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### **The Effect of the Cambodian Water Crisis in Agriculture**

Situated in Southeast Asia along the Gulf of Thailand, Cambodia is a country of 16 million people facing a water crisis. The predominantly rural population lacks necessary infrastructure to provide sanitation systems and water purification for local communities. As a result, waste water, pollution, and harmful chemicals find their way into the water sources designated for human and agricultural use. The struggle to find clean water negatively impacts the everyday lives of rural Cambodians and the way their food systems develop. While the country itself possesses sufficient water volume to support its growing population, the quality of the water leaves the rural areas without enough to satisfy their basic needs. Food quality is affected when there is no clean water that can be used to irrigate crops. Harmful pathogens can travel through contaminated water used for irrigation and end up in the foods people eat. Resulting health issues due to consumption and use of contaminated water can put an already struggling family into an increasingly stressful financial situation, and can limit the efficiency of small farms. To identify a solution to this pressing issue, it's imperative that the voices of local communities are understood and the challenges are identified at the fundamental level.

The water crisis in Cambodia reflects staggering numbers. Rural Cambodia has the highest rate of open defecation in the region, and 1/3 of the total population gets water from non-improved water sources (Llaurado, pg. 1). A non-improved water source can be an unprotected well, surface water, or any other source where there is risk for contamination. Contamination can be traced back to human waste and household wastewater, along with animal and chemical waste. Human waste in water is a symptom of the lack of development in the rural regions of Cambodia. Open defecation can be a result of many things, the biggest being an overall lack of lavatories in the region, so people must instead opt for fields or open bodies of water. This contaminates surrounding water sources. When wastewater is not properly managed, the water nearby is often not safe for consumption and disease can spread. Vulnerable groups like children, the elderly, and the already ill are especially at risk. The communities where these things occur don't have the resources to build sanitation facilities that would improve water quality, so water sources can go untreated. This of course leads to yet another major issue - using contaminated water for agriculture.

Everyday life in Cambodia revolves around water because agriculture and crops, specifically rice, are their primary industry and export. Rice comprises three quarters of the crops grown in Cambodia, harvested by farmers in rural agricultural areas (EU Analysis, pg.1). So much is planted that the excess is

exported to other countries, with rice contributing to a fourth of the national GDP (Ponleu, pg.1). What's important when considering water scarcity in relation to agriculture is that the vast majority of crops are not grown on large, industrial farm plots, but the 3.7 million hectares of cultivated land are divided into an average of 2 hectare size farms worked by families who rely on agriculture for their livelihoods (Cambodia Socio-Economic Survey, pg. 19). Just under half of the working population is employed in the

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agriculture industry, with the average annual salary equating to a little over \$1,000 USD (pg. 19). These small family farms depend on their own labor to earn money for food, housing, education, and healthcare. Water sanitation becomes a major issue for these small farms because a contaminated crop or a sick worker can have a massive negative impact on the economic success of these families. With an entire industry at risk, a great portion of the population is affected by the real health consequences of contaminated water.

Bacteria from the contaminated water can make its way into the food system and onto the plates of those who consume the crops, both domestically where it's grown and to those where it is exported. The bacteria then can make people sick from consumption. While bacteria is a concern, the biggest health risk from wastewater irrigation are intestinal parasites. Roundworm, hookworm, and other parasites are found in quantities of 150 ovum per litre in water that goes untreated, which is 150 times the standard proposed by the World Health Organization for agricultural use, even when farmers use a traditional 'pond settling technique' that allows larger sediments to sink to the bottom (World Health Organization, pg. 1). Sickness related to water contamination can be deadly. According to a national survey of the Cambodian population, 16.7% of the rural population had been to the doctor for a health issue in a period of 30 days (Socio Economic Survey 2016, pg. 66). There are significant financial stressors associated with health issues in rural populations, as 95.4% of those visits were paid with money from savings and wages directly from the families (Socio-Economic Survey 2016, pg. 83). To add to the strain, a sick person who cannot work may lead to more lost wages.

The reasons for the crisis in Cambodia do not originate from a lack of water. Wet seasons due to monsoons and a considerable network of rivers and lakes blanket the country (Overton, pg. 4). The lack of sanitation infrastructure leads to the contamination of otherwise pure water resources. A prime example of this can be found in the village of Phat Sanday, an entirely floating community atop Tonle Sap Lake. The lake itself is the biggest in the region totaling 1,042 square miles of water, yet despite being freshwater, the water from the lake is undrinkable due to contamination (Crothers, pg. 2). Human waste is disposed of directly into the water as Phat Sanday has no established sanitation system, and as a result, the concentration of bacteria and disease-causing pathogens can reach septic concentrations in the dry seasons (Crothers, pg. 1). Diarrheal diseases contracted through sources like these are the leading causes of death in children under 5 in Cambodia (Boudinot, pg. 1). Villagers have also told of the risks associated with drowning, as children fall into the water when toilets are not available. The villages on the lake rely on fishing for their income, an industry that employs over 1.2 million people along the lake (Van Zalinge, pg.1). The water crisis impacts each and every one of them. Therefore, it is necessary to seek solutions

that target water sanitation and hygiene.

To look for ideas that could improve water quality, it's important to examine the processes that have already been shown to be successful. The neighboring country of Vietnam launched a massive project led by the Center for Rural Water Supply and Sanitation (CERWASS) and the Ministry of Agriculture and Rural Development. The project is called the Red River Delta Rural Supply and Sanitation Project, and it aims to bring safe water to rural communities and create sanitary facilities to dispose of human waste. They do so while educating communities about hygiene and ensuring they are capable of managing the infrastructure programs. The two countries are similar in the underdevelopment of rural communities in

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comparison to urban cities, and face the same issues of water contamination and lack of clean drinking water. The scope of the plan to improve water quality in Vietnam is also necessary in Cambodia. The best solution to the Cambodian water crisis would be to identify what worked well in this project in Vietnam and implement similar measures. The main difference between the countries is the level of development. Vietnam has developed rapidly in the past few decades and the population has become slightly wealthier than those in Cambodia due to rapid economic growth. The country has greater access to basic services like water and electricity, and overall ranks 28 places higher than Cambodia on the 2019 Human Development Index (UNDP, pg. 1). It is because of these differences that the outline of the project would need to be adjusted to the needs of the Cambodian people. It is necessary that local villages and communities are consulted to determine location of infrastructure, the method of dissemination of important information related to education in the use of any equipment, and plans tailored to the individual needs of the community. Developing a national plan similar to the CERWASS project would mean a large-scale national effort to bring clean water and sanitation facilities to rural communities.

A national plan would require a few specific steps before implementation. First, to encourage support from communities, there should be teams whose primary purpose is to educate on the benefits of hygienic practices like improved lavatories and protected water sources. There are programs similar to this idea, including one called Water Sanitation and Hygiene (WASH) formed by many organizations including UNICEF. Communities should be informed of the benefits of the new infrastructure beforehand so that project and community leaders can work together to identify goals and seek the best results. Next, there should be clearly defined goals for different regions of land. Regions could be determined based on the ways water is used, whether it is primarily for agriculture, household, or industrial use. Yet again this would require cooperation between leaders of many villages and project leaders. This should be left long-term to members of the villages, and could emphasize how clean water systems improve the safety of crops from contamination and make it safer to eat.

CERWASS received funding for their project through government offices, outside stakeholders and non-governmental organizations, and through participation with local people. The Asian Development Bank (ADB) has already approved \$49 million dollars in funding to the Cambodian government for a similar project. Outside organizations such as Water.org have also been key stakeholders in funding

solutions for the water crisis. To make the best use of funding provided the issues need to be addressed at the root of each community. This would be best achieved by committees composed of members of each village. They would be responsible for identifying areas of need, directing funding toward best possible solutions, and making the installation, maintenance, and education of new infrastructure the responsibility of the members of the village. Community-based support has been shown to produce best results in water projects in Africa, where villagers are the sole caretakers of newly built wells (UNICEF, pg. 1). They receive training to maintain the new buildings and educate the community, and in turn there is a greater drive to preserve the new resources independently. This allows for minimal long-term heavy involvement, and resources can be diverted elsewhere. Following that approach, communities in Cambodia would be left responsible for the new infrastructure.

A second solution to the water crisis that would produce more immediate results is developing water-purifying technologies for household use. Cost-effective ways of managing human waste have

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already appeared on Tonle Sap Lake where there is the most difficulty with water contamination. As a result of drier seasons and damming in Northern Cambodia that affects river flow, the lake that the community depended on began to dwindle in volume and their sources of income along with it. Sanitation systems became too expensive, but the HandyPod toilet system developed by WetlandsWork! emerged as an affordable solution. Capable of being used in both wet and dry environments, waste is filtered through a series of chambers that break down material and uses bacteria and polystyrene to reduce pathogens being released back into the water source (Crothers, pg. 1). These HandyPods have been very successful in the community. With greater use, villages on Tonle Sap Lake can continue to benefit from this safer toilet. To create demand for this product, communities should be educated on the benefits of the system. This could be achieved in a couple of ways. First, by installing a HandyPod in one location for public use, it would be possible for every person in a community to learn how it works and understand why it is being used. If villagers are able to see first-hand how water quality improves by using the HandyPod it would in turn create a drive to get one in their own homes or closer to their own communities. By placing a HandyPod in schools for example, children would be allowed to use and learn about safe and hygienic water sanitation systems. Information can then reach individual households, and families can band together to purchase one for their own homes or with other families to reduce cost. Outside funding from NGOs could be used to offset costs in extremely impoverished areas. Specific locations should be determined by the local communities. Another way to create a demand would be to educate the general population in hygiene. Programs like WASH developed by several organizations including WHO and UNICEF work with communities in similar situations to promote hygiene by educating people and providing resources like soap, and have been shown to be successful in reducing the number of hygiene-related illnesses by over 50% (WASH Education, pg. 1). Establishing a WASH program in Cambodia would encourage communities to seek more hygienic methods of waste disposal. Similar community-led efforts could include placing educational posters, pamphlets, or other means of communication in public food markets and healthcare buildings, places where everyone can see the information.

The impact of water contamination can be felt throughout Cambodia, but it is particularly impactful in rural agricultural communities. Most people get their water from unprotected water sources which is then used for household use and irrigation for crops. This leads to numerous health risks and is especially dangerous when the pathogens in the water contaminate the foods people eat. Not only does this pose financial strain when it comes to healthcare, but is also a clear demonstration of the lack of infrastructure and development in much of Cambodia. There are very few improved water sources and safe latrines for people to use, so they are forced to use local water sources for every water-based need. This crisis can be improved with a thorough national development plan that draws inspiration from a similar project in Vietnam (CERWASS). Governments, communities, and project stakeholders would need to work closely together to identify the needs of each community. Creating a demand for current technologies like HandyPods would continue to help areas like the villages on Tonle Sap Lake. Affordable and effective, introducing the benefits of these technologies to all people by placing a demonstrative installation in a public place is a first step towards making these toilets used throughout the country. Community involvement should take precedence in bringing clean water to rural Cambodia. Those within affected areas are best able to identify specific areas in need of improvement and would know how to make

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changes that align with current ways of life. By making such changes, water will be safe to use and the agricultural sector will benefit.

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