Maxwell Fenton
Dowling Catholic High School
West Des Moines, Iowa
Yemen, Factor 2: Water Scarcity
Yemen: "And From Water We Made All Living Things" - Analysis and Developmental Frameworks on Yemen's Water Crisis

Ancient works on Roman history often extolled the virtues of the former province of "Arabia Felix" (literally 'Happy Arabia'), stretching from modern Saudi Arabia's Empty Quarter to the southern tip of modern Yemen. The province was known as this not only for its fertile soil, but the brilliant irrigation techniques its native populace had used for thousands of years to provide flowing water to its farmers. Millennia after the fact, Arabia Felix is no longer the oasis it once was. Instead, a vast and dry desert has taken its place, as unwise irrigation practices coupled with a number of social and political problems have desiccated this once rich area. Once an agricultural powerhouse, modern day Yemen now imports 80% of its food and faces innumerable policy problems. Water scarcity and the impact it has on both families and the nation's own stability is a key concern. Therefore, assisting Yemen with its problems of water scarcity is imperative to future geopolitical stability in the region in conjunction with bettering the livelihood of the Yemeni people. This essay seeks to accomplish two things: first, it will develop a depiction of life under the looming shadow of water scarcity in Yemen. Specific examples, including the struggles of the average Yemeni family, the problems of decreased agricultural productivity and food scarcity, and the exacerbation of other issues the nation faces through scarcity will be examined. Second, a framework for solving the nation's issues of water resources management through development of a program of proper solutions will be detailed.

The vast majority of Yemeni society is based upon the success of the farm, as massive portions of the nation's economy are dependent upon small family-owned land producing crops. As such, it is imperative to understand the struggles the average farm family faces within Yemen. Typical families have a father who is the traditional head-of-household and primary provider. Mothers raise an average of four to five children and keep house. In rural areas, women often assist on the farm (Wenner). The typical diet in the nation includes staple crops like rice, potatoes, and bread. This is often served with meats like lamb, chicken, or beef. Vegetables are an important part of the rural Yemeni diet as well, especially tomatoes, onions, and other crops all important to the nation's cuisine ("Countries and Their Cultures"). Education in Yemen's rural areas is plagued with absenteeism and gender inequality, largely a result of old tribal customs of farming and culture-based gender roles. Illiteracy rates sit at a constant 45%. Most students regardless of gender drop out before receiving the terminal degree ("Education: Improving…"). A lack of financial support and professional medical doctors cripple the country's few emergency centers, and child/maternal health is in dire straits with an infant mortality rate of 58 out of 1,000 live births (Hammer). Individual farms in the nation are very small: 62% are less than two hectares of land, and only 4% are over 10 hectares (*AQUASTAT*). Crops grown on these small farms are often subsistence staples like grains and vegetables. However, certain irrigated farms grow the narcotic shrub qat (CIA). The future of Yemeni families, especially those that continue to farm, has again been cast into jeopardy at the hands of underdeveloped and ineffective farming practices.

Agricultural practices in the nation remain quite primitive, with terracing of land as a common practice to preserve scarce water and land resources (Alabsi). Solvent irrigation remains difficult with scarce water resources, and over-elaborate policies including well and spring irrigation still in use. These water sources remain community managed and largely incapable of supporting a large population. This is largely from the over-mining of aquifers – the excessive and unplanned tapping of groundwater has left reservoirs drained (Lichtenthaeler). These outdated systems of irrigation remain the single largest roadblock to Yemeni agricultural productivity, as a lack of water robs farmers of the necessary aspects of crop growth. The growing of crops like qat – while important to the Yemeni economy – threatens to throw Yemen into

food scarcity as farmers turn to it as a source of income instead of growing staples like cereals and grain. Qat production is highly water intensive, and more resources are used towards profitable (but ultimately unsustainable) qat growth than food production (Boucek). Further agricultural problems including infrastructural issues, problems of development, and poor policy also remain mainstays regarding the failure of Yemeni agriculture Subsistence agriculture and drought caused by bad water management leave farmers in paranoia as already sparse crop production falls because of scarcity. The current situation for the average Yemeni farm family is bleak, but with understanding of the issues hopefully the nation's problems can be alleviated.

But why does Yemen face such dire crises in general? The answer is found in a report from Yemen's Sana'a University, which recently determined a conservative estimate of the causes of tribal conflicts in the nation's rural areas. The key factor found in 70-80% of such strife was determined to be water (Kasinof). The impact of water scarcity on Yemeni farm families remains tenacious. An imperative to solving the nation's problems that must be examined first is the consequences of scarcity on these people. Access to food markets and decent nutrition continually teeters, as water scarcity coupled with rising food prices have resulted in nearly half the nation going to bed hungry (Jones). Water remains a hugely contentious issue in the nation, especially regarding agricultural practices. There are three key factors in understanding Yemen's issues of water scarcity. Antiquated agricultural practices suck the nation's waters dry, as aquifers slowly become depleted. Furthermore, infrastructural problems including leaky pipes and malfunctioning dams are the culprits of water waste. The farming of the traditional narcotic qat saps the nation's water resources due to a myriad of problems with its harvest. The nation's farmers are the most at risk for the wages of water scarcity, but it is their cooperation that is fully necessary to fixing the nation's issues.

A multitude of issues with water scarcity are in play when it comes to the current state of the Yemeni farm family. Poor water management robs families of both the means to achieve decent agricultural productivity and a household income significantly above the world poverty line. Specifically, the lack of water robs food production – the vast majority of Yemeni water goes to growing crops other than food, and food crops like cereals only receive 10% of water allotment (*Qat, Water…*). The lack of water going toward growing food hampers internal security and productivity, and only creates further problems for Yemeni farmers. Productivity is significantly down in the nation due to what Yemeni farmers are growing other than food – namely qat. The mild narcotic, largely the cause of water scarcity in the country due to its water needs and widespread growth, has sent agricultural productivity into a tailspin as more men spend money on qat instead of reinvesting it into their farms or businesses (Boucek). Water scarcity in general shrinks crop yields, significantly reducing food security and productivity. As many Yemeni farmers remain trapped in subsistence, water scarcity and crowding out by the qat industry's absorption of both capital and liquids rob them of the opportunity to produce sufficient food for their families, let alone for market sale to purchase food with increasing prices (Worth). Adequate nutrition remains scarce with water problems, as many of the country's poor remain malnourished. As a matter of fact, Yemen currently holds the second-highest child malnutrition rate in the world, only behind war-ravaged Afghanistan (Tran). With food prices on the rise largely because of these water crises, barriers to decent nutrition and food access continue to exist (Knickmeyer). Unfortunately, the farming practices of the Yemeni people are too often the direct cause of water scarcity, especially regarding irrigation schemes.

Water scarcity directly causes Yemen to face a plethora of problems, resulting in its poor rural farm families to suffer the most. Yemeni society, especially in tribal areas, remains custom-based, with agrarian and herding societies still commonplace in contrast with an economically modernizing Persian Gulf. Traditional Yemeni farmers rely on ancient irrigation practices compared to the rest of the region, with the backbreaking value of hard farm work as a source of fulfillment for ancient tribal custom. Agricultural policies, specifically those involving irrigation, remain exclusively outdated, as obsolete ideas like surface irrigation (the uncontrolled flow of water over large tracts of land – the same practice

pharaonic Egypt used for irrigation along the Nile River) continue to be used in its rural areas (Heffez). These older policies of irrigation remain highly inefficient, with no way of specifying water use per crop. Seepage rates in agriculture often reach 20-30% in general use (Brown). Water is used in vast quantities with little return on overflow, and an already scarce resource evaporates with lack of proper use.

Furthermore, Yemen's water infrastructure remains the product of years of poor management. Piping and dam problems cause huge amounts of water leakage and are responsible for further water waste. Yemen's current plumbing infrastructure situation remains inferior as compared to other Middle Eastern countries. At Sana'a University, pipes are often covered with plastic bags to prevent water leakage (al-Aliqi). Often, piping systems in the nation simply do not work, with pipes not pumping water effectively. This necessitates the trucking in of water tanks, only increasing fuel costs and efficiency issues (Hammer). When the water does flow, 60% of the water transported through piping systems is lost due to leaks and other issues like empty water cisterns (Heffez). Yemen's infrastructural issues are not just limited to pipes, as dams provide even worse problems with water. The Ma'rib Dam, originally meant to divide up water effectively, was built in 1984 to develop an irrigation scheme for farmers in its vicinity. It succeeded at this task, but it was built without necessary environmental precautions. Farmers down the basin were strangled out of water sources necessary to grow food crops like wheat and vegetables, leading to brief periods of food scarcity. Heavy rains in 2010 caused dam overflow, leading to flooding in Sana'a (al-Mosawa). Little of the water was captured for further agricultural use due to dam mismanagement (Heffez). On a larger scale, nine of the nation's twenty governorates were flooded in 2013. Heavy rains killed 39 internally displaced people fleeing political conflict, and affected at least 20,000 more. The storms also wiped out a number of farms and roads, and destroyed 14 water harvesting reservoirs (*Yemen: Floods…*). Despite the local impacts of improper dams, Yemen faces more widespread water crises in the growing of certain water-intensive crops.

The mild narcotic qat remains a tradition in Yemen. As such, it gains huge value within Yemen's water allocations, with nearly 40% of water from the Sana'a Basin used for its growth. Qat is an *incredibly* water intensive crop to grow, with constant irrigation and wet soil needed for its success. The overreliance upon qat as a crop saps Yemen's potential for agricultural diversification, with the crop taking farming precedence over food. The overuse of water on qat crops means that Yemen's food farmers are pushed out of the Sana'a Basin as qat farming becomes more intensive. The basin, being one of the nation's most intensively used water supplies, is of paramount importance to the nation's food security. Ramzy Mardini and Bruce O. Riedel of the Jamestown Foundation found that for every 100 grams in a "daily bag" of qat, 530 liters (130 US gallons) of water are consumed. As farmers are pushed on to smaller tracts of land, less food is grown and farmers are pushed in to tighter quarters in the Sana'a Basin, increasing food prices (Heffez). Once a vibrant agricultural center, Yemen now is dry and largely dependent upon qat for its minor economic successes (Macleod). As seen in its ongoing problems of water scarcity, Yemen has a long road to travel to achieve real food security. Its problems of outdated agriculture, leaky infrastructure, and qat overdependence all sap its potential for economic and political growth and achievement in a rapidly shifting Middle East.

Yemeni water scarcity remains an ongoing and severe concern, as multiple threats continue to loom over the nation. Qais Ghanem of the Gulf News reports in 2014 that Yemen's annual water requirements stand at 3.4 billion cubic meters. Renewable resources like rain and refilling aquifers provide 2.5 billion cubic meters. Water deficits of 0.9 billion cubic meters exist, meaning that increasingly dramatic circumstances to access water (including deep aquifer tapping) are becoming more commonplace. Estimates suggest that aquifers can take years or even decades to recharge, especially ones reliant upon deep groundwater as water must seep toward the surface in a lengthy process. Because Yemen overuses its aquifers already, this timeframe is stretched significantly longer than that of a normally used aquifer. Half of the agriculture market's water access is squandered on qat, and this number in growing as farmers become

poorer. With only 3% arable land, Yemen's already strained agricultural sector only is worsened as both food security and economic problems run amok. Environmental problems like mineralization of water due to illegal aquifer drilling and water waste further create agricultural issues for Yemen, as farmers become ever more desperate to water their crops. With worsening water supply, the use of brackish water created by mineralization threatens communities due to both health risks associated with drinking it and agricultural concerns with its continued use. While crops in Yemen are salt-resistant to an extent, overuse of mineralized water containing an abundance of salts threatens to kill crops (*Status and New Developments…*). In addition, overuse of water often leads to unintentional deregulation, allowing sewage, pesticides, and seawater to seep in to freshwater supply (Boucek). A lack of sewer sanitization efforts in areas with smaller populations threatens outbreaks of cholera, diarrhea, and typhoid because of the risk of sewage spills into groundwater ("Sanitation Services…"). Yemen's poor water infrastructure has led the international community to attempt aid – but such efforts have been blocked by a number of new fears of unrest.

Burdensome aid policies demand political constraints harmful to Yemen – for example, US aid often comes with the agreement to kill terrorists with drone strikes in exchange for capital. Water scarcity has led to terrorism in the past – Jahm tribesmen blew up oil pipelines after political rights regarding water were restricted by the government in 1998, and will likely do so again (al-Haj). With water scarcity coupled with an already unstable nation, these issues could lead to further unrest and perhaps even civil war (Ghanem). The consequences of Yemeni water crises point to an ultimately severe situation that must be dealt with properly. Yemen's water crises are worsening, as statistics measuring water access are growing bleaker for the nation as time goes on. Access to a stable water supply in Sana'a is likely to dry up by 2017 and the city could become the first capital to run out of water ("Does Yemen…"). Water table measurements have shown that access has gone down by two whole meters – forcing farmers to dig deeper for aquifers, often illegally (Boucek). As the water table continually depletes and measurements of the nation's water continually look darker, it is clear that farm families will continue to face agricultural and economic problems. The situation is rapidly growing worse for farmers and the Yemeni people in general – the situation grows more severe with every day.

Innumerable policy concerns, including the presence of al-Qaeda and tribal violence, demographic changes, and poor governance, all must be considered in the scope of shifting water policies to meet Yemen's needs. All of the listed concerns play directly into Yemen's water scarcity issues – both exacerbating and producing the problem. The particular al-Qaeda affiliate present in Yemen, al-Qaeda in the Arabian Peninsula (AQAP), runs rampant as governmental authority is undermined by the Hadi government's ineffectiveness at dealing with water problems in rural areas (Alic). Dissatisfaction at the government has led many Yemenites to respect al-Qaeda as the authority in tribal areas. The organization has begun to settle local disputes, and handle the tribal populace's concerns of water security, often better than the government can. AQAP has cemented itself as an authority in certain areas by handing out water supplies and settling claims over water rights (Green). Farm families in Yemen's tribal areas can and have become sympathetic to AQAP despite Western efforts to combat terror, and further destabilization and radically Islamic-based influence could metastasize further terror cells in the nation. AQAP-led radicalization of tribal groups leads to attacks on infrastructure, thereby creating resource shortages. AQAP's presence in Yemen is clearly indicative of a security threat both to the West and the Hadi government, and is an issue of conflict resolution exacerbated by water insecurity. Chatham House reported in 2013 that a tribal attack on an oil pipeline in 2011 disrupted domestic fuel supplies, causing microeconomic shocks in the food and water markets due to a lack of fuel to power pumps (Hill). In large scale, the economics of Yemen's water issues create terrorism. Crises among the rest of its people, and specifically their movement to other places, are just as widespread as issues of terrorism.

Chronic problems of demographics lie in Yemen's overpopulation crisis. In 1990, Yemen's population stood at 12 million. In 2010, with 95% growth, it now sits at 23 million (Glass). Population centers like

the capital of Sana'a, Aden, and Ta'izz are where the majority of the country resides. Stretching the problem further, huge portions of the Yemeni rural poor are moving to urban areas at a quickening pace. Rapid urbanization threatens water security specifically in Sana'a, wherein rapid urban growth of upwards of 7% a year leads to increased domestic consumption of water in city limits (Boucek). Already relying on an outdated and leaky pipe system, Sana'a's water security will be further stretched to its breaking points, robbing the urban poor of necessary water. Dissatisfaction of poor families specifically in urban areas could tip the already chronic imbalances of water rights in Sana'a into collapse, and further create problems of resources management all out of the issue of hyper-urbanization. In city aquifers that are on their last drops of water, taps are running dry because of these issues of overpopulation (*Rapid Urbanisation.*…).

Corruption is endemic within Yemen, and aid given to water security often lands in the pockets of politicians instead of the people. Prior to the ceding of power to President Abdrabuh Mansur Hadi in 2012, Yemen's leader was Ali Abdullah Saleh. His 30-year propagation of a corrupt and nepotistic regime led to massive corruption within the then-fledgling Yemeni water security movement. Major economic distortions in favor of the Yemeni elite created unfair diesel subsidies that impaired poverty-stricken farmers by forcing them to purchase increasingly expensive fuel for diesel-powered and ultimately unnecessary water pumps for growing qat (Salisbury). The Saleh government's attempts to create local water corporations (LC's) were a political ploy and caused only further water insecurity. By 2010, the government had set up LC's in the governorates of Ibb, Ta'izz, Hodeida, Aden, Mukalla, Amran, Dhamar, and the City of Sana'a only because they were centrally important to maintaining the Saleh government's authority. All of the governorates that received LC's were essential to keeping Saleh's 30-year regime in power by providing large bases of electoral support. Rural areas like Marib, Jouf, Shabwa, the territory of Sana'a, Mawra, and Mahwit all failed to obtain LC's by the end of the Saleh regime because they were not politically convenient (Boucek). Furthermore, local water councils founded under the Saleh regime often only ran water after massive public demonstrations between month-long spans without flowing taps (Saeed). Even with the Hadi government in power, the economic levers driving Yemen are controlled by the elite, including water governance, meaning that the poor's chances at obtaining resources are often dwindled (Chatham House). Hopefully with a less corrupt government, these issues of both water scarcity and governance can be combatted more effectively in conjunction with appropriate foreign and domestic programs.

As such, a four-pronged plan is best to combat Yemen's water problems. These actions are as follows: a) refurbish water infrastructure and organizations rurally and urbanely, b) discourage qat farming as an economic boon, c) combat corruption and terrorism, and d) obtain water technologies other than desalinization (for the moment).

On both a rural and urban level, Yemen's water infrastructure is simply ineffectual. Awareness programs regarding better irrigation must be taken rurally to better supply Yemen's farmers with the water they need. The implementation of education and awareness programs in Yemen regarding new irrigation practices already has a model to follow: in 2007, Rowyan, an anthropomorphic water drop character, appeared in Yemeni water use campaigns, and was successful in convincing Yemenis from all parts of society to be more cautious about their water usage (Hill). The program was bankrolled by German development group GTZ. Similar programs with different purposes implemented in Yemen's tribal and rural areas could have the same moderating effect in raising public awareness of good irrigation policy, and change the minds of new generations of farmers seeking a traditional agricultural lifestyle. In a society with high illiteracy, the use of characters like these on media like television and images plays a powerful role in changing minds. The program is still in implementation on Yemeni television and poster campaigns. Similarly, the encouragement of micro- or "drip" irrigation, wherein water is localized directly to the soil or roots of plants through pipe systems, would result in a much more efficient agricultural system. Indeed, drip irrigation remains 35% more effective in combatting issues of overflow

and inefficiency (Heffez). The original Rowyan program was developed in the span of a few years, and similar plans could follow its timeline of development. Another ingrained tradition, qat, remains a major part of Yemen's issues and must be fought in a similar way.

Qat growth is arguably Yemen's single worst water security agricultural choice. Discouraging the growth of qat in favor of food and other cash crops is the best way of fixing Yemen's extant water problems from a farming standpoint. Yemen's solution must be twofold regarding qat – it must distance it as tradition, and diversify its agricultural markets to do so. While the drug has existed for centuries, qat has only been tradition on a national scale since after the 1970's, when Yemen began to pave roads allowing easy transport of the drug on a national scale. This allowed the drug to become more of a mainstream habit for Yemenis. Using the Rowyan example of both implementation and funding, the Yemeni government must begin a public awareness campaign regarding qat use similar to anti-drug programs. Because illiteracy is so high within Yemen, this campaign must be fought using images and sound instead of words. By declaring the use of qat as a bad habit – specifically focusing on its health risks like tooth decay and cardiovascular issues, its mainstream use can be fought. However, economic change is necessary as well. Yemen must begin more growth of food products to stabilize its markets while turning more to coffee and cactus pears, both less water-intensive luxury crops, for economic growth (Heffez). Furthermore, cactus pears are an especially positive choice for Yemen, as there are few nations growing the crop in huge scale other than a few nations in Latin America and Africa (*Agro-Industrial…*). Because of a vacuum in competition, Yemen can become internationally competitive in cactus pear markets, enriching farmers by exporting a far more profitable crop than qat. Efforts like government distribution, encouragement through public awareness campaigns, or even limited subsidies can convince farmers to choose this more profitable product. Specific data suggests this could be accomplished within about a decade, as Yemen slowly weans itself off qat production and moves more towards other crops (al-Arashi). These products can be sold on world agriculture markets for good prices in comparison to the local interest of qat. Switching its economy from qat dependency to more diversification will succeed in remedying Yemen's further problems. By partnering with groups like UNFAO, Yemen's economic future can be far brighter agriculturally. However, Yemen's political problems are also at stake in alleviating the nation's issues.

Corruption and terror may seem like issues of good governance or conflict resolution, but the two clearly impact Yemeni water security by making attempts to improve it harder and illegitimizing Western efforts to do so. The Yemeni government directly opposes anti-terror efforts in the form of drone strikes – in December 2013, the Yemeni Parliament voted to end all drone strikes in their nation (Almasmari). The United States promptly disregarded this request. US mistargeting has led to the death of dozens of civilians at wedding parties, funerals, and social functions in Yemen's already disenfranchised rural areas plagued with AQAP members. The Bureau of Investigative Journalism concludes that 311-499 civilians have died in these strikes since 2010. Anti-terror measures in Yemen must take a different form – US policy towards the nation **must** shift away from constant drone strikes combatting perceived acute, short term problems and moreso toward fighting chronic problems the nation faces like water security and poverty. This can be done through changes in policy. Policy regarding drone strikes, through proper research and legislative action could be changed significantly for the better. In March of 2013, a number of diplomats from the Hariri Center for the Middle East at the Atlantic Council appealed to President Barack Obama for a radical shift in Yemen policy. They called for USAID and regional allies to provide economic assistance to Yemen's desperate infrastructural state to fix rural problems of unemployment breeding terrorism. In addition, it called for the ending of constant drone strikes to the nation. Restraint of drone strikes as policy could be encouraged within Yemen, only using them when absolutely necessary – for example, the killing of al-Qaeda leaders. The 2014 successful drone strike on Saleh al-Tais, an operational commander for AQAP, or the targeting of Ibrahim al-Asiri, head bomb-maker of AQAP, is a good example of a proper drone strike. In contrast, consistent use to target low-level militancy has arguably resulted in the growth of terrorism. Furthermore, creating jobs and civil society in the nation as the letter recommended could easily be cross-applied to the development of water infrastructure. This

shift in economic strategy coupled with new military programs is a tall order – but it must be done to preserve hope for Yemeni stability.

Aid for water infrastructure could be gleaned from any number of organizations worldwide. For example, refurbishing of the ancient Yemeni piping system or the construction of better, more effective dams could be bankrolled from a security standpoint. In 2009, noted AQAP member Abdullah al-Asiri died in a failed suicide attack on Prince Muhammed bin Nayef of Saudi Arabia. Shortly after the attack, Prince Mohammed vowed renewed vengeance against terrorism from his hospital bed (Al-Shihri).The House of Saud is fearful of any attempts to delegitimize its authority, and it views terrorism as one of these threats. Close calls like the attempt on the prince's life and general fears of terror resulted in a barrage of new anti-terror laws being passed in 2014. However, the Saudis have taken a wrongheaded approach. The new laws primarily combat internal dissent within Saudi Arabia, criminalizing "acts that 'undermine' the state or society" in the nation (Batrawi). Despite their positive (albeit hamfisted) intentions, al-Asiri was from Yemen, travelling by way of the Ma'rib Governorate, and totally out of the control of Saudi legal efforts. Such laws would have accomplished little in staving off the assassination attempt in 2009. The Israel-based Institute for National Security Studies found in 2012 that the only way to combat continued militancy within Yemen was through Saudi cooperation politically and militarily out of their superior operational capabilities against low-level militancy (Schweitzer). While this strategy is excellent at combatting terrorism's acute problems, an economic approach is Saudi Arabia's best bet to fighting chronic problems. To combat terror, the Saudis must attack it at its roots – internal issues within Yemen, notably water scarcity. Saudi Arabia has quickly become adept at water management. Due to its clear security interests in Yemen, it could bankroll projects in exchange for cooperation on regional security concerns because of the "special relationship" between the two countries (Terrill). Saudi Arabia's main stake in the Mideast is preserving its own security, and it must increasingly look to Yemen's problems of terrorism and instability if it wishes to have a peaceful southern border. Yemen can ill afford to reject help from the Saudis, and as the Hadi government in Yemen considers counterterrorism and water security key concerns, it would undoubtedly accept assistance if it were offered in such a capacity. A cooperative Yemeni government is key to solving problems like terrorism, and especially al-Qaeda. This underscores the import of Yemeni engagement with Saudi Arabia and other international actors (Cooper). By encouraging meaningful water resources development, Saudi Arabia could cooperate with other international actors to insulate itself against potential problems of terrorism from the southern border in the future. Yemen must cooperate with its neighbors if it wishes to solve its water management problems.

Rainwater collection and extensive groundwater studies are the two quickest and most feasible solutions for Yemeni water security (al-Asbahi). The implementation of these two forms of water collection hardware allows Yemeni farmers both easy access to water and easy storage, which are both major parts of the success of such a program. Specifically, purifying renewable resources like rainwater provides a near-constant source of fluid coupled with responsible use. As described in a recent USAID report, an average Yemeni farmer like Khalib al-Humaidi struggled with water scarcity on a daily basis in his profession, sharecropping. The father of three is a potato farmer. Freshwater, already hard to come by in the desert-like conditions where he lives, is a necessity when it comes to growing crops. But he is one of the lucky ones – USAID recently constructed a rainwater processor to alleviate the overuse of natural groundwater for al-Humaidi and several farmers in his community. Many Yemeni farmers still struggle with problems of water scarcity, but solving the problems existent in Yemen's water policy will provide a direct boon to farmers like it did to Mr. al-Humaidi. The water problems in Yemen cannot be "solved" like they were for him on a national level, however. They can only be improved through proper policies. Rainwater programs must be implemented in a similar way to other USAID efforts with the same goal. A case study similar to the execution of rainwater processors was seen in Sri Lanka – in 2012, USAID granted $483,000 to local organizations funding the development of rainwater collectors and purifiers, and conditions improved within a year ("Ancient Water…."). The current situation in Yemen is obviously bleak. But, by encouraging better water measures through the implementation of programs like

rainwater processors, food security in the nation specifically for subsistence farmers could be increased as more effective water policy is implemented (Heffez). When better policies regarding water waste and farming are set into motion, it allows food to be grown both in larger and more intensive amounts – meaning better food security not only for Yemeni farmers but the nation's people in general. Coupled with extensive studies on the trustworthy utilization of groundwater and aquifers allows both replenishment of those resources and a consistent source of water during drought over long periods of time. Again, Sri Lanka's programs could provide the model for this, as a number of studies issued by USAID assisted in both the detection of arsenic and other dangerous chemicals in Sri Lankan water supplies and the general timeframe for proper their usage (Ancient Water…). However, as Yemen's population is bound to expand, neither are totally permanent fixes. Switching to desalinization of saltwater is currently infeasible for Yemen. The vast majority of Yemen's population centers lay in the interior of the country and the nation's government is too poor to run water pipelines through highlands to cities. Even if foreign aid were used for this purpose, it would raise the price of water to cover costs of infrastructure (Glass). However, as Yemen becomes more politically and economically stable, switching to desalinization efforts could replace or partner with earlier rural hardware to save Yemen's parched populace (al-Asbahi). As Yemen continues to save money and partner with foreign actors, it must take small steps toward water security instead of large ones to instability.

Yemen's future regarding water security looks bleak at the moment, but through analysis of the underlying problems present in its water security structure, the myriad issues the country faces can be addressed. By understanding the average Yemeni family, facing the problems in productivity and agriculture, discussing the underlying issues Yemen faces in addition to water crises, and developing a solution, Yemen's future through adoption of these principles is a bright one. Hopefully, with proper management and good governance, this part of Arabia can be "happy" once more.

Works Cited

Agro-industrial Utilization of Cactus Pear. Rep. United Nations Food and Agriculture Organization, 2013. Web. 29 July 2014.

Ahmed, Bilial. "Water and Iron: Intrastate Hydro-politics in Yemen." *Journal of Asfar*. Asfar, Nov. 2012. Web. 21 Feb. 2014.

Alabsi, Ali Abdulmalek. "Yemen." *Yemen*. Food and Agriculture Organization of the United Nations, n.d. Web. 22 Feb. 2014.

Al-Ariqi, Samar. "Housing Woes at Sana'a University | Yemen Times." *Yemen Times*. The Yemen Times, 2 Jan. 2014. Web. 20 Jan. 2014.

Al-Asbahi, Qahtan Yeyha. *Water Resources Information in Yemen*. Rep. National Integrated Water Resources Management Program, June 2005. Web. 22 Feb. 2014.

Al-Haj, Ahmad. "U.S. Oil Pipe Sabotaged in Yemen." *Associated Press News Archive.* Associated Press, 2 Dec. 1998. Web. 22 Feb. 2014.

Al-Shihri, Abdullah. "Prince Mohammed Bin Nayef, Saudi Prince Injured In Suicide Attack, Vows To Continue Fight Against Terrorism." *The Huffington Post*. TheHuffingtonPost.com, 28 Aug. 2009. Web. 29 July 2014.

Alic, Jen. "As Yemen's Water Runs Dry, Al-Qaida Runs Rampant." *OilPrice.com.* OilPrice, 3 May 2012. Web. 23 Feb. 2014.

Almasmari, Hakim, and Mohammed Jamjoom. "Drone Strikes Must End, Yemen's Parliament Says." *CNN*. Cable News Network, 15 Dec. 2013. Web. 22 Feb. 2014.

Al-Mosawa, Shuaib M. "High Water Levels in Marib and Batis Dams." *Internet Archive.* Yemen Today, 14 July 2010. Web. 27 Jan. 2014

Al-Yarisi, Amal. "Malnourishment Threatens Children in Yemen | Yemen Times." *Yemen Times*. Yemen Times, 3 Dec. 2012. Web. 22 Feb. 2014

"Ancient Water Scheme Gives Sri Lankans New Lease on Life." *U.S. Agency for International Development*. USAID, 27 Jan. 2014. Web. 11 Mar. 2014.

Batrawi, Aya. "Saudi Arabia's New Anti-terrorism Law to Criminalise Any Form of Dissent - including Demanding Political Reform and Exposing Corruption." *The Independent*. Independent Digital News and Media, 03 Feb. 2014. Web. 25 July 2014.

Birdsall, Nancy, Milan Vaishnav, Robert L. Ayres, and Sheila Carapico. "6 - No Quick Fix: Foreign Aid and State Performance in Yemen." *Short of the Goal: U.S. Policy and Poorly Performing States*. Washington, D.C.: Center for Global Development, 2006. 182-208. Print.

Boucek, Christopher, and Marina Ottaway. *Yemen on the Brink*. Washington, D.C.: Carnegie Endowment for International Peace, 2010. Print.

Brown, Lester R. "Chapter 7. Raising Water Productivity: Raising Irrigation Water Productivity | Plan B: Rescuing a Planet Under Stress and a Civilization in Trouble." *Chapter 7. Raising Water Productivity: Raising Irrigation Water Productivity | Plan B: Rescuing a Planet Under Stress and a Civilization in Trouble | Earth Policy Institute*. Earth Policy Institute, n.d. Web. 23 Jan. 2014.

Cooper, Helene. "In Yemen, a Counterterrorism Challenge." *The New York Times*. The New York Times, 10 May 2014. Web. 24 July 2014.

"Countries and Their Cultures." *Culture of Yemen*. EveryCulture, n.d. Web. 22 Feb. 2014.

DiPierro, Amy. "Yemen: Scarce Water, Security Threat?" *War News Radio from Swarthmore College RSS*. Swarthmore College, Spring 2013. Web. 22 Feb. 2014.

"Does Yemen Have the Resources to Take Care of Its Refugee Population?" *Future Directions.* Future Directions, 3 July 2013. Web. 22 Feb. 2014

Dorsey, James. "Corruption Fuels Crisis in Water-poor Yemen." - *Eureka Street*. Eureka Street, 2 Feb. 2010. Web. 23 Feb. 2014.

"Drone Strikes in Yemen | The Bureau of Investigative Journalism." *The Bureau of Investigative Journalism*. Bureau of Investigative Journalism, 2014. Web. 12 Mar. 2014.

"Education: Improving Access and Quality of Education in Yemen." *News & Broadcast - Education: Improving Access and Quality of Education in Yemen*. World Bank, 2013. Web. 12 Mar. 2014.

Ghanem, Qais. "Yemen's Future Looking Very Bleak." *Gulf News.* Gulf News, 25 Feb. 2014. Web. 25 Feb. 2014

Ghobari, Mohammed. "Yemen Says Security Forces Kill Senior Al Qaeda Leader." *Reuters*. Thomson Reuters, 25 May 2014. Web. 29 July 2014.

Glass, Nicole. “The Water Crisis in Yemen: Causes, Consequences and Solution”. Rep. American University, June 2010. Web. 23 Feb. 2014.

Green, Daniel. "Al-Qaeda's Shadow Government in Yemen." *Washington Institute.* Washington Institute on Near East Policy, 12 Dec. 2013. Web. 23 Feb. 2014

Hammer, Joshua. “Yemen: Days of Reckoning”. National Geographic, Sept. 2012. Web. 24 Jan. 2014.

Harmala, Jason. "Foreign Policy Experts Urge President Obama to Rethink Yemen Policy." *Atlantic Council*. Atlantic Council, 26 Mar. 2013. Web. 22 Feb. 2014.

Hasan, Najlaa. "Awareness Campaigns Insufficient to Address Yemen's Water Problem | Yemen Times." *Yemen Times*. Yemen Times, 28 Mar. 2013. Web. 22 Feb. 2014.

Haykel, Bernard. "Saudi Arabia's Yemen Dilemma." *Global*. Council on Foreign Relations, 14 June 2011. Web. 12 Mar. 2014.

Heffez, Adam. "How Yemen Chewed Itself Dry." *Global*. Council on Foreign Relations, 23 July 2013. Web. 20 Jan. 2014.

Hill, Ginny, Peter Salisbury, Leonie Northedge, and Jane Kinninmont. *Yemen Corruption, Capital Flight and Global Drivers of Conflict*. Rep. London: Chatham House, 2013. Print.

Hill, Ginny. "Comic Answer to Yemen Water Crisis." *BBC News*. BBC, 09 Apr. 2008. Web. 26 Jan. 2014.

"Humanitarian News and Analysis." *IRINnews*. IRINnews, 13 Aug. 2012. Web. 23 Feb. 2014.

"Iran Tracker." *Yemen*. American Enterprise Institute, 2012. Web. 24 Feb. 2014.

Jamjoom, Mohammed, Jim Sciutto, and Hakim Almasmari. "Yemen Strikes May Target Top Al Qaeda Leaders." *CNN*. Cable News Network, 21 Apr. 2014. Web. 29 July 2014.

Jones, Sam. "Yemen Food Crisis Reaching 'catastrophic Proportions'" *The Guardian*. Guardian News and Media, 23 May 2012. Web. 24 July 2014.

Kasinof, Laura. "At Heart of Yemen's Conflicts: Water Crisis." *The Christian Science Monitor*. The Christian Science Monitor, 05 Nov. 2009. Web. 20 Jan. 2014.

Kasinof, Laura, and Nada Bakri. "Facing Unrest, Yemen's Leader Says He Will Step Down in 2013." *The New York Times*. The New York Times, 02 Feb. 2011. Web. 25 July 2014.

Khan, Azmat. "A Dire Water Shortage." *PBS*. PBS, 7 June 2012. Web. 22 Feb. 2014.

Knickmeyer, Ellen. "Yemen’s Dangerous Hunger Crisis." *The Daily Beast*. Newsweek/Daily Beast, 18 July 2011. Web. 23 Feb. 2014.

Lambers, William. "Fighting Hunger in Yemen." *The New York Times*. The New York Times, 04 Feb. 2011. Web. 23 July 2014.

Layline, Tafline. "Yemen's Water Crisis Could Worsen Security." *Green Prophet*. Green Prophet. 1 Nov. 2010. Web. 22 Feb. 2014.

Lichtenthaeler, Gerhard. "Water Conflict and Cooperation in Yemen". *Middle East Research and Information Project*. Middle East Research Information Project, Winter 2013. Web. 20 Feb. 2014.

Macleod, Hugh, and John Vidal. "Yemen Threatens to Chew Itself to Death over Thirst for Narcotic Qat Plant." *The Guardian*. Guardian News and Media, 27 Feb. 2010. Web. 22 Feb. 2014.

Mardini, Ramzy, and Bruce O. Riedel. *The Battle for Yemen: Al-Qaeda and the Struggle for Stability*. Washington, D.C.: Jamestown Foundation, 2010. Print.

Mayen, Nadia. "Food Shortage Threatens to Kill Thousands of Yemeni Children." *Al-Arabiya*. Al-Arabiya, 17 Dec. 2012. Web. 22 Feb. 2014.

Miller, Ethan. "'No Pakistani Civilians Killed by Drones in 2013' ‹ Newsweek Pakistan." *Newsweek Pakistan*. Newsweek, 13 Mar. 2014. Web. 13 Mar. 2014.

"Millions Are Facing Food Crisis in Yemen, U.N. Agency Says." *The New York Times*. The New York Times, 30 Sept. 2012. Web. 22 Feb. 2014.

Naje, Omar. "Yemen's Capital 'will Run out of Water by 2025' - SciDev.Net." *Yemen's Capital 'will Run out of Water by 2025' - SciDev.Net*. SciDevNEws, 22 Nov. 2010. Web. 23 Feb. 2014.

Polycarpou, Lakis. "Water Matters." *State of the Planet Can Water Scarcity Bring Down a Government Yemen Spirals Out of Control Comments*. Columbia University, 6 Aug. 2011. Web. 23 Feb. 2014.

"PressTV - Yemen Has World's Second Highest Rate of Chronic Malnutrition." *PressTV - Yemen Has World's Second Highest Rate of Chronic Malnutrition*. PressTV, 18 July 2012. Web. 22 Feb. 2014.

Qat, Water, and Agricultural Development. Rep. no. 3. International Food Policy Research Institute, 2011. Web. 23 Feb. 2014.

Quadrennial Defense Review 2014. Publication. United States Department of Defense, 2014. Web. 12 Mar. 2014.

"Rapid Urbanisation Threatening Capital's Water Supplies." *IRINnews*. IRINnews, 14 Aug. 2007. Web. 23 Feb. 2014.

Ruhayem, Rami. "Yemen Facing Water Shortage Crisis." *BBC News*. BBC, 21 Aug. 2013. Web. 22 Feb. 2014.

Saeed, Ali. "Corruption and Inefficiency Hinders Yemen's Local Administration | Yemen Times." *Yemen Times*. Yemen Times, 29 Jan. 2013. Web. 22 Feb. 2014.

Saeed, Ali. "ReliefWeb." *ReliefWeb*. N.p., 22 Sept. 2011. Web. 22 Feb. 2014.

Salisbury, Peter, and The Opinions Expressed in This Piece Are Solely Those of Peter Salisbury. "Why Yemen Must Conquer Corruption to save the Poor." *CNN*. Cable News Network, 01 Jan. 1970. Web. 22 Feb. 2014.

Schlein, Lisa. "Improving Humanitarian Situation Critical to Yemen's Stability." *VOA*. Voice of America, 4 Feb. 2014. Web. 22 Feb. 2014.

Schweitzer, Yoram, Tal First, and Einav Yogev. "Anti-Terror Alliances: Saudi Arabia, Yemen, and the United States vs. Al-Qaeda and Its Affiliates." *Institute for National Security Studies*. Tel Aviv University, 16 May 2012. Web. 24 July 2014.

Status and New Developments on the Use of Brackish Water for Agricultural Production in the Near East. Rep. United Nations Food and Agriculture Organization Regional Office for the Near East (RNE), Nov. 2012. Web. 24 July 2014.

Terrill, Dr. W. Andrew. "Strategic Studies Institute." *The Conflicts in Yemen and U.S. National Security*. Strategic Studies Institute, Jan. 2011. Web. 26 Jan. 2014.

Wenner, Manfred W. "Daily Life and Social Customs." *Encyclopedia Britannica Online*. Encyclopedia Britannica, 4 Dec. 2013. Web. 26 Feb. 2014.

Worth, Robert F. "Thirsty Plant Steals Water In Dry Yemen." *The New York Times*. The New York Times, 31 Oct. 2009. Web. 23 Feb. 2014.

Wulfsohn, Ilan. *A Dangerous Addiction: Qat and Its Draining of Yemen's Water, Economy, and People*. Rep. no. 10. American Friends of Tel Aviv University, 13 Nov. 2013. Web. 23 Feb. 2014.

"Yemen." *AQUASTAT*. Food and Agriculture Organization of the United Nations, 2008. Web. 22 Feb. 2014.

"Yemen." *Central Intelligence Agency*. Central Intelligence Agency, 11 Feb. 2014. Web. 25 Feb. 2014.

Yemen: Floods August – September 2013. Rep. no. 4. United Nations Office for the Coordination of Humanitarian Affairs, 16 Sept. 2014. Web. 24 July 2014.

"Yemen Monthly Market Watch". Rep. World Food Programme, May 2014. Web. 23 July 2014.

"Yemen: Sanitation Services Limited, Sewage Treatment Plants Poor." *IRINnews*. IRINnews, 5 Sept. 2008. Web. 29 July 2014.

"Yemen: Time Running out for Solution to Water Crisis." *IRINnews*. IRINnews, 13 Aug. 2012. Web. 23 Feb. 2014.