

A Study on the Adaptation Systems for Rural Water Supply and Sanitation Sector to Respond to Climate Impact in Svay Rieng Province, Cambodia

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ABSTRACT

Living in Svay Rieng province's urban and rural areas carries a significant danger for those who lack proper access to water, sanitation, and hygiene (WASH). This study has three objectives: (a) to assess the current impact of climate change on rural WASH; (b) to examine the adaptation systems of rural WASH as they respond to climate change; and (c) to determine the elements of appropriate mechanisms and supporting systems for the sustainability of rural WASH's climate change adaptation. As a methodology, this research surveyed 136 samples from 8 districts in Svay Rieng province. The results found that knowledge and awareness of people on climate change were at 92.65%. The main factors that cause climate change are burning fossil fuels like oils, gasoline, and coal. Water and sanitation are two sensitive sectors that are touched by climate change. There are two kinds of elements: appropriate mechanisms and supporting systems for the sustainability of rural water supply. To improve future rural WASH in local communities and adaptation to climate change, people should focus on using high-tech infrastructure for water supply stations such as safe water pipe systems, water treatment stations, pump wells, and ponds that are resilient and adapt to climate impact.

INTRODUCTION

The lack of improved water, sanitation, and hygiene (WASH) is a higher risk for people who are living in urban and rural areas in the developing world. Access to WASH is a very useful sector in social vulnerability to respond to natural disasters for current and future prevention. Svay Rieng province is one of among 25 provinces of Cambodia. Svay Rieng has experienced the effects of climate change since the 1990s. Storms, droughts, and floods have become more frequent, killing people and damaging infrastructure, households, rural water supply infrastructure, and agriculture (CSES, 2020). The most severely impacted sectors by climate change were rural water supply and sanitation. People lack water resources and the safe water supply during floods and droughts. They need safe water for drinking, washing hands, cooking food, and using toilets. In addition, every year the weather became hotter and hotter, decreasing rainfall and making the dry season longer than the rainy season.

This study has three objectives: (a) to assess the current impact of climate change on rural WASH; (b) to examine the adaptation systems of rural WASH as they respond to climate change; and (c) to determine the elements of appropriate mechanisms and supporting systems for the sustainability of rural WASH's climate change adaptation.

LITERATURE REVIEW

Water Supply and Sanitation in Cambodia

The Main Sources of Drinking Water

The definition of a "improved water source," which includes piped water in the home, piped water into a compound yard or plot, a public tap or standpipe, tube or piped wells or boreholes, protected wells and protected springs, rainwater collection, and bottled water, forms the basis of water resources for households. About 80% of Cambodian households had access to a "improved water source" in 2019–20. About 82% of the families in Phnom Penh had piped water into their homes, when comparing the disparities in each domain. About 33% of households in the other urban regions and 10% of those in the rural ones have access to piped water in their homes. However, a tube, piped well, or borehole was a frequently used improved drinking water source for the homes, accounting for roughly 24% in the other urban regions and 38% in the rural ones. However, roughly 12 percent of rural households still obtained their drinking water from a pond, river, or stream (CSES, 2020).

The Sanitation Facilities

The term "improved sanitation facilities" refers to those that are successfully able to segregate human touch from human excreta and are privately held by the home. The sort of restrooms used is an indicator of the cleanliness of the surroundings. The three types of toilets listed under "improved sanitation facility" are "pour flush/flush connected to sewerage", "pour flush/flush connected to septic tank/pit", and "pit latrine with slab". Nearly all of the upgraded toilets that Cambodian households could use were connected to septic and sewer systems, with about 80% of all homes having access to them. Regarding the variations in each domain, roughly 26% of rural

households used insufficient toilet facilities in their homes. However, the lack of improved toilets that rural households, particularly those on open land, have access to continues to be a major problem that must be carefully taken into account (CSES, 2020).

The Variation of Water Resources in Cambodia

The majority of Cambodians (69%) reside in rural areas, and of them, the majority (69% of rural; 55% of the overall population) do so in higher-density semi-rural areas. In Cambodia, there are many different types of rural water supplies (RWS), from sophisticated water treatment and distribution systems to more basic home supplies like wells, rainwater collection, or even manual fetching from lakes, rivers, or ponds. Many of Cambodia's 12 million rural households have seen modifications to their water delivery techniques over the past ten years. Currently, 27% of rural households buy water from a service provider, usually a distributor of bottled water or a piped water supply (PWS) system. PWSs provide service to some rural areas of Cambodia, up from just 11% in 2009, and are run by typically private, either licensed or unregistered organizations (WaterAid Cambodia, 2017).

Water Resources in Cambodia by Seasons

Its prevalence also emerges when examining drinking water sources for dry and wet seasons separately, the latter of which typically lasts from May until October. Based on the results, the World Health Organization (WHO) and Ministry of Rural Development (MRD) in 2013 were designed to characterize water supply practices during the dry and wet seasons separately and revealed that rainwater served as the primary wet season drinking water supply for approximately 60% of rural households. The rainy season in Cambodia has a significant impact on people's drinking water supply habits, and when it's available, rainwater seems to be the preferred water source. However, the use of rainwater falls dramatically in the dry season as few households have sufficient storage capacities. This decline appears to be offset by a substantial rise in surface water use and, to a lesser extent, by the use of tube wells and dug wells (WaterAid Cambodia, 2017).

Climate Change's Impact on WASH

Impact of Flooding

The immediate "loss" of "natural" surface water sources during floods, such as rivers, streams, and springs, causes a slight reduction in the community's access to drinking water. Even while there are still public and private rainwater sources, the extra loss of wells, both public and private, causes a little decrease in the percentage of the community that has access to good water. These losses highlight how poorly established rainwater collection and storage practices are in our study towns; for instance, public RWTs were frequently mismanaged, broken, and lacking in repair plans (Chan et al., 2020).

Impact of Drought

During droughts, a community's proportion of residents with access to enough drinkable water of acceptable quality significantly declines due to the quick depletion of rainwater reservoirs (private and public) as a source of drinking water. This is due to the perception that rainwater is a better source of drinking water and the fact that there is not enough precipitation stored to last through the dry season or a protracted drought. The percentage of a community with enough drinking water of acceptable quality is further decreased by the loss of access to both private and public wells (Chan et al., 2020).

Impact on Sanitation

The hazards that the existing environment, especially variability, poses for sanitation are exacerbated by climate change, which also generates new dangers, heightens uncertainty, and may result in greater disparities in access to sanitation. Three fundamental viewpoints in the literature on climate change – risk-hazard, resilience, and vulnerability – inform these three dimensions. Through a variety of interconnected routes, climate change affects sanitation. Climate dangers develop or get worse as a result of climate change. How these hazards affect physical access to sanitation infrastructure, access to neighbourhood resources and markets, and the livelihoods required to support safe sanitation depend on the social environment and local activities (Kohlitz & Sydney, 2021).

Impact on Ground Water

Impacts of climate change on groundwater recharge, discharge, chemical fate, transport, and storage are a very severe matter. Human activities led to biogeochemical reactions and saltwater intrusion. The influence of droughts and floods on surface water resources is tied to the groundwater resource. Understanding the function of groundwater is extremely difficult since it is influenced by climate change, viability, aquifer properties, human activities, and vegetation dynamics. The country's average temperature is predicted to rise by 2-3 °C, and the annual rainfall is predicted to rise by 25% overall and up to 50% in some regions. Future climate change is anticipated to affect the hydrological cycle, which will therefore have an effect on groundwater resources. Lower rainfall will reduce the groundwater head in coastal areas, which will exacerbate the effects of sea level rises (Somphone & Xayviliya, 2017).

METHODOLOGY

The study location will cover a total of 8 districts in Svay Rieng province. It includes Bavet municipal, Svay Rieng, municipal, Chantrea, Kongpong Rou, Svay Teap, Svay Chrum, Romeas Haek, and Romdul districts in Svay Rieng Province, Cambodia. The total sample size was 136, calculated by the Yamane formula (Yamane, 1967). To understand the supporting mechanisms, we interview people who have been affected by climate change in addition to village leaders, commune councils, and district governors who serve as focal

point personnel for rural supply and sanitation. R-Program and SPSS version 25 were used to examine all of the data and information after being entered into Microsoft Excel.

RESULTS

The Current Impact of Climate Change on Rural WASH

Main Water Resource Systems in Svay Rieng Province

According to the survey findings, it has indicated that the main water resource system in Svay Rieng province by most is groundwater (pump wells, drainage wells, motor wells, mix wells) at 58.8%, followed by rainwater at 14.7%, safe water station pipe systems (local and small communities) at 11.8%, surface water (lake, river, pond) at 11%, and all answers that came last at 3.7%.

In addition, due to the results, it could be explained that the main water resource system in Svay Rieng province is groundwater (pump wells, drainage wells, motor wells, mix wells) as well as rainwater.

Impact of Climate Change on Rural Water Supply and Sanitation

The impact of climate change on rural water supply and sanitation shows that the most significant is the deeper water pressure of groundwater resources (36.76%), followed by a shorter raining season than a dry season (25%), a decrease in annual precipitation (23.53%), and not enough surface sources of water (14.71%).

Due to standard error (SE) 95% confidence and error 5%, the main disasters caused by climate change always happened the most: drought (53.68%), followed by floods (25.74%), storms (11.03%), and tropical diseases (9.56%). The indications of climate change's impact on rural water supply, sanitation, and hygiene are shortage of sources of water: 68.38%, followed by not enough safe water (drinking, cooking, washing, and use in the toilet): 25%, and not enough sources of water for feeding animals and growing crops: 6.62%.

The Importance of Rural Water Supply for Communities

Due to the survey findings, the importance of rural water supply for people in the community is that people use safe water for drinking and industrial purposes (47.59%), followed by people needing water for hand washing and use in the toilet (25.74%), safe water for cooking foods and washing materials in the kitchen (14.71%), and using water for washing clothes, growing crops, and feeding animals (11.76%). The importance of rural water supply for human health is to produce safe water for drinking (58.82%), followed by improvement of their well-being (16.18%), improvement of their standard of living (13.97%), and reduction of concern about a lack of water resources (11.03%).

The Adaptation Systems of Rural WASH

According to the survey findings, there are two types of adaptation systems for rural water supply that need the most: physical infrastructure (62%), followed by non-physical infrastructure (38%).

The physical infrastructure adaptation systems in Svay Rieng Province have found all the answers, which included water supply stations and pipe systems (local and small communities), groundwater resources (pump well, drainage well, motor, mix), rainwater jar storage and water filters, surface water resources (lake, river, pond, canal, and dam), a technical working group, a focal person, and materials.

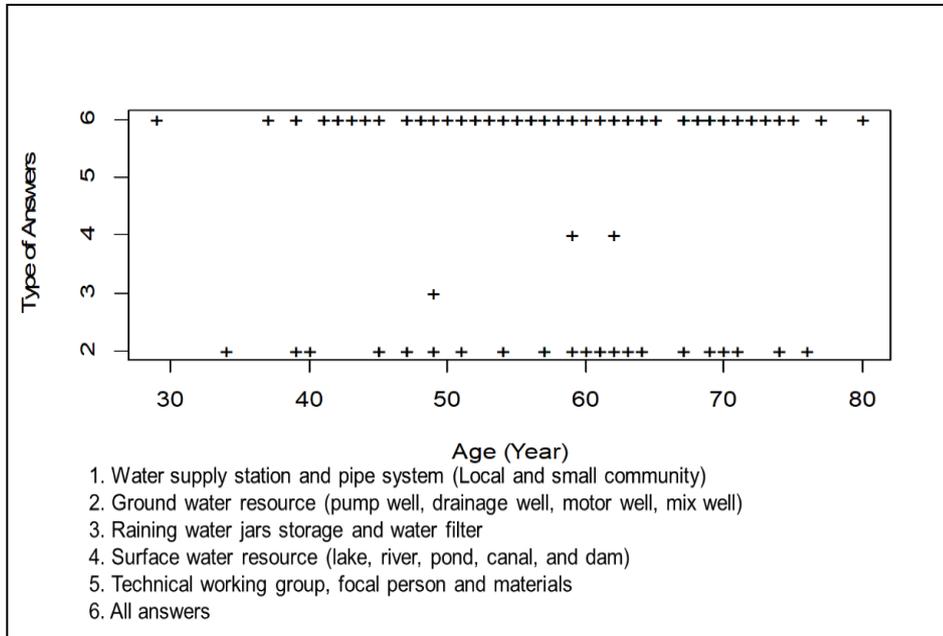


Figure 1. The Physical Infrastructure Adaptation Systems

The non-physical infrastructure adaptation systems in Svay Rieng province have found all the answers, which include strategy, policy, guidelines, and action plans (national and sub-national), capacity, awareness, and knowledge, financial resources, development partners and donors, and community resources and participation.

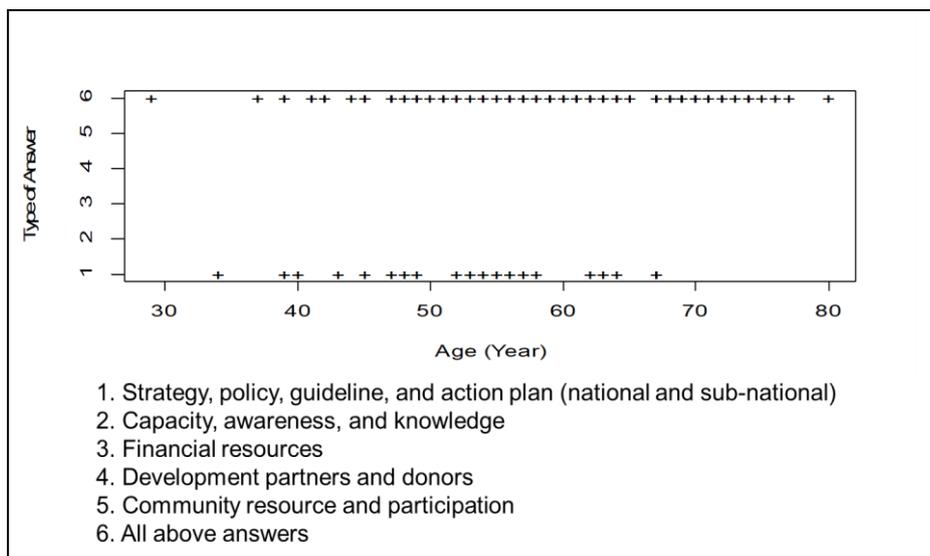


Figure 2. The Non-Physical Infrastructure Adaptation Systems

The Elements of Appropriate Mechanisms and Supporting Systems for the Sustainability of Rural WASH's Climate Change Adaptation

The Appropriate Mechanisms and Supporting Systems

The results showed that the appropriate mechanisms and supporting systems should be implemented for both physical and non-physical answers (58.82%), followed by physical (23.53%), and non-physical (17.65%).

The Physical Elements of Appropriate Mechanisms and Supporting Systems

The results indicated that the physical elements of appropriate mechanisms and supporting systems for sustainability of WASH to adapt to climate impact, which indicated the most, are community infrastructure that can adapt and is resilient to climate impact (40.44%), followed by high-tech infrastructure of water supply stations and pipe systems (14.71%). The rural water infrastructures provide enough safe water: 14.71%; well-prepared groundwater storages (wells, motor wells, and mix wells): 11.03%; well-prepared surface water reservoirs (water jars, ponds, lakes, canals, and dams): 7.35%; good social early warning systems: 7.35%; and the structure and function of the technical working group or focal person, which came last at 4.41%.

The Non-physical Elements of Appropriate Mechanisms and Supporting Systems

The findings showed that 47.59% of the non-physical components of suitable mechanisms and supporting structures for the sustainability of rural water supply and sanitation to adapt to climate impact were being successfully implemented, followed by enough financial resources and social security funds (14.71%), strong capacity of technical working groups and focal person (11.76%), good participation from government, people, and the private sector (11.03%), widespread people's awareness and knowledge about climate change (8.85%), and good coordination with development partners (NGOs and privates) (5.86%).

DISCUSSION

Community Awareness and Knowledge on Climate Change

Based on the results, it has indicated that most of the participants have the basic knowledge and awareness about climate change 92.65% while fewer people don't have there is only 7.3%. Non-significant (ns) in the chi-square test denotes the absence of a link because the sig. or p-value = 0.506 is bigger than 0.05, which implies that the null hypothesis cannot be ruled out. Thus, between the educational background level of participants and their knowledge and awareness about climate change.

The Importance of Physical Elements in Appropriate Mechanisms and Supporting Systems

According to the results, it can be discussed that the important physical elements of appropriate mechanisms and supporting systems for sustainability of rural water supply and sanitation to adapt to climate impact in Svay Rieng

province that have been found and should be needed the most are to ensure sources of water (groundwater and surface water) as well as high-tech infrastructure to adapt to climate impact. As agreed to UNESCO (2020), climate change challenges conventional water infrastructure solutions. Increased focus on infrastructure projects with dual uses could help to some extent. Such projects often address natural disasters such as flood control, regional development, the need for public goods such as navigation, river basin management, and maintaining ecological river flows. The use of nature-based solutions (NBS) can improve climate change adaptation, boost the efficacy, efficiency, and sturdiness of water management infrastructure (including operations and maintenance), and aid in the mitigation of climate change. Also, similar to ADB (2012), MRD has developed the National Rural Water Supply, Sanitation, and Hygiene (RWSSH) Strategy for 2010–2025, which was approved on March 1, 2011. ADB has supported a project to update sector investment to prepare the RWSSH strategy in 2008. A further 13,000 rural residents would need access to clean water, and about 1.477 million would need access to better sanitation, costing about \$37 million in infrastructure alone, to meet the 2015 CMDG target.

The Importance of Non-physical Elements in Appropriate Mechanisms and Supporting Systems

According to the results, it can be discussed that the important physical elements of appropriate mechanisms and supporting systems for sustainability of rural water supply and sanitation to adapt to climate impact in Svay Rieng province that have been found and should be needed the most is a good action plan, strategy, policy, and guidelines that are well implemented and have good participation from the government and people. In addition, as agreed to by ADB (2012), there is significant overlap between the various organizations, but subnational ministerial lines and duties for rural water supply and sanitation are firmly delineated. The Ministry of Interior's Organic Law and the government's deconcentration and decentralization objectives mandate the transfer of some duties for organizing and carrying out rural water supply and sanitation initiatives. The deconcentration and decentralization process allocates duties and functions to the three levels of government (national, province, and commune), along with supplementary duties at the district and village levels. Also, similar to WHO (2019), there are a number of ways to promote climate-resilient sanitation at the national level. The six "building blocks" of climate-resilient health systems are outlined together with national-level processes. The six building blocks are very important for leadership and governance, the health workforce, health information systems, technologies, governance, service delivery, and financing for sustainable water supply.

CONCLUSIONS AND RECOMMENDATIONS

To conclude, knowledge and awareness of people on climate change were at 92.65%. The main factors that cause climate change are burning fossil fuels like oils, gasoline, and coal. Water and sanitation are two sensitive industries that are touched by climate change. There are two kinds of elements:

appropriate mechanisms and supporting systems for the sustainability of rural water supply, including physical infrastructure and non-physical infrastructure. To improve future rural WASH in local communities and adaptation to climate change, people should focus on using high-tech infrastructure for water supply stations such as safe water pipe systems, water treatment stations, pump wells, and ponds that are resilient and adapt to climate impact.

FURTHER STUDY

Further investigation should focus on the technical specifics of developing rural water supply and sanitation infrastructure in order to adapt to and minimize the effects of climate change, as well as how climate change may affect the groundwater resource and quality.

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Hak, Mardy, Han

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