serves a critical role in the anatomy and physiology of the human body (Water Treatment Solutions Lenntech, 2009). Since water is such an important part of life on earth, it only makes sense that the quality of water be just as important as the availability of water to drink. Drinking water should be as clean as possible and free from bacteria or other threats to ensure good health. Widespread diseases that can be transmitted by unclean, unfiltered water are the result of many factors, including, but not limited to, the earthquake that hit Haiti in January 2010. The earthquake destroyed and then contaminated the Haitian drinking supply, and with the rising epidemic of cholera in 2010 it is even more important to ensure that drinking water on the



island is kept as clean as possible. More than 91,000 people have been affected by the disease and already over 2,000 Haitians have died (Lin II, 2010). Cholera tends to spread rather quickly, especially in areas where tainted water is consumed, making it imperative that the water issue in Matènwa is addressed soon (Lin II, 2010).

### *The Bamboo Plant*

Bamboo is known to be one of the most resourceful and useful plants (Bamboo: Remarkable Giant Grasses, 2002-2008), and has been used for many things including building materials, flooring, furniture, food, esthetics, artwork, and clothing (Bamboo: Remarkable Giant Grasses, 2002-2008). There are over one thousand species of bamboo in more than one hundred genera. Bamboo is known as one of the fastest growing plants on earth and was used in construction as early as 2000 BC (Bamboo: Remarkable Giant Grasses, 2002-2008).

Deforestation is known to be an issue in Haiti and this has caused the soil to be extremely eroded. Since bamboo is fast growing and quick spreading it could help with controlling soil erosion on the island of Matènwa by acting as a protective shield against the harsh conditions that lead to the deterioration of the soil.

Bamboo species vary according to height, diameter, and climatic conditions. The temperature in Haiti varies from 71-90°F (Climatetemp.info: Haiti 2008-2010). The average annual humidity is 49.2% in Haiti, with an annual rainfall averaging 53.3 inches (Climatetemp.info: Haiti 2008-2010). Most of the rain arrives in the months of February through May, but even in the driest months there is an average of 1.3 inches of rainfall (Port-au-Prince, Haiti 2010). Haiti has also been known for having drought periods, but the bamboo plant is resilient and known to be hardy when mature; the young plants would be affected the most if

there is a drought period. Matènwa has a tropical climate, thus the bamboo species that are most likely to thrive on La Gonave are those that are acclimated to tropical and subtropical climates (Bamboo: Remarkable Giant Grasses 2008). In particular, the timber bamboo species from the genus *Bambusa* should be able to grow in the climate and also meet the specifications for bamboo needed for this proposed project. This type of bamboo is fast spreading and can withstand heat, cold and drought. It is strong and also resilient enough to be able to withstand manipulation when building a piping system, thus making it a good candidate for this project (BambooGarden: Hardy Timber Bamboo, 2006).

Most tropical and mountain bamboo species clump, meaning that the plants develop from clusters of short rhizomes; rhizomes are horizontal growing stems that send out new bamboo shoots. Bamboo spreads by these creeping rhizomes to form dense, impenetrable clumps (see below, Figure 6).

Not surprisingly climate has an effect on how fast the plant can grow and spread. Bamboos that grow in a cluster or grouping are most common in countries with a tropical climate, and tropical bamboos are usually large with numerous branches at a node. Temperate climates are known to be where creeping rhizomes are mostly found. There are also certain bamboos with aerial stems also known as culms; this type of stem is developed from the underground rhizomes (see below, Figure 6). New bamboo shoots appear in late summer or fall depending on the plant's native area and culms (new bamboo shoots) can grow over a foot a day during the shooting season.



Figure 6: Bamboo Culms Emerging from a Rhizome (courtesy of waynesword.palomar.edu)

The diameter of a bamboo stem ranges from 0.50 to 12 inches, depending on the genus. For example, *Bambusa* is a genus of bamboo that contains large stems with diameters reaching up to six inches. This genus has also been often used for flooring, fences and many other building materials. It is either used in its natural state or it is reconstituted.

Like most grasses, bamboos eventually flower, produce seed, and die. Bamboo does not flower frequently so vegetative propagation is done to grow new plants. This process involves the production of a new plant without the use of seeds. Instead, a piece of rhizome with some buds is cut and planted into damp soil. From the buds on the rhizome, new shoots of bamboo emerge and a large bamboo forest can be grown within one year (*Bamboo: Remarkable Giant Grasses* 2002-2008). The only drawback to this method of propagation is that it results in a large mass of cloned bamboo, which makes the stand more susceptible to disease. If disease strikes, then the entire crop of bamboo could be decimated (*Bamboo: Remarkable Giant Grasses* 2002-2008).

## *The Cultivation of Bamboo*

To begin cultivation of the bamboo plant in Matènwa, an area where the bamboo would be able to grow and spread freely without causing any obstructions would be needed. If this type of area cannot be located, then a barrier would be required to restrict the plant from spreading and becoming a nuisance. Such a barrier is made out of concrete, metal, or plastic and these materials act as a reinforcement to control the rhizomes. These barriers are commonly known as “rhizome barriers” (see below, Figure 7), and their purpose is to deflect the rhizomes from growing horizontally.

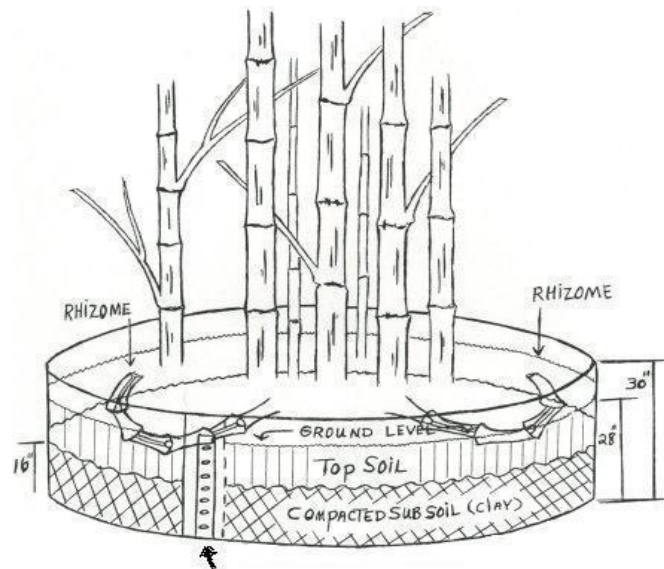


Figure 7: Example of Rhizome Barrier (Courtesy of [bamboogarden.com](http://bamboogarden.com))

The best type of soil for growing most bamboo plants is moderately acidic loamy soil (American Bamboo Society). If the soil does not have enough organic material in it, compost and manure can be added or mulch can be applied to the soil surface to eventually improve the soil’s texture. The organic material helps make the soil suitable by providing more nutrients and improving water retention for the bamboo to thrive (American Bamboo Society).

The exact bamboo type already growing in Matènwa could not be established for this research however basic cultivation methods that are generally used to propagate and cultivate most bamboo plants can be implemented, which include irrigation, fertilization, and weeding. Weeding should be a priority when the plant is young so that the bamboo would not have to compete for nutrients. In Matènwa, irrigation and weeding should be implemented. All plants require additional nutrients; fertilization can be accommodated in Matènwa by using animal manure and/or mulch. Planting of bamboo can be done during any period of the year in areas with mild climates; this allows for production of a continuous crop (American Bamboo Society 2008). A tropical climate would allow for such a planting season, but during the dry season more work would be required to keep young plants nourished and irrigated. Regular irrigation to keep the soil moist during the dry season is a key element in keeping the young plants alive. Planting near a water run-off or next to a river bed will make irrigation much easier by making water readily accessible.

Bamboo is described as a forest plant and requires mulch over its roots to keep the soil moist and soft. Raking or picking up leaves around the plants roots is not necessary because the leaves act as mulch to the plant, which provides the plant with some recycled nutrients. When bamboo is newly planted it requires frequent and sufficient watering. Since Matènwa has a tropical climate the level of watering of the new bamboo plant will depend on the season. During the rainy season watering of the plant will not likely be an issue but the plant's growth should still be monitored. When it is hot or windy the young bamboo will need to be watered; lack of sufficient water leads to poor growth or even death (American Bamboo Society 2008). Too much water on the other hand can also affect new bamboo plants. Once the plant is mature, it is more tolerant to vagaries in temperature and precipitation.

Harvesting bamboo the right way is very important to prevent the deterioration of the bamboo stalks; if bamboo is not harvested correctly and still has some moisture retained, deterioration sets in quickly and damages the harvested stems (Primitive Ways 2005). So in order to ensure good harvesting a clean dry area should be used as storage for the stems and the stems should be monitored to make sure there are no parasites or mold present throughout the harvesting period. On the other hand, good harvesting techniques will guarantee quality products and a strong resilient texture of the bamboo stem. Bamboo is known to have large amounts of starch, thus making it prone to attack by fungi or parasites if the harvested plant is not thoroughly dried.

A bamboo plant should be harvested when it is mature because a young bamboo plant does not have the same strength and resiliency as a mature one. The seasons also play a role in successfully harvesting a bamboo plant. During the dry season the bamboo plant has less moisture and the level of starch in the culms are low. Harvesting bamboo during the rainy season is not advisable because new shoots appear during this season and harvesting may affect the growth of the new shoots. Moreover the starch and moisture content is very high and drying the stems would require a lot of work and would probably be unsuccessful (Gaudua Bamboo 2007 - 2011). Harvesting bamboo is best if done during the dry season in Matènwa because the bamboo can then be set out to thoroughly dry. The stems should also be monitored to avoid molding.

### *Community Empowerment*

Community empowerment is an important factor in any development project, including the success of this proposed bamboo piping system. It can be made possible with the help of an organizing technique known as Participatory Rural Appraisal (PRA), which may be defined as a

multitude of methods that allow people within a local area to “express, enhance, share and analyze their knowledge of life and conditions, to plan and to act” (R. Chambers). Through PRA, villagers are able to facilitate and push forward a development plan themselves, which will help them develop the confidence they need to ensure the success of a new water collection system. PRA is not always done well, but when it succeeds the participating local people gain a sense of satisfaction, which comes from what they have learned and experienced as they develop a new way of looking at what they can accomplish (R. Chambers).

There are certain dangers to avoid when striving to empower a community using PRA. The first of the four dangers is “instant fashion,” where individuals are promoted or obtain titles within a group that are actually empty in meaning. In order to avoid this it is important to remember to avoid promotion of certain individuals (R. Chambers), for every citizen of Matènwa should have an equal say in any system that affects the entire community and feel that they are included in the development project in order to feel connected and empowered. The second danger to avoid is rushing into the implementation of the system (R. Chambers). If any new idea is rushed in the planning and building stages, then the whole system may completely fail. The people of Matènwa must take their time in community discussions so that all decisions are made in the best interest of the entire community. The third danger to avoid is “formalism,” which is something that outsiders aiding the people of Matènwa must avoid (R. Chambers). It is very easy to attach standards and codes to any new system being implemented, but the party that chooses to help Matènwa to address its water problems must remember that it is for the villagers to decide how they choose to develop and maintain any system. The fourth danger that must be avoided is routinization, that is ruts in work practices that are not flexible enough to address unexpected problems or changes in conditions (R. Chambers). There is without a doubt a need

for a certain routine that must be maintained with the piping system if progress is to be made in devising a new way of collecting water, however, the people of Matènwa must avoid letting the routine block improvements that occur unexpectedly. Any party that chooses to help the villagers implement this system into Matènwa must work closely with them to ensure that their wishes and goals are incorporated into the project in order to promote community empowerment.

In addition to PRA, leadership also plays a large role in community empowerment. Whoever rises as the leader of a community can be a crucial component to the success or failure of community empowerment, because there is such a delicate balance between leading in the best interest of the community and leading to promote oneself. Because it is *community* empowerment that is desired, its success is dependent upon the leader and the depth and sincerity of their sense of “us” (Hallam and Bowden).

The most important thing to remember when proposing substantial changes in the ways people collect water is that a new system cannot be brought to the village with the expectation that the villagers will openly accept everything that is proposed. This system must be introduced into the village in a manner that allows for the people of Matènwa to adopt the proposal and make it their own. The goal of this project is to aid the people of Matènwa without stepping on valued cultural traditions, and that is why community empowerment must play such a large role in the implementation of the bamboo piping system. Thus it is crucial that the party that brings this proposal to Matènwa remembers that their advisory role must be carried out in conjunction with the empowerment of the community. By providing advice and resources for the village, the village itself can find ways to remove obstacles in their daily lives while they empower themselves (Hallam and Bowden).



## *Conclusion*

An understanding of Haitian history and culture helps prepare foreigners to work successfully with Haitian communities that are steeped in proud traditions and give clues as to how such communities might be empowered to organize themselves for collective action. Since bamboo grows wild on La Gonave, the scientific cultivation of a species suitable for being used in constructing gutters will contribute to further growth of this crop, which might have additional benefits, such as preventing erosion. The history and economic condition of Haiti underline the importance of addressing the basic issue of providing potable water for everyone.

# Research and Analysis

There are several water distribution options that may be considered for aiding the village of Matènwa. A bamboo piping system leading from a nearby community cistern to individual homes initially appeared to be the best option for ameliorating water distribution in Matènwa. Unfortunately the topography of La Gonave would make it difficult to deliver water from the cistern because Matènwa sits on a part of the island that is higher in elevation than the current water source. Presently villagers must carry water uphill, a time consuming and arduous task, to bring water to their homes. An uphill piping system would thus be ineffective without the use of a pump, but the expense of a water pump is too much for the community itself to purchase and maintain.

Buying the pump for the bamboo piping system gives rise to several further difficulties (i.e. how to raise money to purchase the pump and how much it would cost to maintain a pump). Choosing a pump also raises additional problems concerning its installation and maintenance, as well as potential legal and ethical considerations of mechanical extraction of water from a source meant to serve several other communities. Thus other options were considered. If a bamboo gutter system were on the edge of rooftops of the homes in Matènwa, these gutters could catch water and funnel it to a community catchment in the village with the aid of bamboo piping or directly to individual catchments at each house (see below, Figure 8). Such a water collection system would be easier to construct and could eventually be integrated into a distribution system for the entire village. The rooftop system could first be implemented and tested at the homes that already have the necessary roof construction, to be discussed below. If successful, this type of

water distribution system could be implemented elsewhere on La Gonave or even on the main island.

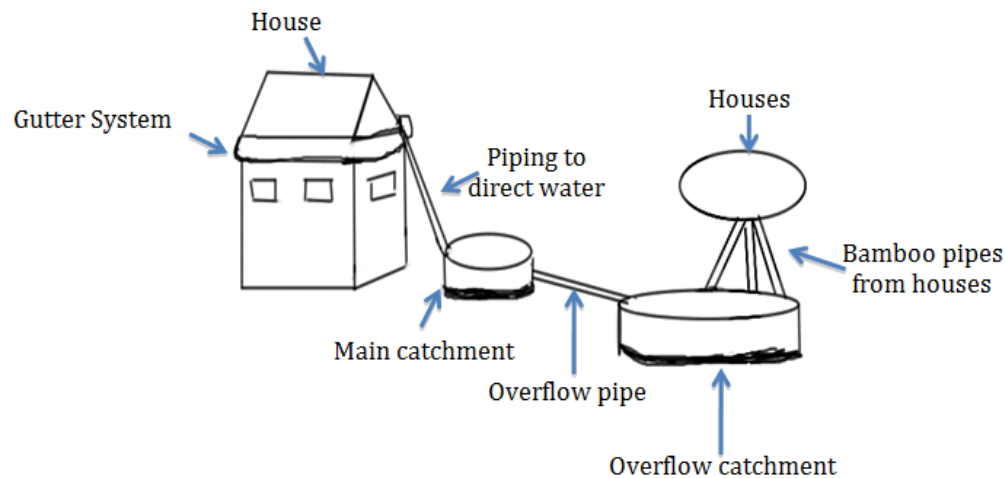


Figure 8: Concept of Bamboo Piping System and Catchment

### *Existing Bamboo Gutter and Piping Systems*

Water distribution through the use of bamboo is currently being used in various locations throughout the world, suggesting that this plan could work also in Matènwa. For example, in Orissa, India over one hundred women came together to construct a bamboo piping system to transport water from a nearby stream to multiple villages (Panda, 2008). This example is similar to the situation faced by the people of Matènwa; the women of Orissa sought a new way to transport water so that they would not have to carry heavy jugs uphill in order to bring water to their families.

Irrigation systems built from bamboo have also been implemented in other parts of the world. For instance in Meghalaya, a northeastern state of India, a drip irrigation system was built from bamboo to water the state's black pepper and betel leaf crops (see below, Figure 9).



Figure 9: Bamboo Irrigation Piping in Meghalaya, India (courtesy of [www.rainwaterharvesting.org](http://www.rainwaterharvesting.org))

Likewise, descriptions and illustrations of other systems delivering water already exist in published articles and on the web, including particularly the website of The Tearfund International Learning Zone. This organization’s website provides illustrations of assembly of such a piping system (see below, Figure 10) (Bamboo Water Pipes, 2005). Likewise, this figure allows a closer look regarding what could work, what would also probably not work, and what to be careful of in such a project.

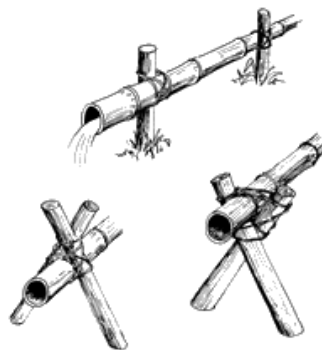


Figure 10: “Supporting Pipes;” Sample Illustration from Tearfund International Learning Zone (courtesy of [www.tilz.tearfund.org](http://www.tilz.tearfund.org))

If a bamboo water distribution system proved to be successful in Orissa and bamboo is being used as pipes in other areas of the world, then it is likely that this idea can also be

implemented in the village of Matènwa. Such a system could alleviate the difficulties that accompany retrieving water by hand on the island through a cheap and efficient system. The water conduit pipes could be made entirely of bamboo grown on the island and it could transport fresh water from water sources to Matènwa. Such a system would benefit villagers by allowing easy access to clean water without the time-consuming walk or extreme labor that takes up much of the day for women and children. In addition, the use of a water catchment system from rooftops of homes in Matènwa, such as a bamboo gutter system, should also be taken into consideration. Such a system would involve water harvesting by constructing a bamboo gutter to catch the water falling off rooftops, which would then be transported by bamboo piping to a central catchment in the village.

### *Considering Different Water Conveyance Options*

With the many difficulties arising from the transportation of water from the existing cistern to the village, only one other option seemed feasible since the well is located downhill in relation to Matènwa. In order to have water on hand easily, Matènwa needs to have an above ground rainwater cistern for the whole village to use and each household needs to have a rooftop catchment system, using a gutter made from bamboo grown on the island. The cistern would prove to be crucial during the times when the village lacks rain to collect. A cistern is a waterproof receptacle using a waterproof liner that holds and stores liquids, typically water. The cistern will store water directly collected from rainwater or indirectly through a bamboo gutter piping system from the rooftop of nearby buildings.

Sustainability should be a major consideration in making decisions about development projects in Matènwa. A cistern is one of the more sustainable solutions to water storage because

it does not need frequent mechanical maintenance to continue working and a local cistern also does not take water away from other villages. The general pricing of a below-ground water cistern made of plastic from the U.S. ranges from \$350 for a 325 gallon tank to \$2,300 for a 2,500 gallon tank, about 14,000 *gourde*. This is roughly equal to a dollar for each gallon the cistern supposedly holds (Outlet, 2010). For an open top tank, the price ranges from \$280 for a 350 gallon to \$1,400 for a 2,700 gallon tank, about 40,000 *gourde*. An advantage to an open top tank is that it would allow the villagers to open the top of the tank to collect water during rainfall directly (Outlet, Cylindrical Flat Bottom Open Top Tanks, 2011). The price of the cisterns in Haitian currency (*gourde*) ranges from 14,000 to over 40,000 *gourde*, not including the price of transporting the cistern to Matènwa. These prices make it prohibitive for the villagers of Matènwa to buy a cistern; they already have difficulty finding the money to construct concrete tanks.

There are some steps to ensuring water quality and proper cistern maintenance; for example the water stored inside the cistern should not be stored for more than two or three months at a time and chlorine should be added to the tank to disinfect the water. The old, stale water, instead of being wasted and discarded, could be used for washing or agriculture. The pricing behind buying a new cistern for the village is too expensive, further research and efforts should be taken to provide a cistern for the village.

A communal, central catchment system, no longer a cistern due to its affordability, supplied by an overflow from the catchments from the household rooftop collection system at each house is the most feasible idea. The central catchment would be located in the center of a set of three to six homes and would fill up from the rain and from overflows from individual catchments at the homes. The central catchment should have some type of valve allowing the

villagers to be able to tap into the catchment for water when there is a necessity for it, which will be discussed in more depth later in this chapter (see below, Figure 11). Catchments could be created out of different types of materials, such as metal or concrete. Concrete is already used on the island, and though it is expensive, it would be the best material for this type of construction due to its durability and ability to withstand the harshest conditions, such as extreme heat, and if reinforced, earthquakes and hurricanes. When considering a metal catchment it is important to note that extreme heat may cause the water stored inside to evaporate or boil; this would defeat the purpose of allowing citizens of Matènwa to use the water to cool off by drinking the water since temperatures in Haiti can raise to mid-90s degrees Fahrenheit, causing dehydration, though loss of water through evaporation is the main concern in this case.

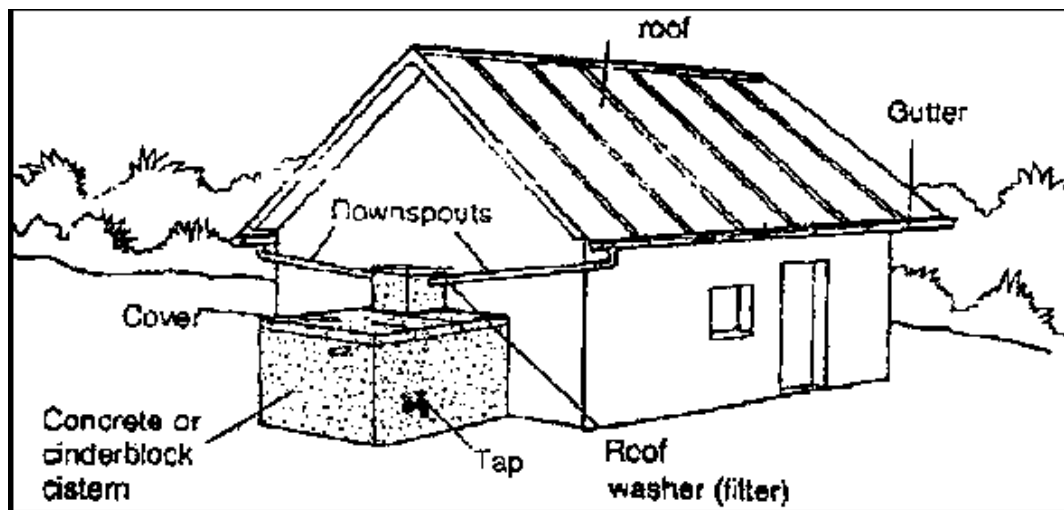


Figure 11: Concept of bamboo gutter system (courtesy of [www.oas.org/dsd](http://www.oas.org/dsd))

The use of a water pump was initially discussed by the group but was quickly eliminated from the options. The main reasons for its rejection were its maintenance needs, pricing, and the operational aspects of a pump. The using of a pump for this project was not feasible for the

people of Matènwa to use. See Appendix B for more information about the water pump and why it was deemed unsuitable.

### *A Possible Resolution to the Water Distribution Issue*

We believe the proper resolution to the current difficulties of collecting water is for the people of Matènwa is to create a gutter system made entirely of bamboo and tied together with some sort of plant material (e.g. hemp, which also grows on the island). The gutter system would connect to all four corners or the one edge of the rooftop to ensure proper rainwater collection off the roof (see below, Figure 12). Having a central rainwater collection cistern for the village does not seem to be a financially feasible manner of rainwater collection because of its price. The gutter system on each house would then lead down into individual catchments, where the water would be held until the people living in those homes had to empty the basin or used the water.

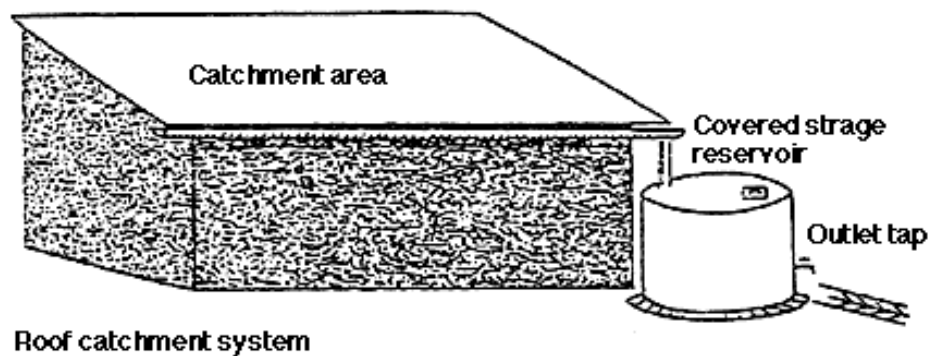


Figure 12: Concept of bamboo gutter system on one type of home (courtesy of [www.unep.or.jp](http://www.unep.or.jp))

For the system to work properly the roof should be made out of materials such as corrugated metal or other metal and constructed at a sloped angle; a flat rooftop would not work



properly because the water would not drain. The rooftop must also offer the same protection as a normal rooftop, protecting the home from UV ray exposure when there is no rain; the new roofs should not lack the same benefits as the old rooftops. After the water is stored, when the family wants to use the water to drink, the proper disinfection and water purification methods could be employed. Rainwater captured from such a roofing system is actually potable and thus, does not require the same level of disinfection as ground water (Department of Sustainable Development). In Belize, drinking water is captured from rooftops and retained in this way.

### *What is Needed to Ensure Success*

To implement this water collection and distribution system successfully the people of the village need to make changes to their rooftops and draining systems for their homes. The rooftops need to be changed to metal roofs that are connected at a downward slope, and apparently some of the homes in Matènwa already fit these criteria (a 30-45 degree angle would work best). A survey on the houses of Matènwa by Zanmite is currently underway, and a long-term development project might consider rooftops for proper water harvesting in order for the rain to hit the rooftop and slide down to the edges and into a gutter. A bamboo gutter system would then be connected to the edges of the rooftops, which would collect the rainwater. At one end of the gutter system there would be another bamboo tube that would allow the water to go down the tube into a catchment system.

To save money and use materials that are already on the island as well as commonly used by the local people, the catchment base, the part that stores the rainwater, can be made out of any material as long as it can properly hold water. For example the water can be collected in basins or barrels of some sort, which can serve as the catchments. The water needs to be caught and

stored in a clean container, so the people can use the water for drinking or cooking purposes. The larger the container used for catchment the better in order to avoid any overload and loss of water. The catchment unit should be adequately covered while collecting the water to keep out bugs and other potentially contaminating vermin. A lid also minimizes the loss of water due to evaporation. While the system is not in use, the catchment should be cleaned to minimize the count of parasites and waterborne disease.

This new system should be recommended to the people of Matènwa such that it demonstrates to them that this system will benefit their daily lives and that they have the power to make any alterations or changes to the system that they would like. It is crucial that the villagers see this project as something that will improve their daily lives, because if they feel comfortable with the idea and know that they control it, it will be easier for them to accept the water system and maintain it for future generations. The community as a whole must develop the process of building and maintaining this system (as we shall discuss in the following chapter), exercising their choice of whether or not to accept the aid of those presenting this proposal for implementation of the bamboo piping system.

# Implementation

To ensure success in implementing this proposed bamboo-piping system, a detailed community empowerment plan should be developed in Matènwa that involves the whole community's approval. It is very important that this system is maintained and supervised by the villagers after being implemented. Zanmite could supervise the overall project and would facilitate instruction and decision making among members of the Matènwa community who want to participate in the project, allowing the people of Matènwa to be co-leaders. To successfully carry out the transfer of responsibility, the third party helping the village needs to effectively show the benefits that a rooftop water harvesting system will bring to the everyday activities of the village. The people of Matènwa need to see the usefulness and feasibility of ameliorating their methods for collecting water and be able and willing to continue the process in the future.

The people of Matènwa need to see the practicality and the effectiveness of the new system and then include the system into their everyday lives to effectively maintain it. Bringing innovation into traditional cultural and social practices is sometimes a hard process, but not an impossible step. There are many Haitian people living in America as well as many Americans who are living in Haiti, each party mostly living according to the culture and practices of their resident country, showing that traditional culture of Haiti can adopt practices and innovation from others. To properly implement the water piping system into Matènwa the first step is to understand Haitian culture and history so that innovative ideas can be introduced into traditional practices.

## *Community Organizing to Implement Water Harvesting Methods*

In the town of Matènwa, Zanmite has successfully put into operation an art center that functions under the care of residents of the community. The goal of the art center, the Matènwa Community Learning Center, built by Zanmite was to “encourage self-respect and independence using new methods of self-sufficiency” (Project, 2010). Ellen LeBow, on January 26, 2010 spoke to the group through email of the way she successfully brought the art center into the daily lives of the local people, which was by instating a few rules and showing the people the benefits of taking care of the center. She went on to say,

*The artists met with us and made up a list of principles for members to follow if they were to stay in the art center. This included clean up, respect of others, and absolutely no violence. Also rules about how artists can make requests, communicate with me, or replace new artists if others leave. They elected a smaller committee made up of representatives from each group. This committee makes the decisions for the rest of the group. If there is a problem sometimes they call a meeting for the entire art center to discuss what to do. We bring them materials they can't get where they are. Each group knows what kind of work they need to do. They already are skilled at their artisanship. Each group has a manager who is responsible for overseeing people's work quality and taking care of materials, keeping track of how much they need to be paid for finished work and communicating with me.*

Zanmite’s general rules concerning the art center might be helpful in successfully implementing the water piping system. For example, this could involve having the community create rules that they would all collectively agree to follow and also creating a committee that makes all major decisions in the town or even making the same committee in charge of the water project for the town, if they feel they can do the task. For instance, a rule they could create is that each family must properly take care of their own gutter system. The people themselves need to

choose the appropriate individuals to get the water instead of shifting the responsibility on the shoulders of someone else in the village.

### *Steps to Success*

In order for the plan to work, Zanmite or any development agency in Matènwa might follow what the group calls the steps to success, suggestions in setting up a development plan.

1. Set up committee, made up of people from Matènwa to run the bamboo gutter water collection project
  - a. Designate inspectors to inspect and inventory rooftops
  - b. Designate propagators and growers of bamboo
  - c. Designate harvester
  - d. Designate people to prepare bamboo for construction
  - e. Designate people to assemble the rooftop bamboo gutter system
  - f. Designate people to assemble the piping from bamboo gutter to catchment
  - g. Designate a person or group to maintain and repair the system on a rotating schedule or assign responsibility to individual families
2. Growers grow bamboo (*full growth occurs within 4-6 years*) (American Bamboo Society)
3. After growth harvesters harvest bamboo
4. Have bamboo chopped to length and prepared for use as pipes or gutters
5. Construct gutter system and attach it to home roof
6. Inspect roofs to make sure gutter system will hold

7. Obtain and install catchments (basins or barrels)
8. Run piping from gutter to catchments to pool water
9. Inspect catchment system to make sure water will flow properly
10. Maintain the gutter systems in the village

The overriding principle and main idea to always remember in this project is “the project should empower the community.”

### *Advantages of Rooftop Water Collection*

Great results could come from the rooftop gutter water captured and the piping system. Zanmite told the group in early April 2010 that women and children are mostly the ones gathering water. With the new system they will not have to travel for water, allowing the daily chore of water transport to be handled by fewer people. Transportation of water is a time consuming process, which keeps children out of schools and the women unable to do other tasks. With the water being collected at home due to the rooftop system, the children can go back to school and the women can contribute more time to other task such as micro-enterprises, for example the artwork done at the Art Center by *Atis Fanm*.

One out of every five children in the world is not enrolled in primary school (Children, 2002). Education of a child is not directly represented in economic growth but certainly more education leads to economic improvement (Affairs, 2010). In 2009 the rate of people with jobs who have been properly educated between 16-64 years old was a higher percentage than those who haven't been educated in the U.S., which is a statistic that would be great to see in Matènwa

(Statistics, 2009). In 1982 about 65% of Haitians over ten years old hadn't received any education and only 8% were educated past the primary level (U.S. Library of Congress).

With children at school furthering their education, the mothers and other women will have more time. Women in Matènwa will have more time to contribute to the future of their village; for example, they could do more with the Matènwa Community Learning Center and art program. There are guidelines established for setting up a micro-enterprise (Sustainability, 1997). "Women for Women International" is a group that supports micro-enterprises for women. Distributing microloans to enterprises created by women, they have served more than 77,000 women and benefited more than 414,000 families and community members (International, 2009). Women for Women International consolidated financial statements in 2009 and they provided for many businesses to continue and expand. Women for Women International distributed millions in microloans to business to support micro enterprises. A group like this, supporting micro-enterprises by women, could help the women of La Gonave, specifically Matènwa, as well as help the production and the development of an economy. It has been determined that when women are more engaged in economic improvement, it positively impacts children and families (Collins).

# Conclusion and Recommendations

To make water collection and distribution easier in Matènwa, the best option is to implement a bamboo gutter system that will catch rainwater from rooftops and use bamboo piping to transport this water into individual catchments at each home. This type of water collection and distribution would help to eliminate the daily travel and labor that women and children must carry out to obtain drinkable water for their families. With the implementation of this new system villagers will have to travel only as far as a few yards as opposed to a couple of miles to collect water.

The types of bamboo that will thrive well in Matènwa, due to its tropical climate, are of the *Bambusa* genus or of the tropical genera in the bamboo grouping. If these types of bamboo exist on the island of La Gonave, they should be used in the construction of the bamboo gutter and piping. Alternatively, other bamboo could be provided via Zanmite, for example. The catchments may be large basins or barrels with an adequate covering on the top to keep bugs and other potentially contaminating vermin out of the water, as well as prevent the water from evaporating.

Finally, it is crucial that citizens of Matènwa feel like they have the principal role in deciding and implementing the system. In fact, the project can only be successfully carried out if the villagers embrace it. It is not any outside party's role to empower their community, but instead they must limit themselves to providing the seed of the idea, and then assist the villagers by making available to them the resources they need in order to empower themselves (Hallam and Bowden).








# Appendix A: Tropical Bamboo






Bamboo grows in two main forms and this is determined by the rhizome or root of the plant. Rhizomes can be described as underground lateral stems that have roots below and send shoots to the surface, these shoots produce new plants. The two main types of growth are clumpers and runners. In general, the bamboo that clumps is tropical and the runners are common to a more temperate climate. Clumpers stay close to the domain plant and expand horizontally while the running growth type bamboo is invasive and spreads very quickly. In general the types of bamboo that clump are tropical and since Haiti has a tropical climate the main focus is on the different types of tropical bamboo genera and their species. Below are a few examples of different Genera and their species.

\***Bambusa** Found in subtropical and tropical areas and this genus usually produces giant bamboo species. There are about 37 species. **\*Genus:**


*Photos Courtesy of tropicalbamboo.org*

Bamboo Name	Maximum Height	Maximum Diameter	Picture
<i>Bambusa balcooa</i>	60'	6"	
<i>Bambusa blumeana</i>	60'	4"	
<i>Bambusa beecheyana</i>	50'	5"	
<i>Bambusa dolichomerithalla</i>	35'	2"	
<i>Bambusa textilis</i> <i>Kanapaha</i>	50'	2.5"	

**\*Dendrocalamus** Also tropical and similar to the genus Bambusa, it produces giant bamboo and has about 29 species.

Bamboo Name	Maximum Height	Maximum Diameter	Picture
<i>Dendrocalamus giganteus</i>	100'	12"	
<i>Dendrocalamus validus</i>	45'	5"	
<i>Dendrocalamus strictus</i>	60'	5'	
<i>Dendrocalamus sikkimensis</i>	65'	6"	
<i>Dendrocalamus giganteus variegatus</i>	100'	12"	

**\*Otatea** Found in Central America and Mexico this bamboo genus has 3 known species.

Bamboo Name	Maximum Height	Maximum Diameter	Picture
<i>Otatea acuminata aztecorum</i>	20'	1.5"	
<i>Otatea fimbriata</i>	14'	0.75"	-----
<i>Otatea acuminata</i>	15'	0.75"	-----

**\*Schizostachyum** Shrub-like bamboo that clump and sometimes climb

Bamboo Name	Maximum Height	Maximum Diameter	Picture
<i>Schizostachyum jaculans</i>	30'	1.25"	
<i>Schizostachyum brachycladum (green)</i>	45'	3"	
<i>Schizostachyum brachycladum (yellow)</i>	45'	3"	

## Appendix B: Water Pump

Originally the team evaluated the option of pumping water from the cistern currently in use to the village through bamboo piping. A pump would be necessary because Matènwa is located uphill from the cistern now in use, some two miles downhill. This added gravity as an additional factor working against pumping water to Matènwa. With the aid of a pump to help bring water uphill from the original cistern to the village, the villagers would be able to stay closer to their homes and take water from some type of containment system holding the water at the top of the hill. This would eliminate navigating the rugged terrain whenever they needed something to drink. With the pump, however, other questions arose:

- Would the pump be manually or mechanically operated?
- Would there be enough power to provide adequate lift to provide adequate water for the entire village?
- How would manual pumping duties be allocated to provide adequate water to the village?
- What materials would be used to construct the pump?
- If the pump were purchased, where would the funding for the materials for the pump come from?

Water pumps would obviously need a power source in order to operate, and in this case, raise water up a two-mile slope to Matènwa, there are many different ways to power an appliance like a water pump, for example: gas, oil, hand powered, water powered, wind powered, or solar powered. Taking into account the well's location and the resources of the village, the

most reasonable ways to power the pump are either through solar power or manual power, for example using some type of crank method. La Gonave receives an abundance of sunlight, which the solar panels could absorb then convert into electrical energy to power the water pump when someone in Matènwa needs access to it. Or alternatively, one of the villagers could go down to the well every other day or so and hand pump or turn a crank to power the pump and have some sort of storage container in Matènwa where the water would be stored for use. It could be accessed over a set amount of time until the water in the storage container is depleted or close to depletion.

Unfortunately with the lack of energy sources on the island, the cost of acquiring a powered pump, and the responsibilities that come with maintaining the pump, using a water pump was determined not to be a practical idea. With the use of some pumps that would have to be put into the well, it would then become inaccessible from the actual source, which could be used by other villages, and water can only be taken from the hose at the end of the pump, which would be located near Matènwa. The reason the well would be inaccessible directly is because it would not allow other items to enter since it has to be covered nor would it remove water due to the size of the pump placed inside. Since the well is a communal well it is an essential water source for multiple other villages. If the people of Matènwa took over the well that could potentially cause many problems among the island and could also put the equipment at risk. Aside from the ethical issue involved in appropriating a well that was placed in an area for all surrounding villages to use, the cost of a water pump made for a well ranges from the low hundreds to mid-thousands (USD) depending on the specifications of the well. On the other hand the pump would successfully transport the water from point A to point B in a short amount of time, which in comparison to the amount of time and labor the people of Matènwa expend each

time they go to the well for water, is not too preposterous in comparison. There are pumps that don't actually have to be placed directly in the well, but the group opposed the idea of a pump that can work outside the well for other reasons.

Unfortunately the people of Matènwa live on an average family income, which is very low if there is any income at all coming into the household. Factoring in the cost of solar panels also adds to the price of the water pump. Each panel varies in price depending on size, amount of power, and the brand name of the company. With Haiti being one of the poorest countries in the western hemisphere (80% of people living below poverty line, 54% living adjacent to poverty line), paying for a fuel or an electrically powered pump or using solar panels is very unrealistic for Matènwa. Along with costs, there is the additional problem associated with sustainability in the use of electrical and mechanical appliances. Due to a lack of resources or companies specializing in the use of water pumps or solar panels in Haiti maintaining a pump and solar panels becomes at best challenging and increases the cost of using a water pump. Someone could be put in charge of taking care of the pump but without the proper training or experience they run the risk of damaging the pump, resulting in the need to purchase a new one. With the use of a water pump the issue of the amount of water the villagers could take before exhausting the well also raises further questions about the viability of this option. If the well dries out, with no other accessible and efficient water source in the general vicinity, the people of Matènwa will have no water to drink or use. Thus there needs to be some form of regulation limiting the amount of water that can be extracted daily. These regulations can be tailored according to the seasons, maybe stricter during the dry season when water gets scarce.

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