WASH and Climate-Related Issues in Cambodia

A Scoping Review

Dr Danet Hak, Chan Arun Phoeurn, Dr Lien Pham

east meets west
A PROGRAM OF THRIVE NETWORKS

Australian Aid

Water For Women

This review was prepared as part of the research project *Climate change impacts, adaptation measures, and inclusive resilience system in WASH: A case study of marginalised communities in rural Cambodia,* funded by Australian Department of Foreign Affairs and Trade, under the Women for Water Fund, Innovation and Impact Grant.

Prepared by: Dr Danet Hak, Chan Arun Phoeurn

Edited by: Dr Lien Pham

Cover photograph by: Danet Hak

Illustrated by: BRCK Creative Studios

Citation (Harvard): Hak, D, Phoeurn, A. and Pham, L. (2021) *WASH and climate-related issues in Cambodia. A scoping review.* Phnom Penh, Cambodia. East Meets West Foundation.

For further information about the review and research project, please contact Dr Lien Pham at lien.pham@eastmeetswest.org.

CAMBODIA AT A GLANCE

Cambodia has made significant strides in economic development. Its per capita gross domestic product increased fivefold from $300 in 2000 to $1,500 in 2018. Economic growth in 2018 remained strong at 7.3% of its Gross Domestic Product (GDP), fuelled by expanding tourism and strong foreign direct investment. Given the strong link between economic growth and the provision of basic services, the government plans to ensure that all rural residents, who account for about 77% of the country's total population of 16 million, will have access to improved water supply and sanitation services by 2025[1].

Out of 15.4 million of Cambodian people, 78% are the rural residents. Less than 27% and 50% of population have access to improved water supply and sanitation, respectively. From a report of Asian Development Bank in 2016[1], losses of $12 per capita (financial) and $33 per capita (economic) were caused yearly by the lack of sanitation access. Economic losses are the result of impacts on health (43% of total), costs related to pollution of water and fisheries (33%), access costs relating to journey and waiting times (9%), and lost receipts from

tourism (16%). Incidents of diarrhea are the second-largest cause of infant and under-5 mortality in Cambodia, which are among the highest in the region[1].

WASH SITUATION IN CAMBODIA

Rate of WASH Access

Inadequate access to rural water supply and sanitation (RWSS) stems from weak planning and governance, inadequate finances, limited capacity, and external factors such as climate change. Ineffective planning and governance derive from structural reasons, including partial decentralization reforms and lack of information systems. Inadequate financing derives from limited public resources to meet targets, inadequate revenues, and households' lack of access to finance. Skills need strengthening, particularly at the local level. Projected changes in rainfall (increasing during the wet, decreasing during the dry season), and rising temperatures, will increase flooding and prolong droughts. Thus, investments in infrastructure, coupled with reforms to bring services closer to the people, are needed[1].

ADB reported that in 2017, access to improved water supply in rural areas stood at 73%, but only 11% of that water supply was piped. Rural residents spend considerable time and financial resources on acquiring their daily drinking water from distant water sources, collecting rainwater, or having it delivered to their homes. Access to improved sanitation was at 56% in rural areas, and about 41% of rural residents are still practising open defecation. However, there is conflict in data from the NAP II[2]. Perhaps it is a matter of data collection methodology or delay in publishing. The first case commonly happens in Cambodia as one statistic counts only the facilities provided by the government and the other one counts both public and private-own facilities. **Figure 1** shows WASH facilities in the rural areas reported by NAP II and CSES 2017[3].

Fig.1: WASH Indicators 2014-2018

[1] Asian Development Bank,2016. *Concept paper, Proposed Loans Cambodia: Third Rural Water Supply and Sanitation Services Sector Development Program*. https://www.adb.org/sites/default/files/project-document/201566/50101-002-cp.pdf

[2] MRD (2019). *National Action Plan Rural Water Supply, Sanitation and Hygiene 2019–2023.*

[3] Ministry of Planning (2018). *Cambodia Socio Economic Survey (CSES) 2017.*

Inequalities in access by income status are large. For example, among the poorest income quantile of the rural population, only 21% had access to improved sanitation, while access was at 100% in the richest income quintile (Figure 2 and 3).

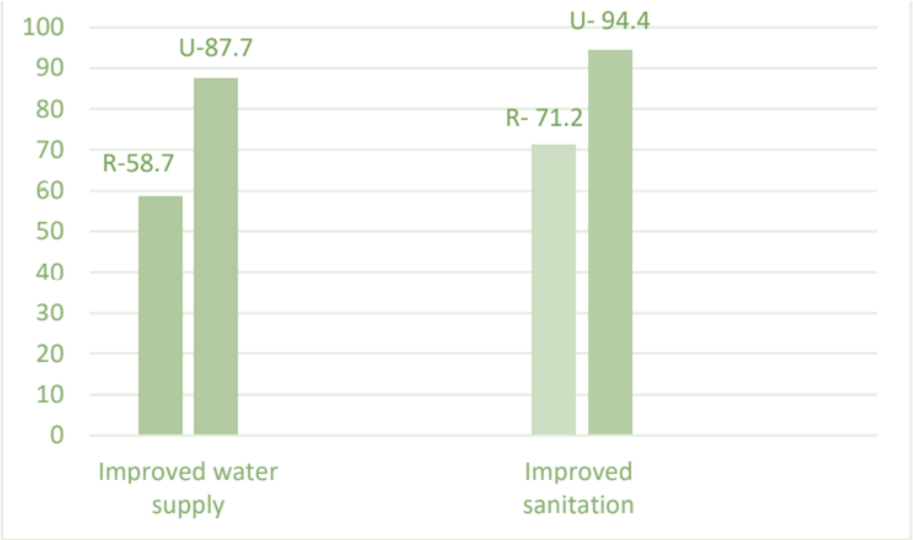


Fig.2: *Inequality of RWSSH services. Source: MRD (2019)*

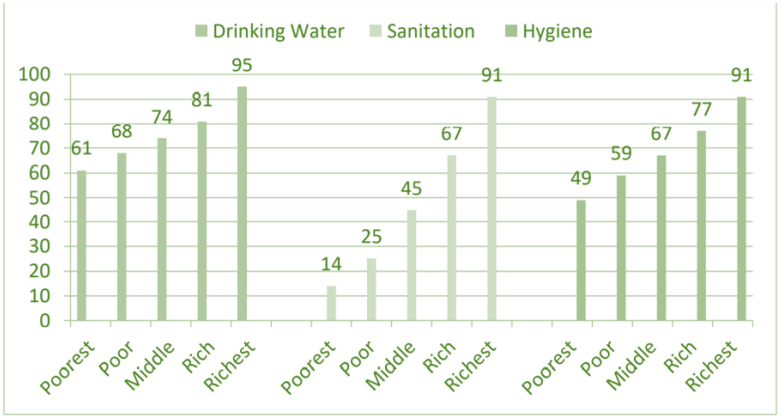


Fig.3: Rate of services by wealth quintile. Source: MRD (2019)

WASH Access at School and Health Centres

As shown in Table 1, only 48 per cent of rural schools have a limited drinking water service (defined as an improved source with water available); 38 per cent have a basic sanitation service (defined as an improved single-sex facility that is usable); and 39 per cent have a basic hygiene service (defined as a hand-washing facility with water and soap available).

Table 1: Wash Facilities in schools

	Drinking water Limited service	Sanitation Basic service (improved, usable and single sex)	Hygiene Basic service (facility with water and soap)
National	49	39	41
Urban	49	48	50
Rural	**48**	**38**	**39**
Pre-primary	33	12	27
Primary	61	48	49
Secondary	47	67	40

Overall, 90 per cent of health centres were reported to have access to basic water supply, while only 37 per cent had access to basic sanitation facilities. A 2015 assessment by the National Institute of Public Health and the Ministry of Health (MoH), with support from WaterAid, the World Health Organization (WHO) and UNICEF, in health care facilities in five provinces indicated insufficient WASH facilities:

- Although there was water supply, 49 per cent lacked safe drinking water, mainly for clients, and there are water shortages during the dry season.
- 6 per cent of health care facilities rely on unimproved/open water sources
- Improved toilets were available but did not meet the needs of people with reduced mobility; there were not enough toilets with menstrual hygiene management facilities designated for women and girls.
- There were relatively poor hand hygiene facilities at the point of care and within toilets.

WASH Access at School and Health Centres

The outcome and output targets of the NAP were the basis for developing the RWSSH 2019–2023 Provincial Action Plan (PAP) in each of the 25 provinces. The planned targets of each province for basic water supply, sanitation and 16 hygiene services are shown in Figure 4 and 5.

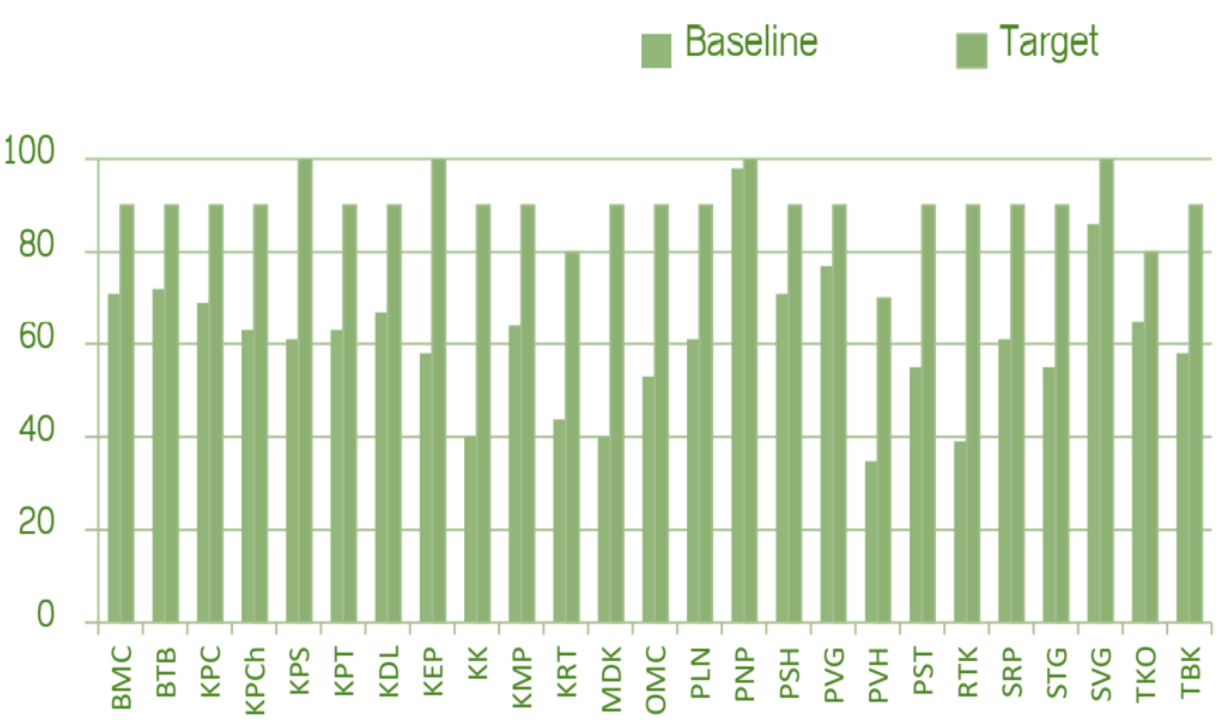


Fig.4: PAP targets-Basic Water Supply Service

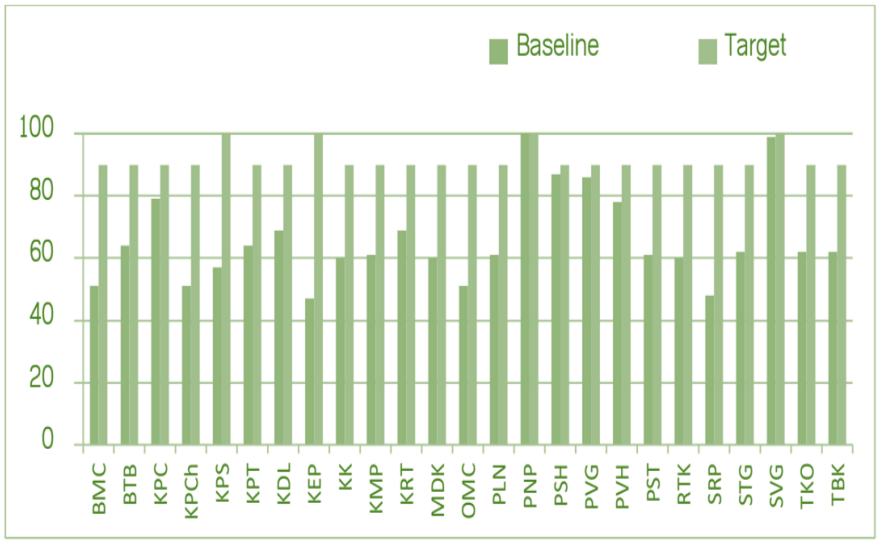


Fig.5: PAP targets-Basic sanitation service

- BMC: Banteay Mean Chey
- BTB: Battambang
- KPC: Kampong Chnang
- KPCh: Kampong Cham
- KPS: Kampong Speu
- KPT: Kampong Thom
- KDL: Kandal
- KEP: Kep
- KK: Koh Kong
- KMP: Kampot
- KRT: Kratie
- MDK: Mondolkiri
- OMC: Odor Mean Chey
- PLN: Pailen
- PNP: Phnom Penh
- PSH: Preah Sihanouk
- PVG: Prey Veng
- PVH: Preah Vihear
- PST: Pursat
- RTK: Ratannakiri
- SRP: Siem Reap
- STG: Stung Treng
- SVG: Svay Rieng
- TKO: Takeo
- TBK: Tbong Kmom

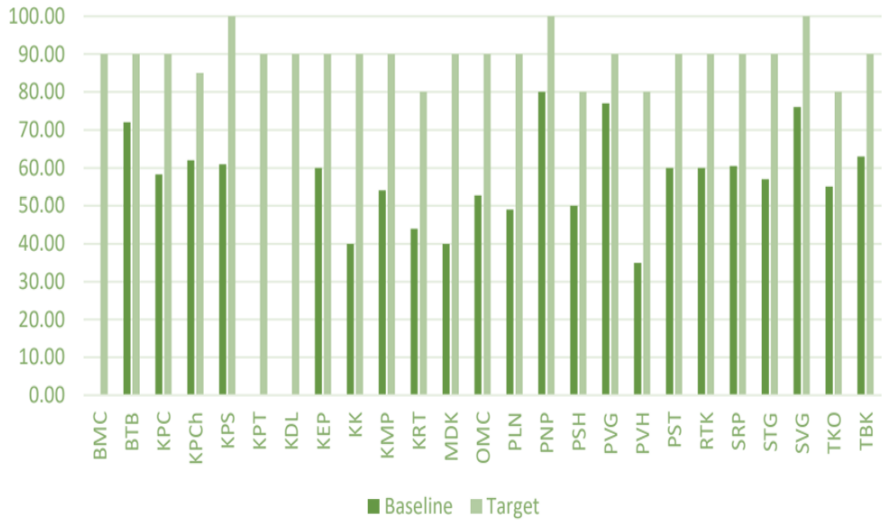


Fig.6: PAP targets-Basic hygiene service

- BMC: Banteay Mean Chey
- BTB: Battambang
- KPC: Kampong Chnang
- KPCh: Kampong Cham
- KPS: Kampong Speu
- KPT: Kampong Thom
- KDL: Kandal
- KEP: Kep
- KK: Koh Kong
- KMP: Kampot
- KRT: Kratie
- MDK: Mondolkiri
- OMC: Odor Mean Chey
- PLN: Pailen
- PNP: Phnom Penh
- PSH: Preah Sihanouk
- PVG: Prey Veng
- PVH: Preah Vihear
- PST: Pursat
- RTK: Ratannakiri
- SRP: Siem Reap
- STG: Stung Treng
- SVG: Svay Rieng
- TKO: Takeo
- TBK: Tbong Kmom

Sanitation in Challenging Environment (SCE)

The government and wider stakeholders are recognizing the growing issue of the climate crisis. However, there are multiple, complex challenges to overcome in terms of providing a long term, sustainable response, as well as building community resilience to climate change and water resource issues. Responses to addressing the WASH issues impacted by climate change and water security are still limited both in policy and service delivery.

It is expected that over a quarter of Cambodians (approximately four million people), which is equal to 27% of Cambodian people are living in the challenging environment that impact their ability to access appropriate and improved sanitation solutions at all times. To achieve the universal coverage by 2025, MRD defined two output indicators in the NAPII that by 2023, there will be:

- 70% of rural households in the challenging environment with access to basic sanitation services
- 36 districts with entrepreneurs providing sanitation products and services for sanitation in the challenging environment

In 2019, the Ministry of Rural Development has recommended guidance principles for rural households whose toilets are to be built in the challenging environment. The challenging areas are interpreted as locations subject to one or more of the following conditions but not limited to:

1. Floating: Houses are floating for at least part of each year.
2. Hard Ground: Latrine pit cannot be dug by hand
3. Water Scarce: The community lacks access to the water required to use conventional pour-flush pans
4. Moderately, Medium and Severely Flood Affected

The definition flood affected people were categorised in four level as:

1. Severely affected: people dealing with challenging area problems every day or for months at a time
2. Medium affected: people dealing with the problems for weeks at a time every year, or once every 2-3 years plus annual flooding.
3. Moderately affected: people dealing with challenging area problems for short time periods of a week or less annually, or affected once every 5-10 years by large flood or rainfall events; and
4. Unaffected: people who are out of the flood locally or have otherwise resolved sanitation issues.

Cambodia's universal access to WASH

There have been increasing efforts and more investment in promoting hygiene behaviour change in water, sanitation and hygiene recently in Cambodia. In the rural WASH sector, with a clear policy framework from the government aimed at reaching universal access by 2025, enabling an active coordination mechanism at the national level. This provides an opportunity for collective action with stakeholders working together and maximising resources to deliver the National Action Plan. In addition, the Ministry of Rural Development has produced a national behaviour change communication guideline that prioritises ending open defecation, handwashing with soap and treating drinking water. Recently the Ministry, with support from the World Bank, IDE and partners has endorsed a National Social Behaviour Change Communication Campaign Strategy for the sector

As a result, in 2019, many communes and four districts became open defecation free. Still, the next challenge is to work out how to attain universal access at a provincial level, particularly ensuring that the most marginalised groups are included and have access to services. Five provinces (Kampong Speu, Svay Rieng, Kampong Chhnang, Prey Veng and Kep) have now committed to becoming open defecation free by 2023, two

years before the national target. Open defecation reduced by 31.5 per cent, and a total of 1,789 villages, 67 communes and two districts attained open-defecation-free (ODF) status[4].

NATIONAL POLICY

In Phase 1, National WASH Action Plan (NAP I 2014-2018) aims to reach sanitation coverage by 60% within 2018 and 100% by 2025. However, the Phase 2 NAP (2019-2023), the time frame to achieve the goal was extend to 2030. NAP II enforces the special attention on the needs of women and girls and those in vulnerable situations. Table 2 represents the expected results by the end of NAP II 2023.

Table 2. NAP II – National WASH Target in Cambodia

Outcome indicators	Baseline (%)	2023 target (%)	Gap to be covered (population)	Gap to be covered (households)
Rural households use basic water supply services	58.7	90	3,529,771	797,839
Rural households use safely managed water supply services	16	33	2230900	504500
Rural households use basic sanitation services	71.2	90	2264836	511924
Rural households use safely managed sanitation services	Not available	35	4593040	1044000
Rural households use safely managed sanitation services	77.1	90	1692860	383000

INSTITUTIONAL ARRANGEMENTS FOR RURAL WATER SUPPLY AND SANITATION SERVICES

MRD is the agency responsible for implementing the NAP and is accountable for delivering the expected results. MRD's Department of Rural Water Supply (DRWS) and Department of Rural Health Care (DRHC) are the two technical departments that will coordinate and lead NAP implementation at the national level.

The Technical Working Group of Rural Water Supply, Sanitation and Hygiene (RWSSH), in its role of ensuring effective coordination of the government's response to rural WASH, will provide a forum for MRD to coordinate and track progress on expected results, supported by other government entities and development partners.

At the provincial level, PDRDs will be responsible for implementing PAPs, and will be accountable for delivering the expected results. The Secretariat of Provincial Working Group of RWSSH will oversee the implementation of the PAPs, including targeting of RWSSH investments and providing support to district administrations. MRD's District Offices of Rural Development (DORD) will play important roles in supporting district administrations and commune councils with monitoring and will provide technical support and investment planning. A growing number of districts, especially those that have undertaken the transferred

[4] Ministry of Planning (2018). *Cambodia Socio Economic Survey (CSES) 2017.*

RWSSH functions under MRD's decentralization initiative, have also established RWSSH district working groups.

Development partners will continue to play an important role in supporting the implementation and monitoring of the NAP II and PAPs II. Private sector actors are expected to serve as the sector partners and participate in the provision of RWSSH services within the framework of the NAP II and PAPs II.

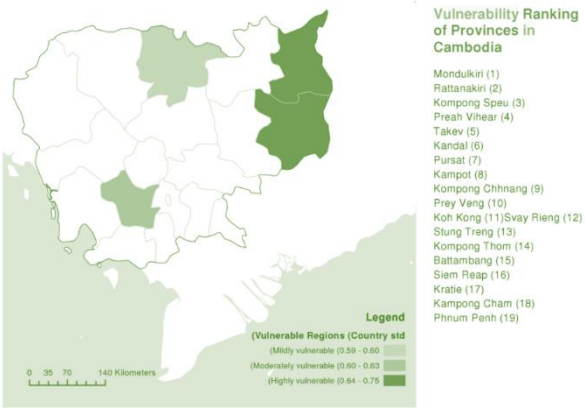
Cambodia has made progress in reforming the policy, legal, and institutional framework for decentralised RWSS service provision. However, the sustainable delivery of services is still hampered by structural shortcomings, including incomplete decentralization reforms. The MRD has not fully decentralised staff and functions; communities lack adequate guidelines and support to operate and maintain RWSS facilities, and private sector participation is limited to water supply services in a few towns and villages because legislation that properly governs private involvement in the RWSS service provision does not exist.

CLIMATE CHANGE AND ITS IMPACT ON WASH ACCESS AND USE

Climate Change and Disaster Risks in Cambodia

Cambodia is thought to be one of the most vulnerable countries in the Southeast Asian region to the impacts of climate change[5]. Flooding and drought are major meteorological hazards in Cambodia. In 2011, floods affected more than 1.5 million people in 18 of the 24 provinces, including four provinces along the Mekong River and the Tonle Sap Lake, which suffered the heaviest damage. The total damage caused by floods was estimated to be more than 1% of the country's gross domestic product. In 2013, floods affected 1.5 million people and claimed 168 lives in 20 provinces. In 2015 and 2016, droughts caused less rainfall, warmer weather, and delayed or shortened monsoon rains, affecting about 2.4 million people. Cambodia is also exposed to climate change risks with increased flooding and prolonged droughts, which may affect the quality of RWSS services[6].

Seven provinces in Cambodia fall under the 50 most vulnerable regions in Southeast Asia. The dominant feature of their vulnerability is their lowest adaptive capacity resulting from their lowest indices of human resource development and high rate of poverty in Asia[4]. Figure 7 shows the vulnerability ranking of 19 provinces in Cambodia.



[5] Yusuf A, Francisco H. (2010) *Hotspots! Mapping Climate Change Vulnerability in Southeast Asia.* Singapore: Economy and Environment Program for Southeast Asia. http://books.google.com/books?hl=en&lr=&id=A-sXDFLcMR8C&oi=fnd&pg=PA4&dq=Hotspots!+Mapping+climate+change+vulnerability+in+Southeast+Asia&ots=rpD7y9lP_A&sig=ZcbftQTBQriLhBr_Wq Cenctl8C8.

[6] ADB. (2019). *Report and Recommendation of the President to the Board of Directors, Proposed Loans, Grant, and Administration of Grant Kingdom of Cambodia:* Third Rural Water Supply and Sanitation Services Sector Development Program. Manila.

Likely Impact of Climate Change on WASH Sector

The impacts of climate change on sanitation infrastructure are a mix of positive and negative, depending on the nature of the changes likely to occur with climate change and changes in the types of technologies demanded by households[7]. In countries likely to become drier, the impact on simple onsite sanitation infrastructure may be positive, as groundwater pollution risks may reduce as the distance between the base of pits and groundwater (and hence travel time for pathogens) increases. Drying environments may also mean that seasonal groundwater flooding of pits will be less frequent. Even so, such technologies may be vulnerable to damage and destruction from short-term flood events. By contrast, both declining water availability and increased flooding will pose major threats to sewerage and septic systems reliant on water. Securing sufficient water to ensure conventional sewers function as designed may be problematic and, even for modified sewerage, securing sufficient volumes of water for flushing and operation may be challenging. Declining water flows may adversely impact water quality in rivers receiving wastewater, although at present the low rates of treatment in sewerage systems indicate that other factors may be more important than climate change for the foreseeable future.

Where annual rainfall increases or there is a shift to higher intensity events, the impacts on sanitation may be more profound[8]. For onsite sanitation, the risks are primarily related to flooding and may have very serious public health implications. All onsite systems are vulnerable to flooding, and under more severe conditions this may result in widespread spillage of faecal matter in the environment and to contamination of drinking water supplies.

According to Quasim (2019)[9], in Southeast Asia, the flood consequence on human health can occur during and after the flood events. It was reported about the increasing rate of injury, the spread of communicable, vector and water-borne disease especially faecal-oral disease within the evacuation sites and waterlogging areas. This happened due to the lack of access to sanitation and the consumption of contaminated water sources containing faecal pathogens. The common communicable and water-borne diseases that occurred during the flood onsets were: cholera, diarrhoea, hepatitis type A and E rotavirus, typhoid and gastrointestinal, whereas the common vector diseases are dengue and malaria.

Faecal sludge management (FSM) chains may be vulnerable to climate impacts. In urban areas, in particular, FSM as a system is gaining traction as the demand for low-cost toilets drives the demand for simple pit latrines, but space constraints preclude approaches used in rural areas (replacing latrines once a pit is full). Typically, FSM chains involve the collection and transportation of waste in vehicles, with disposal in a treatment facility. Risks of flooding will impact the ability to empty vehicles to access communities if roads become impassable.

Sewer systems are highly vulnerable to greater rainfall, particularly where combined sewers are used. Even when sewers are not combined, the risk of damage to sewers during flood events is high and higher for modified sewers that are typically laid at shallower depths. Wastewater treatment works may also be adversely affected because they are often low-lying and next to rivers that are likely to flood[10].

---

[7] Howard, G.,Calow R., Macdonald, A. and Bartram, J. (2016). *Climate Change and Water and Sanitation: Likely Impacts and Emerging Trends for Action.* The Annual Review of Environment and Resources.

[8] Ibid

[9] Qasim. B & Abdul Syukor A.R. (2016). *The impact of flood on safe drinking water supply and sanitation in Southeast Asia: A health priority-Review.*

[10] Howard, G.,Calow R., Macdonald, A. and Bartram, J. (2016). *Climate Change and Water and Sanitation: Likely Impacts and Emerging Trends for Action.* The Annual Review of Environment and Resources.

Case studies in Cambodia

So far, there are not many significant attempts to quantify the impact of climate change on WASH in Cambodia. There are several studies, but the focuses are very localised and on the other climate-related issues. Still, we could get to summarise the stories of climate change impacted on WASH access and use from those studies as describe below.

Impacts caused by flood

1. ***Limited mobilisation*:**

   During the flood condition, the physical capital that households need is a boat. Without this, they cannot access health and WASH facilities, markets, education and income generation. The local government are failed to provide adequate means for transportation supports during that time. The households have to find their ways to travel and are unavoidable expose to the flood water[11]. Constraints on mobility can prevent residents from accessing urgent medical treatment. Participants from Vealsbov, one among informal settler in Phnom Penh, reported a case of three women gave birth en-route to the hospital, while a baby with a high fever died during the journey. Wading through water also carries the risk of being bitten by snakes, scorpions and centipedes. In Vealsbov, for example, participants estimated that as many as 10 per cent of community members had been bitten by poisonous snakes for which they required urgent medical treatment[12].

2. ***WASH facilities become very contaminated***

   For households that have toilets below the floodwater level have no choice but to defecate and discharge their wastewater into the water. Floodwater caused the septic tank to pull out. This causes water to become very contaminated.

   In the high groundwater area, the contamination chain is similar to the flood-prone area during the flood season. In the area where the groundwater level is almost reached the topsoil level, toilets could either be blocked or back-flow[13]. The groundwater comes to contact with the human faeces and become health hazardous since many people in the rural area drink well water directly without treatment.

3. ***The outbreak of WASH-related disease and insect***

   Despite the limited diagnostic capacity in Cambodia at present, previous research findings suggest that the common aetiologies of paediatric diarrheal diseases in Cambodia include Escherichia coli and rotavirus, with Shigella species implicated in cases of dysentery (bloody diarrhoea). Cholera also occurs in relatively frequent epidemic cycles in Cambodia and is strongly linked to changes in temperature,

[11] Fujihara J, Ly B.T., Xaisomkhan T., Prom V., Inoue E. (2019). Humanitarian assistance to decreasing vulnerability in flood-prone village: A Case study in Beoung Leas Village, Steung Sen District, Kampong Thom Province, Cambodia. *International of Environment and Rural Development*.

[12] Flower, B., Fortnam, M., Kol, L., Sasin, P., & Wood, R. G. (2018). Using participatory methods to uncover interacting urban risks: a case study of three informal settlements in Phnom Penh, Cambodia. *Environment and Urbanization.*

[13] Dynamic Aliance Consulting Group. (2020). *Final Report: Assessment of Digesters*. 2nd Rural Water Supply and Sanitation Sector Project-Additional Financing, MRD.

rainfall, and other environmental conditions[14]. A study about the impact of seasonal flooding on an urban poor community in Battambang Province revealed that households suffered from water-borne diseases including flu, cold, and Skin disease resulting from their direct contact with the contaminated floodwater. Insect and snacks could also threaten the well-being of the household[15]. There was an increase in dengue infection among children living in three slum areas of Phnom Penh and caused five deaths in the past five years[16]. Conditions are worse for disabilities and poor people that need supports and could not access the source of income.

4. ***Inadequate Evacuation Resources*:**
   The community in Boeung Leas, Kampong Thom Province used pagoda as a flood evacuation centre. However, the centre was lack of accommodation and WASH facilities to be ready for the big number of evacuated people[17].

5. ***Limited access to clean water*:**
   The households could use the pipe water as their source of water consumption in the flood condition. However, things are getting worse for the communities that do not have access to the piped water supply. The communities become more prone to health hazards and incidents in attempting access to clean water[18].

6. ***Challenge for faecal sludge management*:**
   With increased toilet coverage, the overall sanitation situation is improved, however, due to inadequate pit emptying and safe disposal services in Cambodia, haphazard disposal of faecal sludge into the open environment is posing a major threat to public health of the population living in the urban, peri-urban and Open Defecation Free (ODF) declared rural communities. Although the new standard toilets are not likely to require emptying for 4-5 years, the Ministry of Rural Development (MRD) requested for these to be emptied annually, before the rainy season to minimise environmental contamination during annual flooding and more severe events. This is based on the bad experience during severe flooding in 2011 when the incidence of water-related diseases was magnified.

The impact caused by drought

Countrywide, the main sources of drinking water for villagers during the dry season are wells (58%), ponds (14%), streams (12%), and rivers (9%); the rest of the supply comes from underground water. The main sources of irrigation water for agriculture are lakes (19%), rain (18%), rivers (13%), streams (12%), and reservoirs (11%); the rest comes from underground water. Water shortages are a common occurrence year-

[14] Mclver L.J, Chan V.S., Bowen K.J., Idding S.N., Hero K., RaingSey P.P. (2014). Review of Climate Change and Water-Related Diseases in Cambodia and Findings from Stakeholder Knowledge Assessments. Asia-*Pacific Journal of Public Health*, 1–10.

[15] Flower, B., Fortnam, M., Kol, L., Sasin, P., & Wood, R. G. (2018). Using participatory methods to uncover interacting urban risks: a case study of three informal settlements in Phnom Penh, Cambodia. *Environment and Urbanization.*

16 Qasim. B & Abdul Syukor A.R. (2016). *The impact of flood on safe drinking water supply and sanitation in Southeast Asia: A health priority-Review.*

17 Ibid

[18] Dara Lim. (N/A). *Impacts of Seasonal Flooding on the Lives of Battambang Urban Poor, Cambodia*. Urban Climate Change Resilience in Southeast Asia (UCRSEA) project.

round: 81% of households interviewed suffered from water shortages for agricultural uses, while 54% suffered from water shortages for personal uses[19].

In 2015 Cambodia faced its most severe drought on record as a result of climate change and multiple threats to water resources. Assessments of drought impact by key informant interviews were undertaken in 18 out of the 25 provinces in 2016[20]. All participants claimed that rural people in those 18 provinces experienced drought. Water shortage causes affected families to spend more on water budget. The price that could be more expensive created another burden to the poor people. Water scarcity affect the practices of communities' hygiene. For example, communities did not have enough water for bathing and adequate hygiene for breastfeeding moms. In addition, the uses of poor-quality water may increase the risks of people getting sick due to communicable and water-borne diseases.

Sensitivities

Certain subsectors of Cambodia's population may be considered to be more vulnerable than others concerning climate change impacts on water and health. In 2009, nearly 23% of the population was reported to be living below the poverty line, with a high concentration of people living very near the poverty line. According to the Cambodian Socio-Economic Survey of 2007, 78% of rural employees then worked in the agricultural sector, which comprises crop production, livestock, farming, and fishing, all highly climate-sensitive livelihoods.

These groups include residents of flood-and drought-prone areas and certain occupations (e.g., rice farmers and other agricultural workers). Both groups may be considered at increased risk of exposure to diseases transmitted via contact with pooled water (such as that which occurs in rice paddies or during flood conditions), notably diarrheal disease, melioidosis, and leptospirosis. People living in poverty may also be at higher risk, which may be partly because of their limited abilities to access improved water and sanitation facilities. In addition, referring to a study conducted in Kampong Speu of Cambodia, approximately two-thirds of the villages studied were highly vulnerable to climate change impacts, among whom, women were more vulnerable. Women are generally the ones who take care of the elderly and children and do not have many options to earn besides selling the morning glory, fishing and farming.

A "knowledge, attitudes, and practices" survey carried out by the Ministry for Rural Development in 2010 found a strong correlation between households that had latrines and those which treated water appropriately and practiced safe hygiene. This suggests that factors such as income and education are likely linked with health-protective behaviours such as latrine use, water treatment, and hand hygiene.

CLIMATE CHANGE ADAPTATION ON WASH IN CAMBODIA

Among Southeast Asian countries, Cambodia has been characterised as having the lowest climate change adaptive capacity due to its poor technologies, lack of infrastructure, and poor socio-economic conditions[4]. The prevalence of communicable diseases in Cambodia has been exacerbated by a combination of weak socio-economic conditions and poor infrastructure and services, featuring malnutrition, inadequacy of the rural water supply and sanitation services, as well as a poor health-care system and poor-quality housing and living environments. Thus, improvements in the evacuation procedures, the health-care system, water supply, and

[19] Royal Government of Cambodia. (2006). *National Adaptation Program of Action to Climate Change*. Ministry of Environment.

20 Participant Organisations of the Humanitarian Response Forum. (2016). *Synthesis Report of NGO Drought Assessments in Cambodia.*

sanitation facilities, as well as a reduction in exposure to extreme climatic catastrophes, are critical priorities for both public health and human development more generally[21].

In other research of Kyoto University[22], villagers were also asked whether they had noticed any changes in drought and flood frequencies in recent years. For 58% of villagers interviewed, the frequency of floods had increased in recent years. The figure is more significant for droughts, as 71% of villagers interviewed had witnessed an increase in the frequency of droughts. Although these figures cannot be considered to be representative of Cambodia as a whole, they are noteworthy as much as the areas surveyed were specifically chosen for their vulnerability to climate hazards.

National policy and institutional setting

The government in Cambodia has progressively come to focus its attention on this issue. Cambodia signed the United Nations Framework Convention on Climate Change (UNFCCC) in 1995 and the Kyoto Protocol in 2002. The Department of Climate Change (CCD) was established in 2009 within the Ministry of Environment (MOE) to coordinate climate change-related commitments. The National Climate Change Committee was established in 2006 with 19 members, all high-level decision makers from relevant government organizations, with a view to enhancing cooperation between relevant organizations in implementing the UNFCCC.

The Cambodian government formulated its National Adaptation Program of Actions to Climate Change (NAPA) in 2006. A Cambodian national program of action on climate change (NAPA) was completed in 2006 and identified a number of high-priority projects for addressing climate vulnerability in both health and non-health (water, agriculture, and coastal zone) sectors[23].

Limitation of Institutional capacity for Climate Change Adaptation (CCA) In WASH Sector

Long term strategic plans for research in the area of climate application information should also be developed in concert with climate change research. However, a Cambodian Climate Change Strategic Plan, together with Sectoral Climate Change Strategic Plans including health and water, are under development[11].

The recent NAP II (2019) integrates climate matter into its activity clusters for increasing safe drinking water services. However, the adaptive measures are still rough and elusive. In term of adaptive measures, the action plans aim to:

1. Establish more community-managed water supply system and community-managed bottled water system (20L) that could sustain disasters and climate risks.
2. Provide 19,500 climate-resilient boreholes, 4,000 protected dug wells, and 4,000 household rainwater harvesting systems in compliance with MRD's rural water supply technical design and construction supervision manual.
3. 500 communes implement water safety plans incorporating climate change adaptation and disaster risk management principles.

---

21 Va Dany, Kathryn J. Bowen & Fiona Miller (2015) *Assessing the institutional capacity to adapt to climate change: a case study in the Cambodian health and water sectors.*

22 Shaw, R., Nguyen, N. H., Prabhakar, S. V. R. K., & Provash, M. (2008). *Drought management considerations for climate change adaptation: Focus on the Mekong Region – Cambodia report.*

23 Royal Government of Cambodia. (2006). *National Adaptation Program of Action to Climate Change*. Phnom Penh: Ministry of Environment.

Beside that there is no strategy mentioned regarding the CCA for sanitation expansion. Instead, the focuses are on: (1) increasing and sustaining the ODF (Open Defecation Free) status, (2) promoting onsite and offsite faecal sludge management, (3) having adequate entrepreneurs providing sanitation services in the challenging environment, and (4) increasing access to sanitation for remaining households, schools, and public health care facilities in Cambodia.

The need for strong coordination has yet to be met. The sector involves various government ministries that play a role in water and sanitation, plus a multiplicity of donors, NGOs, and private operators. There is limited engagement of sectors to implement the integration of WASH into relevant development programs. While coordination between existing traditional donors and the government is well established, newly emerging donors who have been growing stronger in importance and volume of support over time, have not been brought into the existing coordination mechanism. Various technical guidelines are yet to be developed for effective interventions to address both emerging and long-standing issues, such as community-owned and managed water supply systems, faecal sludge management, and the climate resilience of WASH infrastructure.

Climate Change Response at Local Level

Nationwide decentralization of rural WASH functions to district and provincial authorities came into effect in January 2020. There are significant hurdles and challenges. There is little knowledge of policy frameworks at the sub-national level, limited coordination, and no monitoring systems to track progress against national plans. There will need to be a concerted effort to develop capacity and transfer sufficient finances to deliver at the sub-national level, and to ensure that investments in WASH support the inclusion of the most marginalised communities and households[24].

From NAPA (2006), the preparedness of villagers to extreme climate events is low, as is their adaptation capacity to climate change. There are cases where local communities are resourceful when dealing with climate hazards, but these are exceptions and usually coincide with settlements with higher social capital and stronger local institutions.

Villagers may be aware of possible coping and adaptation mechanisms such as rehabilitating water storage structures and irrigation canals, building dikes and water control structures, strengthening dwellings against windstorm etc. However, the lack of financial resources has generally prevented local communities from implementing these projects.

Much of the efforts of authorities have focused on post-disaster management, rather than on disaster prevention and adaptation to extreme climate events. While post-disaster management needs to be expanded to all victims, successful prevention and adaptation will require additional commitment from Government and international organizations.

While early warning and forecasting are very important for flood and drought risk management, such reliable local forecasts are non-existent in Cambodia. Villagers in downstream areas essentially rely on word of mouth from upstream areas to ready themselves for floods. Windstorms and high tides similarly find local communities unprepared. Information about water levels, which may be occasionally advertised in public areas, leave local people perplexed about how to interpret them.

Table 3 and 4 below summarise the type of coping responses and their implementations for adaptation. Most of the coping responses are at the household level and not sustainable. While technical and hardware

[24] WaterAid Cambodia. (2020). *WaterAid Cambodia Country Strategy 2020-2023.*

supports were suggested as being important to CCA, they were generally considered to be insufficient or almost non-existent in some locations.

Type of coping	Type of coping responses	Results and implications for adaptation
Short-term coping	Elevated enclosures for livestock, elevate ground level, replace wooden parts of houses to concrete	Spend more
	Increasing the household's food stock, increasing feedstock for animals,	Spend more
	Preparing boats	Spend more
	Excavate to safer place (higher road, pagoda, temporary tent, temporary home)	Outbreak of water-borne diseases due to the lack of WASH services
	construct wells or harvest rainwater	yielded water for a season only and subsequently lowered the water table
	Move all assets to the street and upper floors	Spent a lot and lost many assets
	Repair broken houses and bridges	Paid US$ 1–3,000 every year for repair
	Engage in one job	Income shortage
	Wait for external relief	Relief was provided irregularly
	Use smoke, lime or mosquito repellent to protect against snakes and pests	Still easily bitten by snakes and mosquitoes. Houses on fire because of smoking out pests (rare but with huge impacts on the whole community).
	Build bridges	Helpful for improving accessibility
	Saving group	Helpful for pooling money in case of emergency
	Walk through the flood water to buy food and access the medical services, sometime could be far up to 2 Km	Compensate time and labor for other crucial activities and expose to water-borne disease
	Buy or fetch water from neighbours or relative	Helpful for improving accessibility
Erosive Coping	Use flood water for daily consumption due to lack of portable water supply	Get diarrhea and other diseases
	Borrow from moneylenders to raise the ground higher or renovate houses	Suffer from high interest rates
	Defecate into plastic bags that are then thrown into open spaces underneath and between dwellings	Water pollution
Transformative coping[19]	Innovate sewage and drainage systems	Fewer risks from diseases and snakes
	Diversify income sources	Manage livelihoods during floods
	Build reserve houses for rent and shelter	Enable flexible responses to situations
	Construct protective dykes	Prevent sinking and land erosion
	Relocate from boats to inland houses	Less risk of house destruction
	Diversify social networks	Obtain help through various channels
	Participate in education programmes	Be alert and well prepared

Type of coping	Role in assisting the victims	Funding source
The recognition paper for the poor	Improve accessibility of the poor for social services including exemption for medical services.	Government
Humanitarian assistances	Short-term food and accommodation support	Government/Donor

Adaptation to drought

In term of sanitation, 17% of households reported adapt to drought by reducing the frequency of their bathing time to few times a week[16]. In some affected areas, people have reportedly stopped bathing and cleaning, which could pose a health threat[9]. For household uses, 28% of villagers suggest digging wells as a possible solution. Ponds and reservoirs for dry-season storage are alternative options. For measures for household water uses and agricultural uses, the most often quoted obstacle to implementation is the lack of financial resources, with 33% and 41% of respondents, respectively.

Technical Adaptation for Sanitation in the Challenging Environment

Proposed amendments to existing pit latrines

Proposed amendments to existing pit latrines to improve suitability for challenging environments are :

1. ***Flood Prone Locations:***
   - Latrine pits must be designed and constructed so that they (1) do not contaminate flood waters, and (2) cannot be easily opened, releasing the pit contents (faecal sludge) into flood waters.
   - The top and any exposed rings of latrine pits are carefully sealed with mortar to stop faecal waste from escaping the pits and contaminating floodwaters.
   - Latrine pit concrete ring stacks are raised above the height of floodwaters (to contain the faecal sludge), with a separate soakage trench for black water.
   - Latrines must be accessible and useable year-round, including during times of flooding. Latrine pans must be elevated well above the maximum height of floodwaters, either inside houses or in separate elevated structures.
   - Simplified septic tank/anaerobic baffled reactors can be created using a series of sealed concrete pit chambers.

2. ***High Groundwater Locations:***
   - Raise the latrine pan and latrine pit in an earth mound to separate the latrine pit from the groundwater table by at least 2 metres.
   - Constructing simplified anaerobic baffled reactors with a higher outflow point using a series of connected, sealed concrete pits. For example: sealing the base of the first latrine pit and connecting this to a second soakage pit that is only one-ring deep and is located just below ground level.

Sanitation Service Delivery for SCE

The Department of Rural Health care of MRD endorsed the list of sanitation enterprises to provide their services in the SCE regions. In addition, some of common service type for SCE areas are described below.

Raised toilet pit

MRD guideline[25] has recommended it as a toilet option particularly for fixed houses on stilts.

Features:

- Faeces are contained in sealed concrete rings and avoid contamination during flooding. Pit is raised above high flood water level.
- Pit is connected to a toilet bowel/chamber box by pipes.
- Outlet of the pit could be connected to a separate soak pit to discharge the effluent.
- Pit has to be emptied regularly depending upon the number of users and size of the pits.

Advantages:

- Construction materials are easily available in the market and masons are familiar with the system.
- The system is safe to use during flooding.

Limitations:

- Emptying pit may be difficult and could be risky, if it is raised more than 2 m. above ground level. In addition to that emptying pit and safe disposal system is required to meet the expected sanitation benefit and minimise health hazard risk in the community.
- If flood level is raised more than 2m high, poor families may not be able to afford the system due to high cost of concrete rings and installation cost.
- Technical supervision by skilled technical personnel is required for installation of latrine pits if high flood level is more than 2 metre high.

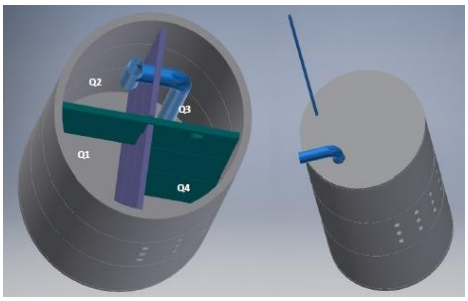
Figure 2: Raised toilet pit, Source: MRD, SNV/2011

Three-Chamber Pit Latrine

This toilet model is introduced jointly by EWB and IDE.

Features:

- The system works under anaerobic digestion process.
- Made of 1 m. diameter concrete rings with reinforced panel dividers.
- All joints are sealed with cement paste and mortar.
- Third compartment is filled with stone aggregate as media to separate solid particles from effluent and enhance efficiency to digest fecal sludge.



Advantages:

- Adapted to conventional concrete ring pit.
- Provided more hydraulic retention time for digestion due to compartments.
- Additional filtering material (stone aggregates) helps to improve the quality of effluent

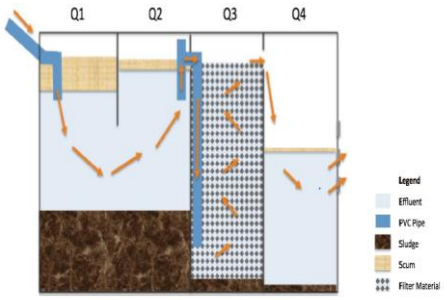


Figure 3: 3C pit latrine, Source: IDE, EWB. 2017

Limitations:

- Require special technical supervision during installation of the toilet pit
- May block the flow inside pit during high flood due to hydraulic pressure from outside, if proper height is not maintained.
- Additional cost USD$ 30-40 compared to the normal toilet ring pit of the same size[26].

HandyPod (latest modified version 2016-17)

Following a series of field test of different toilet models in floating village since 2009, Wetlands Work recently refined a new model of handy pod for both floating and flood prone households. Wetlands Work has conducted preliminary research on the quality of effluent and continued its research on deposit of faecal sludge inside the bio-digester. This is the only option currently available for floating communities in Cambodia.

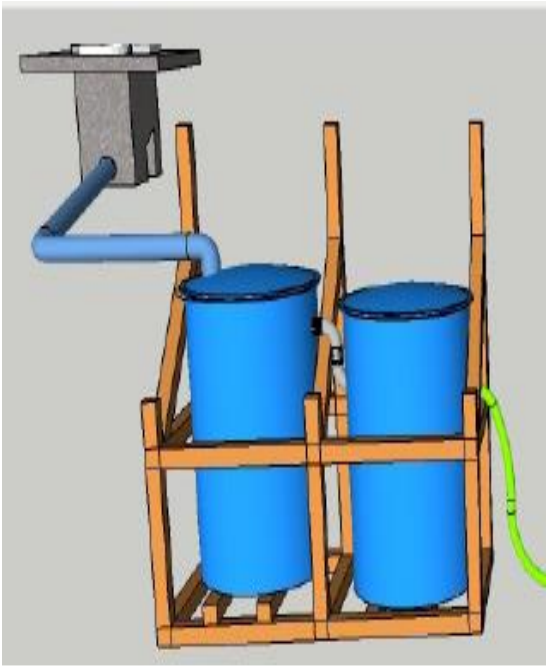


Figure 4: Handy Pod 2016-17.

Features:

- The system functions under anaerobic condition inside the digesters.
- The digester is connected to ceramic toilet pan.
- Two plastic containers (200 lit) are connected in series.
- Filler materials/mediums are filled inside the second container.
- Wooden frame is used to fix two containers on the boat.
- During dry season effluent may safely disposed to the nearby plantation area.

Advantages:

- Safe to use for both dry and floating conditions.
- Durable and low maintenance.
- No bad smell for regular use and
- Safe against the storm.

Limitations:

- The test on accumulation of sludge is under progress. Need to develop faecal sludge emptying and safe disposal protocol in future.
- Although the effluent test result indicated 50% reduction in E-coli, it may require additional treatment devices to improve the quality of effluent before discharging into the environment.