



Race to 2015: America's Role in Eliminating the Water Crisis

*Washington Internship for Students of Engineering (WISE)
American Institute of Chemical Engineers (AIChE)*

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Preface:

About the Author:

Christina DeLago is a rising undergraduate senior at Stevens Institute of Technology in Hoboken, New Jersey. She is pursuing a bachelor's degree in Chemical Engineering with a minor in Public Policy, and is sponsored this summer by the American Institute of Chemical Engineers. She will be graduating in May 2014 and plans to attend graduate school to study Environmental Engineering, concentrating in Water Resources. She is a student member and the Mid-Atlantic Regional Liaison for the American Institute of Chemical Engineers and an active member of the National Society of Black Engineers. At Stevens, Christina is also the Service Vice President of Alpha Phi Omega, a community service co-ed fraternity, Philanthropy chair of Theta Phi Alpha, a freshman Resident Assistant, and a Campus Tour Guide.

About the WISE Program

The Washington Internships for Students of Engineering provides engineering students the opportunity to discuss and research a public policy issue of their choice pertaining to science, technology and engineering over a nine week period. Each student is sponsored by a professional society, with 2013's interns representing AIChE, ASME, ASTM International, SAE, ASHRAE, ANS, and IEEE.

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Executive Summary:

Today, one in every five people does not have access to clean water, with a majority of those effected coming from third-world countries. Many rivers and lakes have now been contaminated due to improper sanitation and disposal of human, industrial, and domestic wastes causing them to contain poisonous amounts of multiple contaminants and .bacteria This, in addition to natural causes such as droughts, over population, and natural disasters have turned the need for water into a fast-growing problem that could soon turn into a global epidemic if proper precautions are not taken. With the turn of the new millennia in 2000, many of the world's leading countries gathered with the initiative to halt the water crisis, as well as other issues plaguing the world's poorest populations. As a result, in 2005, the United Nations enacted the Millennium Development Goals, with the seventh goal being to reduce the proportion of people without access to clean water and proper sanitation by 50% before 2015. A portion of this goal was prematurely achieved in 2010 with two billion people worldwide gained access to a sustainable water source.

This report focuses on this initiative by examining what the American government agencies and non-profit organizations have done thus far to aid the United Nations in completing this goal and identifying what still needs to be implemented to fulfill the objective.

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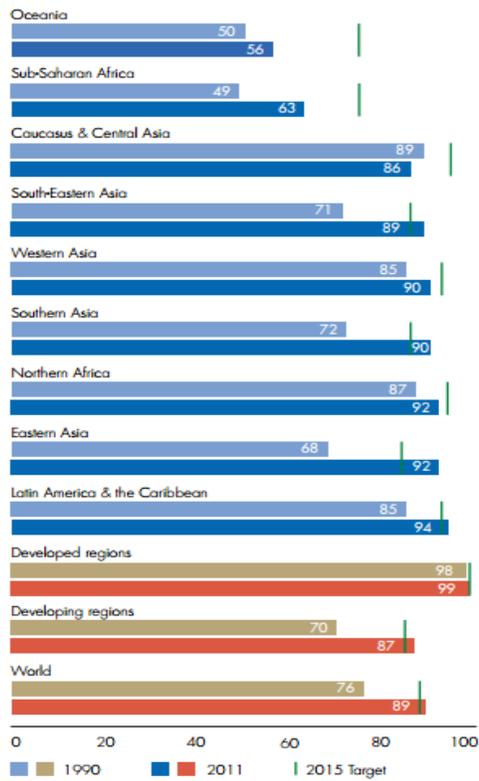
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Figure 1:
Proportion of population using an improved water source

More than 2.1 billion people have gained access to improved drinking water sources since 1990, exceeding the MDG target

Proportion of population using an improved water source, 1990 and 2011 (Percentage)



Source: The Millenium Development Goals Report, 2013; The United Nations, July 2013

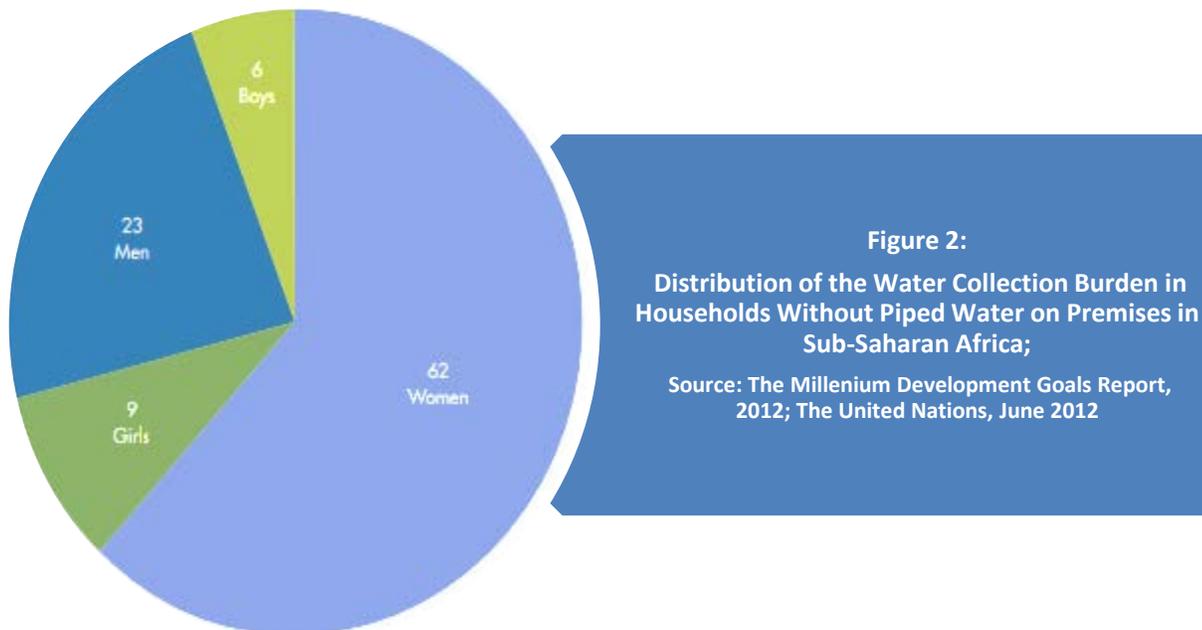
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improvement in the proportion of the population using an improved water source since 1990.

Correspondingly in vaster regions such as Sub-Saharan Africa, the water crisis is an issue that has now spanned several centuries. While improvements have been seen in the past two decades, the issue is so ingrained and so prevalent, there is still a great amount of progress to be made for the region to halve its own proportion of citizens living without.

The Origins of the Water Crisis

The water epidemic is a result of multiple problems that vary per region. Some of these problems have been left unresolved for generations, allowing them to escalate into communal catastrophes affecting every aspect of the inhabitants' lives. The continent of Africa, for example, typically characterized by its desert terrain and perpetual year-long droughts has, as aforementioned, been struggling with water stress for centuries. Particularly in the case of Sub-Saharan Africa, hand dug wells and watering holes were the main source of water dating back to



before the Common Era. Yet due to a sharp increase in population, as well as outbreaks of social

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and political unrest, coupled with a lack of growth in updated water and sanitation measures, has rendered a majority of these assets obsolete. Consequently many areas have been unable to sustain their population's growing need for water, forcing citizens to either relocate or make daily treks to water sources miles away. This responsibility to acquire water falls on the young girls and women of the community, forcing them to miss and eventually drop out of school, in addition to putting themselves in harm's way by forcing them to take such treacherous trips on a daily basis. It is estimated that "for the 25 [Sub-Saharan] countries combined,... women spend at least 16 million hours each day per round trip; men spend 6 million hours; and children, 4 million hours"ⁱ

Similarly, in other underdeveloped regions of the world, where clean water once ran in abundance, most of the resources are unusable due to contamination from varying causes. Factors such as improper disposal of human and industrial waste combined with inadequate to no water treatment systems has left most of the water unfit for human consumption. In Bangladesh specifically, the cause of water contamination was and currently still is predominantly due to over population and the natural large contamination levels of arsenic in their well waters . According to the 2011 Bangladeshi governmental censusⁱⁱ, there were about 150,000 people per square kilometer, making it the most densely populated country in the world. In addition, only 16% of Bangladesh's rural population has access to proper latrines. Although several major fresh water rivers, such as the Ganges, run straight through the country, due to the lack of proper sanitation, most of this water is undrinkable. Since so many citizens do not have access to clean water, a large portion of Bangladeshi children constantly contract water-borne diseases such as dysenteryⁱⁱⁱ.

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Water, though commonly taken for granted by the average first world inhabitant, is the most essential component to every aspect of life. Water is imperative for all agriculture, sanitation, health, domestic, and industrial practices-- in addition to of course keeping the human body hydrated. Without a reliable, consistent, and easily accessible water source, it becomes impossible to harvest and care after food resources, such as crops and livestock.

What's the Problem?

With a universal mutual understanding that water is our most precious natural resource, it brings many to wonder how such a large proportion of the world can still be living without in this technology driven era. It seems preposterous to most that we have the expertise to send rovers to Mars-- yet we still cannot figure out how to provide water, the most basic necessity, to the citizens of our own planet. Foreseeably, in the past fifty years scientists and engineers have indeed found economical, efficient ways to provide clean water to countries in need.

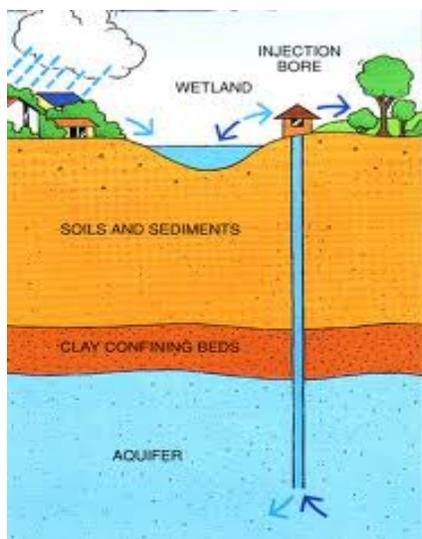


Figure 3:
Diagram of
Underground Aquifer()
Source:
<http://www.aila.org.au>

Figure 4:
Photo of Auger drill(),
commonly used to break
through layers of earth
located above aquifers
Source: Wikimedia.com



Advancements in certain science fields such as hydrology, geology, and topography has allowed experts to accurately envisage the location of deep underground aquifers, essentially lakes hidden underneath the ground's surface. Along with the implementation of large auger drills, engineers are now able to break through the hard layers of earth hiding these valued resources

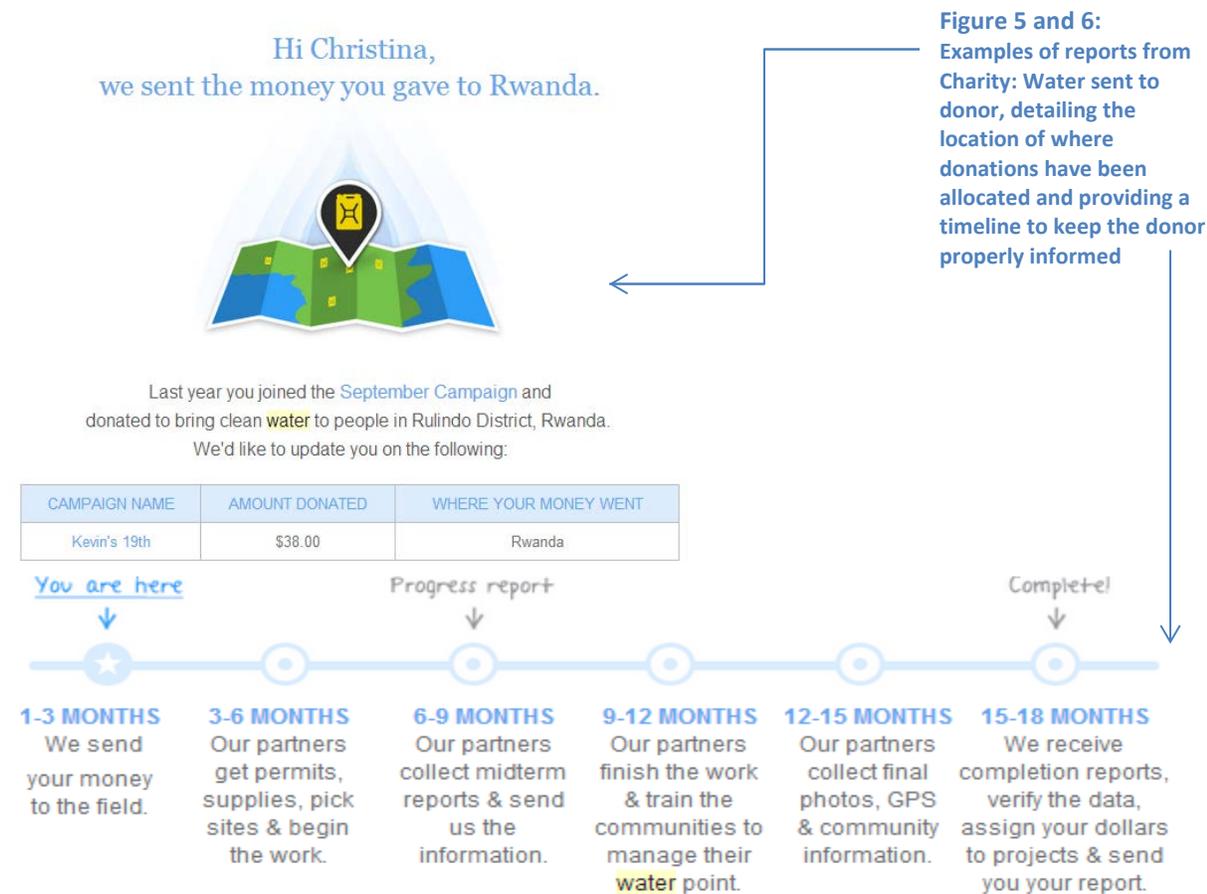
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and create simple drill wells that can serve a population indefinitely with little to no maintenance needed-- if the community properly knows how to take care of it that is. Similarly, in countries where the water sources have since been contaminated, implementation of purification systems as well as educating the public on better sanitization and irrigation practices is available and can certainly be accomplished.

Non-Governmental Organizations

Currently, many of these water and sanitation related NGOs advocate to inform Congress, the Department of State, and the United States Agency of International Development (USAID) of the importance of funding Water, Sanitation, and Hygiene (WASH) programming in developing countries. Groups such as Interaction, Water Aid, and WASH Advocates are called upon to help write and promote the legislation that will aspire to explain within the US Code why the United States needs to be concerned and involved with international WASH programs, as well as to dictate how they will do so. Correspondingly, non-profits organizations such as Charity: Water and The Water Project serve to inform and educate the public on the water crisis and build sympathies that lead to voluntary civilian donations. They give this collected money to larger organizations such as World Vision and Water Aid who go and actually complete these projects. Charity: Water for example goes as far as to send the donor updates of the water project their money went to support in the form of pictures and map coordinates, ensuring that the donor feels apart of the implementation process.

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Source: Personal Email

This system of NGOs working together with one common goal in mind is imperative. With this, each individual organization is able to focus on equally important sectors of the foreign aid process—advocating to the federal government, building public awareness and support, taking part in the legislation process, and lastly, actually executing the necessary work in the needed countries.

The 2015 United Nations Millennium Development Goals

With the turn of the new millennium in 2000, the United Nations pledged “to free people from extreme poverty and multiple deprivations”^{iv}. Enacted in 2005, the eight Millennium Development Goals for 2015 tackle a wide array of subjects across the board to eradicate poverty

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and raise the standard of living within the world's poorest populations. Goal number seven in particular strives to ensure environmental sustainability by undertaking four different targets.

The third of these targets, also known as MDG 7.C is to "reduce by half the proportion of people without sustainable drinking water and basic sanitation"^v

Although the two parts of Target 7.C seemingly go hand in hand, the water and sanitation efforts have been backed disproportionately, leading to a large success gap between the two in recent years. The water half of the target was met prematurely in 2010, five years ahead of schedule. With this triumph, 2 billion people have gained access to a clean and updated water source since the MDG comparative baseline year of 1990. Contrastingly, the sanitation half of the target is well behind schedule, leading the United Nations to believe it will be nearly impossible to see this goal completed by 2015. 33% of the world still does not have an adequate source of sanitation, with 15% of the world's populations still practicing open defecation as their primary source of disposal. These ill practices lead to the recontamination of many newly updated and provided water and agricultural resources which ultimately drag down all aspects of life and abrogates the progress done to combat the water crisis.

To help aid the UN's MDG goals, countries around the world have made modifications to their foreign aid policies, as well to their annual budgets. In November of 2005, America quickly passed Senator Paul Simon's Water for the Poor Act of 2005 which officially recognizes the progress of Target 7.C of the United Nations Millennium Development Goals as one of America's top foreign aid priorities. Equivalently, this act states its purpose is to "seek to reduce by one-half from the baseline year 1990 the proportion of people who are unable to reach or afford safe drinking water and the proportion of people without access to basic sanitation by 2015"^{vi}. This Act amends several parts of the Foreign Assistance Act of 1961 as well as the

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Agricultural Trade Development and Assistance Act of 1954 to give water and sanitation aid a larger ranking of importance in the eyes of all relevant agencies. The Water for the Poor Act states that America will help complete the aforementioned by focusing all assistance on countries in the greatest need, improving water management to prevent waste, and by promoting long-term affordable sustainability by “the creation of innovative financing mechanisms”^{vii}. As could be expected, the majority of the responsibility under this bill falls upon the US Department of State and the United States Agency of International Development; who then build WASH program funding into their annual budgets and then primarily hand over said money to organizations such as World Vision or private sector companies to do the work in the necessary nations.

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management, which prevents year round production.”^x If the problem were to be addressed from the long-term sustainability perspective instead of just making quick three to four year fixes, many underdeveloped nations would be able to permanently eradicate the issue of water and sanitation and eventually become self-sufficient societies.

It has been stated time and time again by WASH advocates and politicians that every \$1 invested in safe water and sanitation yields an economic return between \$3 and \$34, depending on the region^{xi}. However because the people who lack safe drinking water are the same people who are unable to initially invest in the necessary infrastructure^{xii}, reliance on foreign aid becomes a key factor in acquiring sustainable systems. Yet as previously mentioned, to create a self-sustaining water resource system, developers must take into account the community they are entering and fully understand the physical and social environment beforehand. In 2002, the SADC, Southern African Development Community, published a technical report entitled *Defining and Mainstreaming Environmental Sustainability in Water Resources Management in Southern Africa*. This document served to investigate the sustainability, or lack thereof, of water resource projects in South Africa, as well as to make recommendations for the future. This study found that unsustainable projects in the long run do more harm than good, for it “undermin[es] and threaten[s] the sustainability of the water resource base itself, and if this remains unchecked then it is likely to further exacerbate water scarcity in a region that has a limited endowment of water”^{xiii}. Without fully assessing the community beforehand, there is no way to assure that a water system can be successfully integrated into the community’s lifestyle. If the system is not meeting the community’s needs, there is no reason for the citizens to want to sustain it; similarly, if the community is unable to meet the needs of the system, they cannot possibly upkeep it, no matter how much they would like to. This cycle of unsustainability leaves the community and

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their natural resources exhausted, leading to even worse conditions than prior to the intervention as abovementioned. The detrimental effects of such practices can be seen in the South Asian country of Nepal, where “The infrastructure, after it is constructed and handed over to the concerned authority is either never looked after or poorly managed by the concerned authority until it reaches a totally defunct stage”^{xiv}. In WaterAid’s assessment of functionality of 6,278 of Nepal’s water points, only 30% of those were found to be functioning to design, with 50% needing assistance, and the remaining 20% in inoperative conditions.

Table 3. Sustainability results of projects

Sector	Number of services (projects) in percentage		
	Sustained (%)	Sustained but at risk (%)	Not sustained (%)
Water services	31	54	15
Sanitation services	12	50	38
Hygiene services	0	85	15

Figure 7:

Table from WaterAid's Long term sustainability monitoring Report of Nepal; Documents statically the proportion of 26 Water Aid sponsored WASH projects in Nepal, based off of five Core Sustainability factors pertaining to design flow, the benefit to the targeted population, the usage of hygienic latrines, open defecation status, and hand washing, in addition to four sustainability dimensions: Technical, Institutional, Social/Environmental, and Financial.

Those considered to be “Sustained” met all core factors and scored above a 70% in all four categories; “Sustained but at risk” met all core factors but failed to score above 70% in all four sustainability dimensions; Not sustained failing in both aspects.

Source: *Long Term Sustainability monitoring: WaterAid’s experience in Nepal (Adhikari 9)*

These poorly managed projects lead to a large overestimation on statistics in official reports, such as the United Nations’ Millennium Development Goal reports-- when there is actually much more work to be done in regions that are thought to have completed the goal. In addition, all the money that originally went into building these un-sustained projects is ultimately going to waste. This exhausts the natural resources in these developing countries, which forces them to rely even more on handouts from higher powers, whether it be international institutions

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such as UNICEF or more stable economies such as that of the United States, Japan, and the United Kingdom, which consequentially minimizes their chance of ever becoming a self-sustaining state.

Distribution of Wealth

According to the National Intelligence Council's 2013 *Global Trends 2030* Report, by the year 2030 China and India will be the next global powerhouses, serving as “nearly twice the

Ten countries are home to two thirds of the global population without an improved drinking water source

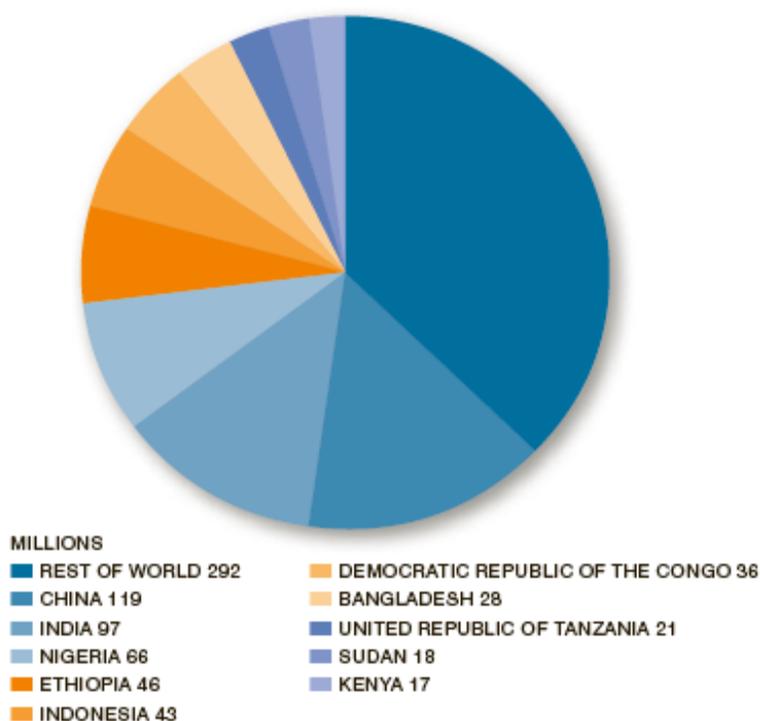


Figure 8:

Pie Chart of the ten countries with the largest population without access to an improved drinking water source in 2012, population without access in millions

Source: UNICEF Progress on Drinking Water and Sanitation: 2012 Update

engine for growth as the United States and the EU combined”^{xv}. Even still, surprisingly enough, a large proportion of the world's population living with an unimproved water source still comes from one of these two nations. **Of the entire global population living without an improved water**

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source are, 15% are inhabitants of China; 13% are inhabitants of India. Upon further inspection, one will realize that this statistic accounts for 9% and 8% China and India's total populations respectively. Even though there has been much improvement in WASH from these two countries in recent years, this is still deplorable in comparison to the world's current leading countries where virtually 100% of their citizens have unlimited access to clean water.

On the other side of the spectrum, the South African country of Angola has come into millions of dollars due to a recent boom in its oil industry. In its capital Luanda, renting a two-bedroom unfurnished apartment costs an average of \$7,000 per month^{xvi}, with "its hotels crammed with oil executives and its harbors filled with tankers carrying away 1.4 million barrels of crude pumped... each day"^{xvii}. Interestingly enough, Angola is still classified as a third world country by the UN, with only 38% of its rural population having access to a clean water source^{xviii}. The less fortunate inhabitants of Luanda's slums are left to drink from the contaminated and polluted Bengo River, where they are rationed to two gallons a day for drinking, bathing, washing, and cleaning. While China, India, and Angola are three very different countries, they all have federal governments with the capability to bring potable, clean water to each of their citizens. Unfortunately, they thus far have not done so, placing unnecessary stress on the living conditions of their own citizens.

Political Tactics Taking Precedence to Need

In February 2013, Rajiv Shah, the Administrator of the United States Agency for International Development, released the agency's *Water and Development Strategy* report. Although this is a great step forward for America's participation and support of WASH programming, it plainly states that WASH advocacy is integral to the success of America's

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national security interests^{xix}. This directly undermines the Water for the Poor Act of 2005, which indicates that only high priority countries should be in contention for receiving aid—not countries that are politically attractive at the moment. Upon further researching the issue, it becomes evident that the State Department strategically chooses more diplomatically attractive countries to give assistance to over more eligible nations. For example, although 96% of citizens in the Middle-Eastern country of Jordan have access to an improved water source, in September 2010, the Millennium Challenge Corporation approved a five-year, \$275.1 million compact to increase the supply of water available to households and businesses. This allocation was met with harsh criticism, with many analysts arguing that “Jordan should not be eligible... [as] it is already one of the largest recipients of U.S. aid, has access to private sector capital, and is not a democracy”^{xx}. Many speculate that America’s concentrated interest in Jordan is due to its prime proximity to the Middle East’s most controversial countries—wedged in between Israel, Syria, Iraq, and Saudi Arabia. Many countries could better benefit from American aid. Current levels of Political appeal should not have a heavily weighted effect on the decision of matters as important as water and sanitation and this is an issue that many agree should be more closely investigated in the future.

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consistently fails at various stages of the bill process, getting closer to success every time. In its most recent 2012 introduction, the bill unanimously passed through the house of the Senate and only died in the House of Representatives by a few votes.

After this last failed attempt, America's top WASH advocates and experts, along with USAID and Earl Blumenaur's foreign policy office have taken to tweaking and modifying previously introduced versions of the Water for the World Act to take into account nearly all of the abovementioned concerns and shortcomings. This fresh version, entitled the Water for the World Act of 2013 will yet again be introduced to the 113th Congress and brings about many positive additions and necessary changes to America's water resource foreign aid policy.

Water for the World Act: Creation of USAID Senior Advisor for Water

The bill's first introduction to Congress in 2009 called for the creation of a Senior Advisor for Water within USAID to manage and supervise the WASH activities outlined in the 2005 Water for the Poor Act^{xxi}. With the establishment of this position, the primary responsibility of overseeing the progress of the Act is transferred from the Secretary of State to USAID's Office of Water and Development. Even without the passing of the Water for the World Act, in February 2011, USAID named Christian Holmes the first Global Water Coordinator.

The new Water for the World Act of 2013 will recognize the Global Water Coordinator position as the Senior Advisor for Water, and codify the position into the structure of USAID, making it a permanent office for years to come. By doing so, the US will be making a statement that the progress of WASH in underdeveloped regions will remain a long term focal point—not

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just a right now in the midst of the MDGs. The Global Water Coordinator reports directly to the USAID Administrator on the progress and specific strategies of their staff. In addition, the Water Coordinator must work with other offices and bureaus within USAID, and other related governmental agencies to integrate supplement water strategies into already in progress foreign aid food security stratagems^{xxii}.

Water for the World Act of 2013: Creation of the Special Coordinator for International Water

In addition to the codification of the USAID Global Coordinator position, the Water for the World Act calls for the formation of the Special Coordinator of International Water to oversee the Department of State's actions regarding water and sanitation activities. The role's main purpose is to guarantee that water and sanitation are regarded with urgent priority in all of America's global development strategies. As the Senate Foreign Relations committee commented on the 2012 Water for the World Act, "Water activities should not take place in isolation or in a vacuum but should be integrated in a broader development framework... there are many different ways to lead to improved access to safe drinking water, and infrastructure investments and related management activities are important components to that equation" With this mentality in place, America can assure that much more people are receiving access to clean water.

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Water for the World Act of 2013: No new funding—just improving implementation

A distinctive quality of the Water for the World Act of 2013 is that it does not require any additional budget allocations or increases—instead, it outlines more efficient ways for the US to go about using the funds already allocated through its 2005 predecessor. The bill will outline quantifiable goals that it strives to reach that will allow Congress to more accurately assess the headway that USAID and the State Department have been making with said funding. The bill will achieve this by breaking goals up into manageable timelines, spanning over six year periods which will give USAID, the State Department, and the Millennium Challenge Corporation enough time to target appropriate projects and countries and need, and then execute them in the most efficient and sustainable ways possible. In addition, this Act will guarantee that 25% of the funding needed to complete these goals is being appropriated from non-governmental areas.

This addition to the bill will give USAID as well as the State Department more time to take sustainability into account when assisting the concerned countries. The Millennium Challenge Corporation, a US foreign aid agency and the second biggest funder to US government WASH programming, only operates off five-year compact contracts with eligible nations. This new timeline basis will give the MCC enough time to evaluate and discuss the nation's top needs and concerns and then actually begin implementation in these chosen countries. There is a very strict and detailed selection process within the MCC, which is used to root out countries with corrupt governments not looking to reform. Similarly, if it is evident that the country involved has a growing average population income, or has a large wealth gap, they too will become ineligible from receiving a compact grant. The MCC allows the chosen nations to develop their own guideline for how they would like to spend the money. This ensures that the

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new water purification systems, wells, sanitation plans, etcetera are exactly what that specific community wants and needs, and, most importantly, that the community will be able to understand the technology, as well as maintain it. The money is given out in increments over the five years, with American officials approving and overseeing all major purchases being made to ensure the money is being spent wisely.



Figure 9:

Timeline of five year, \$540 million Senegal Compact put into effect on September 23, 2010. This compact is comprised of two separate projects. The first pertains to Irrigation and Water Resources, primarily to improve Senegal's irrigations systems. The second ultimately plans to rehabilitate two of Senegal's national roads, RN6 and RN2.

Source: www.mcc.gov

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OPERATIONAL PRINCIPLES:

- Support host country ownership
- Build in sustainability from the start
- Apply integrated approaches to development
- Leverage “solution holders” and partner strategically
- Promote gender equality and female empowerment
- Leverage science and technology
- Measure and evaluate impact
- Achieve resilience

Figure 10:
List of USAID’s Operational Principles to follow in respects to Water and Development, from the February 2013 Water and Development Strategy Report

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that is to eradicate the world population of citizen's living without an adequate water resource.

This ensures that the bill has no partisan or strategic agenda in respect to American and global

politics. This also will ensure that the money is only going to countries that are truly in need and

to secure the sustainability of the projects in those countries.

