Report of the Survey with Households and Local Authorities in Rural Cambodia on WASH, Climate Change and Adaptation

April 2022

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Water For Women

Australian Aid

east meets west
A PROGRAM OF THRIVE NETWORKS

This report was compiled from the survey conducted in 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.

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1. INTRODUCTION

Building on the WASH project Women-Led Output-Base Aid (WOBA) Cambodia, which is funded by Australian Department of Foreign Affairs and Trade, under the Women for Water Fund, the research study entitled Climate change impacts, adaptation measures, and inclusive resilience system in WASH: A case study of marginalized communities in rural Cambodia is conducted to further assesses the impacts of climate change on the access and use of WASH services among the poor and GESI households in rural Cambodia as well as to explore the role of private sector in collective adaptation for the said communities. This research study is funded through the Innovation and Impact Grant of the Women for Water Fund.

In Phase 1 (July 2021 to May 2022) of the study, a survey was conducted with households and local authorities in five provinces in rural Cambodia. The aim is to understand the current state of socio-economic situation, access and use of WASH service, perception of climate change impacts and existing adaptive capacity of the Cambodian rural households, particularly the poor and GESI groups.

2. METHODOLOGY

2.1 Study Site

The survey was carried out in five provinces of the WOBA project where rural livelihoods are affected by different climate driven phenomena such as floods and drought. The five provinces include Kratie and Kampong Cham that lay along the Mekong mainstream, Prey Veng and Kampong Speu in the downstream of Mekong Basin, and Pursat which is in Tonle Sap basin (Fig. 1). According to Yusuf (2010), Kampong Speu, Pursat and Prey Veng stand among the top 10 vulnerable provinces in Cambodia, followed by Kratie and Kampong Cham . During the rainy season, because 85% of Cambodia's land area is within the lower Mekong basin and mostly is a floodplain, it usually suffered by water-induced disasters such as storms, heavy rainfall, and runoff from the northern mountains which cause seasonal flooding and overflow of the Mekong River, its tributaries and the Tonle Sap River (Davis, 2015) . In this sense, the location that is on low terrain usually severely suffered from seasonal floods between early July and early October . While Prey Veng, Pursat, Kratie and Kampong Cham which are plain and adjacent to major rivers are mostly affected by the flood, Kampong Speu province is on the hilly side and more affected by drought (NCDM, 2003) . The survey was conducted with 428 households and 96 local authorities in 32 rural communes across the five provinces. The distribution of surveyed households and local authorities in each province is given in Table 1.

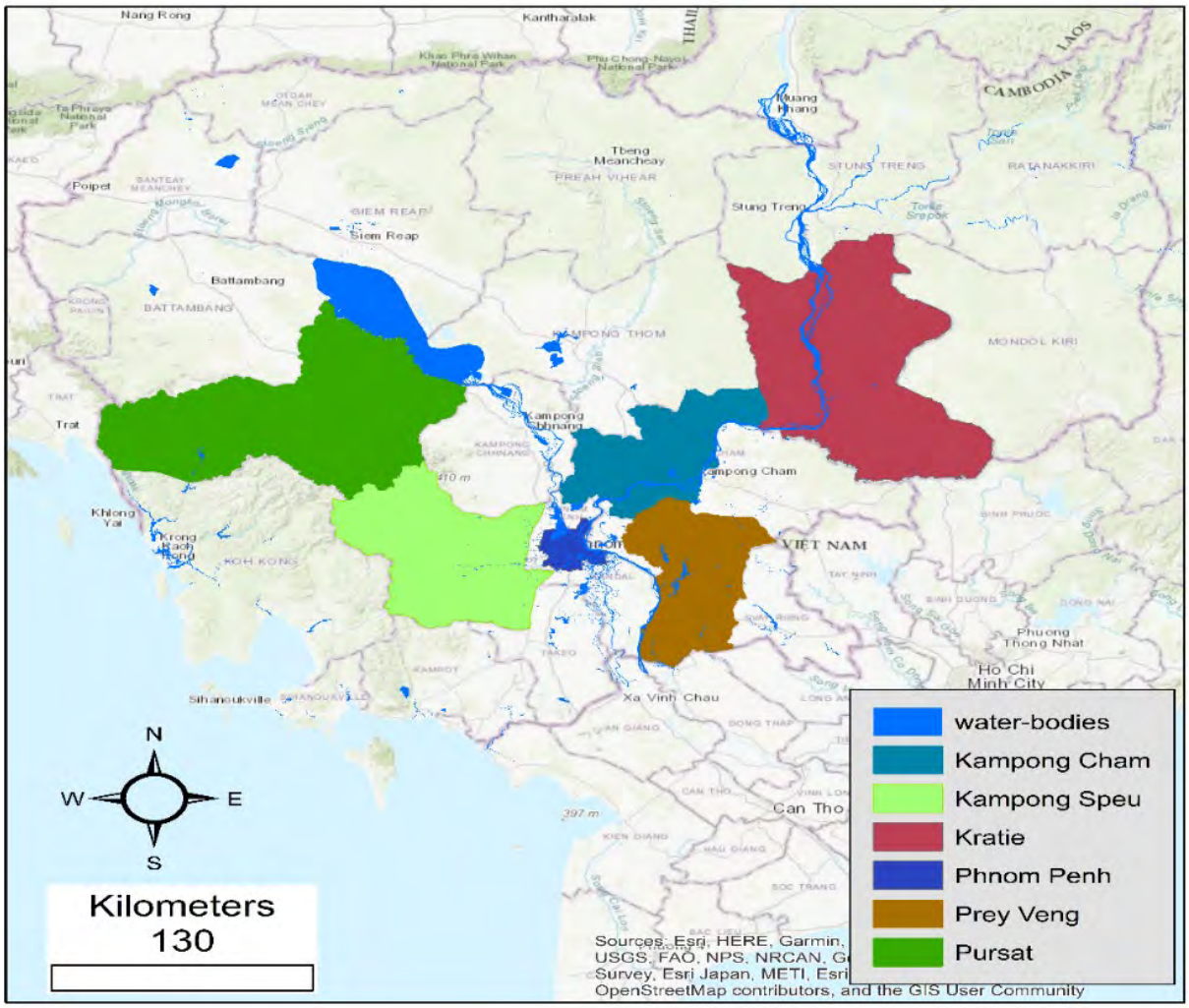


Figure 1: Overview of the Study Site.

Province	District	Commune	Number of Survey Households/ authorities
Kampong Cham	Chamkar Ler	Svay Teab	91 households, 20 authorities
	Kang Meas	Angkor Ban, Surkorng	
	Batheay	Sandek, Tang Krasang	
Kraties	Prek Prasab	Chroy Banteay	91 households, 19 authorities
	Chhlong	Preak Samann, Hann Chey, Khsach Andet	
	Sambo	Sandann, Sambo	
Prey Veng	Kampong Trabek	Korkchork, Prasat, Pratheat, Chrey, Cheang Dek	84 households, 34 authorities
	Svay Antor	Chea Khlang, Toek Tla, Mebon	
	Kamchay Mear	Trabaek, Smoang khang Cherng, Khranhung	
Pursat	Phnom Kravanh	Pteas Rong, Pro Ngel, Santrea	95 households, 13 authorities
	Pursat Krong	Chameourn Phal, Roleab	
Kampong Speu	Boseth	Phong, Katt Plok, Svay Chorcheb	67 households, 10 authorities
	Phnom Srouch	Prey Kmeng	

Table 1. Distribution of the Survey Participants.

2.2 Questionnaire Design and Survey Methods

Face-to-face interview method was used to survey the households to maximise response rate and completion of the survey. Emunerators were trained to conduct the survey and they carried out the interviews. The households were purposively selected from the list of recipients of WOBA subsidies for WASH service. These households are diverse in terms of socio-economic and disadvantage (termed as GESI in WOBA) status. Overall, the survey households comprise f poor, non-poor, GESI poor, and GESI non-poor households, which account for 27.5%, 25.7%, 21%, and 25.7% respectively.

The questionnaire was developed by the researchers. It comprises six parts which aim to collect different kinds of information. Part 1 aims to collect information regarding household's access to water, sanitation, and hygiene. It consists of the questions that elicit the sources of water, water availability and quality issues, sanitation services and problem concerning access and use of latrine facility. Part 2 consists of questions that intend to capture information about the households' experiences of climate related events and climate variations in their locality. Part 3 and Part 4 aim to understand the household perception about the impacts and their coping responses to flood and drought respectively. Part 5 was mainly designed to collect the information regarding the communities' climate change adaptive capacity, and their awareness of the adaptation options. The last part are the questions about demographic information which include income source, educational level, economic status, GESI status, gender, and age group.

The surveyed local authorities include district and commune officers of the Department of Rural Development, Commune Council member, Commune Head, and Village Chief. Face-to-face interview method was conducted by the research team also used to maximise response rate and completion of the survey. Two researchers conducted the survey with the local authorities. The questionnaire used for this survey is basically the same as the questionnaire used for households' survey, except some questions regarding individual household's status such as income level, educational level, and a few others were excluded.

2.3 Data Analysis

The data collected from both surveys were keyed-in into the Qualtrics system in which the survey was programmed. The survey results were extracted from Qualtrics after all data entry was completed and checked against the paper surveys to ensure proper coding and that missing or incomplete data set is not present. All in all, 5 cases with incomplete data were removed from the household survey data set leaving only 423 cases for the statistical analysis.

SPSS statistical analysis software was used as main tool to perform data analysis for this study. In general, for both the household survey and authorities survey data sets were explored using the same steps as follows:

1. Frequency analysis was run for the whole data set in order to explore the patterns of the responses, while a reliability test, chi-square Goodness-of-fit, was also performed in order to verify that the variations in the data set are meaningful.

2. Chi-square association test was run on the questions that have significant response pattern to identify the association among different factors such as access to water, access to latrine, experience and perception on climate variation and climate related experience, impacts and response of flood and drought, awareness of climate change adaptive capacity, income source, income level, education level, household status and so on.

3. Multinomial logistic regression analysis was conducted on the factors that show significant association on the chi-square association tests to confirm the relationship, particularly, between household's characteristics such as economic, personal experience, and demographic factor with their experience or perception of the impacts of flood, drouth and other climate related hazards as well as their awareness and choice of climate change adaptation.

4. Exploratory factor analysis was conducted on all the questions that related to experience or perception of the impact of flood and drought, awareness of climate change adaptation options being practiced in the villages and household's characteristics such as income source, income level, education level and so on, to further explore the underlying relationship pattern among those variables.

3. HOUSEHOLD SURVEY RESULTS

3.1 Respondent Characteristics

The households participated in this survey are rural households who resided mostly in the areas that are previously prone to environmental challenges such as flood and drought, and the access to clean water and sanitation are still limited. of the 423 households who participated in the survey, 81% were living in challenging environment such as drought, flood and related events (i.e., intense rain, hurricanes), water scarce, and hardground. Specifically, 40% of the respondents mentioned that their village is affected by drought, 24% claimed to be in flood affected area, 3.78% are affected by more than one hazards, and 1% are living in water scarce area (Fig.2).

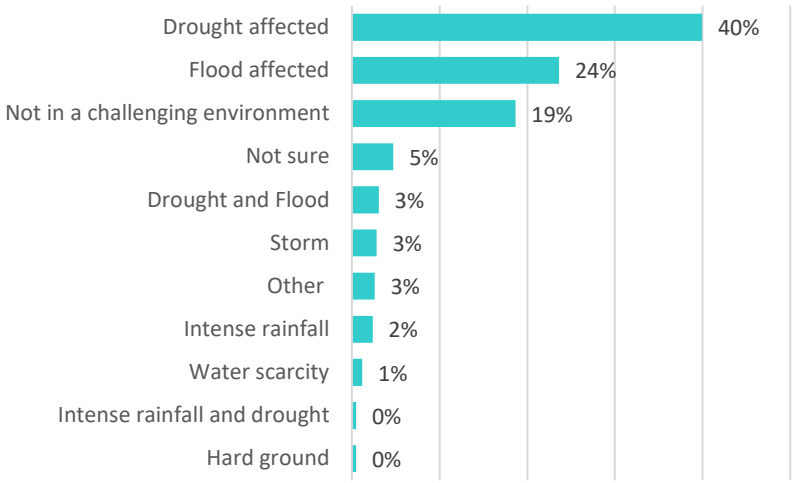


Fig. 2. Types of Challenging Environments

The respondents are also diverse in term of gender, age, education, household characteristics and economic background.

- 71.39% of the respondents are female, 28.61% are male.
- Most are in the economic active population whose age between 18 and 65 years old (Fig.3a).
- 55.56% of the respondents are from medium size households that has 4 to 6 members, 28.84% are from small households with 1 to 3 members, 13% from large households with 7 to 10 members, and 2.6% are from extra-large household with 11 or more members (Fig.3b).

• The household's education level is significantly low, and a least 20% of the participated household have never attended school. Generally, the highest education level for the majority of participated household are primary school and secondary school which account for 39.1% and 25.3% respectively. 12.29% of the respondents mentioned that the highest education level of their household is upper secondary school while less than 1% of the households have a family member who has attended vocational/professional school and university.

• In term of household economic status, most of the respondents belong to the low-income household who live on less than 150 US Dollars per month. As indicated in Fig.4a, about 13% of the household have monthly income of less than 50 US Dollars, 30.97% has average monthly income between 50 to 100 US Dollars, 14.18% has monthly income between 100 and 150 US Dollars, and at less 1.42% of the household has irregular monthly income (Fig.4a).

• Farming is the main income source for the majority of the household participants, which account for 35.70%. Other important income sources are labourer, service provider, small business, construction worker and factory worker which account for 8.98%, 7.80%, 7.80%, 6.38%, and 5.91 % respectively (Fig. 4b). 41.75% are unemployed households who live on government support, charitable from the community or relies on relative support.

Fig. 2. Types of Challenging Environments

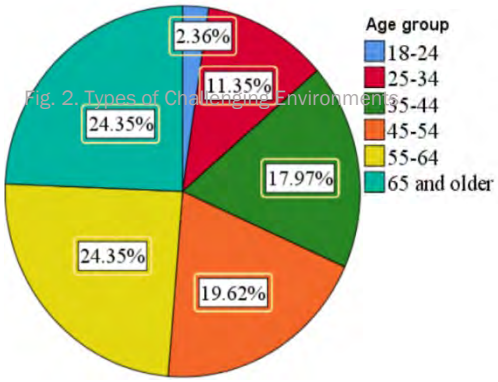


Fig. 3a. Age Group

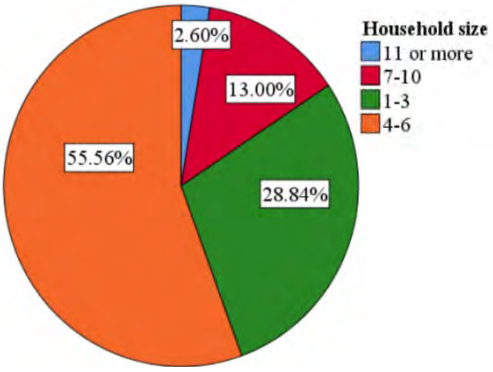


Fig. 3b. Household

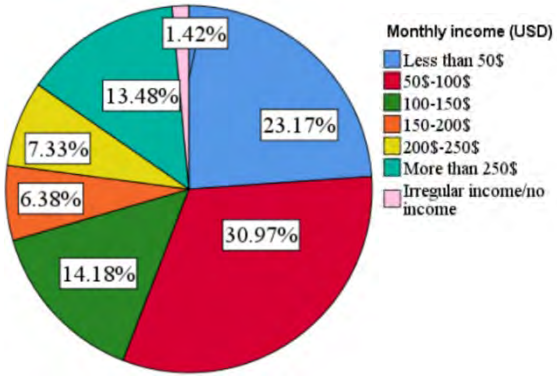


Fig. 4a. Monthly Income in USD

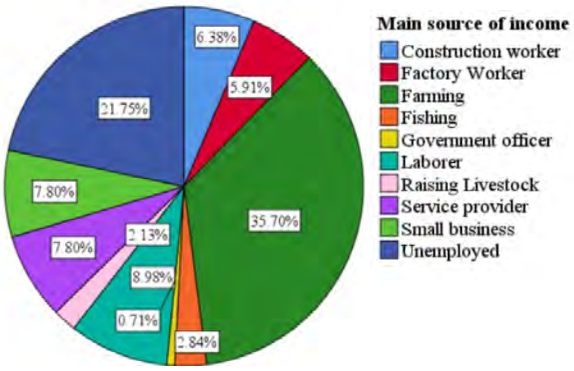


Fig. 4b. Main Source of Income

Most of the households belong to GESI categories, which mostly are the family with kid below 5 years old, with elderly above 65 years old and/or a female led households. Overall, 61.47% of the respondents are from GESI household, 10.60% are from GESI and Female led household, and 27.90% are non-GESI households (Fig.5a). In term of poor status, about half of the participants belong to poor household who currently own ID poor 1 or 2, 13.71% were previously belong to ID poor group, and 36.64% are non-poor households (Fig. 5b).

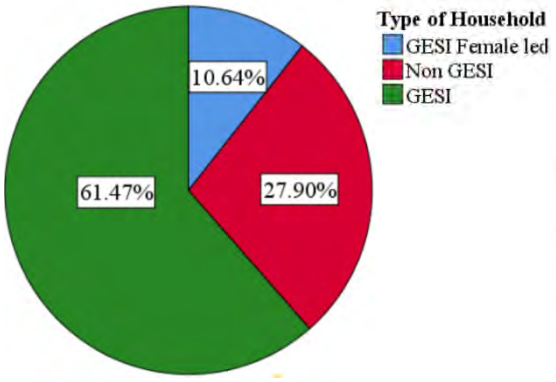


Fig. 5a. Type of Household

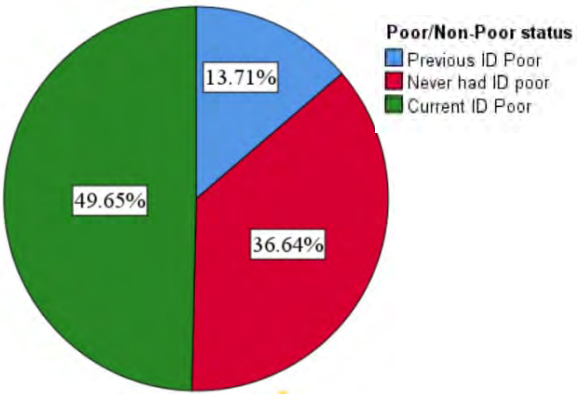


Fig. 5b. Economic Status

3.2 Access to Water and Sanitation

3.2.1 Access to Water

- There is no significant different in term of source of water used for drinking water and for other domestic uses.

- The main source of drinking water is tube well or borehole, follow by stored rained water, pipe water outside of the household dwelling, bottled water, and surface water such as river, stream or lake. There is no significant difference in term of source of drinking water during normal day, flood period and drought period, except for stored rainwater that is used significantly during flood period and normal day but less used in drought period (Fig.6).

- Most of the household have water access in their yard or in their household dwelling. Only 19.6% has to collect water from elsewhere. About 58.4% of the respondent mentioned that female adult in their household is the person who responsible to collect water while 2.4% mentioned it was responsible by children aged below 15 (Fig. 7).

- Regarding the availability and quality of the water, 66.2% of the household mentioned that water is always available from their main source, 10.9% mentioned that water is available most of the time, 22.2% said water is available for some time, and very small % of the households mentioned that water is not available. In term of water quality, at least 25.8% of the respondent mentioned that the quality of water from their main source of water is not always acceptable. The main issues relating to perception of unacceptable water quality are color, smell, or taste, hardness, and presence of material which particularly occurred during flood period (Fig. 8).

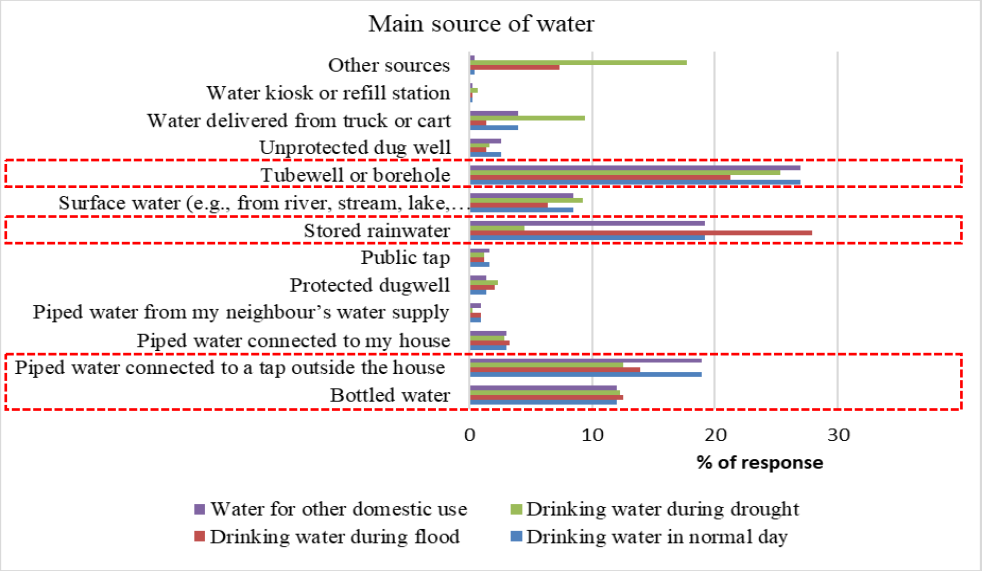


Fig. 6. Main Source of Water

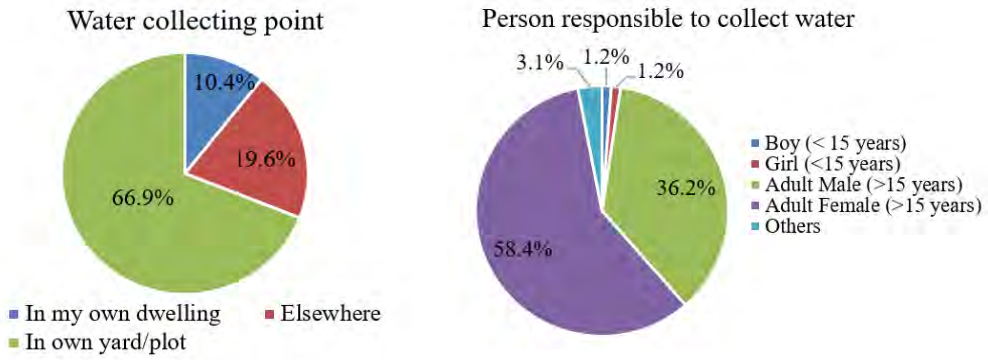


Fig. 7. Water collecting and person who is responsible to collect water.

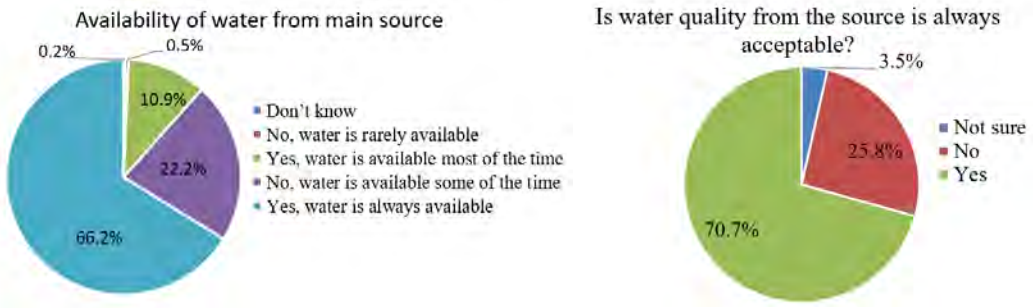


Fig. 8. Availability and Quality of Water from Main Source

- In normal day, 74.2% of the respondents mentioned that they don't perceive water quality problem. But, during flood period only 4% of the respondent did not perceive water quality problem.

- Among those who perceive water quality problem, at least some 15.6% did not take any treatment to make water safer for drinking in normal day. This number increases to 22.7% during flood period. This may indicate that flood impact can put additional pressure on the household daily life which leave them no choice but to drink water from the source without treatment.

- The most common choice for households to make their drinking water safer is boiling. Other choices include use water filter, add chlorine, buy bottled water, collect and store rained water and let water settle on its own. Among these options, if done appropriately and with good hygienic practice, boiling, using water filters, and bottled water can be a good option that can reduced health risk from water bone diseases. Other options such as stored rainwater and let water settle by itself is not an effective measure. Basically, it only makes water look more presentable. There is no variation in term of choices for making water safer for drinking between normal day and during flood event (Fig. 9).

- Choice of option to make water safer for drinking seems to associate closely with village geographical characteristic and level of education yet doesn't seem to associate with the economic status of the households. As indicated in Table 2, choice of option to make water safer for drinking represented is significantly associated with village geographical characteristic and household's highest level of education at α =0.002 and 0.001 respectively. Phi and Cramer's V for both variables are above 0.15 indicates a strong association between the variable.

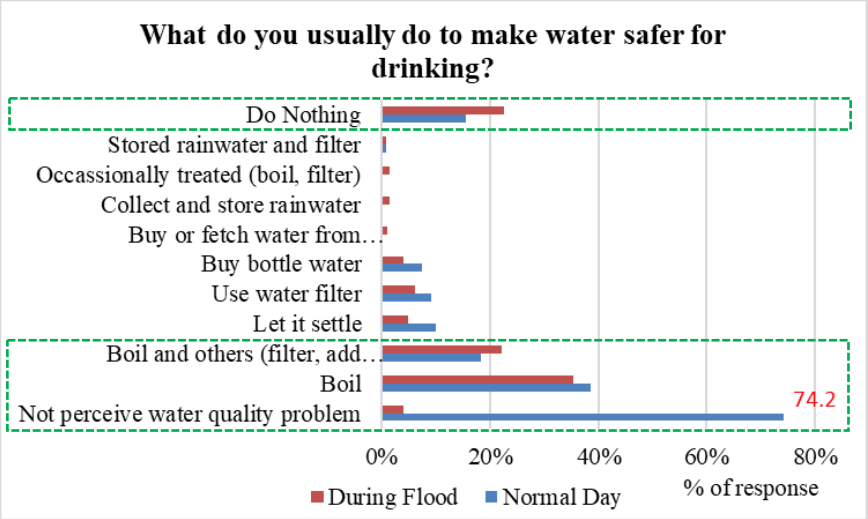


Fig. 9. Option to Make Water Safer for Drinking

- Based on the results of Chi-square association tests, the availability of water is closely related to water source and village geographical characteristic. The availability of water from main source is significantly associate with type of water sources (Q5 and Q9) at α = 0.000 for both variable, and Phi and Cramer's V above 0.15, which indicate very strong association. Similarly, the availability of water from main source (Q11) is significantly associate with the village geographical characteristic (Q60) at α = 0.002 for both variable, and Phi and Cramer's V above 0.15. This result is agreed with the diversity of water sources mentioned by surveyed households, particularly main sources of water include groundwater (tube well/bored hole), piped water, stored rainwater and surface water. While the usage of these source of waters vary according to geographical location, water availability varies seasonally. For instance, groundwater is used more in Prey Veng province, and it usually become shortage around the end of dry season (IWMI, 2013) .

- There is no association between water quality, water source, and village geographical characteristic.

3.2.2 Access to Toilet and Sanitation

According to the survey response (Figure 10):

- Flush or pour flush pit latrine is the most common type of toilet facility used by household in the study areas, which account for about 81.1% of surveyed households. Other types of toilet such as pit latrine with slab and twin pit latrine with slab are also commonly used by the community. Only 85.3% of the toilets has supper structure, the remaining are just toilet bowl without cover.
- Only 0.7% of the households has toilet facility that connect with septic tank.
- At least 7.3% of the household does not have toilet facility.
- At least 5.9% still practice open defecation into bush or field.
- 79.67% has toilet facility in their yard, while 20.33% have the toilet in their dwelling.
- About 14.4% of the survey households share their toilets facility with others who are not their households' member.
- At least 3.1% have ever emptied their pit latrine. Among them, 45% mentioned that the content was emptied to an open environment such as uncovered pit, open ground, water body or elsewhere.
- Regarding access to toilet, 11.1% of the survey household mentioned that their family members are not able to access toilet facility at all the time. Additionally, among all the survey households, about 18.2% mentioned that they face some risk while using toilet. Common risks include risk of harassment, fear of insects/snake, and health risk (Fig.10).
- Having access to toilet at all the time doesn't seem to associate any factors including household economic status, education level, GESI status and village category.

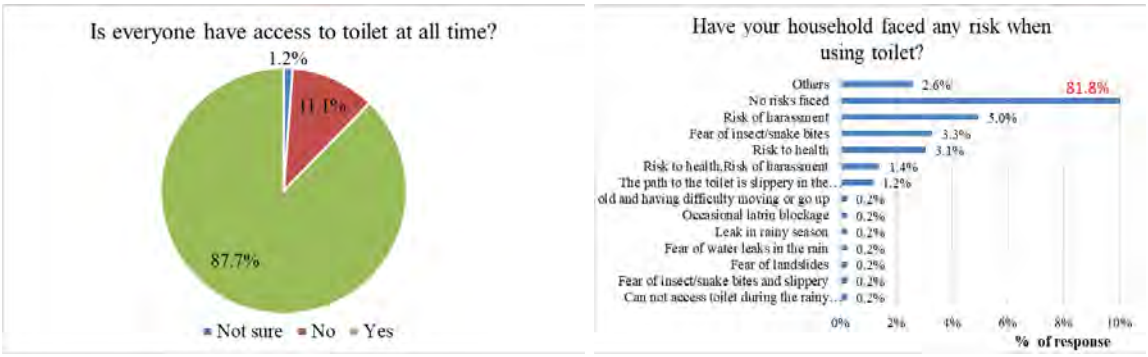


Fig. 10. Access to Toilet and Risk Faced by Household While Using

3.3 Observations of Climate Hazards

Most prevailing climate hazard during the last 10 years are intense rainfall, drought, and storm. Other significant hazard includes flood and temperature increase (Fig. 11a). These climate hazards were also perceived by the majority of the respondent as becoming more frequent and more intense (Fig.11 c &d).

Rainfall pattern has become less predictable, in the timing of wet and dry season has changed, and warmer dry period are common variations that are noticed by a majority of the respondent (Fig.11b).

As shown in Figure 12, most of the households are more concern about drought, storm, and intense rain rather than flood. The percentage of the respondents who has expressed that they are quite concern about these climate hazards are 64.4%, 57.2%, 44.7% and 44.4% respectively. This is likely due to the fact that most of the respondents are farmers who need flood water for their rice field. Therefore, they perceive flood as benefit rather than harm. In addition, despite most of the respondents mentioned that intense rainfall event has become more intense and more frequent, flood frequency and intensity were perceived as become less of a threat than before. This could be linked to the improvement of road and water infrastructures in recent years that help to prevent flood (Fig.12).

There is a very strong association between household's experience of climate hazards and climate variation and geographical characteristic of the village. For instance, the household's experience of climate hazards and climate variation is significantly and strongly associated with geographical characteristic of the household's village at $\alpha = 0.000$, and Phi and Cramer's V greater than 0.15. This finding is reasonable given the surveyed households are dispersed across five different province which affected by different types of hazards (refer section 2.1).

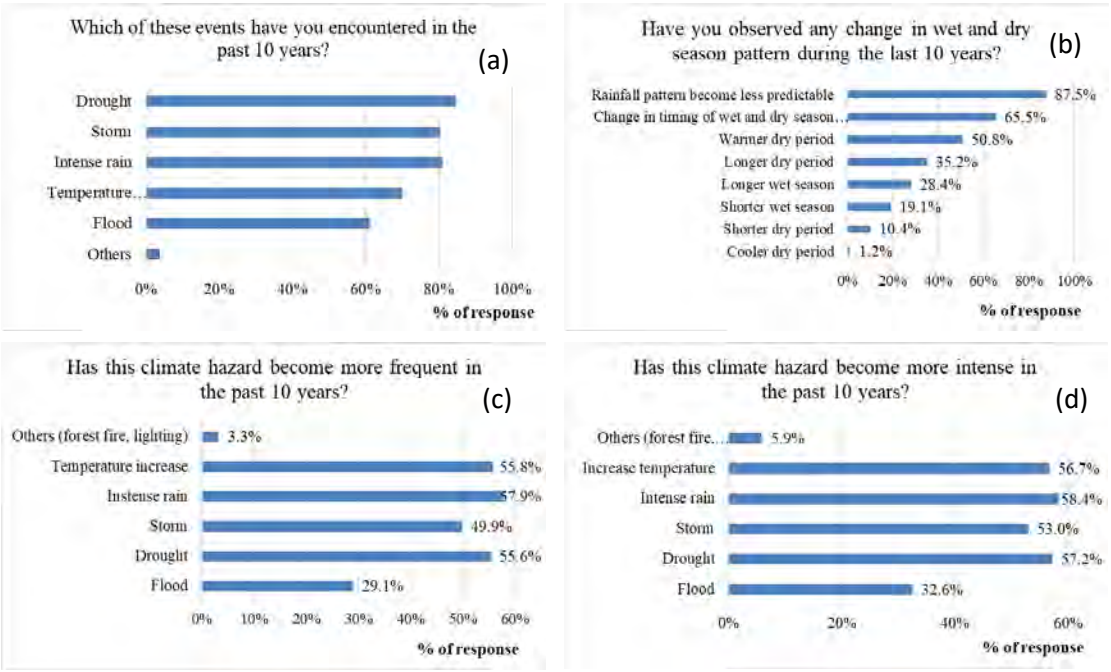


Fig. 11. Experience of Climate Hazard and Climate Variations

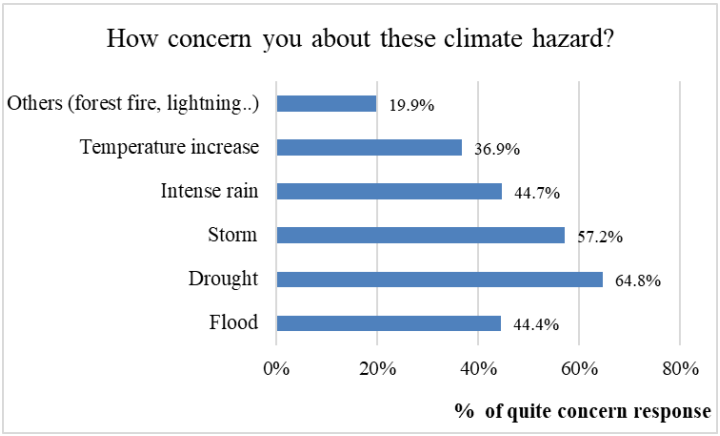


Fig. 12. Climate Hazards That Cause Concerns to Survey Households

3.4 Perception of Flood Impacts

The surveyed households perceived the impact of flood differently. As shown in Figure 13, some households mentioned that they experienced flood every year, while some others experienced it every few years or every 5 to 10 years. Similarly, the perception of households on flood duration is also very diverse. However, this variation is reasonable since the effect of flood on each household strongly depend on the geographical location of the household, house characteristics, and economic source. So far, the household which located along the Mekong mainstream and around Tonle Sap Lake such as Kratie, Kampong Cham, Prey Veng and Pursat is more prone to flood and related events, while households that located in Kampong Speu is more prone to drought (refer to section 2.1).

This association is confirmed by the results of Chi-square association tests which show a strong and significant relationship between perception of flood duration with geographical characteristics of the village, and household's main source of income at α = 0.000, Phi and Cramer's V greater than 0.15 for both variable. Similarly, household's experience on flood frequency is also found significantly and strongly associated with village geographical characteristic at α=0.000, Phi and Cramer's V greater than 0.15 (Table 2).

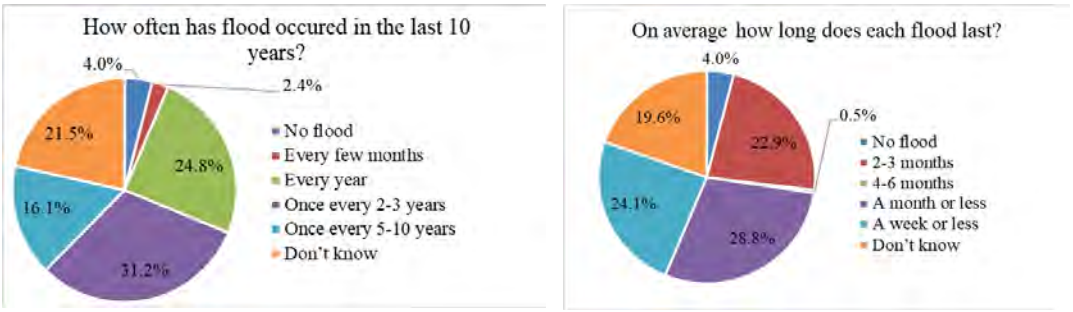


Fig. 13. Climate hazards That Cause Concerns to Survey Households

	Chi-squares tests		Symmetric Measure	
	Pearson Chi-square	Asymptotic Significant	Phi	Cramer's V
Q28-Q60	84.236	0.000	0.446	0.200
Q28-Q68	88.038	0.000	0.456	0.204
Q29-Q60	79.506	0.000	0.434	0.194

Q28-How often has flood occurred in the past 10 years?
Q29-On average how long does each flood last?
Q60-Which of the following category is your village?
Q68-What is your household's main source of income?

Table 2. Association between perception of flood duration and flood frequency with village geographical characteristic and source of income

The main concerns regarding flood for the surveyed household are difficulties for transport and mobility due to muddy road and financial problems. The majority of households mentioned that they encountered difficulty to transport and mobility for daily activities, unable to access health facility, market, school and their workplace (Fig.14).

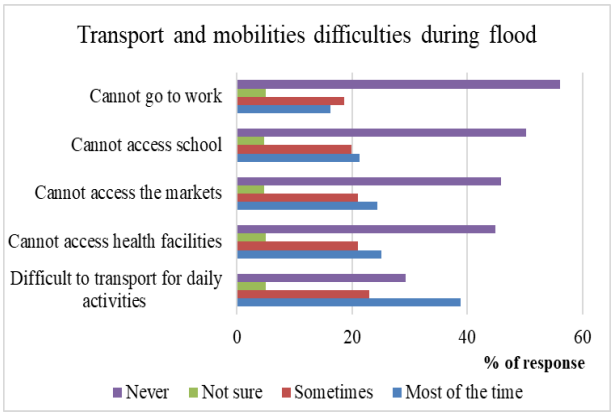


Fig. 14. Transportation and Mobility Difficulties

Factors relating to financial problems, as reported by households, are loss of crop yield, loss of income and increase cost of food and basic amenities. The most common response to cope with financial loss during flood period is taking on non-farming jobs, raising rear livestock and grow vegetable, relying on government support or support from relatives, and migrating to another place (Fig 15). This result reflects the findings of McIver (2014) that people in the sectors that do not rely solely on natural resources such as farmers and fishermen would have less impact on their income sources during the flood hazard. This, possibly explains that for respondents whose sources of income are from farming, would perceive floods more seriously and tend to pay more attention to the flood duration and frequency compared with those whose sources of income are different . Source of income such as agricultural sector is more sensitive to climate change and related events. Therefore, it is common that households who do not have a source of finance directly or passively from the natural resources would have stronger economic status, which usually allows them to have various ways to cope better. In return, their exposure and vulnerability to flood are less intense. Access to resources during flood is one of the key factors that would define the fate of rural marginalised who could not afford to move away or take on the adaptation measure but to stay in the climate-risk prone areas. Being unable to cope with climate change, dependent on natural resources and affected by the seasonal flood is one of the roots of marginalized households' poverty. This perception was reflected in a study of Fujihara (2019) and NCSD/MoE (2020) , who found that income shortage of poor households during flood caused them to be more economically devasted.

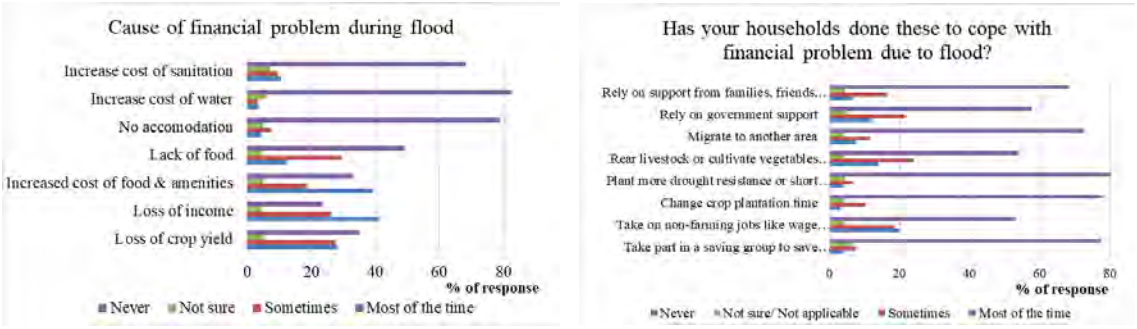


Fig. 14. Financial Difficulties during Flood Period

The households surveyed also expressed that flood has impacted their health, as well as their access and use of water and toilet facility. As shown in Figure 16a, some respondents experienced water quality problem (i.e., worse color, worse smell, worse taste, and presence of contaminated materials) during flood period. On the other hand, the survey households also perceived health concerns such as flu or cold, skin disease, and insect bite (Fig 16b).

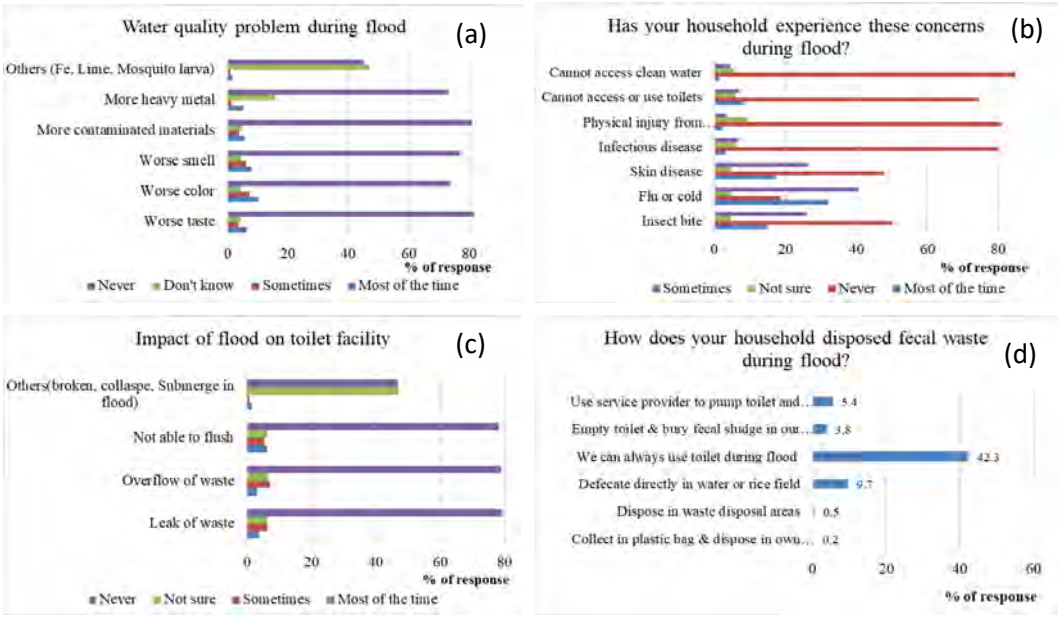


Fig. 16. Flood Impact on Water Quality (a), health (b), toilet facility (c), and household's fecal management (d)

As shown in Fig 16c & d, flood also affect household's access and use of toilet facility. The surveyed households reported that during flood period, most of the time, they are not able to flush their toilet (6.1%), there is waste leakage from the toilet (3.8%) and there is overflow of waste from their toilet (3.1%). In addition, some other households also mentioned that they encountered the above-mentioned problems for some time during flood period. This result indicates the likelihood that during flood period the rate of open defecation or fecal waste disposal into open environment is increased.

How the communities respond to flood is very likely to be associated with how flood has impacts on their financials sources. There are significant association between financial difficulties during flood with households coping options. So far, household cope with financial problem due to loss of crop yield, loss of income, and increase cost of food and basic amenities by taking on non-farming job such as labor work, cultivate rear livestock and vegetable, and rely on government support. The association about these variables are significant at α=0.000, Phi and Cramer's V greater than 0.15 for all variables. This result may confirm that how the households respond to flood impact is strongly associated with how they perceive impacts, especially on their livelihood resource.

	Chi-squares tests		Symmetric Measure	
	Pearson Chi-square	Asymptotic Significant	Phi	Cramer's V
Q38-1-Q39-2	438.607	0.000	1.018	0.720
Q38-1-Q39-5	456.562	0.000	1.039	0.735
Q38-1-Q39-7	433.757	0.000	1.013	0.716
Q38-2-Q39-2	441.699	0.000	1.022	0.723
Q38-2-Q39-5	463.884	0.000	1.047	0.740
Q38-3-Q39-7	459.018	0.000	1.042	0,737
Q38-3-Q39-2	450.480	0.000	1.032	0.730
Q38-3-Q39-5	443.182	0.000	1.024	0.724
Q38-3-Q39-7	452.287	0.000	1.034	0.731

Q38-1- Loss of crop yield
Q38-2- Loss of income
Q38-3- Increased cost of food and basic amenities
Q39-2-Take on non-farming jobs
Q39-5-Rear livestock or cultivate vegetables or root crop in backyard

Table 5. Association between perception of flood impacts on financial problem and coping responses

The perception of flood impact on health and hygiene problem is significantly associated with the geographical characteristic of the village and income sources. Chi-square association test results show significant association between health concerns during flood, as reported by the surveyed household's, including insect bite, flu or cold, skin disease, and poor hygiene due to no access to toilet with geographical characteristic of the village at α = 0.000, 0.000, 0.007, and 0.000 respectively, while Phi and Cramer's V are greater than 0.15 for all parameters indicate a strong association.

Similarly, household's perception of flood impact on health such as insect bite and poor hygiene due to no access to toilet is strongly and significantly associated with household's main source of income at α = 0.024 and 0.009 respectively, while Phi and Cramer's V are greater than 0.15. This finding reflect the fact that the impact of flood on human health is dependent on the level of flood exposure which relies on both the geographic location and household's characteristics (including source of income) itself.

Perception of water quality problem during flood is strongly associated with main source of drinking water and the geographical characteristic of the village. The results of the chi-square association test indicate that household's perception of water quality problem such as worse taste, worse color, worse smell, more contaminated materials and more heavy material are strongly and significantly associated with their main source of drinking water during flood at α = 0.000, Phi and Cramer's V greater than 0.15 for all variables.

These water quality problems are also found to be significantly associated with the village geographic characteristics at α = 0.017, 0.023, and 0.005 respectively. This results in reasonable given that water quality itself is very sensitive to a wide range of factor, for example, characteristics of the water source (open water, groundwater, or rainwater) and the condition of surrounding environment such as present of waste, runoff, geochemistry of the area and so on. The strong association between household's perception on water quality parameters such as taste, color and present of the heavy material with geographic location can be explained by the present of heavy metal, especially arsenic, which concentrated in the area along the Mekong river.

3.5 Perception of Drought Impacts

Similar to experience on flood, the surveyed households expressed different experiences of drought. There is no clear pattern on the perception of drought frequency and duration (Fig.17). These results support NCSD/MoE (2020)'s findings which stated that "different social groups experience climate vulnerability differently; women, children, the disabled, the elderly and other socially marginalized groups often feel the impacts of climate change disproportionately"8.

The chi-square association test indicates that the perception of the household on drought duration and frequency are correlated with village geographical characteristic. These associations are significant at α = 0.000, and Phi and Cramer's V greater than 0.15 for both variable. These results reflect the different type of hazards experience by household's who reside in different geographic location of the study site, particularly people who live in Kampong Speu and Prey Veng province may perceive more drought than others (see section 2.1).

No significant association between household's perception on drought frequency and duration and type of income source was found. This unexpected finding is likely to be resulting from the fact that regardless of what is their main income source, the surveyed households are exposed to similar level of drought (typically described by the amount of rainfall and temperature). Unlike flood impact which with vary from place to event at village level, the impact of drought is more widespread at regional level.

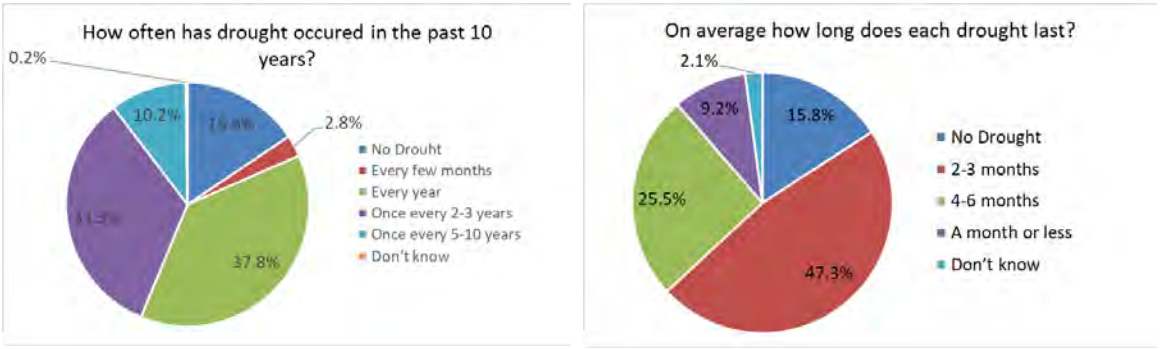


Fig. 17. Household's Experience of Flood Frequency and Duration

Access to water is the main impact of drought that is of concern for the surveyed households. Other impacts of drought raised by surveyed household include loss of income, increase cost of food and basic amenities, loss of crop yield, loss of farming capacity, loss of livestock, loss of fishing capacity, and cannot access and use water. The proportions of the households that reported they have encountered these problems most of the time during drought period are 36.4%, 35.5%, 32.2%, 24.6%, 20.8%, 6.1% and 5.7% respectively. The actions that taken by surveyed household to cope with drought includes take on different jobs, migrate to another area, buy bottled water and rely on support from government and others (Fig. 18).

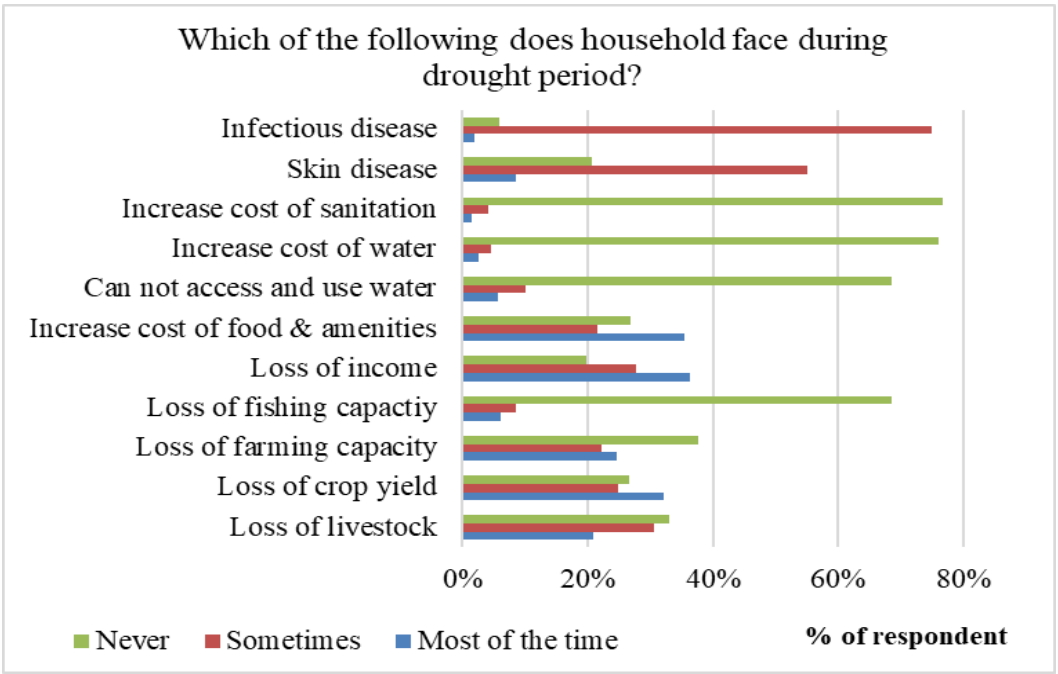


Fig 17: Household perception of drought impacts and response

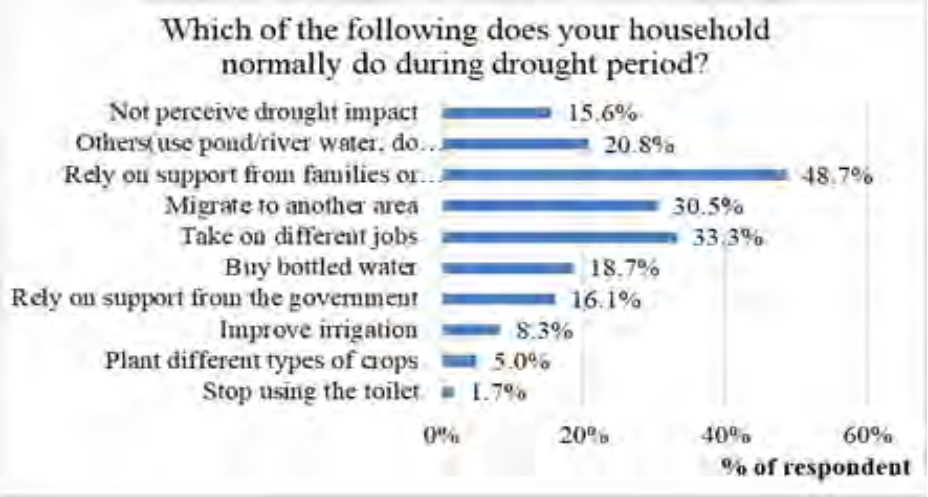


Fig 18. Coping responses to drought

The perception of impact of drought as well as their coping measure is very likely to associate with village geographical characteristic and household economic status including income source, income level and household characteristics such as presence of GESI members in the household. As indicated in Table 6, geographical characteristics (Q60) seem to have significant impact on the household's perception on impact of drought on their financial loss such as loss of livestock (Q47-1), loss of crop yield (Q47-2), and loss of farming capacity (Q4703) at α=0.000 and Phi and Cramer's V greater than 0.15 for all variables. This finding is likely due to the fact that household's main source of income varies according geographical location and also sensitive to climate hazards.

Table 6 also indicates that household's perceive financial problem such as loss of livestock (Q47-1), loss of crop yield (Q47-2), and loss of farming capacity (Q4703) are significantly associated with poor status (Q64) at α = 0.010, 0.002, and 0.09 respectively. However, the association might not be strong as Phi and Cramer's V value are less than 0.15 for all variables. There is also a weak association between the presence of GESI member with household perception of drought impact on their loss of income (α=0.034, Phi = 0.15, Cramer's V = 0.11)

There is a strong and significant association between household's income level and household's perception of drought impact on their financial loss such as loss of livestock, and loss of income source (Q47-2 at α = 0.016, 0.002. Similarly, income source is also to be significantly associated with household's perception of drought impacts on their financial loss of crop yield, and loss of farming capacity at α = 0.017 and 0.024, respectively. Phi and Cramer's V values are greater than 0.15 for all cases, indicating a strong association among variables (Table 6). This result is consistent with the study conducted by McIver (2014) which found that household's perception of climate impacts is associated with their economic background, particularly households who engages more in sector that directly rely on natural resource are more sensitive to climate change impacts then others.

	Chi-squares tests		Symmetric Measure	
	Pearson Chi-square	Asymptotic Significant	Phi	Cramer's V
Q47-1-Q60	81.728	0.000	0.440	0.311
Q47-2-Q60	69.656	0.000	0.406	0.287
Q47-3-Q60	55.860	0.000	0.363	0.257
Q47-1-Q64	13.392	0.010	0.178	0.128
Q47-2-Q64	17.087	0.002	0.201	0.12
Q47-3-Q64	13.420	0.009	0.178	0.126
Q47-3-Q65	10.412	0.034	0.157	0.111
Q47-2-Q68	32.990	0.017	0.279	0.197
Q47-3-Q68	31.694	0.024	0.274	0.194
Q47-1-Q69	30.436	0.016	0.268	0.190
Q47-2-Q69	37.389	0.002	0.297	0.210

Q47-1- Loss of livestock
Q47-2- Loss of crop yield
Q47-3-Loss of farming capacity
Q64- Economic status of HH
Q65-GESI status of HH
Q68-Main source of income?
Q69-Monthly income in Cambodian Riels

Table 6: Association between financial loss and geographical characteristics of the village HH type, and

Table 7 indicates the association between household's access and use of water during drought with geographic location and income level. These findings are reasonable given that access to and use of water among rural community is strongly affect by water sources which closely related with geographical location; and income level which commonly a typical factor affecting household's capacity to adapt or cropping with climate impact. For instant, household who has good economic status are able to buy more water storage to reserve water for dry seasons uses while poor household doesn't have such a capacity.

	Chi-squares tests		Symmetric Measure	
	Pearson Chi-square	Asymptotic Significant	Phi	Cramer's V
Q47-7-Q60	65.032	0.000	0.392	0.277
Q47-7-Q69	28.965	0.024	0.262	0.185

Q47-7- Cannot access and use water
Q60- Geographical location
Q69- Household monthly income in Cambodian Riels

Table 7: Association between household's access and use of water during drought with geographical location and income level

3.6 Climate Change Adaptation

Climate change adaptation options that households are mostly aware of are government provision of social and health services (27.1%), raised roads and raised household areas (20.09%), rainwater harvesting system (18.67%), community-managed bottled water (18.43%), community managed water supply system (15.60%) and provision of climate resilient latrines (14. 18%) (Fig 18).

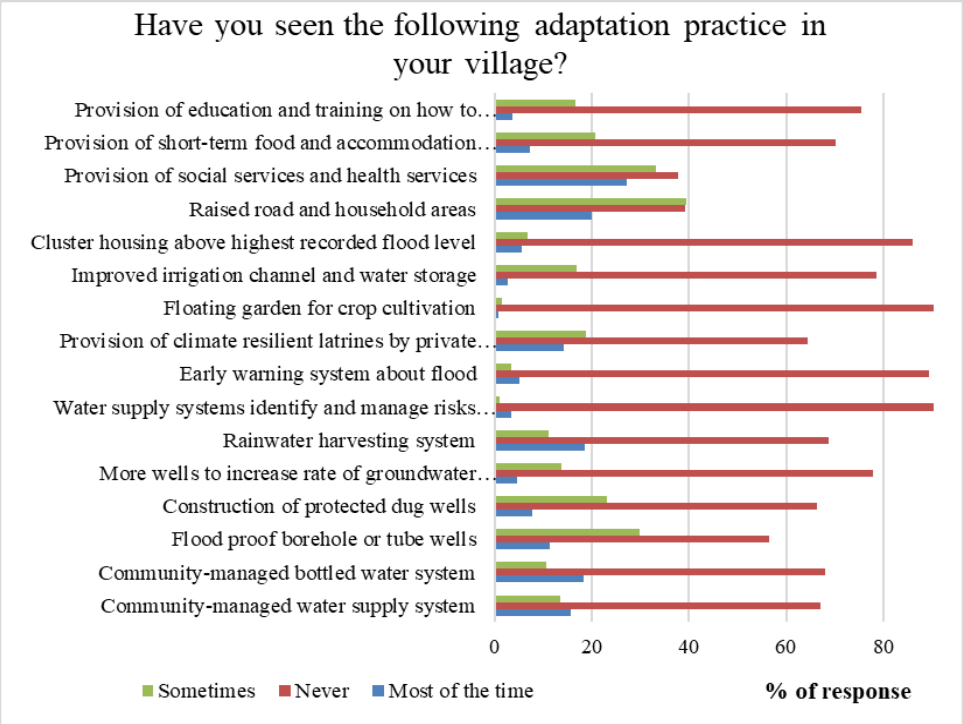


Fig. 18: Household awareness of climate change adaptation options

The adaption option that are most taken up by the surveyed households include construction of wells or harvesting rainwater, elevate ground level, elevate encloser for livestock and increase household's food stock (Figure 19). The % of respondent mentioned they have taken these adaptation options for most of the times are 20.9%, 10.87%, 8.03%, 7.80% respectively.

Awareness of the survey household on climate change adaptation option is very likely to associate with village geographical characteristics. The association between awareness on the type of adaptation such as community-managed water supply system, community-managed bottled water system, rainwater harvesting system, raised road and household areas, and provision of social services and health service with geographical characteristic of the village are strongly significant at α smaller than 0.05, and Phi and Cramer' V greater than 0.15 for all variables.

Similarly, household's choice on adaptation options such as strengthen dwelling, elevate ground, construct well or rainwater harvesting, and increase food stock also have a strong and significant association with village geographical characteristics at α less than 0.05 and Phi and Cramer's V greater than 0.15 for all variables. This finding suggests that how the community choose to response to climate change impact is strongly associate with how they are expose to climate hazard, which is strongly associated with geographical location factors.

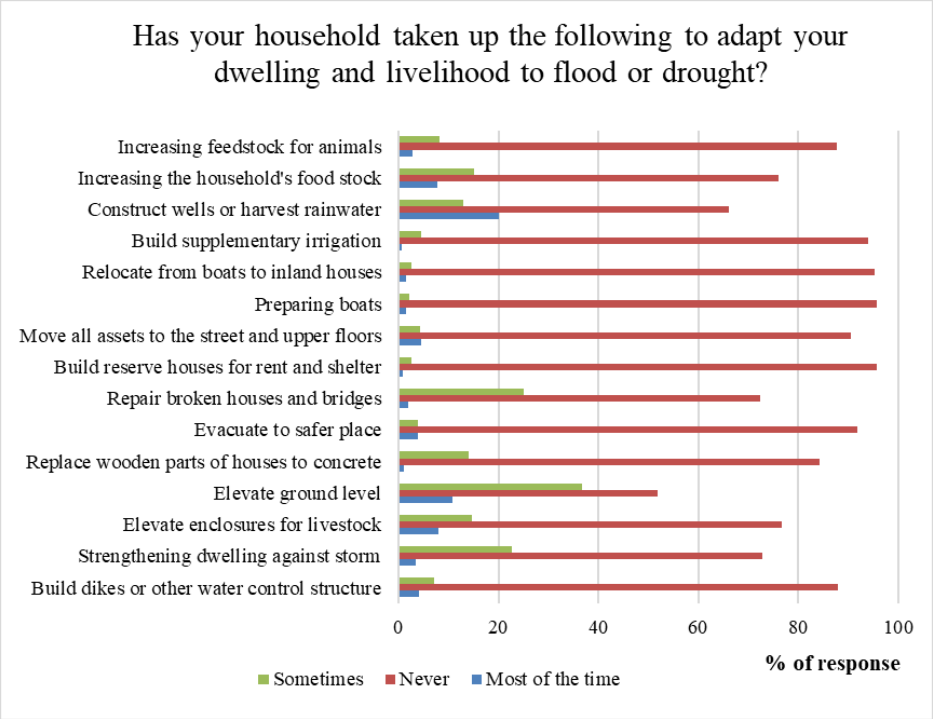


Fig. 19: Adaptation option taken up by surveyed households

Taking adaptation option is very likely to associate with village category, main source of income and income level, particularly for community-managed bottled water system, rainwater harvesting system, strengthening dwell against storm at $\alpha = 0.011$, 0.048, and 0.005 respectively. There are also significant association between income level and the with their awareness of climate change adaptation option such as flood proof bore hole or tube well, rainwater harvesting, provision of climate resilient latrines by private sector, raised road and household areas, provision of social services and health services, as well as household's choice of adaptation such as construct wells or harvest rainwater. These association are strongly significant at α smaller than 0.05 and Phi and Cramer' V greater that 0.15 for all cases. According to these results, the awareness of climate change adaptation is most likely to governmental by both the household income source, and income level.

Most common actions that surveyed households wish to do to help their family adapt to flood, drought and other climate related hazards are evacuation site reservation, improve access to clean water, upgrade house to be more resilient, increase food stock, and improve access to sanitation (latrine), which account for 52.5%, 17%, 7.3%, 5.4%, and 4.5% respectively.

At least 17% and 12.8% of the households mentioned that they have no intention to build latrine and connect to pipe water that can adapt to flood or other climate related hazards respectively (Fig. 20a & b). Of these households, 60% reported lack of financial resource as the main reason (Fig. 20c).

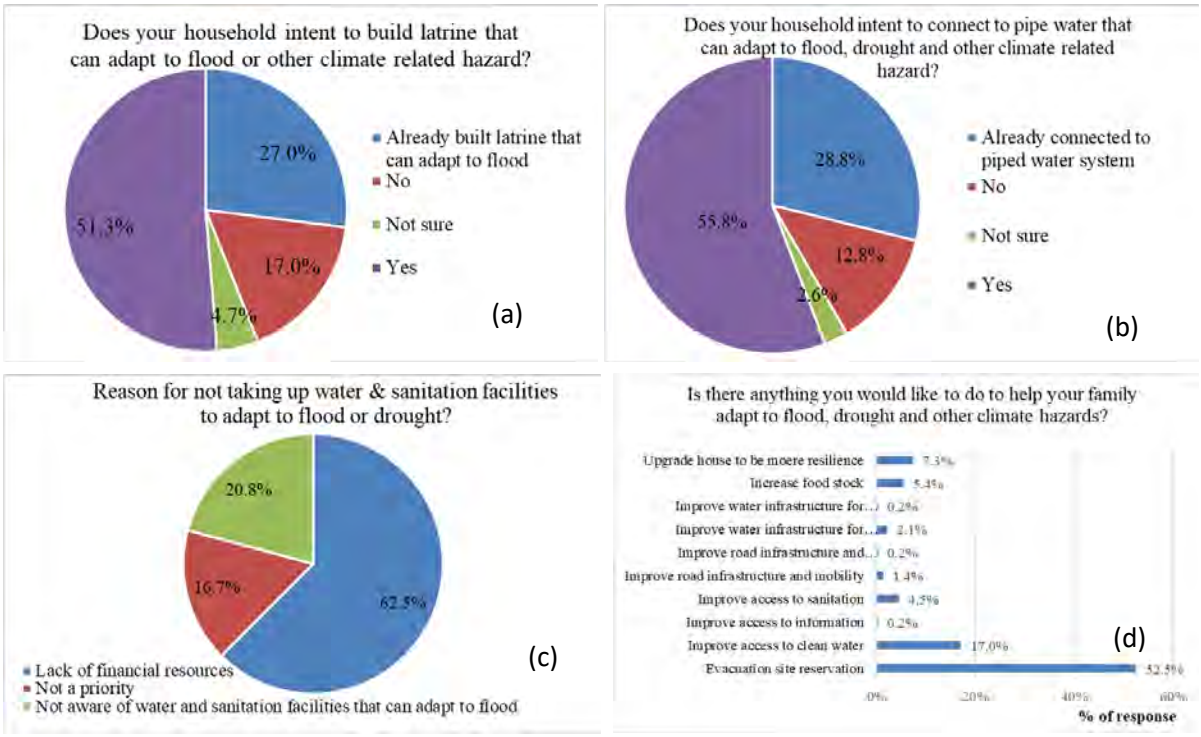


Fig. 20: (a) Household's intention to build resilient latrine, (b) household's intention to connect with resilient pipe water, (c) Reason for household not taking up water & sanitation facilities that can adapt to flood or drought, (d) actions that surveyed household wish to do to help their family to adapt to flood, drought and other climate related hazards.

About 61.9% of the respondent mentioned that they had never attended any education education/awareness raising program about adaptation to flood, drought, or other climate hazard, while 88.4% of the surveyed household expressed that they are willing to learn more about how to adapt to flood, drought or other climate hazard if there is any opportunity available (Fig. 21a&b).

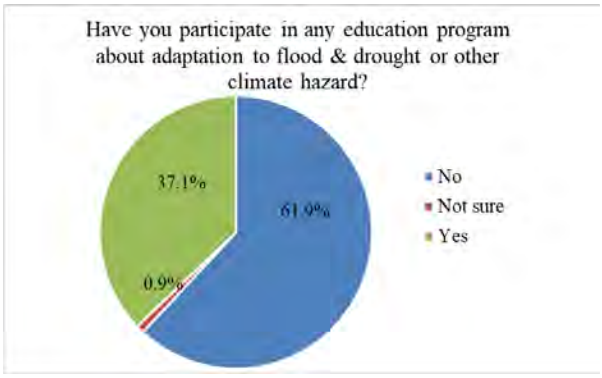


Fig. 21a. Attend education on climate change

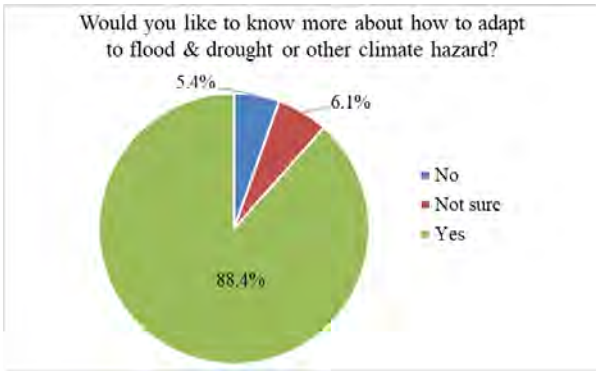


Fig .21b. Learn more about adaptation

There is a strong association between how surveyed household want to do to help their family adapt to flood, drought or other climate related event with their participation in related education program, village geographical characteristic, household poor status and household income level (Table 9). These associations are strongly and significantly at α smaller than 0.05 and Phi and Cramer's V greater than 0.15 for all cases.

	Chi-squares tests		Symmetric Measure	
	Pearson Chi-square	Asymptotic Significant	Phi	Cramer's V
Q55-Q57	46.885	0.001	0.333	0.235
Q55-Q60	102.513	0.001	0.492	0.201
Q55-Q64	64.025	0.000	0.389	0.275
Q55-Q69	98.173	0.015	0.482	0.182

Q55- Helping your household adapt
Q57-Participation any education program about adaptation
Q60-Geographical characteristics of village
Q64-Economic status
Q69-Monthly income in Cambodian Riels

Table 9: Association between how the surveyed household like to do to help their family adapt to flood or drought with other factors

The surveyed household would request the government to provide support such as financial support to improve pipe water supply capacity in the village (13.7%), road construction and improvement (10.64%), construction and improvement of irrigation and flood control infrastructure (8.27%), provide food and amenities during flood, drought and disaster period (10.17%), improve latrine facility (7.33%), construct well (3.78%), provide crop variety (3. 78%), provide better market for rice product (1.13%), provide ID poor (1.18%), Provide electricity (1.18%) and others such as raise ground level, provide water storage, construct hospital and school, provide boat, provide fertilizer and strengthen social security, with a small % of respondents.

3.7 Regression Analysis

The multinomial logistic regression analysis was conducted to confirm the relationship, particularly, between household's characteristics and access to water and sanitation, perception and response to climate change as well as awareness of climate change adaptation, which were identified by the Chi-square association tests. Household's characteristics were divided into three categories: (1) economic factor which includes type of income, income level, ID poor ownership, and present of GESI member in the household, (2) individual factor including age group, gender, and duration of residency in the village, and (3) geographical factor with represent by village category. These factors were used as explanatory variables to predict access to water and latrine, experience or perception of climate variation and impacts of flood, drought, or other climate related hazards, as well as awareness and choice of adaptations to flood, drought and other climate related hazards.

3.7.1 Influence of Economic Factor

The results of the multinomial regression tests in Table 10 indicates that household's economic situation such as poor status, present of GESI member, type of income source, and income level can have very strong influence on:

- Household's experience of financial and health concerns during flood and drought.
- Household's choice to cope with flood and drought impacts, particularly what they would do ensure safe drinking water during flood and what action they would take to during drought period.
- Household's awareness of adaptation option that are being practiced locally.
- Household's intention to build resilient latrine and connect with resilient water supply system.

	Model Fitting Information				Goodness-of-Fit	
Dependent variable	AIC	BIC	-2 log Likelihood	p-value	Pearson Chi-square	p-value
Loss of crop yield	691.994	752.052	661.994	0.001	525.176	0.707
Insect bites	622.388	682.447	592.388	0.032	491.253	0.945
Treatment of water	986.737	1146.892	906.737	0.000	1250.428	1.000
Loss of livestock	523.784	562.533	503.784	0.003	345.306	0.351
Loss of crop yield	551.589	609.713	521.589	0.000	410.997	0.999
Loss of farming capacity	502.475	541.225	482.475	0.000	316.103	0.776
Coping response to drought	1241.873	1435.900	1141.873	0.000	1734.365	0.221
Community-managed water supply system	551.797	612.472	521.797	0.034	538.317	0.747
Flood proof borehole or tube wells	580.321	640.996	550.321	0.022	561.140	0.490
Rainwater harvesting system	528.515	589.190	498.515	0.002	587.424	0.213
Resilient latrines	580.571	641.246	550.571	0.028	554.420	0.570
Elevated road and household areas	645.113	705.789	615.113	0.015	499.632	0.970
Social services and health services	672.663	733.338	642.663	0.043	543.061	0.699
Strengthening dwelling	432.688	493.363	402.688	0.001	391.394	1.000
Elevate ground level	575.481	636.156	545.481	0.015	451.666	1.000
Intend to build resilient latrine	672.948	733.623	642.948	0.015	587.103	0.216
Intend to connect to piped water	611.675	672.350	581.675	0.008	544.545	0.683

Table 10. Influence of household's economic factors on their experience and perception of flood, drought and other climate related hazards

3.7.2 Influence of Individual Factor

According to the results of the multinomial regression shown in Table 13, Household's personal experience including level of education, gender, and the duration of residency in the village can strongly influence on:

- Household's choice to cope with flood and drought impacts, particularly what they would do ensure safe drinking water during flood and what action they would take to during drought period.
- Household's awareness of adaptation option that are being practiced locally.
- Household's intention to build resilient latrine and connect with resilient water supply system.

	Model Fitting Information				Goodness-of-Fit	
Dependent variable	AIC	BIC	-2 log Likelihood	p-value	Pearson Chi-square	p-value
Treatment of water	318.864	446.910	254.864	0.045	123.933	0.996
Coping responses to drought	397.807	553.028	317.807	0.001	162.287	0.824
Flood proof borehole or tube wells	174.184	222.696	150.184	0.004	72.172	0.201
Resilient latrines	167.607	216.118	143.607	0.000	80.675	0.066
Social services and health services	169.518	218.030	145.518	0.022	70.964	0.230
Intend to build resilient latrine	161.228	209.740	137.228	0.000	59.457	0.603
Intend to connect to piped water	147.690	196.202	123.690	0.002	57.782	0.662

Table 11. Influence of individual factor on household experience and awareness of adaptation practices

3.7.3 Influence of geographical factor

Similar to the economic and individual factors, geographical factor also significantly influences household's experiences of flood and drought impacts and awareness of adaptation practices in the villages. But, it has no influence on household's intention to build resilient latrine or connect to resilience water supply (Table 12).

	Model Fitting Information				Goodness-of-Fit	
Dependent variable	AIC	BIC	-2 log Likelihood	p-value	Pearson Chi-square	p-value
Cannot go to work	106.518	130.556	94.518	0.046	38.992	0.001
Increased cost of food and basic amenities	114.742	138.780	102.742	0.039	41.976	0.000
Insect bites	123.930	147.968	111.930	0.002	54.746	0.000
Treatment of water	986.737	1146.892	906.737	0.000	1250.428	1.000
Coping responses to drought	254.910	332.577	214.910	0.007	82.179	0.003
Community-managed water supply system	91.145	115.429	79.145	0.003	28.507	0.019
Resilient larine	85.172	109.456	73.172	0.013	22.906	0.086
Raised roads and household areas	112.303	136.588	100.303	0.004	45.761	0.000
Social services and health services	75.552	99.836	63.552	0.009	20.602	0.150
Elevate ground level	75.552	99.836	63.552	0.009	14.914	0.458
Repair broken houses and bridges	65.207	89.491	53.207	0.004	15.744	0.399

Table 12. Influence of household's personal experience on their experience and perception of flood, drought and other climate related hazards

3.7 Regression Analysis

The exploratory factor analysis was conducted on all the questions that related to experience or perception of the impact of flood and drought, awareness of climate change adaptation options being practiced in the villages and household's characteristics such as income source, income level, education level and so on, to further explore the underlying relationship pattern among those variables.

The distribution of variance contributing for each factor is very disperse and relatively small. The total variance explained by the first 10 factors is only about 48.7 % of the total data variance. However, the KMO measure of sampling adequacy is 0.752 and the Barlette's test is significant at alpha=0.000, indicating that the data set is satisfied for the analysis. A summary of the factor analysis indicate:

- An underlying relationship pattern between households' experience of the flood and drought with their awareness and choice of adaptations and the household economic status.
- Income source seems to affect household's perception of flood and drought impacts but does not affect their response or adaptation choice, while the income level is like to influence both.
- Geographic variable seems to influence on household's experience of flood and drought rather than their awareness and choice of adaptations.
- These results agree with the regression analysis results that household's perception on the impact of flood, drought and other climate related hazards, as well as their awareness and choice of adaptation option is very likely to be influence by household's economic status and village geographical characteristics.

4. Local Authority Survey Results

4.1 Respondent Characteristics

- The respondent consists of village head, commune heads, commune council member, officer of provincial department of rural department/ district office. Out of the total respondent only 21.9% are female.
- All respondents have resided in their village more than 7 years.
- Similar to the response from the households, most of the participated authority claimed that their villages are either flood affected, or drought affected. Some authority also mentioned that their village is affected by multiple impacts.
- 93.8 % of the participating authority mentioned that main source of income of the villager is farming.

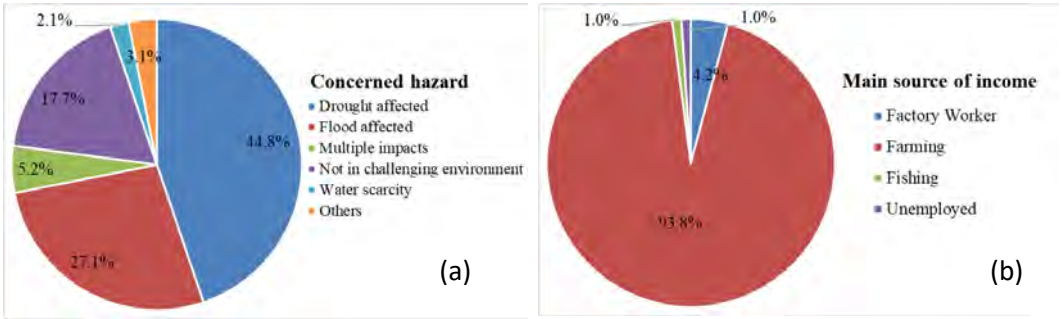


Fig. 22: (a) Village category mentioned by the authority, (b) Main income source of the villager mentioned by the authority

4.2 Access to Water and Sanitation

4.2.1 Access to Water

- The main sources of drinking water are tube well or borehole, follow by pipe water outside of the household dwelling, bottled water. There is no significant difference in term of source of drinking water during normal day, flood period and drought period, except for stored rainwater that is used significantly during flood period but less used in drought period (Fig.23a). This result is also similar to the household surveyed responses.

- Regarding the availability of water, 78.1% of the authority mentioned that water is always available from the main source, 7.3% mentioned that water in available most of the time, 14.6 % said water is available for some time, and none of the authority mentioned that water is not available. This respond pattern is like the household's response, except that some small percentage of the household mentioned that water is not available.

- In term of water quality, 77.1% of the authority mentioned that water quality is usually acceptable for basic consumption, while 20.8% mentioned that it is not usually acceptable. The season that the water quality is not acceptable is water contain materials (7.3%), unacceptable smell (9.4%), unacceptable color (9.4%), unacceptable taste (8.3%), others i.e., hardness (8.3%). This finding is similar to results of household survey.

- According to the surveyed authorities, the most common method for villagers to treat their drinking water is boiling. During normal day 1% of the surveyed authority mentioned that the villagers do not treat their drinking water while during flood period 18.8% of the authority mentioned that households does not treat their drinking water. There is significant pattern between normal day and during flood period, which is similar to the household survey results, almost 80% of the surveyed authority mentioned that they don't perceive water quality problem during normal day, while only about 8% of theme mentioned that they don't perceive water quality problem during flood period (Fig. 24)

- Water availability and water quality seem to have a strong correlation with source of water as indicated by the result of chi-square association test. Source of water is strongly and significantly associated with water availability and water quality at $\alpha = 0.007$ and 0.001 respectively, while Phi and Cramer' V for both variables are greater than 0.15. This result has the same pattern as finding from household's survey which also shows a strong association between water availability and quality with source of water. This could be because the survey location is disperse in terms of geographical and environmental conditions which are the natural factor that affect water availability and quality.

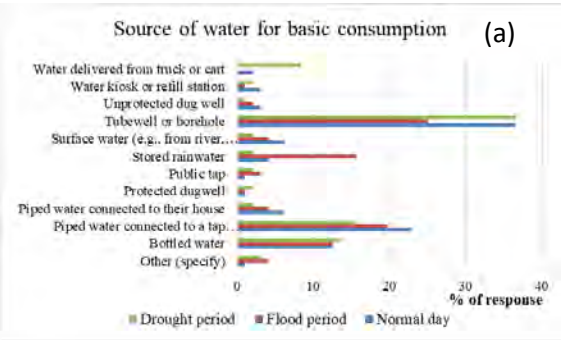


Fig. 23a: Source of Water

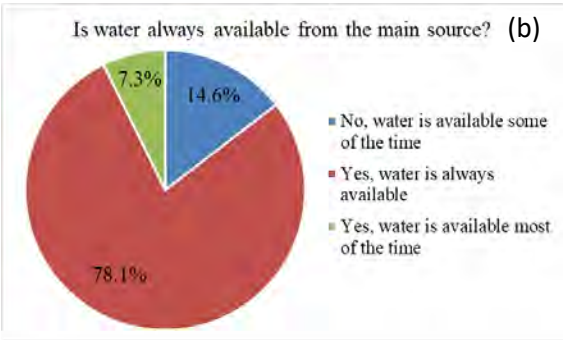
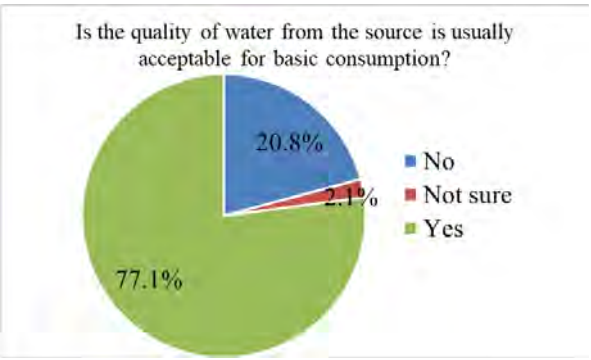


Fig. 23b: Water Availability



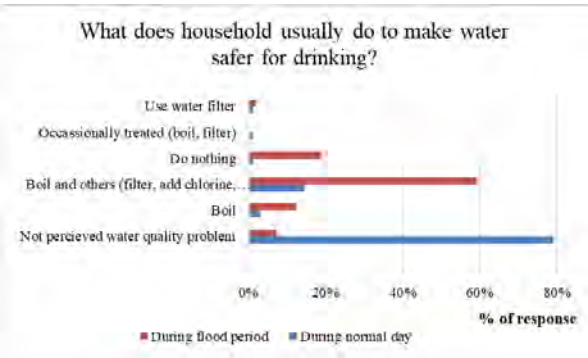
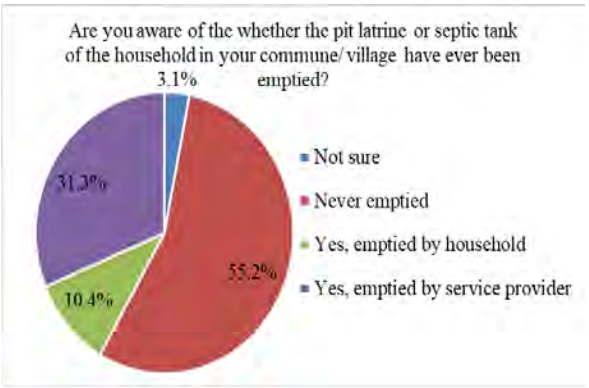


Fig. 24: Water quality and drinking water treatment practice

4.2.2 Access to Sanitation and Hygiene Practice

According to the surveyed authority, toilet facility is located in the household's yard/plot but outside of the household's dwelling.

85.4% of the authority mentioned that typical type of toilet facility using by the villager is pure flush/ flush to pit latrine, while 8.3% and 3.1% mentioned that pit latrine and twin pit latrine with slab is common toilet type in their village respectively. At least 3.1% of the authority mentioned that there are household in their village who does not have their own toilet facility.



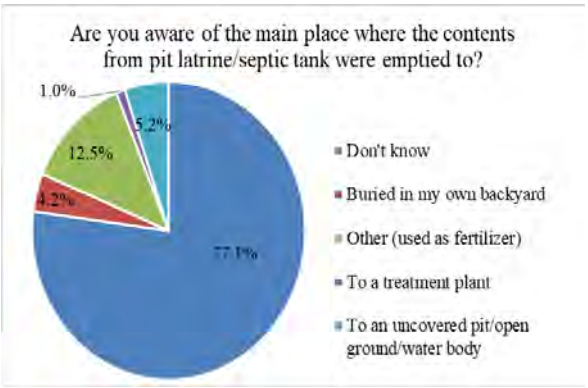


Fig. 25: Awareness of pit latrine problem in the village

31.3% of the surveyed authority mentioned that they are aware that households in their village had their pit latrine emptied by private service provider, while 10.4% mentioned that household emptied their pit latrine by themselves

77.1% of the authority mentioned that they have no idea where the toilet content is emptied to, and 5.2% mentioned that the toilet content is emptied to uncover pit/open ground or water body (Fig. 25). According to Neth et al., (2017), due to the limitation of pit emptying service, mainly provided by the department of public work and transport which covers only downtown area, the measures that households usually take include (1) manually emptying pits by themselves or laborers, (2) adding more rings once the pit is full or connecting overflow to drainage instead of emptying pits, and (3) using disposal service. The effluence then sent to the farm for fertilizer, open space or water body.

4.3 Perception of Climate Change Impacts

4.3.1 Climate Hazards

Drought is the most common climate hazard perceived by the respondent, follow by intense rain, storm, temperature increase and flood. These hazards are also perceived by most of the respondents as become more intense and more frequent during the past 10 years. Similarly, most of the respondent are more concerned about drought and storm rather than flood and other events (Fig.26). This finding is comparable the results of household survey which show the same response pattern.

Common variation in wet and dry season patterns observed by the respondents during the last 10 years include change in rainfall pattern to become less predictable (91.7%), change in timing of wet and dry season (64.6%) and warmer dry period (63.5%).

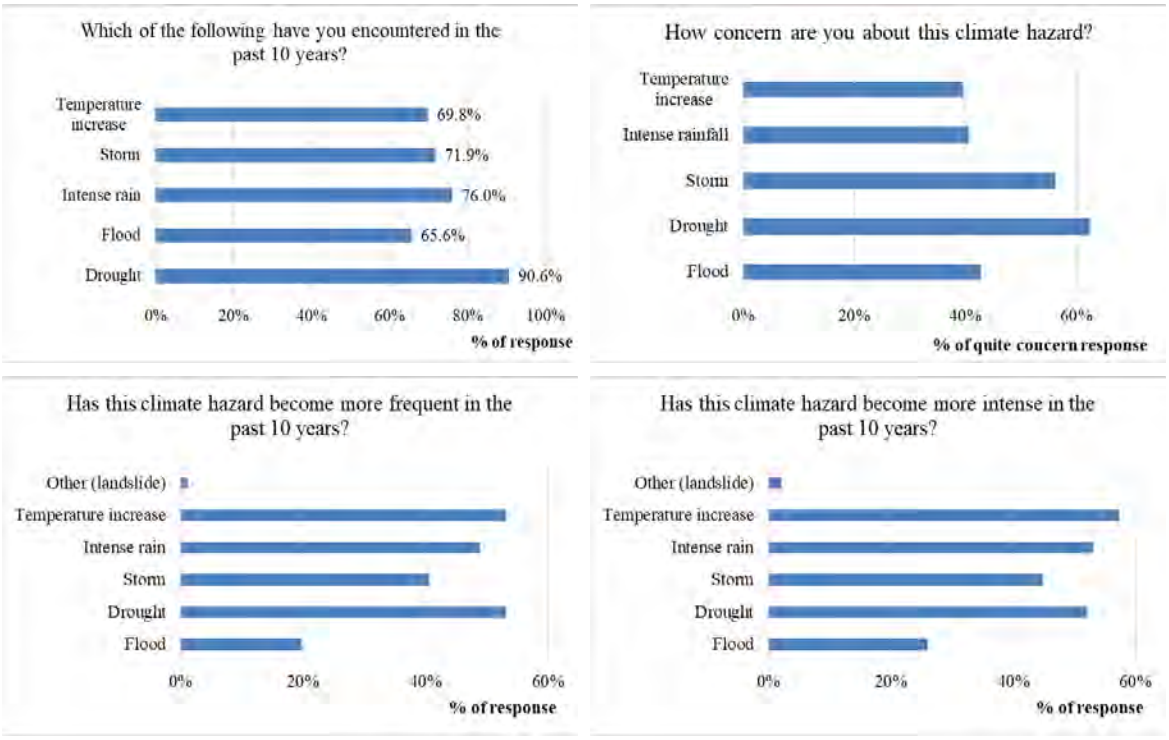


Fig. 26: Perception of Climate Variations

The perception of the respondents on the frequency and duration of flood and drought events varies significantly (Fig. 27). These variations seem to have no association with other factors such as village geographical characteristic and source of income as found in the household surveyed.

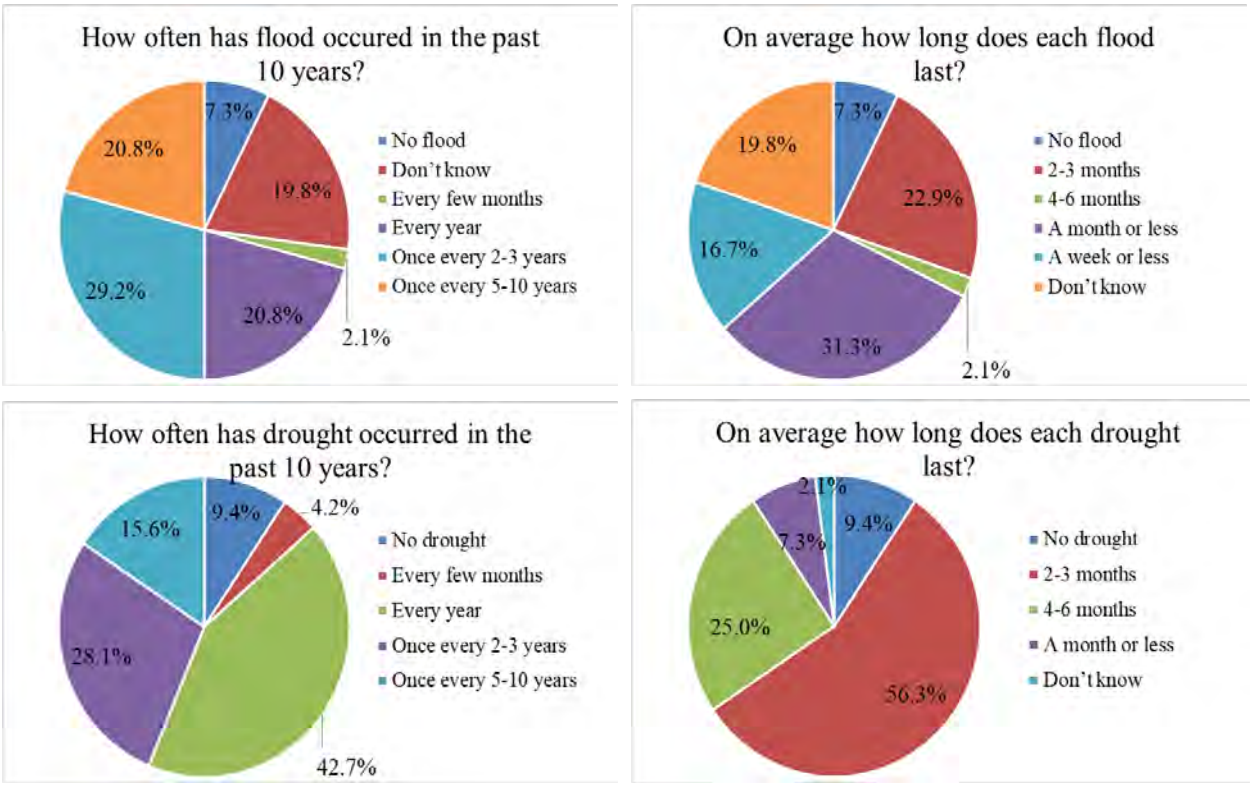


Fig. 27: Perception of Flood Events

4.3.2 Impact of Floods

Similar to the result of household's survey, flood impacts on the community in many ways including transport and mobility, health, and financial concerns. As shown in Figure 28 , the most common transport and mobility impacts causing by flood are difficulty to transport for daily activities, cannot access to health facility, can not access the market, can not access school and can not go to work. On the other hand, Most common financial problem facing by villager during flood period are loss of income, loss of crop yield, and increase cost of food and basic amenity. Typical solutions for household to cope with this financial problem are taking non-farming job, rear livestock or cultivate vegetable, migrate to other areas, rely on support form the government, and plan more drought resistant crops (Fig. 28).

Most common health concerned during flood are flu or cold (19.8%), followed by skin disease (9.4%) and infectious disease (7.3%) .

Flood also impact on water quality as some of respondents mentioned that their water color, smell and taste become worse during flood. In addition, some respondents also mentioned that there is presence of contaminated material in the water source during flood season.

Typical impact of flood on toilet facility are causing the toilet to become clogged or unable to flush, causing overflow of waste, and waste leakage. At least 13.5% of the respondent mentioned that the households practice open defecation (directly into water or rice field) during flood period when they cannot use their toilet facility (Fig. 29). This results is similar to finding of from the household survey results.

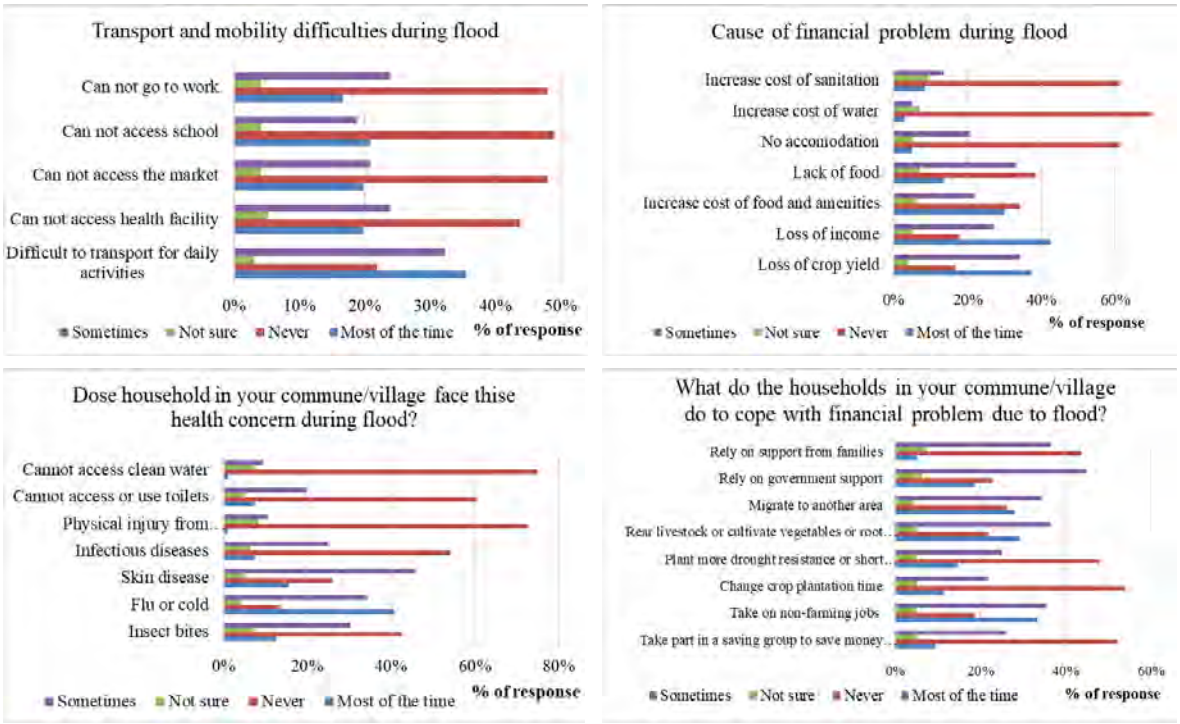


Fig. 28: Impacts of flood on transport and mobility, health concern, financial problems, and solution

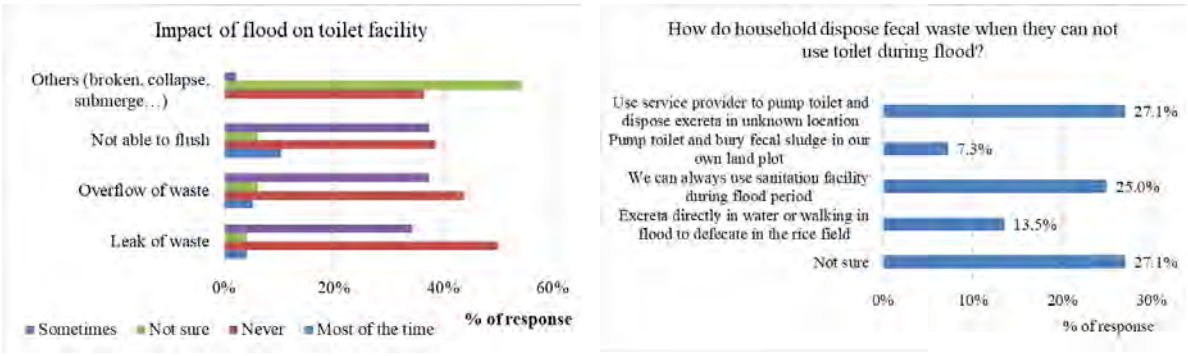
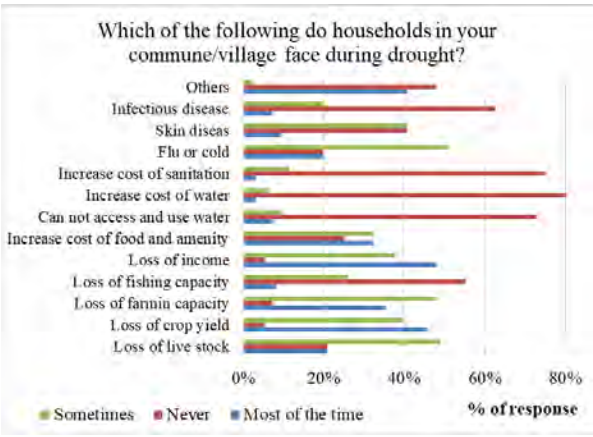


Fig. 29: Impacts of flood on toilet facility and fecal disposal practiced by household during flood

4.3.3 Impacts of Drought

The local authorities perceive common impacts of drought facing by villagers to be loss of income (47.9%), loss of crop yield (45.5%), loss of farming capacity (35.4%), loss of livestock (20.8%), and health concerns such as flu or cold (19.8%), while common solutions to cope with this drought impacts are take on different jobs (54.2%), migrate to other area (59.4%), rely on support from government (61.5%), improve irrigation system (30.2%), plan different type of crop (27.1%) and buy bottled water (39.6%) (Fig. 30).



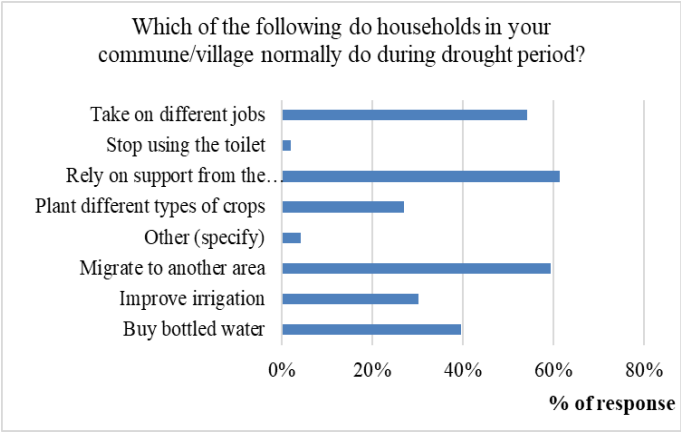


Fig. 30: Impacts of drought on facing by household and their response as reported by the surveyed authority

Table 13 indicate the association between the impact of drought on financial loss due to factors such as loss of livestock, loss of crop yield, loss of farming capacity, and loss of income with geographical characteristics of the village. These association are strongly significant with α value less than 0.05 and Phi and Cramer' V value greater than 0.15 for all cases. This result has the same pattern with the result of household survey.

	Chi-squares tests		Symmetric Measure	
	Pearson Chi-square	Asymptotic Significant	Phi	Cramer's V
Q60-Q47-1	20.976	0.021	0.467	0.331
Q60-Q47-2	20.337	0.028	0.460	0.325
Q60-Q47-3	26.375	0.003	0.524	0.371
Q60-Q47-4	21.425	0.018	0.472	0.334
Q60-Q47-5	20.583	0.024	0.463	0.327

Q47-1-Loss of livestock
Q47-2- Loss of crop yield
Q47-3-Loss of farming capacity
Q47-4-Loss of fishing capacity
Q47-5-Loss of income
Q60-Geographical characteristics of village

Table 13. Association between drought impacts and village category

Table 14 indicate the association between the impact of drought on health such as cannot access and use water, increase cost of sanitation, Flu or cold, and skin disease with geographical characteristics of the village. These association are strongly significant with α value less than 0.05 and Phi and Cramer' V value greater than 0.15 for all cases. This result doesn't agree with the pattern found in household survey results which found no association between geographical location with drought impact on health, except of access and use water.

	Chi-squares tests		Symmetric Measure	
	Pearson Chi-square	Asymptotic Significant	Phi	Cramer's V
Q60-Q47-7	20.779	0.023	0.465	0.329
Q60-Q47-9	29.889	0.001	0.558	0.395
Q60-Q47-10	18.802	0.043	0.443	0.313
Q60-Q47-11	19.437	0.35	0.450	0.318

Q47-7-Cannot access and use water
Q47-9-Increased cost of sanitation
Q47-10-Flu or cold
Q47-11-Skin disease
Q60-Geographical characteristics of village

Table 14. Association between drought impacts on access health with village category

4.3.4 Climate Change Adaptation

Typical adaptation option observed by the authorities in their village are community manage water supply (24.0%), community-manage bottled water system (33.3%), rainwater harvesting system (28.1%), flood proof bored hold or tube well, provision of short-term food and accommodation (24.0%), provision of education/training how to adapt to flood or drought (19.8%), cluster housing above highest level of recorded flood (17.7%), improve irrigation channel and water storage (17.7%), and provision of resilient latrine by private service provider (20.8%) (Fig. 31). This result show quite a different pattern from the household survey results in which the surveyed households were only aware of a few adaptation practices such as provision of social and health services (27.1%), raised roads and raised household areas (20.09%), rainwater harvesting system (18.67%), community-managed bottled water (18.43%), community managed water supply system (15.60%) and provision of climate resilient latrines (14. 18%).

As shown in Fig 32, typical adaptation measures taken by the villagers to cope with the impact of flood, drought or other climate related events are elevate ground level (38.5%), elevate encloser for livestock (21.9%), strengthening dwelling against storm (19.8%), build dike or other water control structure (15.6%) , and replace wooden part of the house to concrete (17.7%), while the household survey result found that only construction of wells or harvesting rainwater (20.9%), elevate ground level (10.8%) , elevate encloser for livestock (8.03%) and increase household's food stock (7.80%) were reported by household as their adaptation practice.

About 49% and 58.3% of the surveyed authorities mentioned that household in their villages intend to build resilient latrine and connect to water supply system that can adapt to flood and drought, respectively (Fig. 33). Similar to household survey result, the main reason that make households decide not to build resilient latrine or connect to resilient water supply is lack of financial resource.

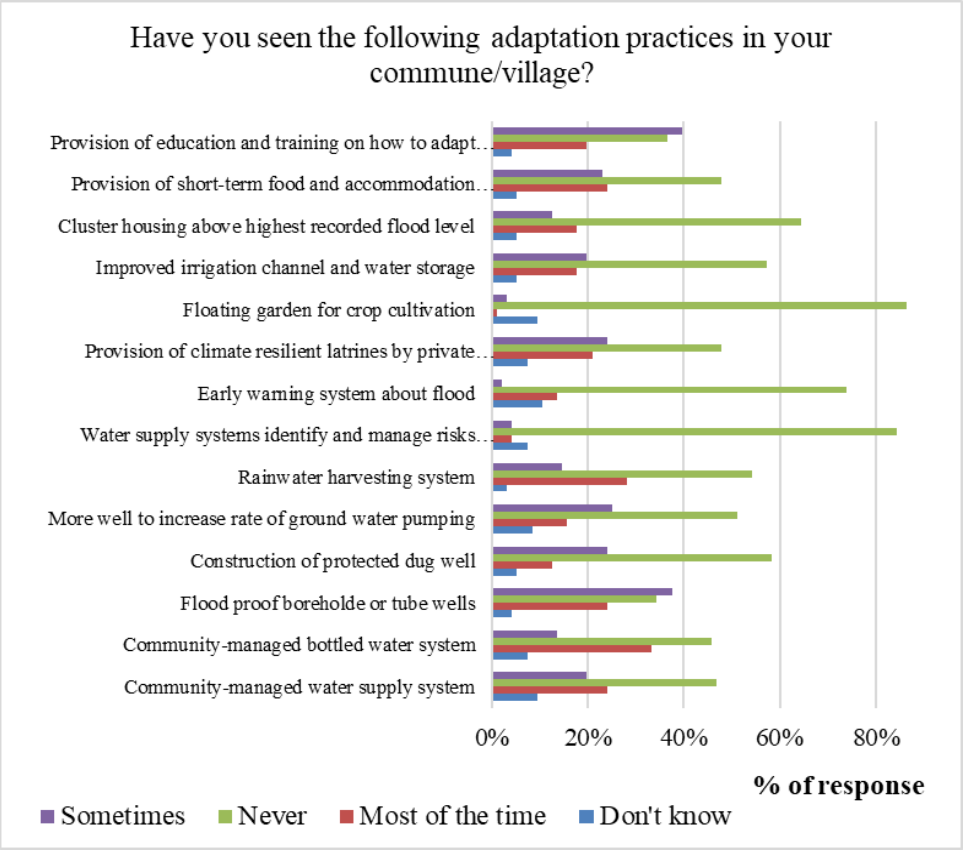


Fig. 31: Adaptation practices observed by the surveyed authorities

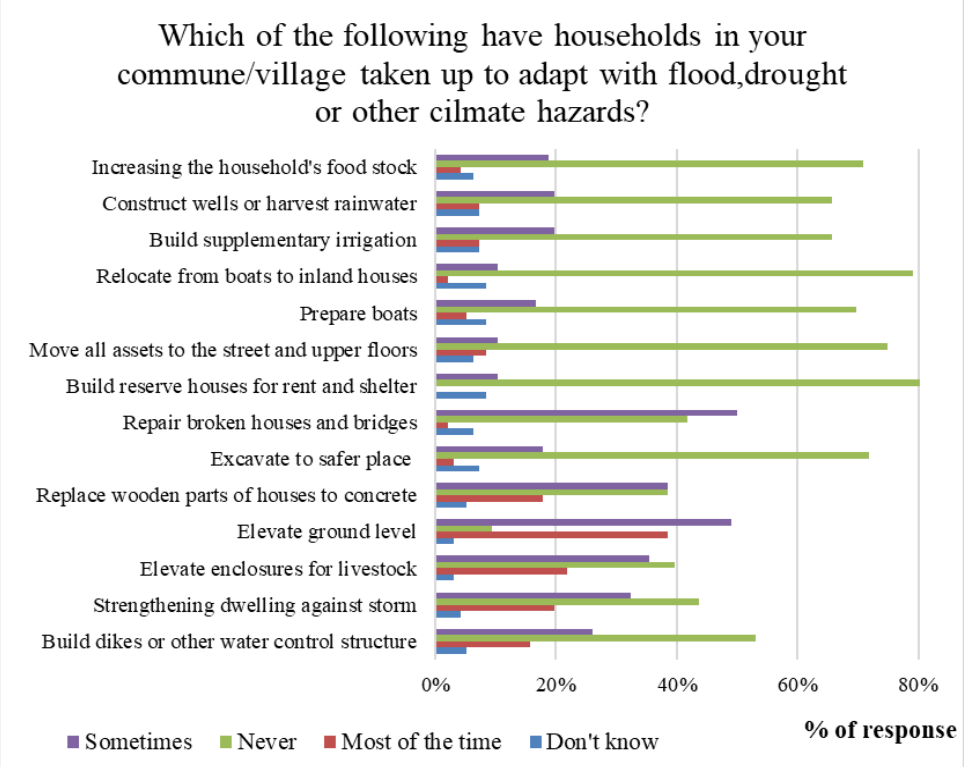
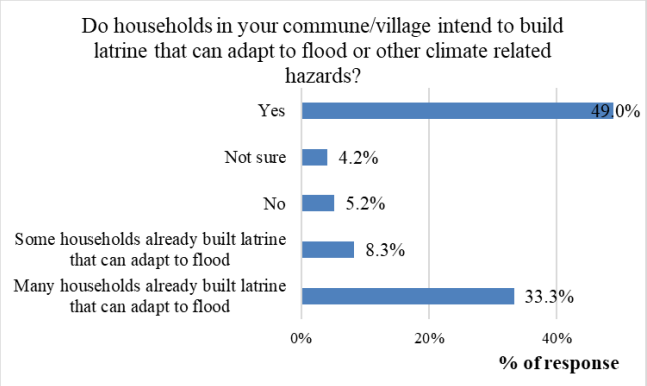


Fig. 32: Adaptation option taken by villager to cope with flood, drought or other climate related hazard



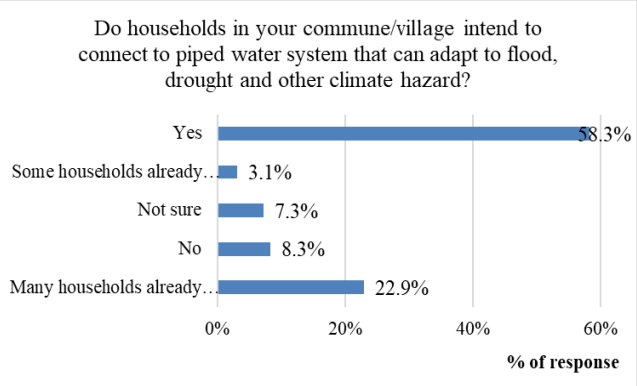
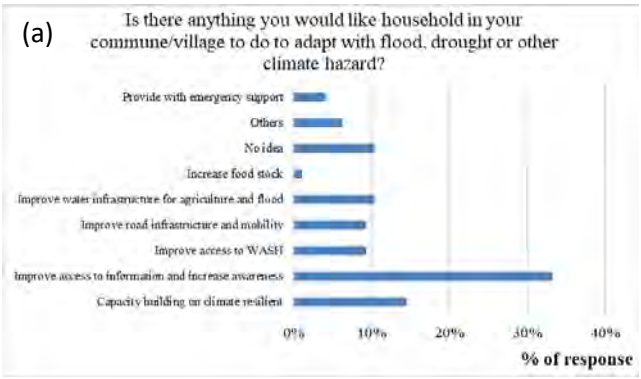


Fig. 33: Intention of villager to construct resilient latrine and connect to resilient water supply system

There is no significant association between the variables related to the awareness and choice of adaption with other variable, as found in the household survey results.

According to figure 34, adaption actions that the LAs would like the villagers to do include improve access to information and increase awareness (33.3%), capacity building on climate resilient (14.6%), improve water infrastructure for agriculture and flood control (10.4%), improve access to WASH (9.4%), improve road infrastructure (9.4%), and provide with emergency support (4.2%).

Typical adaptation options that the surveyed authority would like to do to help community better adapt to flood, drought and other climate related events are improve access to information and increase awareness of the community member (36.5%), improve infrastructure for agriculture and flood control (13.5%), improve road infrastructure and mobility (13.5%), improve access to WASH (9.4%), and provide emergency support (9.4%).



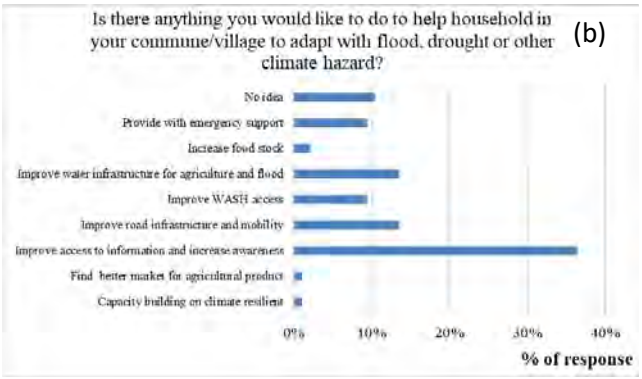


Fig. 34: Adaptation actions that the surveyed authority would like to take to help the community better adapt to flood, drought or other climate related hazards

Government supports which the surveyed authority would like to have include provide resilient infrastructure such as road, water storage and irrigation system (38.1%), increase awareness about climate change adaptation to villager (12.4%), provide emergency support during disaster 17.5%, improve access to WASH (11.3%), reduce price of fertilizer (3.1%), provide boat and pump during flood (2.1%) and provide latrine to poor household (1%). This results is more or less similar to the results of household survey, which indicate that most households would the government to provide more support on infrastructure development and improve access to clean water.

77.7% of the surveyed authority have attended training or received information about adaptation to flood and drought or other climate related hazards. 93% of them mentioned that they want to know more about how to adapt to flood and drought or other climate related hazards. This result is very different from the household survey result which indicate that only 37.1% of the households have ever attend training received information about adaptation to flood and drought or other climate related hazards and 88.4% of them expressed their interest to know more about how to adapt to flood and drought or other climate related hazards.

5. Limitations

Further analysis of differences or similarities between geographical characteristics will add more value to the research given climate change impact is strongly governed by geographical characteristics. A larger sample size will be necessary. These characteristics as reported in the survey are observations of the respondents, which could be compared with actual geographical data relating to climate or natural disasters. This would need further climate data for the surveyed areas to be collected at the village level.

Disaggregate analysis is quite important when studying human perception as perception is governed by extrinsic and intrinsic factors. However, due to the small sample size, interpretation of disaggregate analysis (i.e., age group, gender, personal experience) in this study is very limited.

6. Conclusion

The key findings of both surveys are summarised in response to the following questions:

What is the background and context of the surveyed households and local authorities?

- The majority of study locations are either flood affected, or drought affected.
- Main income sources of the majority of the household in the surveyed communities is farming. Other type of income source includes construction worker, factory worker, laborer, service provider, and small business. At least 21.75% of the surveyed households is unemployed.

What are the WASH situations of these surveyed households and communities?

- The main sources of drinking water are tube well or borehole, follow by stored rained water, pipe water outside of the household dwelling, bottled water, and surface water such as river, stream or lake. There is no significant difference in term of source of drinking water during normal day, flood period and drought period.
- There is no significant different in term of source of water used for drinking water and for other domestic uses.
- Flush or pour flush pit latrine is the most common type of toilet facility used by household in the study areas. Only 0.7% of the households has toilet facility that connect with septic tank.
- At least 7.3% of the household does not have toilet facility, and at least 5.9% still practice open defecation into bush or field.

What are climate risks hazards, exposure, and vulnerability at the household and community level?

- Most prevailing climate hazard during the last 10 years are intense rainfall, Drought, and Storm. These hazards are also perceived by the household as become more frequent and more intense. Household perceive flood as beneficial rather hazards as the majority of the community are farmer to relied on flood water for their crop. Despite most of the respondents mentioned that intense rainfall event has become more intense and more frequent, flood frequency and intensity were perceived as become less threat than before. This could be linked to the improvement of road and water infrastructures in recent years that help to prevent flood.

- There is a very strong association between household's experience of climate hazards and climate variation and the category of the village.

What are the direct and indirect impact of these climate risks at the household and community level?

- The impact of flood on the survey household includes causing difficulties for transport and mobility due to muddy road and financial problem causing by the loss of crop yield, loss of income and increase cost of food and basic amenity.

- The perception of flood impact on health and hygiene problem is significantly associated with village categories and income sources.

- Perception on water quality problem increase significantly during flood periods. Based on the results of Chi-square association tests, the availability of water is closely related to water source and village category. There is no association between water quality, water source, and village category.

- Common impacts of drought raised by surveyed household include loss of livestock, loss of crop yield, loss of farming capacity, loss of income, and increase cost of food and basic amenities.

- The perception of impact of drought as well as their coping measure is very likely to associate with village geographical characteristic and household economic status including income source, income level and household characteristics such as present of GESI member.

- Household's economic situation such as poor status, present of GESI member, type of income source, and income level can have very strong influence on: Household's experience of financial and health concerns during flood and drought, Household's choice to cope with flood and drought impacts, Household's awareness of adaptation option that are being practiced locally and household's intention to build resilient latrine and connect with resilient water supply system.

What are ways in which households and communities cope with and/or to climate hazards?

- How the communities would response to flood is very likely to be associated with how flood has impacts on their financials sources such as income source and level.

- The results of the survey indicates that climate change adaptation options that have been seen/ aware of or taken by the respondent most of the time are provision of social and health services, raised road and household area, rainwater harvesting system, community-managed bottled water, community managed water supply system and provision of climate resilient. The adaption option that are most taken up by the surveyed households include construction of wells or harvesting rainwater, elevate ground level, elevate encloser for livestock and increase household's food stock. The decision on taken up adaptation option is very likely to associate with village category, main source of income and income level.

- Individual factors including level of education, gender, and the duration of residency in the village can strongly influence on: choice to cope with flood and drought impacts, awareness of adaptation option that are being practiced locally, and intention to build resilient latrine and connect with resilient water supply system.

- Geographic factor also significantly influence on the household's experiences of flood and drought impacts and awareness of adaptation practices in the villages.

• Overall, the adaptive capacity of the households and communities are very limited. The main factors include lack of information and general knowledge about climate change, adaptation measures, and financial resources. The lack of knowledge appears to be for both households and local authority level, and there is willingness in both groups to learn more about climate change and adaption.

FOOTNOTES

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Designed by: