

# Providing Sustainable Clean Water to Raing Khvav Village in Pursat, Cambodia

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## Abstract

While water scarcity alone is one critical issue facing the world today, it is estimated that 2.1 billion people do not have access to safe drinking water; moreover, 4.5 billion still lack proper sanitation, thus causing 340,000 deaths of children under 5 years old from diarrheal diseases. (U.N. Report, 2019). Families and communities are locked in a cycle-of-poverty as they are affected by serious waterborne diseases - including viral and bacterial gastroenteritis, dysentery and cholera.

A national NGO in Cambodia, Life with Dignity (formally Lutheran World Development Cambodia), has been actively engaged in identifying rural communities with available water resources, yet lacked a proper water system infrastructure to enable clean water access to individual households. In late 2018, LWD approached me to assist in conducting a Water Access Feasibility Study for a rural village, Raing Khvav, in Pursat Province. The case study includes the following: 1) Socio-economic review of the village community of 208 households; 2) Analysis of the village's current access to clean water; 3) Identification of local, clean water source options that are available; and finally, 4) Propose a new water system that can meet stated objectives and key performance indicators (KPI).

**Keywords:** water supply systems, poverty alleviation, Cambodia

## INTRODUCTION

### Facing a Global Water Crisis

During the past century, global water use has grown at a rate that is double the rate of population growth. As a result, the availability of total water resources has gradually declined during this same period. According to World Data Lab, more than 2.3 billion people worldwide now live in areas identified as being water-scarce. The World Economic Forum now includes water scarcity among the three top global concerns, together with terrorism and climate change. A report by the Huffington Post in 2016 warned that “water shortages have also increased the potential for global conflicts, especially in parts of the Middle East and Africa.”

The United Nations warns that while water scarcity alone is one critical issue facing the world today, it is estimated that 2.1 billion people do not have access to safe drinking water; moreover, 4.5 billion still lack proper sanitation, thus causing 340,000 deaths of children under 5 years old from diarrheal diseases. Families and communities are locked in a cycle-of-poverty as they are affected by serious waterborne diseases - including viral and bacterial gastroenteritis, dysentery and cholera.

Water scarcity can also be defined in terms of an economic crisis. It is estimated that 1.4 billion jobs, representing 42 percent of the global workforce, are contingent upon adequate water sources. Government agencies estimate that billions are lost annually as families spend countless hours gathering water for household use. Furthermore, millions of people are unable to pursue adequate education and employment opportunities due to a lack of water. The World Health Organization (2016) reports, “Universal access to basic water and sanitation would result in \$18.5 billion in economic benefits each year.” The UN echoes this same sentiment, “Water is at the core of sustainable development and it is critical for socio-economic development, energy and food production, healthy ecosystems and for human survival itself”.

## **CAMBODIA CONTEXT**

### **Impressive Growth but Challenges Remain**

Since the late 1990s, the once poverty-stricken country of Cambodia has experienced impressive economic growth. During the 1998-2018 period, Cambodia's economic growth has averaged 8 percent, which was the direct outcome of favorable garment exports, foreign investment, and tourism. During the past 20 years, the poverty rate has been cut to 14 percent, which is in sharp contrast to a poverty level of 48 percent a decade earlier. In 2009, Cambodia was successful in reaching the Millennium Development Goal to reduce poverty by 50 percent. Cambodia has made significant progress in all socio-economic indicators, particularly in health and education. It is noteworthy that mortality rates for children under five years old have fallen from 85 per 1000 in 2005 to 35 per 1000 today.

Despite progress in the socio-economic indicators of health and education, Cambodia still faces serious challenges today. The World Bank reports that while MDGs have been met, 4.5 million people remain extremely vulnerable to returning to poverty when suddenly exposed to external economic factors. One-in-three children under the age of five suffer from stunted growth and only 36 percent of three-to-five-year olds are enrolled in pre-school. Furthermore, only 57 percent of the children report completion of secondary school, despite a high level of early enrollment rates.

## Cambodia's Challenge of Access to Safe Water

Cambodia is a nation with a population of 15.6 million, which borders Thailand, Vietnam, and Laos. Although the nation has experienced impressive economic gains during the past 20 years, 4 million people still lack access to safe drinking water, and 6 million lack proper sanitation. Since 77 percent of Cambodians live in rural areas, access to safe water disproportionately affects these poorer communities. This is in contrast to 80 percent of the people in Phnom Penh who have access to safe water. UNICEF's Cambodia Representative, Rena Flowers, asserts: "Attention to rural water supply, sanitation, and hygiene will unquestionably deliver results – fewer child deaths, better learning at school, more productive workers, reduced healthcare costs of a people".

The lack of clean water has had a tragic impact on young children's health. In Cambodia, diarrhea remains the main cause of death for children under 5 years old. Besides illness and death, unsafe drinking water is considered a key factor in low educational achievement in the country. In a report issued by the Water Project, excessive school absences, due to water-borne diseases, has resulted in low academic achievement rates.

Still another reason cited for the crisis of unsafe drinking water is the lack of funding and government commitment to place "safe water" as a priority. Cambodians point out that government funding is now overly focused on infrastructure, such as the building of roads.

## RESEARCH METHODOLOGY

A national NGO in Cambodia, Life with Dignity (formally Lutheran World Development Cambodia), has been actively engaged in identifying rural communities with available water resources, yet lacked a proper water system infrastructure to enable clean water access to individual households. In late 2018, LWD approached me to assist in conducting a Water Access Feasibility Study for a rural village, Raing Khvav, in Pursat Province. The study would include the following: 1) Socio-economic review of the village community of 208 households; 2) Analysis of the village's current access to clean water; 3) Identification of local, clean water source options that are available; and finally, 4) Propose a new water system that can meet stated objectives and key performance indicators (KPI).

This feasibility study used a "mixed" quantitative and qualitative approach. The quantitative part of the research included a 20-question written questionnaire that was translated into Khmer, the official language of Cambodia. The survey covered household socio-economic characteristics and demographics, current household water use, and perceived benefits of alternative water supply systems.

After the written survey was completed and analyzed, I traveled to Cambodia on two occasions during 2019 to meet village residents to validate survey results and to further carry out qualitative interviews with individual households and community groups. Approximately 30 interview sessions were completed during the two scheduled field site visits in May and October, respectively. The interviews were homogeneous in terms of gender, occupation, and social backgrounds, which promoted open discussion about challenges facing the village community and water use. Additionally, consultations were held with several seasoned professionals in rural water system management. This provided valuable insights into water volume requirements, water quality measurements, practical water filtering options, and legal compliance related to land and water use. This approach of “research triangulation” provided invaluable information about the village’s socio-economic conditions, water-use history, and water access options.

## **SOCIO-ECONOMIC CHARACTERISTICS OF THE PROJECT AREA**

### **Overview of Pursat Province**

Pursat Province is 174 kilometers northwest of Phnom Penh and is accessible by a national highway or water. The province is the 4th largest in Cambodia and ranks 14th in population size. The total population is approximately 400,000 persons, accounting for 3 percent of the total population of Cambodia. Major crops of the area include rice (370,000 tons), maize (8,000 tons), cassava (70,000 tons), beans (865 tons) and soybeans (585 tons). Forests cover 58 percent of the province. Data Source reports that Pursat is ranked as one of the 16 poorest provinces in Cambodia, with an overall poverty rate of approximately 20 percent, as compared to 13.5 percent who have been identified as living in extreme poverty.

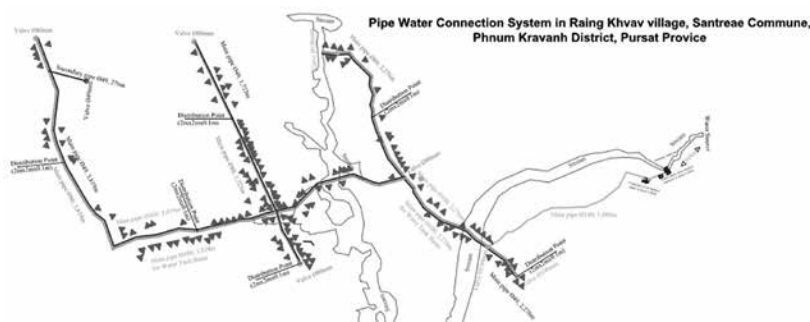


**Figure 1**  
Pursat Province, Cambodia

### **Characteristics of Raing Khvav Village**

The site of the feasibility study is Raing Khvav village. The village is located in Kravahh District, near the Phnom Aoral Wildlife Sanctuary Area – 56 kilometers from Pursat City. In

total, the village has 208 families or 856 persons. These households consist of extended families, including nieces, nephews, distant relatives and grandparents. The main occupation of the villagers is farming, particularly rice. In addition to rice farming, residents are involved in household animal raising, household businesses, collecting non-timber forest products, and growing mixed vegetables for sale in the local market.



**Figure 2**

Raing Khvav Village 208 Households

### Household Characteristics

Feedback from 58 of the 208 households was considered an appropriate level to ascertain the socio-economic characteristics of Raing Khvav Village. The data collection first confirmed that 79 percent of the residents are directly engaged in farming, while 10 percent identified small business ownership as their main occupation. Residents said that children are expected to help with agriculture work and the portage of water for the household. Twenty-seven percent of the households indicated no formal education, followed by 64 percent that reported primary school as the highest level of educational achievement. Only 9 percent cite completion of secondary school, while no one has attended university or technical college. According to parents, children in Raing Khvav have limited access to secondary school education due to a burdensome travel distance to the nearest secondary school. Respondents also pointed out that while the community children have access to primary school education, the school buildings are dilapidated and in need of extensive repairs. Teachers further shared that a final challenge facing young children is the need to migrate with their parents to other farming areas during harvest times. This results in a lack of educational continuity, thus resulting in a high dropout rate.

The majority of the 208 households are considered poor – even when compared to other Cambodians. Internet and telephone access are not available, thus severely limiting regional, national and international news and information. My site visits to the village also confirmed that lighting is limited to candles, kerosene lamps and wood-burning. Moreover, due to very poor road conditions, the closest medical care facility is a three to four-hour drive from the

village. Another indication of the poor economic conditions is that only 2 percent of the homes are constructed of cement, compared to 84 percent who live in dwellings constructed of wood. Still another twelve percent of the villagers live in homes that have a basic structure of thatch, while 2 percent exclusively use mud.

### **Family Asset Ownership**

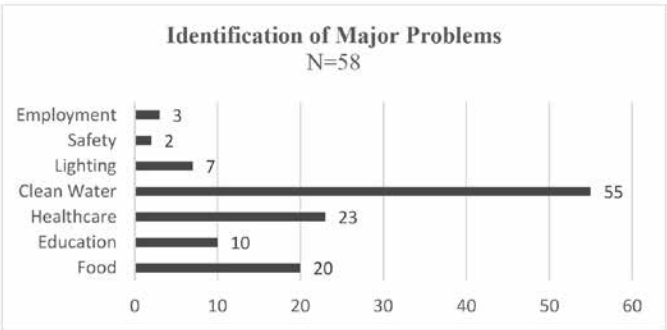
Eighty-three percent of the households document motorbike ownership, as compared to only 2 percent who own an automobile. Forty-eight percent report using a bicycle, which indicates that the mobility of the residents is very limited. Public transportation is not available. Additionally, we can conclude that information access is poor with 51 percent of the residents reporting cellular phone ownership, while only 41 percent cite daily television use – followed by 28 percent who regularly obtain information from radio. Eighty-four percent of the homes report ownership of chickens, and 43 percent had cows to support their work and livelihood.

### **Family Income and Expenditures**

On average, monthly income for the residents in this study equaled approximately 104 dollars or approximately 11,500 JPY. The data shows that 50 percent of the households earn less than the U.N. designated poverty threshold of 1.90 dollars a day. In other words, 50 percent of these village residents are not able to meet minimum living conditions and experience difficulty in meeting the basic needs of food and water. Furthermore, approximately 70 percent of the residents indicate spending more than 40 of their disposable income on food and water. This high allocation of income to cover basic food supplies is characteristic of people living in poverty. Conversely, 70 percent of the households spend less than 10 percent or less of household income on child education – particularly due to limited family income. Several parents further commented that secondary school education is not an option for their children due to the need to work to support the family.

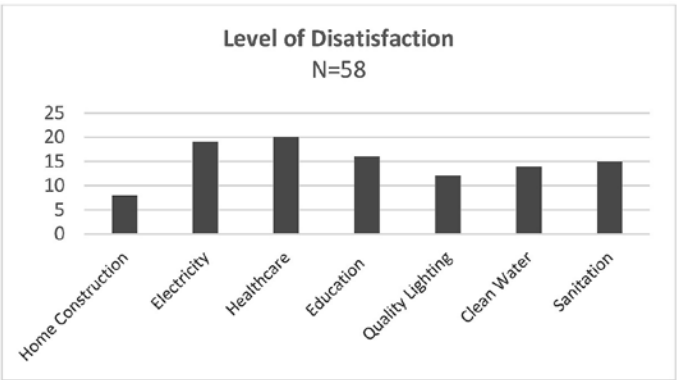
### **Identification of Major Socio-Economic Problems**

To more fully understand the challenges facing the residents of Raing Khvav Village, participants were asked to identify the two most serious problems facing their community. Ninety-four percent of the households cite the lack of clean drinking water as an urgent matter. This data was confirmed in follow-up one-on-one interviews and focus group discussions, whereby residents said that water-borne illnesses are a serious concern. Parents and teachers claimed that children are often ill due to contaminated water, thus resulting in a high degree of school absenteeism. Similarly, 40 percent said that inadequate healthcare was a critical challenge, followed by 34 percent who said that a lack of food was a high priority concern. A lesser number of 17 percent indicated concerns about child education, and 12 percent mentioned inadequate lighting as a significant problem.



**Figure 3**  
Socio-economic Problems Facing Local Community

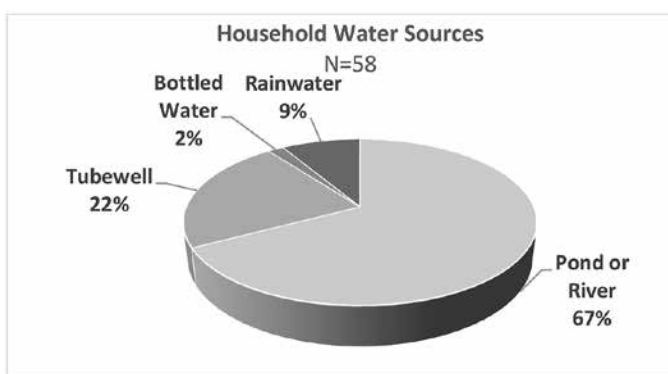
Figure 4 below shows the results of a cross-reference survey question focused on the level of satisfaction across a range of socio-economic determinants. A comparatively low level of satisfaction was found in the areas of access to healthcare, electricity, sanitation, education, and clean water. Field research interviews with residents, individually and in focus groups, further confirmed the low level of satisfaction of quality healthcare. Residents confirmed the high prevalence of diarrheal diseases, typhoid fever, malaria, and dengue fever. Parents expressed concern that many children in the area suffer from preventable diseases, such as polio, diphtheria, tetanus, measles tuberculosis and hepatitis. Discussions also revealed that women and children commonly face mild malnutrition due to inadequate knowledge about breastfeeding and child nutrition. It was also divulged there is inadequate awareness among youth regarding reproductive health issues. Finally, community leaders said that antenatal care, postnatal care, and delivery services are severely underdeveloped.



**Figure 4**  
Level of Dissatisfaction Across Socio-Economic Variable

## Baseline Household Water Use Information

A second objective of the survey instrument was to more fully understand the current household water use experience of the 208 households. Sixty-seven percent of the survey respondents said that a nearby river or pond was their main source of drinking water, followed by 22 percent who have access to a tube-well. Nine percent of the homes obtain water from rainwater, but only 2 percent purchase bottled water. For the majority who depend on a nearby river or pond, family members take one to two hours daily to portage water to their homes. Twelve homes that are a far distance from the natural water source spend three or more hours daily for portage.



**Figure 5**  
Main Source of Water for Rural Households

In follow-up interview sessions, residents said they sometimes have to spend up to 10 to 20 dollars a month, representing 10 percent to 15 percent of their disposable income, to arrange for someone to deliver bottled water for household uses of cooking and bathing. Finally, residents were asked to identify the main problems associated with their current water use. Twenty-nine percent alleged hardship in collecting water from a water source a long-distance away. Also, 22 percent said that water collected had a bad smell, a direct result of contamination and improper filtering. Seventeen percent expressed concern about the high cost when hiring someone to portage water, followed by approximately 10 percent who cited the presence of bacteria and health concerns. Additionally, during on-site interviews, residents said they did not have sufficient water to care for their animals or engage in small-plot vegetable farming. As a result, family income and nutrition were negatively impacted – especially during times of seasonal drought.



## VILLAGE WATER SYSTEM STRUCTURE

### Government Approval

Leadership from the national NGO, Life with Dignity, worked with the local community during the past few years to set priorities for village development. Through extensive consultations with residents, village leaders, and provincial government leaders, it was agreed that the village of Raing Khvav faced insurmountable challenges related to employment, child education, health care, water access, and sanitation. Many of these challenges, of course, are interrelated; however, the community identified the development of a clean water system as a priority. As a part of this participatory planning process, the community communicated with local and regional government authorities about the possibility of accessing water from a nearby mountain stream through a piped infrastructure. The respective officials approved access to the water stream to provide water to the 208 households in the village. Hereafter, official letters of support were provided by the Ministry of Environment and Provincial government offices.

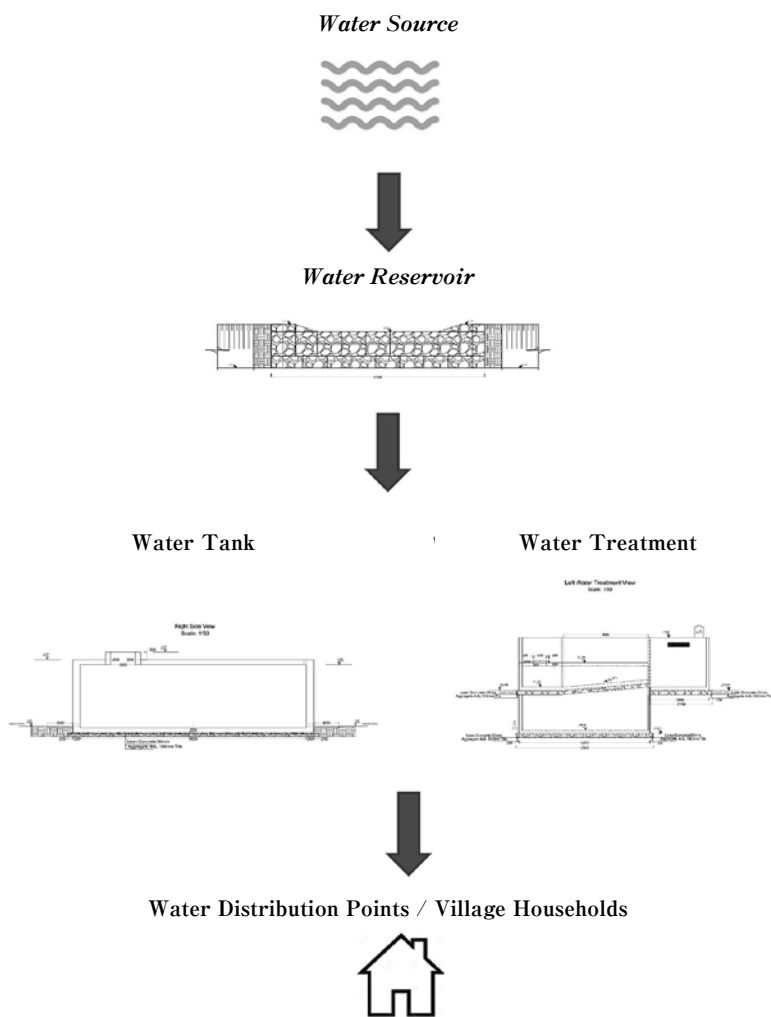
### Engineer Feasibility Study

Following government approval, it was agreed to engage a professional engineer to study the feasibility of providing adequate and sustainable water to the village community. As such, the engineer was commissioned to propose a structure that would meet the water needs of the community, and have a minimal environmental impact of the forest area. The engineering study concluded that the water source stream had an annual capacity of 28,000 cubic meters, thus providing a minimum of 60 to 70 liters of water a day to each of the 208 households year-round, but without significantly depleting the water source or causing harm to the surrounding ecosystem.

The engineer surveyed the height of the water source at 132.246 meters, as compared to the elevation of the village homes in the range of 125.109 to 134.782 meters. Most importantly, the engineering consultant concluded that total water pressure was sufficient to reach all homes along a distance of 27,000 meters. Moreover, the amount of water outflow would sufficiently support the projected increase of households - to a level of 225 homes - in 5 years hence.

Shown in Figure 6, the conceptual design of the proposed water supply system came out of extensive discussions with LWD, assigned consultant engineer and members of the community Water Management Committee. In practice, approximately 20 to 30 percent of the daily outflow of the water stream of 28,000 cubic meters would be channeled into a water reservoir. From the reservoir, water to meet the daily water supply for the village would

flow into a water basin with a length of 9 meters, a width of 5 meters and a depth of 2.5 meters. One advantage of the water basin is that large particles of sediment fall to the bottom, representing an important step in preparing the water for filtration. Thus, the water basin is an important intermediary holding area for the village water before processing the water through a treatment tank. Then, this next step in the treatment process makes use of a sand and charcoal filter process which removes bacteria and viruses. In addition to the above measures, chloramine can be mixed into the water at levels that kill infectious bacteria – such as escherichia coli (e.coli) – but are still safe to drink. At the end of this filtering process, the volume of water is more than sufficient to provide for water year-round for both daily household use, home vegetable plots, and animal care.



**Figure 6**  
Village Water Supply System

Finally, based on finances available, the local community will have two options to access water. If finances are limited, the village residents will need to portage water from one of five water distribution points located in the village. Then, as home finances improve over a two or three-year period, the community can take steps to pipe water directly into each of the 208 households. A water usage meter would be installed, and a small fee would be charged – based on total water used for the month. These paid water fees would be managed by the Community Water Management Committee and used for long-term maintenance of the water supply system.

### Project Beneficiaries

The targeted beneficiaries are 205 families, comprising 883 people. This includes 397 children, 9 people with disabilities, and 28 specially-targeted households that fall into the definition of “extremely poor”. The data collection revealed that these poorest households currently make less than 50 cents per day, meaning they struggle to cover the basic daily necessities of food and healthcare.

No.	Description	Total	Females
1	Population	883	409
2	Families	208	
3	Children	397	127
4	People with Disabilities	9	5
5	Very Poor – Level 1	13	
6	Extremely Poor – Level 2	15	

**Figure 7**  
Summary of Target Segment Beneficiaries

### Water System Proposed Key Performance Indicators

As Project Advisor and researcher, I worked with the national NGO and members of the local community to identify key performance indicators (KPI), against which project success would later be evaluated. In summary, the main KPI is to provide water access to all village households, coupled with enhanced community knowledge about the interrelationship between clean water and human health. A corollary objective is to alleviate waterborne diseases and improve health. A final KPI is to improve small-scale agriculture production, thus increasing income.

KPI Category	Definition of Key Performance Indicator
Water Access	100 percent of the target community will have sustainable access to clean water for household and small-plot-agriculture use.
Healthcare Knowledge	85 percent of the adults will have increased knowledge about the interrelationship between clean water, sanitation and health at the time of project completion; furthermore, adults will become actively engage in improved sanitation, and hygiene planning.
Child Awareness	85 percent of the children in the community will have improved knowledge regarding sanitation and hygiene; furthermore, children will actively engage in improved sanitation and hygiene.
Disease Reduction	A reduction of waterborne diseases by 50 percent in year-one, followed by a further reduction of 25 percent in year two.
Small-plot Farming	50 percent of the families will engage in small-plot crop farming at the end of year one.

**Figure 8**  
Project Key Performance Indicators

### Long-term Water System Sustainability

As a part of the planning process, the local community outlined concrete steps that would be taken to ensure long-term sustainability. Most importantly, a community-based Water Management Committee was established to first coordinate the construction of the Water System. Committee functions during the planning/construction phase would include that of obtaining land-use approval from government authorities, oversight of day-to-day construction, organizing community awareness sessions, and raising funds from the local community to cover a portion of construction costs.

In addition to the establishment of the community-based Water Management Committee, long term sustainability would be enhanced through LWD training in the area of water management and financial accounting. In addition to training, LWD will make available its services and also work with the community to draw upon expertise from the private sector, NGO community, and appropriate government agencies. From a financial standpoint, sustainability would be further enhanced when recipient households pay a monthly fee, based on the amount of water use. All fees collected would then be used to provide for ongoing maintenance and supplementary training, when deemed necessary.

### Water System Project Financing

The national NGO, LWD, worked with three contractors in the region to obtain estimates for the proposed village water system. Assuming a construction period of ten to twelve months, all three financial estimates obtained were in the 90,000 to 110,000 USD range.

Furthermore, training and community awareness building sessions would cost an additional 10,000 dollars.

Due to a lack of village financial resources to cover upfront construction costs, LWD accepted responsibility to seek international funding from partner organizations to cover ninety percent of the project costs. Then, to promote “local ownership and control”, village residents would be expected to cover the costs of piping from the main water line to their respective homes. Additionally, it was further agreed that local households should pay a nominal fee for water usage; collected usage fees would be designated to cover ongoing maintenance and supplies, such as chloramine, to ensure that safe-drinking standards are maintained.

## FINAL RECOMMENDATIONS

To mitigate the pending water crisis that is facing Cambodia, regional and national government officials, NGO representatives, and corporate entities should take an active role in promoting the effective use of available water resources. All stakeholders must make a concerted effort to diversify water sources, including tube wells, rainwater harvesting and the use of water streams – especially in rural, mountainous areas. Next, the technical competencies of government agencies, NGOs and community-based organizations in the areas of water resource management and water infrastructure development must be strengthened through vocational training programs. Moreover, nongovernment organizations, community-based organizations, local governments, and corporate stakeholders should continue to lobby national government officials to provide needed financial resources to support research that is focused on the innovation of low-cost water systems that are effective in improving the lives of rural residents. Finally, improvement in the monitoring, assessment, and reporting of current water conditions in terms of both quantity and quality is needed on the part of governments, local communities, and NGOs. Water monitoring systems are inadequately funded, thus requiring more resources to be allocated. Related, Cambodia needs improved water testing labs throughout the rural areas, so that the cycle of water-borne diseases is stopped.

## ACKNOWLEDGMENT

This research was possible due to the cooperation and support of Life with Dignity (Cambodia) and the Japan Evangelical Lutheran Association (Japan). It has been a privilege to walk together on this journey to better understand how we can continue to improve the livelihood of the “poorest of the poor” in Cambodia and other parts of Asia.

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