Mackenzie Pritchard
Coffman High School
Dublin, OH, USA

Restoring Water Systems and Distribution Throughout Cambodia

Introduction

The challenge of providing clean water to its inhabitants is one that many developing countries face. Cambodia, a small country in Southeast Asia, is facing a massive water crisis. The country's rural population bears the brunt of the issue; many areas are suffering from a lack of clean water and latrines. With a rapidly expanding economy, Cambodia has an issue controlling pollution of its bodies of water from industrial and agricultural runoff. The urban areas of Cambodia are where almost all industrial work is concentrated. One of the contributors to pollution is waste from factories being dumped into nearby bodies of water. Without a system put in place to monitor and clean wastewater, it is inevitable that waste finds itself in Cambodia's major water systems. Focusing on rural areas, these make up the majority of Cambodia's population and land area. Without access to essential resources, water and food scarcity plague rural provinces. With an expanding population and economy, Cambodia needs to find a way to fix its sanitation and water quality issues. There are a few steps the country can take in order to ensure water insecurity is eliminated, starting with manageable tasks such as improving education on water handling and hygiene, and using water basins and filters. Afterwards, it is of utmost importance that Cambodia builds a system of navigable roads to connect its cities and towns. To make sure water availability persists throughout the country, Cambodia can then look to improve its entire water infrastructure using Integrated Water Resources Management.

Environment and Climate

Cambodia is a relatively small country, only slightly larger than the state of Mississippi. It sits comfortably between Thailand, Laos, and Vietnam. Its southwest coast is open to the ocean, more specifically, the Gulf of Thailand. Cambodia's climate consists of two distinct seasons: a monsoon season followed by a dry season. The Mekong River (Mékôngk) propels itself through Southeast Asia, acting as a hotspot for economic stability and growth. Originating in Qinghai province, The Mekong River travels southwards, forming the border of Laos and Myanmar, passing through Cambodia and Vietnam, and finally draining into the South China Sea. As the twelfth largest river in the world, it plays a decisive role in the livelihood of millions of fishers and farmers.

Most of Cambodia's land is made up of sandy, low nutrient soil; however, in the Eastern portion of the country, red-soil provides nutrients to grow crops such as rubber and cotton (Chandler). Red soil is a type of soil that develops in warm, temperate, moist climates. It is known to have a high iron content, as well as a neutral to acidic pH. Red soil consists of two layers; a sandy and porous layer sits atop a dark, fertile bottom layer. With proper irrigation and management, red-soil areas can yield a high production of crops (White et al, 2000). Additionally, all the extra rain that occurs during the monsoon season can cause the Mekong River to flood. As the excess water flows into basins and along floodplains, sedimentation occurs. Silt, sand, gravel, and clay particles settle on the temporarily flooded land. When the water recedes, it leaves behind nutrient rich, hydroponic soils which allow for cultivation of rice. Rice and rubber are two of Cambodia's main exports; however, its greatest commodity, textiles, accounts for 68% of total exports (The World Factbook).

Another vital body of water is the Tonle Sap Lake, whose interactions with the Mekong River determine the livelihood of fishers. The size of the Tonle Sap Lake can fluctuate multiple times in a year due to its interactions with the Mekong River. The complex relationships between the bodies of water in Cambodia and the climate result in a fragile system. Because of this, the distribution and quality of water resources must be monitored so that harm to the ecosystem is minimized.

History

Once a communist country ravaged by civil war, Cambodia has managed to find an unsteady footing, building a new economic and political ladder. The consequences of the Cambodian genocide continue to burden the country today. Both its culture and economy were crippled by the rule of Pol Pot and the Khmer Rouge. Millions of men, women, and children were killed: many of which were artists, musicians, monks, and teachers. Artifacts were destroyed alongside most of the country's books in an attempt to erase Cambodian knowledge and traditions. Former "monkey" dancer, Proeung Chhieng explains in "Restoring Cambodian Culture," "...only ten female and seven male dancers from the Royal Ballet survived Pol Pot time, and that even of these survivors, some went mad and have lost their memories because of their suffering"'(Blaustein 427). The genocide wiped not only people out, but an entire culture. However, with new leadership, Cambodia's leaders are eager to restore Khmer traditions. Unfortunately, Cambodia remains one of the poorest countries in Southeast Asia, struggling to overcome the weight of environmental and social disputes. Though the people in power may want to restore Cambodia's culture and economy, there is still an internal struggle for control. This leads to high levels of government corruption, meaning there is less progress in improving the state of the country. Because of this, Cambodia is unable to provide ample services such as latrines, hospitals, and schools. Without basic needs, the rural population of Cambodia are forced into a situation where they cannot easily gain traction on the economic ladder. As of now, access to resources is what really defines wealth in Cambodia. A person who is provided the luxury of clean water and latrine systems, and access to education is more likely to become "wealthy."

Fortunately, the Cambodian government is in the process of trying to revive a gutted education system, an operation that has been lasting for nearly 40 years. Recently, Cambodia has made leaps and bounds in terms of its education system, with the number of students enrolling in preschools doubling. However, issues with funding, preparedness, and ineffective teaching practices cause many students to drop out. According to the World Factbook, the average amount of years children attend school is 10 years. Even in their third year of school, many children still can't read or write. Supporting a proper education requires time, resources, and funds. The latter of which Cambodia seems to struggle with providing. Consequently, the youth of Cambodia suffer; even with the elementary education they've received, there's not much they can do with it. Many of the drop-outs return to their families to assist in fishing/farming. Education in general is not enough to improve Cambodia's society. Children who attend school need to learn basic skills like reading and writing to advance into more complicated subjects. To build a generation of people who *can* teach properly, there must first be a blueprint. Teachers should have credentials and have experience in the subject they're teaching. This may mean that teachers may need to come from other countries, or move to rural areas to teach. Afterwards, the curriculum will be passed down, evolving and improving as time progresses. If the initial model is effective, the next ones should mimic or enhance it. Rebuilding a broken system takes time, and it takes effort, but the benefits the citizens of Cambodia will reap far outweigh the cost. Though there have been tangible advances in the Cambodian education system, there is still far to go. Education is an extremely important part of a developed society, and if Cambodia can begin to educate its people, societal and environmental improvements will follow.

As Cambodia continues to industrialize, it faces the onerous task of providing its people with proper sanitation, as well as handling water pollution. There is an obvious imbalance between rural and urban areas when it comes to quality of life. Disparity between the two areas extends throughout many organizations such as healthcare, education, access to clean water, latrines, and housing. In fact, millions of Cambodians live in rural areas: 75.8% as of 2020 (The World Factbook). The most common dwelling is a wooden house built on stilts, with walls made of woven bamboo. An average Cambodian family consists of four people, those of whom most likely work an agricultural or fishing related job. Food either comes from local markets or is self-provided. Rural areas are disproportionately affected by sanitation issues, with 2 in 5 people with no access to a toilet. Most water comes from rainfall, and it is likely it will be contaminated in some way in the process leading up to consumption. Past attempts at establishing a stable sewage system had proved to be harder than expected, with maintenance and design costing much more than the Cambodian government was ready to handle. Sewage systems built in urban areas suffered from faulty engineering and could not function efficiently. Most were not able to handle extra precipitation from monsoon rains. Sewer discharge did not receive further treatment, and wastewater found itself in surrounding wetlands, still containing pollutants. One of the pollutants was industrial runoff. This runoff contained metal such as iron, which was also found in soil. Another pollutant was human feces, due to the fact that open defecation was commonly practiced. As another example of an attempt to combat the surplus of polluted water, wastewater treatment plants were established and funded by donor countries. However, there was no chance these plants would be permanent after donor countries stopped providing Cambodia money. Soon after funds were retracted, Cambodia was unable to pay for maintenance, and most plants were abandoned. The wastewater treatment plants were a great idea on paper, but in practice, they were not able to make a lasting impact.

Water Quality Issues and Solutions

Cambodia faces several concerns in terms of water quality, the main ones being arsenic contamination, and high levels of fecal coliform. Arsenic contamination in Cambodia is a major source of groundwater pollution. Arsenic dissolves in water due to natural processes such as weathering and volcanic eruptions; this seems to be the case for arsenic contamination in Cambodian wells and groundwater. Ingestion/inhalation of arsenic is shown to lead to cancer, as well as birth defects. Long-term drinking of arsenic contaminated water leads to arsenicosis. Ratha Phok elaborates in "Arsenic Contamination in Cambodia: A Status Review," that, "Non-cancer effects can include thickening and discoloration of the skin, stomach pain, nausea, vomiting; diarrhea; numbness in hands and feet; partial paralysis; and blindness. Arsenic has been linked to cancer of the bladder, lungs, skin, kidney, nasal passages, liver, and prostate" (Phok et al). Arsenic contamination is not widespread throughout Cambodia, mostly affecting areas around the Mekong River and Tonle Sap Lake. However, it remains an ongoing issue, with government programs working on implementing groundwater purification tools, as well as providing alternate water sources.

The second major culprit of Cambodia's sanitation crisis are the high levels of fecal coliform found in surface water and in water-collection containers. Though some bacterial pollution can be traced back to practice of open-defecation, in reality, most fecal contamination stems from improper technique and handling of water after collection. As stated by Crane, Jones, & Berkeley, 2015 (qtd. In Poirot et al.), in their *Food and Nutrition Bulletin*, "Water-borne pathogens such as cryptosporidium, amoeba, *Escherichia coli* (*E. coli*), and *Giardia duodenalis* have been associated with faltering child growth in Cambodia" (Poirot, et al. 2). Other waterborne diseases include hepatitis A, bacterial diarrhea, and typhoid fever. Children, pregnant women, and the elderly are especially susceptible to waterborne disease, and the impact of contracting them can be massive. Certain viruses can damage organ function or even lead to death. The Cambodian government, with assistance from foreign programs, has been looking into ways to

improve water quality, especially in rural areas. The hope is to reduce the spread of waterborne illnesses among rural communities.

The most practical solution to begin resolving water pollution and sanitation issues in Cambodia is the establishment of clean latrine systems and sanitary water collection methods. Programs improving these systems have already been implemented by the Cambodian government, as well as by donor countries and organizations such as UNICEF. This solution takes into account the culture, as well as cost restraints of building new sanitation and water collection systems. Traditional rainwater collection methods have many drawbacks, including lack of storage space and open tops, which allow contaminants to enter the water with ease. The containers themselves are unhygienic and serve as prime areas for mosquito reproduction. In *Journal of Water Management Modelling*, "An Overview of Water Quality Issues in Cambodia," Irvine writes, "...RDIC tested water from 150 traditional water jars randomly selected from two separate villages east of Phnom Penh. All of the jars tested positive for high levels of *E. coli* and mosquito larvae were observed in 82 percent of the jars" (Irvine, et al. 17).

To improve on traditional water jars, a new model has been introduced into the field: earth tanks. Named to promote cultural acceptance, earth tanks are spherical and enclosed, in an attempt to dissuade mosquito breeding and contamination. They are very low cost: only $75 is needed to build a 4200L tank. A tank of that size is enough to support a family of six through the dry season. To install an earth tank, there are a couple steps that need to be completed. Firstly, a mold must be made. A hemispherical frame is filled and packed with mud, which afterwards is covered with used cement bags, secured with nails. Then, chicken wire is fitted around the mold. Once the mold is finished, cement is applied on it in several layers. Before the structure dries, four holes are made so that it can be lifted easily with hooks (as it is nearly half a ton). The next step in completing the earth tank is movement and assembly. The two hemispheres and base are sealed together at location, and a spigot is installed so that water can be drawn out of the tank.

Of course, earth tanks are not useful without water flowing into them, so a gutter and PVC pipe system must be implemented to guide rainwater into the tank. There is also the option to add a ceramic filter. Ceramic filters have been used for years, and are a great tool to clean water. The filters can be produced locally, have a low production cost, and require little maintenance. After these steps have been completed, the earth tank is ready to use. For areas with more people, such as schools, larger tanks are provided. To distribute the water, students are given access to treadle pumps, allowing water to be moved to certain points. Each endpoint, then, has a ceramic purifier.

However, as with any newly-introduced form of water collection, there must also be proper education to be able to successfully implement it. Education programs, such as the curriculum established by the RDIC (Research Development International Cambodia) focus on hands-on learning and visual presentations to help children retain information. Education in proper hygiene and water handling is an important step in solving the water crisis. Simple actions, such as washing hands and using the toilet can be taught and implemented in daily life. In terms of personal hygiene, the RDIC has also developed a simple latrine. The latrine is formed with two cylinders, one active and one sedentary. The active hole can be used for up to 18 months before it must be covered. Then, the family can switch to using the second hole as they wait for the contents within the first to decompose (the resulting compost can be used as fertilizer). This solution requires the Cambodian government to step forward in the form of better water regulation policies, as well as support for education and funds to build simple latrine and water collection systems in rural areas. It has already done this in the form of the RDIC, but there is still more that can be done. It also is essential that outside sources take steps to support change within rural communities by jump-starting construction projects and education programs.

The Importance of Foreign Aid

Expanding on the concept of foreign aid, there are many ways a country can receive money or resources from another country. The ones that will likely work best for Cambodia are bilateral aid, multilateral aid, voluntary aid, and project aid. Starting with bilateral and multilateral aid, these are forms of foreign aid that are given government to government (Thelwell). A multilateral aid would be, for example, from the United Nations. A bilateral aid would be directly from one government to another. The United States already provides funds to multiple countries using bilateral aid. Project aid is funds saved for a specific purpose, such as building roads or schools. This type of aid is the most straightforward, as the funds are only to be used for specific purposes. With bilateral or multilateral aid, the country who receives the money has more freedom on how to use it. This allows for more flexibility, but also more risk, as the country may decide to use the funds unwisely or inefficiently. The downside of project aids is the fact that the project could fail. Going back to the example stated earlier, the wastewater treatment plants that were constructed in Cambodia's urban areas could be considered project aid. However, without funds from donor countries, the treatment plants were abandoned.

Finally, there is voluntary aid. When a person thinks of foreign aid, they likely imagine some sort of charity or donation. Voluntary aid is an effective way to get ordinary people involved in domestic or foreign affairs. Donations are simple and useful, but volunteering is a more involved method of charity. A person who donates or volunteers for an organization will feel better about themselves, and feel like they're making a difference. Though voluntary aid is beneficial to both donor and receiver, the funds and assistance from charity sources can be inconsistent compared to the other options. To convince ordinary people to chip in to help a country they see as disconnected from themselves, organizations must find ways to appeal to people's sympathy or wants. By helping a country now, there can be an opportunity for future cooperation, both economically and socially. The biggest problem with foreign aid is the willingness to provide it, and then the ability of the recipient to use it wisely. Even so, foreign aid is essential for Cambodia's development.

The Impact of Government

Government plays an immense role in a country's success and stability. The Khmer Rouge (CPK), in their time of ruling, planned and implemented an extensive irrigation system in order to maximize rice production. Their methods were cruel and controlling. The Khmer Rouge used water and agriculture as a way to control Cambodians; their vision of a perfect communist society killed millions. Their irrigation system was planned so that profits could be reaped even in the dry season. By politicizing water infrastructure, the government seized control of millions of lives. Water and society can be seen as two interconnected systems, and water is usually seen as a commodity, not a necessity. Stian Rice explains the goals of the Khmer Rouge: "The new government, known as the CPK, declared the re-organisation and re-establishment of rice production as a primary objective. In the words of Pol Pot:
"We have greater resources than other countries in terms of rice fields.… It is the Party's wish to transform agriculture from a backward type to a modern type in ten to fifteen years. We are working [here] on a Four- Year Plan in order to set off in the direction of achieving this 10–15 year target. (Party Center of the Communist Party of Kampuchea, 1976a, p. 131)" (Rice, et al. 389). The Khmer Rouge planned to relieve food scarcity and use excess rice as a way to receive goods from other countries.

As with many things, what sounds good on paper might not work in reality. In order to reinvent Cambodian agriculture, the CPK impounded millions of Cambodians in forced labor, and levied a strict food ration. The facsimile nature of the Khmer Rouge allowed the water management implementation to pass through easily. Citizens were seen as materials in the plan and nothing else. Post-CPK, the Cambodian government has made advances in reversing the negative effects of their reign. With the civil war still relatively fresh, people are likely suspicious and scared of the government. An unwillingness to

work alongside the government will hinder progress in solving water insecurity. In order to regain trust, the government must use its power in ways that assist most residents. This can include building new roadways, providing funds to struggling organizations, and promising safety. Once people begin to recover, they will be more willing to do what the government asks of them. Instilling citizen's trust in the government will lead to cooperation and progress in all aspects of water management and distribution.

Even with its expansive water systems and relatively long monsoon season, water is a coveted resource in Cambodia, with only a small amount of it safe to use for drinking and agriculture. In fact, during the dry season, there can be a lack of water in certain areas. Using the Oddar Meanchey province as an example, this area of Cambodia suffers from a *lack* of water, especially during the dry season. Although the province was affected by the Khmer Rouge regime, its population has exploded since then; the stress and demand for resources is only growing. Rémi Valois, Jean-Michel Vouillamoz, Sambo Lun, and Ludovic Arnout describe the state of the province in their article, "Assessment of water resources to support the development of irrigation in northwest Cambodia: a water budget approach," "Lack of water during the dry season is clearly an obstacle for the development of this agricultural area because almost all inhabitants are farmers. Moreover, they occasionally face a rainfall shortage or a delay in the onset of the monsoon, which affects their crops and their food security. In fact, the Red Cross carried out a survey among 200 households in 2010 which revealed that 73% of farmers had already faced drought in May, June and July" (Valois, Rémi et al. 1). In order to distribute clean water around the country, there must be a transportation system in place. Water is not only important for hygiene and drinking, but it also dictates food insecurity, which can be seen in the Oddar Meanchey province. The prevalence of farming as an occupation makes water a vital resource.

Road Infrastructure

Right now, many rural communities are isolated due to a lack of good road infrastructure. With a decrease in transportation via waterways, it is more important now than ever to have functioning roadways. Many of the existing roads were damaged during the civil war, and Cambodia has been working to fix them with aid from international donors. As of 2009, 73.8% of all of the country's roads are rural (The Council for the Development of Cambodia (CDC)). The main issue with the rural roads is the fact that many of them are easily flooded during heavy rainfall. Flooding can also cause vegetation to block roadways and hinder travel. Some of this is due to the road's positioning. A road that lays low will have a high chance of flooding or being blocked. The state of a roadway dictates travel time. Time is a resource that is unlimited; however, being able to use it efficiently is essential for upwards progress. If a route takes a half hour longer each time it is driven, hours and hours can be wasted as it is traveled thousands of times. The impact of the genocide crippled not only Cambodia's culture, but also its infrastructure. Working to create an effective road and highway system will better connect Cambodia's people, as well as provide citizens with access to necessities such as water and food. With developed and improved roads, the stress of food and water insecurity will be alleviated throughout the country, especially in isolated, rural areas.

Looking Towards the Future: IWRM

As a final step, Cambodia can use Integrated Water Resources Management, which focuses on evaluating movement and availability of water in relation to economic, social, and environmental states within certain areas. More simply stated: a water management plan. An example of IWRM implementation is in the Heihe River Basin (HRB), China. This method of water regulation was put in place in an attempt to combat the area's ever-changing climate. The Heihe River Basin, along with many other areas in China, suffered from increasing levels of water shortages. The entire ecosystem had been slowly deteriorating; the groundwater was rapidly drying, biodiversity was declining, and water quality was worsened. With

ever growing strain on water usage within the watershed, new goals had to be made in order to manage water rationing for industrial, agricultural, and home use. Water played a pivotal role in the economy in the HRB, and over the century, water demand has increased. The new objective was to manage the watershed, and combat water saving issues and environmental degradation due to human activities. To complete this goal, decisions had to be made while keeping in mind the relationship between the socio-economic state, land use, water demand, groundwater, and environment. Throughout the watershed, the uses of water resources differed greatly.

Chinese scientists created multiple models to simulate the differing areas that work alongside each other. Then, they used the different models to run experiments and compare results. As years passed, a new idea, integrated water resources management (IWRM) came to be developed and used. The IWRM is a very flexible water management model, and it is used around the world in a variety of settings. Meaning, that this method could be used to better control and understand Cambodia's water allocation and usage. Further described by Xiangzheng Deng and Chunhong Zhao in their article "Identification of Water Scarcity and Providing Solutions for Adapting to Climate Changes in the Heihe River Basin of China", "…IWRM takes a broader holistic view and examines a more complete range of solutions. It has promoted the water management to move into the substantial scientific research period, with good public participation mechanism and considering water, ecology, and social economy in the basin scale…" (8).

Though its environment is drastically different compared to the Heihe River Basin, Cambodia can use the concepts established by the IWRM to focus on improving its own policies and regulations in relation to water distribution and sanitation. By deciding what issues are most critical, solutions can be analyzed and organized so that they can be implemented. A way to lay out all the different options would be with the application of multicriteria decision analysis (MCDA). Basically, an objective must be chosen along with criteria to weigh each solution. Then, the importance of each criterion must be laid out so that each solution can be calculated mathematically to find the one with the highest score. This method of analyzing options helps to show which solution would work best to fix a certain issue. Once the solution is implemented, progress can be evaluated. If the new method does not work as expected, it can be changed.

Summary

In Cambodia, it isn't a lack of water that is the issue, it is the lack of *clean* water. To succeed in establishing stronger regulations, the separate areas of Cambodia's fractured government must learn to work together, and young professionals must step up to the task, as many skilled workers were killed during the Khmer Rouge. Though there aren't many people with a college education in Cambodia, there are some. Deciding on new policies for water management and allocation will be very difficult, and the people working on it may need to reach out to foreign countries for help. Using the IWRM would be beneficial to Cambodia, as it not only takes into account the socioeconomic state, but also supports sustainability, and provides options to solve conflicting needs. With a better established water management system, the Cambodian economy will be able to flourish alongside its people.

The best solution for Cambodia, at the moment, is to start simple. Constructing functional latrine and filter/collection systems will provide a base for more complicated procedures and policies to rest on. First, looking to educate the rural population on hygiene, then encouraging them to spread their knowledge to others will greatly speed along the process. Water transportation is also an essential step in guaranteeing water security. Constructing functioning roads and highways offers more options to rural areas farther from large water sources. After a base is established, the country will be ready for the next step: more regulation and control over their water distribution. Using the IWRM model alongside examples from other countries, Cambodia can begin asserting control over water distribution and look to gain

economically in return. Of course, all this improvement won't happen immediately. By starting small and simple, costs will be low while at the same time improving living conditions in rural areas. Once the economy and people have begun to steady themselves, more time and money can be allocated to water management policies and distribution. The institution of these policies will take a lot of time (as well as money and trust from the population), but as long as the progress is steady, change will come. A suggestion would be to start with simple solutions, which do not take much time or resources to implement. Cambodia is a developing country, still recovering from a devastating civil war, so first and foremost, it should look to improve its economy and raise the quality of life for its people.

Cambodia is suffering a major water crisis, originating from an unstable government and lack of education. Attempts to improve water quality are largely due to donor countries stepping in. The Cambodian government must take action as a united force, along with the support of the people to implement permanent solutions to improving water quality and living situations. Starting with basic latrine, filter, and storage tank construction, coupled with proper hygiene education, Cambodia can greatly improve the living situations of its rural population. A proper road infrastructure to better connect its population will also aid in economic growth. After implementing a reliable base, more contemporary methods can be phased in to begin regulating water distribution and movement throughout the watershed. With a single goal in mind, Cambodia can find itself on the path to sustainable development and industrial growth, without the weight of a water crisis dragging it down.

Works Cited

Blaustein, S. “Restoring Cambodian Culture.” *Nation*, vol. 249, no. 12, Oct. 1989, pp. 426–429. *EBSCOhost*, search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=a9h&AN=8910230942&site=ehost-live.

Central Intelligence Agency, Central Intelligence Agency, 1 Feb. 2018, www.cia.gov/library/publications/the-world-factbook/geos/cb.html.

Chandler, David P. “Cambodia.” *Encyclopædia Britannica*, Encyclopædia Britannica, Inc., www.britannica.com/place/Cambodia.

“Decade, Water for Life, 2015, UN-Water, United Nations, MDG, Water, Sanitation, Financing, Gender, IWRM, Human Right, Transboundary, Cities, Quality, Food Security.” *United Nations*, United Nations, www.un.org/waterforlifedecade/iwrm.shtml.

Deng, Xiangzheng, and Chunhong Zhao. “Identification of Water Scarcity and Providing Solutions for Adapting to Climate Changes in the Heihe River Basin of China.” *Advances in Meteorology*, vol. 2015, June 2015, pp. 1–13. *EBSCOhost*, doi:10.1155/2015/279173.

Irvine, Kim, et al. “An Overview of Water Quality Issues in Cambodia.” *Journal of Water Management Modeling*, 5 Feb. 2006, doi:R225-02.

OKEOLA, Olayinka Gafar, and Bolaji Fatai SULE. “Holistic Diagnostic of an Urban Water Supply System Management Using Hydro--Economics Model.” *Annals of the Faculty of Engineering Hunedoara - International Journal of Engineering*, no. 4, Nov. 2020, pp. 123–132. *EBSCOhost*, search.ebscohost.com/login.aspx?direct=true&AuthType=cookie,ip,uid&db=a9h&AN=147879462&site=ehost-live.

Phok, Ratha & Nandalal, K D W & Pitawala, H.M.T.G. & Dharmagunawardhane, H & Weerakoon, S.. (2018). Arsenic Contamination in Cambodia: A Status Review.

Poirot, Etienne, et al. “Water Quality for Young Children in Cambodia—High Contamination at Collection and Consumption Level.” *Maternal & Child Nutrition*, vol. 16, Oct. 2020, pp. 1–9. *EBSCOhost*, doi:10.1111/mcn.12744

Resource Development International, rdic.org/.

Rice, Stian, et al. “The Hydro-logic of Genocide: Remaking Land, Water, and Bodies in Democratic Kampuchea, 1975–1979.” *Area*, vol. 52, no. 2, June 2020, pp. 386–393. *EBSCOhost*, doi:10.1111/area.12582.

“The Council for the Development of Cambodia (CDC) " Roads.” *Council for the Development of Cambodia (CDC)*, www.cambodiainvestment.gov.kh/investors-information/infrastructure/roads.html#:~:text=Cambodia’s road network currently extends approximately 44,709 km,,tertiary roads for which the MRD is responsible.

Thelwell, Kim. “5 Different Types of Foreign Aid.” *The Borgen Project*, Kim Thelwell Https://Borgenproject.org/Wp-Content/Uploads/The_Borgen_Project_Logo_small.Jpg, 11 Sept. 2020, borgenproject.org/5-types-of-foreign-aid/.

Valois, Rémi, et al. “Assessment of Water Resources to Support the Development of Irrigation in Northwest Cambodia: A Water Budget Approach.” *Hydrological Sciences Journal/Journal Des Sciences Hydrologiques*, vol. 62, no. 11, Sept. 2017, pp. 1840–1855. *EBSCOhost*, doi:10.1080/02626667.2017.1351030.

White, P., Dobermann, A., Oberthür, T. and Ros, C. (2000), The rice soils of Cambodia. I. Soil classification for agronomists using the Cambodian Agronomic Soil Classification system. Soil Use and Management, 16: 12-19. https://doi.org/10.1111/j.1475-2743.2000.tb00164.x