# Aanalysis of Local Community Awareness on Climate Hazards in Pursat Province, Cambodia

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***Abstract*— Pursat province, a potential province for agricultural development in Cambodia, is prone to climate hazards such as flood and drought. Almost every year, flooding and flash flood happen during the monsoon season while drought frequently occurs all year round, resulted in damages to agriculture, housing, and infrastructure. To propose a proper mitigation measure for such natural disasters, understanding characteristics of the climate hazards and local community awareness on those hazards are considered as one of the essential steps to implement. This study is aimed to identify ways and means for rural and indigenous communities, as well as to local institutions, to prepare and to mitigate and respond to natural disasters. Structured and semi-structured questionnaire survey on 750 peoples out of 47,880 people in 45 villages of Bakan and Phnom Kravanh district in Pursat province was conducted. Seventeen samples on average in each village were randomly selected for the interview. Major findings of the survey are: (1) the area, mainly relying on agriculture, is high vulnerability to climate hazard especially drought and flood; (2) drought is the major climate hazard confronting by communities whose main assets confronting to drought are agricultural land, water supply, livelihood, livestock, and natural resources; (3) flood occurred was flashflood that takes shorter time to finish. Flood hazard is not really a major problem at the present but in the future, it would be; (4) the capacity response to drought and flood is low and also limit to response climate hazards in the future. The results provide important information for further studies in order to propose a sustainable disaster management strategy.**

***Keywords*— *Climate hazards, drought, flood, local community awareness, Pursat province***

## I. INTRODUCTION

Pursat province, the potential province for agricultural development, is prone to natural disasters including flood, drought, and typhoon. Almost every year, climate hazards cause significant damages and losses to lives, injury, loss of livestock, and damages to housing, crop and community infrastructures. The most vulnerable group during the disaster occurrence includes the poor, women-headed households, children, old people, and the disables. Previously remarkable flood damages in the province were in 1996, 2000, 2011 and 2013, which normally shoved the local people into poverty, food insecurity, and health problem while drought happens almost every year, which severely affects crop productivity especially rice. Flood and drought recovery, for a developing country like Cambodia, always takes time and good budget allocation, which directly or indirectly prolongs the growth of the country economy.

The Royal Government of Cambodia (RGC) plans to develop Cambodia to be an upper-middle-income country in 2030 and a high-income country in 2050 [1]. In order to reach this target, many strategic plans have been set up including the disaster management plan both national and local level to help to improve the quality of life of local people to be resilient with the flood as well as other disasters. To implement this strategic plan, understanding about characteristics of the climate hazards and awareness of local people to respond to those hazards is very essential for flood risk management [2]. Therefore the RGC agency particularly, Ministry of Water Resources and Meteorology (MOWRAM) cooperated with Asian Development Bank (ADB) under the project of Community Based Disaster Risk Management (CBDRM) and Farmer Water Users Community (FWUC) proposed an activity called "Hazard Vulnerability and Capacity Assessment (HVCA)" to accelerate the CBDRM plan in 45 villages of Bakan and Phnom Kravanh district in Pursat province, so as to enable with provision of safer villages.

The public awareness and attitudes towards climate hazards such as flood and drought need to be understood for hazard management plan while this impact could be mitigated through the application of both structural and non-structural measures. Therefore, the overall objective of HVCA was to identify ways and means for rural and indigenous communities, as well as to local institutions, to prepare and to mitigate and respond to

natural disasters in 45 villages of Bakan and Phnom Kravanh districts in Pursat province. The key research questions are:

1. What is the characteristic of flood and drought in Bakan and Phnom Kravanh districts?
2. What are the major impacts of flood and drought on the local people in the villages?
3. What are the flood and drought responses of people living in Bakan and Phnom Kravanh district?

## II. Materials and Methods

### A. Study area

Pursat, the fourth biggest province in Cambodia, is located in the western part of country with the total area of 12,692 km$^2$. It is located at 12°00'N to 13°00'N North latitude and 102°55'E to 104°30'E East longitude (Fig. 1). The whole province is divided into 6 districts: Bakan, Kandieng, Krakor, Phnom Kravanh, Krong Pursat, and Veal Veng district with the total population of 397,107 heads in 2008. The climate is humid and tropical but with some variation over the period of a year. The highest monthly rainfall was about 260 mm in October while the highest temperature was in April, around 35 °C. The total annual rainfall is typically around 1,500 mm [3].

The 45 villages are located in 5 communes in Bakan and Phnom Kravanh districts as shown in Fig. 1 with the total area of around 380 km$^2$. The area is laid in the central part of the Pursat river catchment surrounded by Cardamon Mountain at the south-western part of the province, starting at an elevation of around 1.7 masl to 1778 masl, and flat land at the north-eastern part of the province until reaching the Tonle Sap Great Lake. The Pursat River has two main tributaries, the Stung Peam (Peam river) and Stung Santre (Santre river), both flow in a northerly direction and meets the Pursat river at latitude 12°20' and longitude 103°45', just above the Bac Trakoun hydrological station. This situation makes the selected villages prone to flood and flash flood during the intensive rainfall, and easily get dry without rain in just a few weeks. Moreover, storm and lightning also caused deaths, injuries, as well as properties lose to local people during the monsoon season.

### B. Hazard Vulnerability and Capacity Assessment (HVCA)

The Hazard, Vulnerability and Capacity Assessment (HVCA) refers to the use of participatory rural appraisal method and tools in gathering information about past patterns of hazards, present threats and vulnerabilities at the community level and of the available resources community uses or can use to cope with the adverse effects of a disaster event. As shown in Fig. 2, the conduct of HVCA is not the desired end goal, yet an HVCA is conducted because of the need to obtain a disaster risk profile of the community and based on this, formulate and implement a proper-disaster preparedness and mitigation plan for the community. In this research, climate hazards mainly refer to flood and drought – the characteristic and the impact of flood and drought.

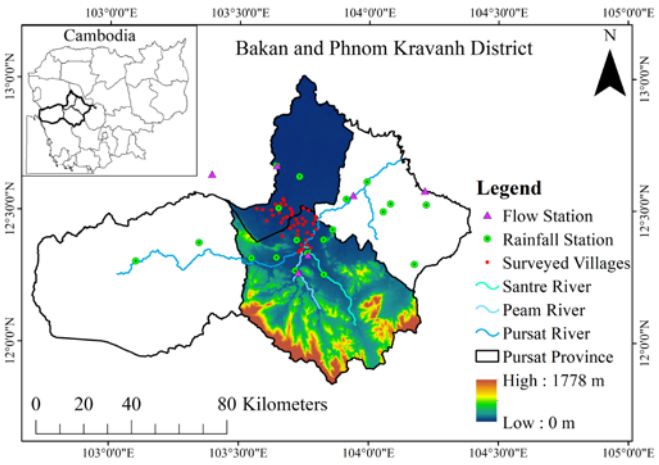


Fig. 1. Bakan and Phnom Kravanh districts, Pursat province

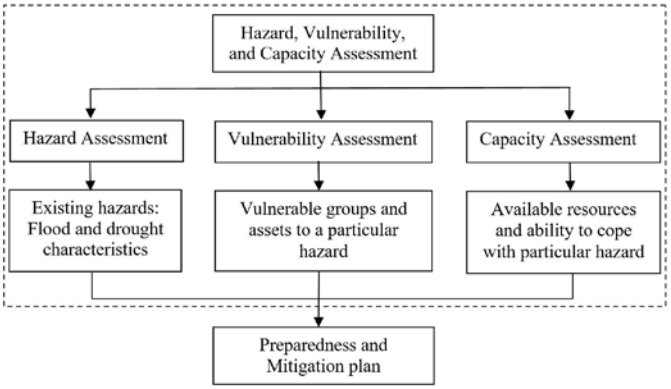


Fig. 2. Component of Hazard, Vulnerability and Capacity Assessment

### C. Questionnaire survey

A set of questions was designed and developed by the HVCA group. The questionnaire is composed of 5 main sections which are general information, population data, socio-economic data, disaster events and vulnerability assessment, and disaster events response and capacity assessment.

The data collection and HVCA processing was conducted in 45 villages from 30 December 2015 to 05 April 2016 by Agrifood Consultants International (ACI) national staff team including gender staff and team, where the theme was in consonance of provincial and district administration. Prior intimation was given to all government line departments and community based stakeholders to ensure wider participation or to be on board. The process started with direct group discussions with villagers to know some basic demographic facts of the village and commune including number of villages, demography, river network, and infrastructure. Other facts included of different hazards prevalent in the area and disaster history, livelihood of the villagers and a visit of the area for a better understanding. The processes were very interactive, giving everybody a right to participate and provided full chance to speak and ask anything from the team, about which they do not understand. After orientation, the villagers were asked to deliver facts and figures and to make it further interesting. The

team spent 3 days to process HVCA for each village. It is a participatory process of 15 to 17 villagers engaged.

TABLE I. AREA, POPULATION, AND SAMPLE SIZE OF EACH VILLAGE

| N° | Name of village | Area ($km^2$) | Population (head) | Sample size | Sample density (head/$km^2$) |
|---|---|---|---|---|---|
| 1 | Trayang Sa | 2.11 | 424 | 15 | 7.11 |
| 2 | Boeng Kak | 4.83 | 909 | 15 | 3.11 |
| 3 | Serei Kunthea | 3.66 | 830 | 15 | 4.10 |
| 4 | Chhnal Moan | 4.69 | 635 | 15 | 3.20 |
| 5 | Rohal Til | 31.00 | 1783 | 15 | 0.48 |
| 6 | Ou Ruessei | 2.00 | 1085 | 16 | 8.00 |
| 7 | Chan Serei | 1.02 | 301 | 14 | 13.73 |
| 8 | Buor Chres | 2.62 | 513 | 17 | 6.49 |
| 9 | Prahal | 27.31 | 1911 | 17 | 0.62 |
| 10 | Prey Veang | 8.63 | 1644 | 15 | 1.74 |
| 11 | Prey Kantout | 93.63 | 1907 | 17 | 0.18 |
| 12 | Prek Mouy | 8.99 | 909 | 15 | 1.67 |
| 13 | Tuol Thma | 3.30 | 488 | 15 | 4.55 |
| 14 | Kandal | 3.17 | 1207 | 15 | 4.73 |
| 15 | Thmei | 9.00 | 1551 | 18 | 2.00 |
| 16 | Baos Ko | 5.23 | 1114 | 16 | 3.06 |
| 17 | Tuol Chreav | 3.15 | 423 | 15 | 4.77 |
| 18 | Prey Roung | 10.50 | 1340 | 15 | 1.43 |
| 19 | Kaoh Svay | 4.27 | 795 | 17 | 3.98 |
| 20 | Prey Tao | 3.10 | 570 | 19 | 6.13 |
| 21 | Kouk Rumlo | 2.20 | 456 | 27 | 12.27 |
| 22 | Tuol Pongro | 3.09 | 386 | 15 | 4.85 |
| 23 | Krabau Chrum | 4.88 | 1710 | 15 | 3.08 |
| 24 | Damnak Kansaeng | Missing | 488 | 15 | 0.00 |
| 25 | Som Sant | 15.91 | 2242 | 16 | 1.01 |
| 26 | Tang Kouk | 27.88 | 2189 | 16 | 0.57 |
| 27 | Ou Rumchang | 3.80 | 1623 | 15 | 3.95 |
| 28 | Koh Voat | 4.05 | 849 | 18 | 4.44 |
| 29 | Kaoh Svay | 4.27 | 795 | 16 | 3.74 |
| 30 | Ou Heng | 3.61 | 989 | 15 | 4.15 |
| 31 | Prek Mouy | Missing | 1981 | 20 | 0.00 |
| 32 | Preaek Bei | 1.74 | 911 | 15 | 8.62 |
| 33 | Samraong 1 | 1.51 | 577 | 15 | 9.93 |
| 34 | Samraong Pi | 6.56 | 1792 | 21 | 3.20 |
| 35 | Ta Lou | 7.50 | 1813 | 21 | 2.80 |
| 36 | Thlok Dangkao | 9.30 | 1669 | 16 | 1.72 |
| 37 | Kranham | 6.37 | 1459 | 15 | 2.35 |
| 38 | Bak Chenhchien | 5.11 | 1824 | 21 | 4.11 |
| 39 | Stokhtom | 4.69 | 950 | 16 | 3.41 |
| 40 | Prey Kanlang | 4.45 | 1057 | 15 | 3.37 |
| 41 | Chrey Kroem | 3.75 | 1887 | 15 | 4.00 |
| 42 | Phteah Rung | 10.43 | 1249 | 15 | 1.44 |
| 43 | Bat Rumduol | Missing | 2263 | 20 | 0.00 |
| 44 | Ta Sas | 7.70 | 1632 | 22 | 2.86 |
| 45 | Chongruk | 7.46 | 1750 | 19 | 2.55 |
| | Total | 378.47 | 54880 | 750 | |
| | Average | 9.01 | 1220 | 17 | 1.98 |

## III. RESULTS AND DISCUSSION

### A. *Spacial distribution of samples and general information of respondants*

The HVCA team interviewed 750 persons, in which 377 respondents are female. The average age of the persons is found to be 48 years old, the less aged is 17 years old, and the most aged is 85 years old. The distribution of the age of the respondents is illustrated in Fig. 3. The statistic reflects that approximately 72% of respondents are local farmers while the rests are working as local government agencies and doing small business. However, still a part of their income comes from agriculture even though they have other positions in the government or do other small businesses.

TABLE I indicates the area, name, total population, and the sample size of each village. The average sample size is found to be 17 people per village on average varying from 27 respondents in Kouk Romlo villagae to 14 respondents in Chan Serei village. The average sample density is approximately 2 people/$km^2$.

### B. *Population data*

The population data provides the basic information about the detail statistics of the respondents living in the villages, which included following important sub-details in the order of average, minimum, and maximum of male and female population as 628/160/1,164, number of households as 264/66/481, number of children (0-15 years old) as 415/10/852, number of elderly persons (> 60 years old) as 79/13/249, number of orphan as 3/0/21, number of landless families as 11/0/47, number of people migrating per year (average last 5 years) on seasonal basis as 44/0/153, number of people migrating per year (average last 5 years) on long-term basis as 22/0/212.

The total population in the 45 villages are 54,880 people in which 51.5 % are female with 11,870 of households meaning that there are around 4 or 5 people in a family on average. The main source of income of the people is agricultural activities where typical activities are growing rice, cassava, and other vegetables as well as livestock. People migrated out for work are about 9.6 % of the total population, in which 50.2% migrated within Cambodia and 49.8% did outside Cambodia. People migrated out for are adults who mostly finished their study in primary and secondary school.

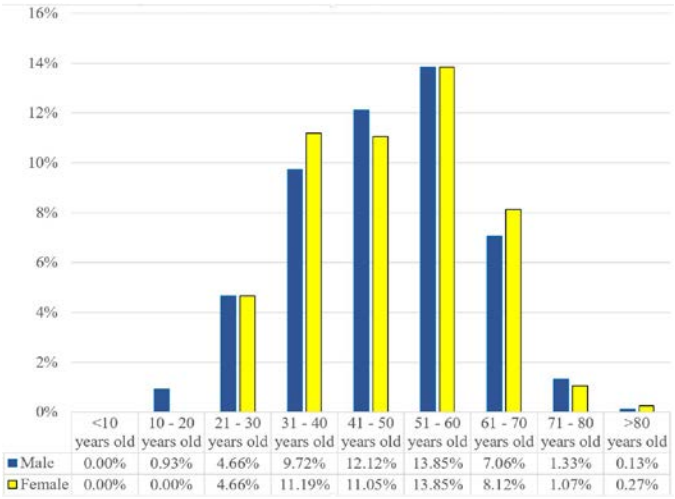


Fig. 3. Age of respondents

### C. Socio-economic data

Understanding about socio-economic development in the community is very necessary for disaster risk management because the risk is different based on the level of standard of living of the people [4].

The percentage of the household having motorbike, car, 2-wheel tractor, 4-wheel tractor, livestock, poultry, concrete or brick house, water storage tank, and mobile phone are indicated in Fig. 5. All families have poultry basically referred to household chickens and ducks, and their own water storage tanks (big jar) for rainwater harvesting for water supply during the dry season. Moreover, all families own the mobile phone more than one since it is very useful and affordable. On the other hand, only 2% of the family has their own car, 4-wheel tractor, and concrete/brick house while 68% of the household owns motorbikes, 63% feeds animal such as cattle and pigs, and 24% of household have the 2-wheel tractor.

Fig. 6 indicates the challenges of the socio-economic development in the villages. The most difficult issue for the people in the villages is lacking of irrigation system. Because all most 100% of the main source of income is agriculture, lacking of irrigation system makes their agricultural activities less intense. For example, people can grow rice only once per year depending on rainwater, which is very risky and vulnerable to the impact of climate hazards such as flood and drought. Moreover, according to [5], agriculture in Cambodia is more or less affected by climate change without climate change adaptation measure. Other challenges are lack of market and low price for agricultural products, especially the price for the rice and cassava, lack of stable employment and no factories nearby the community resulted in migration out for work, lack of infrastructure such as road, water supply and sanitation. Other difficulties are the lack of technical support for agriculture, health problems and being in debt of micro-finance (50% of the household).

### D. Disaster events and vulnerability assessment

The frequent hazards over the last 20 years are indicated in TABLE II. The level of severity of the hazards are classified based on the experience of respondents in term of the impact of climate hazards on their agricultural productivity since agriculture is the main source of their incomes. In this case, people get 100% of their agricultural products without the impact of climate hazards (3 tons/ha for paddy rice on average); based on this baseline scenario, the orders of severity of climate hazards are categorized; for instance, less than 15% of yield reduction is called Slightly (*); between 15% to 30% of yield reduction is called Moderate (**); 30% to 60% of yield reduction is called Severe (***), and more than 60% is called Extreme (****). According to National Committee for Disaster Management (NCDM), the majority of agricultural damages in Cambodia is caused by flood and drought, where 70% of damages caused by flood and other 30% caused by drought. People easily differentiate these two climate hazards by the amount of water availability for their crops during the growing period in each year; crop damages due to water scarcity is called Drought, and on the other hand, crop damages due to too much water in the field is called Flood.

Based on this classification, it can be summarized that slightly and moderate drought happened in 2002, 2004, 2009, 2012, 2013, and extreme flood recently happened in 2014, 2015 and 2016. The significant flood was in 2000, 2011 and 2013. Storm only occurred in 2012, 2013 and 2014. In 2013, storm and flood were the major climate hazards in the country which severely affected and destroyed crops, households and infrastructures. According to the record of National Committee for Disaster Management (NCDM), flood rarely occurred; however, the damages caused by flood are more severe comparing with drought.

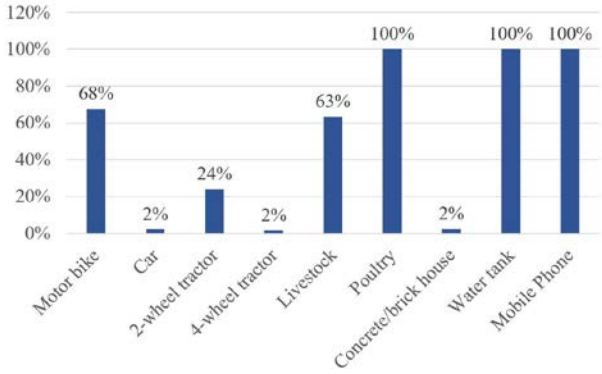


Fig. 4. Household having these assets

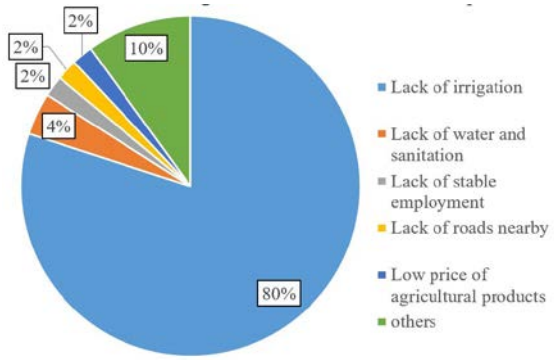


Fig. 5. Challenges of socio-economic development

TABLE II. HISTORY OF OCCURRENCE CLIMATE HAZARDS

| Year | Drought | Flood | Storm | Hot temperature |
|---|---|---|---|---|
| 1995-1999 | | | | |
| 2000-2004 | ** | **** | | |
| 2005-2009 | ** | | | |
| 2010 | | | | |
| 2011 | | ** | | |
| 2012 | * | | ** | * |
| 2013 | ** | ** | *** | * |
| 2014 | **** | | ** | ** |
| 2015 | **** | | | ** |
| 2016 | **** | | | ** |

* Slightly, ** Moderate, *** Severe, **** Extreme

TABLE III. MAJOR IMPACT BY CLIMATE HAZARD

| Rank of impact | Drought | Flood | Storm |
|---|---|---|---|
| 1st | Crop | Road | Housing |
| 2nd | Water supply | Crops | People |
| 3rd | Livestock | Livestock | Crops |
| 4th | People | People | Livestock |

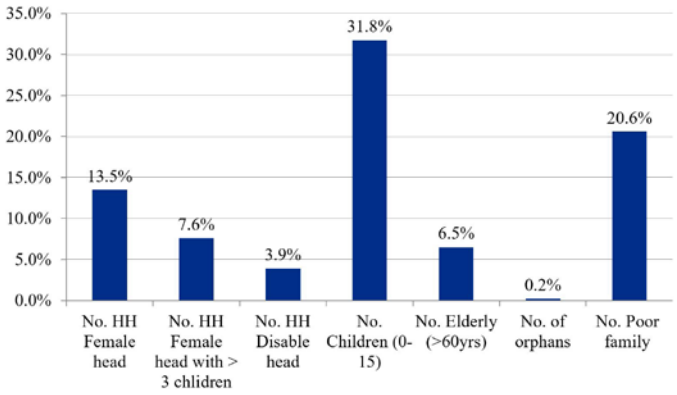


Fig. 6. Vulnerable group during the climate hazards

The major impact by climate hazard is summarized in TABLE III. As can be seen, crop is the most vulnerable to drought, while infrastructure and housing are susceptible to flood and storm respectively. The most vulnerable group during the climate hazards in the villages are illustrated in Fig. 7. The vertical axis refers to the number of vulnerable group in percentage (%). From the survey, children are the most vulnerable group to all climate hazards (31.8%), which is similar to the record from National Committee for Disaster Management (NCDM) of Cambodia between 1996 and 2014, where the people death, missing, injured during the climate hazards were mostly children (0-15 years old). Besides, poor family (income less than 100 US$ per month per family), women-headed family, the elder group (> 60 years old), disable people and orphans are also very vulnerable to climate hazards since they are not resilient enough to climate hazards both physical and financial condition.

*E. Disaster events response and capacity assessment*

The discussion in this part focuses mainly on the behavior of the local people in the villages to respond to flood and drought with their traditional measures. Well-understood about the knowledge and behavior of the local people coping with climate hazards leads to define the appropriate preparedness and mitigation measures for the community.

The identification of the hazard can be observed by the people. In this case, 100% of the respondents know exactly which hazards occurred when their crops were damaged, for example, their crops destroyed by flood or affected by drought. Moreover, 24% of respondents revealed that they define the characteristic of flood or drought due to the water level in the river and based on their experiences, they can predict some climate hazards and prepare their assets from damages caused by those hazards; however, this situation is valid for only people who live near water sources. Similarly, 73% of the respondents identify the hazards differently due to their experiences in different ways such as observing the insect behaviors, dead animals, unusually hot, heavy rainfall, strong wind, and no rainfall.

Besides hazard identification, the statistic also reflected that 42% of the total villages (19 villages) had the disaster response plan and preparation while 58% (26 villages) did not prepare any disaster. People often adapt with the climate hazards by the traditional measures; for instance, seed and fertilizer preparation, reserve water (water jar, ponds…), plant cassava instead of rice, animals shelters, migrate for work to get income for family in the case of drought, and paddy rice seed preparation, reserve food, medicine, and clean water, prepare stuffs and put high enough safe from level of flood water, reserve safe place for family and animal, migrate for work for income in the case of flood. However, it is confirmed that the traditional adaptation is practical in the case that the hazard is not extreme and frequent so that they can have time and money to prepare and respond to the climate events; otherwise, they are still highly vulnerable.

As can be seen in Fig. 7, the nearest safe sites for most of the villagers were school, health center, elevated place and pagoda. The average maximum distance of these places is more or less than 1000m. The furthest safe place was high way, which was around 3000 to 4000m from their houses.

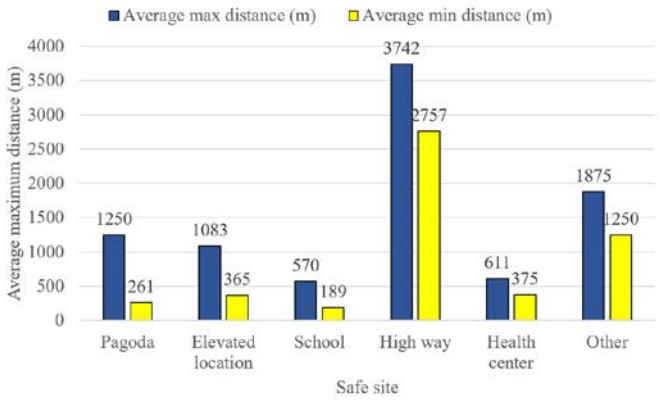


Fig. 7. Range of distance to safe site for most people

### F. HVCA evaluation

The same study was conducted in district Thatta, Sinhd, Pakistan [6]. The study area is around 17,355 km$^2$ with the total population 1.113 million in 1998, which is quite big comparing with the area and population of 45 villages in Bakan and Phnom Kravanh districts. According to the finding, the district Thatta's economy are based on agriculture and fishing, where the main crops are wheat, rice and sugarcane. Flood hazard is the most affected to life, health, property, and natural floodplain resources comparing with drought, which is different from our study area, where flood is not really a major problem climate hazard. The element at risk during flooding in the district Thatta are elderly people (> 65 years old), Children (< 15 years old) and pregnant women livestock, housing and infrastructure, which is quite the same of those in Bakan and Phnom Kravanh districts; however, other hazards in district Thatta are cyclone and sea water intrusion since the area is located near the Arabian Sea. The most vulnerable group of these hazards are people who live near the sea, and also some assets such boats and nets, as already mentioned fishing is the second occupation to get the income in the area. Comparing to Bakan and Phnom Krvanh, both are prone to climate hazards or it can be said that district Thatta is even more vulnerable due to the location, however, in term of capacity assessment, the people in district Thatta are better since they have experienced many type of climate hazards so it seems that they can adapt with typical hazards, whereas the ability and resources of the people in Bakan and Phnom Kravanh districts are very limited and this situation make them more vulnerable if extreme hazards occur in the future.

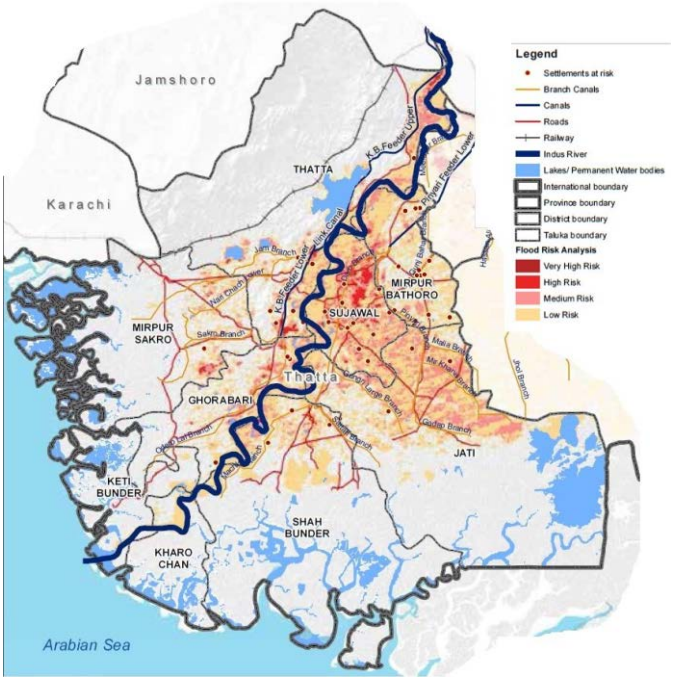


Fig. 8. Distict Thatta, Sinhd, Pakistan

## IV. CONCLUSION

This study attempts to analyze ways and means for rural and indigenous communities, as well as to local institutions, to prepare and to mitigate and respond to natural disasters. A set of questions was developed and used to interview 750 people in 45 villages within two districts: Bakan and Phnom Kravanh districts, Pursat province, the most vulnerable area to climate hazards, corresponding to about 2 sample/km$^2$ on average by Agrifood Consulting International team. Questionnaire survey was conducted using a random method for respondents as local farmers together with some criteria such as local governor selection, for example, village chief and deputy village chief. The questionnaire composes of 7 main sections such as general information, geographical data, population data, socioeconomic data, disaster events and vulnerability assessment, disaster events response and capacity assessment, mitigation mechanisms. The survey took place around 3 months from 30 December 2015 to 05 April 2016. Major findings of the survey are: (1) the area, mainly relying on agriculture, is high vulnerability to climate hazard especially drought and flood. The major challenges for socio-economic development in the villages were lacking of irrigation system, water and sanitation, stable employment in the villages, low price of agricultural products; (2) drought is the major climate hazard confronting by communities whose main assets confronting to drought are agricultural land, water supply, livelihood, livestock, and natural resources; (3) flood occurred was flashflood that takes shorter time to finish. Flood hazard is not really a major problem at the present but in the future, it would be. The main assets confronting to flood are infrastructure, agricultural land, housing, and livestock; (4) the capacity response to drought and flood is low and also limit to response climate hazards in the future. The results provide important information for further studies in order to propose a sustainable disaster management strategy.


## ACKNOWLEDGMENT

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