Drought in Mekong River and Vulnerability of Livelihood

In Chiang Khan District Lower Mekong Basin Thailand

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Acknowledgement

To my Mum, my Dad, my family and friends,
To Sara, Mine and LUMES,
To the people of Mekong and Chiang Khan,

Thank you all.

Orasa Kongthong
May 2011

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Abstract

The aim of this study is to identify the impacts of the drought in Mekong River on community livelihood and to see how they adapt to reduce vulnerability. Chiang Khan District in Loei Province, Thailand, is selected as the case study for the in-depth field investigation.

The central research question is thus posed as to how the drought in Mekong River affects community livelihood in Chiang Khan District. It further addresses three key research aims: the likely causes of drought, its impacts on community livelihood, and adaptive capacity and vulnerability. The research employs a case study approach and qualitative research tools including secondary data collection, field survey, semi-structured interviews, non-participant observation and participant observation. Firstly, the study concludes that, with information available today, the likely cause of drought is assumed to be some combination of seasonal fluctuation, the upstream cascade dams, and climate change. Secondly, the study reveals that the drought significantly impacts livelihood of the Chiang Khan community, by imposing impacts on four key issues: fishery, agriculture along the Mekong River bank, domestic water use, and transportation. Thirdly, the study remarks that different groups of people have different levels of capitals thus different adaptive capacities and vulnerability, when exposed to drought. Fishers have the least adaptive capacities, thus are the most vulnerable. Next are the farmers along the Mekong River bank. In both cases, their adaptive capacities are very limited, both at individual and to a small extent community levels. Their capacities are therefore limited.

The study recommends that Chiang Khan community develop a plan to achieve “Sustainable Livelihood for Chiang Khan Community”; that all involved parties make concerted efforts to maintain fishery sustainability which includes improving fishers’ adaptive capacity; that all riparian nations establish a placed-based development strategies for the Mekong River Basin; that all riparian nations learn from ‘failure’ lessons and turn on the new leaves by being more cooperative; and that comprehensive database be established, with special emphasis on socio-economic information.

Keywords: Drought, Vulnerability, Livelihood, Chiang Khan, Lower Mekong Basin

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List of Acronyms and Abbreviations

ABARE - BRS	Australian Bureau of Agriculture and Resource Economics - Bureau of Rural Science
ASEAN	Association of Southeast Asian Nations, consisting of Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
IFAD	International Fund for Agricultural Department
KKU	Khon Kaen University
Lao PDR	Lao People's Democratic Republic, also called ‘Laos’
LMB	Lower Mekong Basin
LPFFS	Loei Provincial Freshwater Fishery Station
LPOFF	Loei Provincial Office of Freshwater Fishery
MRB	Mekong River Basin
MRC	Mekong River Commission
MSL	Mean Sea Level
PODPM	Provincial Office of Disaster Prevention and Mitigation
PRA	Participatory Rapid Appraisal
PR China	People's Republic of China, also called ‘China’
PWWA	Provincial Water Work Authority
RQ	Research Question
SD	Standard Deviation
UN	United Nations
UMB	Upper Mekong Basin
VNMD	Vietnam National Mekong Committee

Glossary

Cascade dams	The term ‘cascade dams’ in this thesis refers to a series of eight large hydropower dams built in the upstream Mekong River mainstream (Fig.4 in Chapter 2). So designed, the highest dam uses the stored water to generate electricity, then flows to the next dam which stores the used water and uses it to generate electricity. Same process continues. Water flows from the top to the bottom dams, step by step, as does cascade (waterfall), thus the name, ‘cascade dams’ (Liengcharoensit, 2011).
Chiang Khan community	Chiang Khan community and Chiang Khan district is used interchangeably in this thesis, depending on context. Chiang Khan community refers to community within the Chiang Khan district, whose details are described in Section 2.3, Chapter 2; and the boundary shown pictorially in Fig.2 Chapter 1.
Hydrograph	Hydrograph is a graph which shows variation in river discharge over time, in response to a precipitation event. In practice, the river discharge is measured and plotted on the Y-axis, against time which is on the X-axis. The unit of the discharge is typically expressed in cubic meter per second; while the unit of time is typically expressed in days (Ratanachai, 2011).
Lancang	The internationally known ‘Mekong River’ is called ‘Lancang’ in China and ‘Dza Chu’ in Tibet. It is interesting that the word ‘Lancang’ (pronounced ‘Lan Chang’ is coincidental with the old name of Laos, Lan Chang’ meaning ‘Land of million elephants’ (Kasetsiri and Khamkhun, 2000, p.21)

Chapter 1 Introduction

Mekong River is the world's 12th largest river (Cronin, 2009, p.149) and the largest in Southeast Asia. Covering an area of nearly 0.8 million sq.km., the Mekong River Basin (MRB) lies in six countries: P.R. China, Myanmar, Thailand, Lao PDR, Cambodia, and Vietnam (Fig.1). An Upper Mekong Basin (UMB) lies in P.R. China and Myanmar; while a Lower Mekong Basin (LMB) lies in Thailand, Lao PDR, Cambodia, and Vietnam. While less information about UMB is available, LMB is currently the home of approx. 60 million inhabitants, and it is forecast to reach 90 million in 2025 (Mainuddin and Kirby, 2009, p. 1567; MRC, 2010b, p.31; Wang, 2010), more than half of which are rural poor (Kirby et al., 2010, p.575). Kirby et al. (ibid.) recently described people in Cambodia and Lao PDR as among the poorest in the world. Millions of these rural poor depend on the Mekong River and have their livelihood inextricably bound to it.

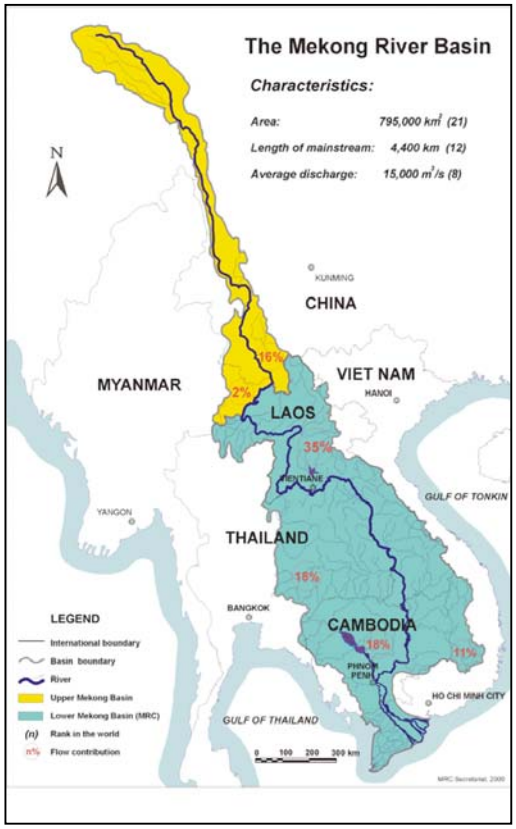


Figure 1 Thailand & Mekong River Basin

Source: VNMC, 2011

The past few decades have witnessed the MRB as encompassing one of the most complex coupled human-environment issues involving numerous development activities, numerous parties and stakeholders, and posing severe threats to environmental resource of Mekong River, as well as livelihood of the rural poor in the LMB. These include China's construction of a series of eight large hydropower cascade dams; a joint proposal of Lao PDR, and Cambodia and Thailand to build 11 equally large hydropower dams in the LMB. The wake-up call was manifested by the record low level of the Mekong River and the prolonged draught in the dry season of 2010[1] causing widespread impacts to local communities. It remained controversial whether such a devastating phenomenon was seasonal fluctuation, or an effect of climate change, or caused by the cascade dams altering the Mekong River hydrograph (Bryan et al., 2009; Kummu and Sarkkula, 2008; Stone, 2010).

[1] Having been officially monitored since 1963, the Mekong River water level has been found to fluctuate seasonally. The water level usually peaks around August and September, and begins to decline thereafter. The low water levels are typically recorded from January to May, with the lowest level around 0.6 - 1.5 meters generally observed during March and April. The drought years were recorded in 1993, 1995, 2008, 2009 and 2010. The second lowest level was 0.33 meters which was recorded in 2009, and the lowest in history was 0.32 meters which was recorded in 2010 (KKU, 2010)

1.1 Research Justification

Current uses of Mekong River resources in Thailand, as well as other riparian nations, include hydropower, fishery, irrigation, tourism and transportation. Most hydropower projects, both administered locally and jointly administered with neighboring countries, have raised serious concerns that they would lead to disastrous social and environmental consequences. While many of the past cases have not yet been satisfactorily solved, new larger scale proposals emerged. Thailand joined hands with its neighbors, Lao PDR and Cambodia, planning 11 large hydropower dams on the Mekong River's mainstream. Such plans raised widespread social and environmental concerns (Global Geopolitics & Political Economy, 2010, p.1-3; Bangkok Post, 2010).

As above mentioned, it has been controversial whether the record low level of the Mekong River and the prolonged drought in the dry season of 2010 were seasonal fluctuation, or effects of climate change and caused by the cascade dams. Nonetheless, such phenomena have prompted region-wide worries and concerns that the worst may have not yet arrived. Several issues were highlighted and discussed in the first MRC summit in Thailand, held on 5 April 2010, under the theme, "Transboundary Water Resources Management in a Changing World" (MRC, 2010a). Andrew Walker from the Department of Political and Social Change, Australian National University, for example, remarked, *'. . . believes the Chinese dams have little impact on current low levels in Mekong'* (Al Jazeera, 2010). Pienporn Deetes, an outstanding Thai NGO from International Living Rivers, on the other hand, advocated that, *'water fluctuation of almost 60 centimeters was observed in one day . . . so it could not be anything else but the effect of the dam . . .'* (Al Jazeera, ibid.). While it remains inconclusive as to what caused prolonged drought in Mekong River, the evidence brought into the debates provided sufficient reason to believe that it has severe impacts on biodiversity, fishery resources, potable water supply, and most importantly, community livelihood.

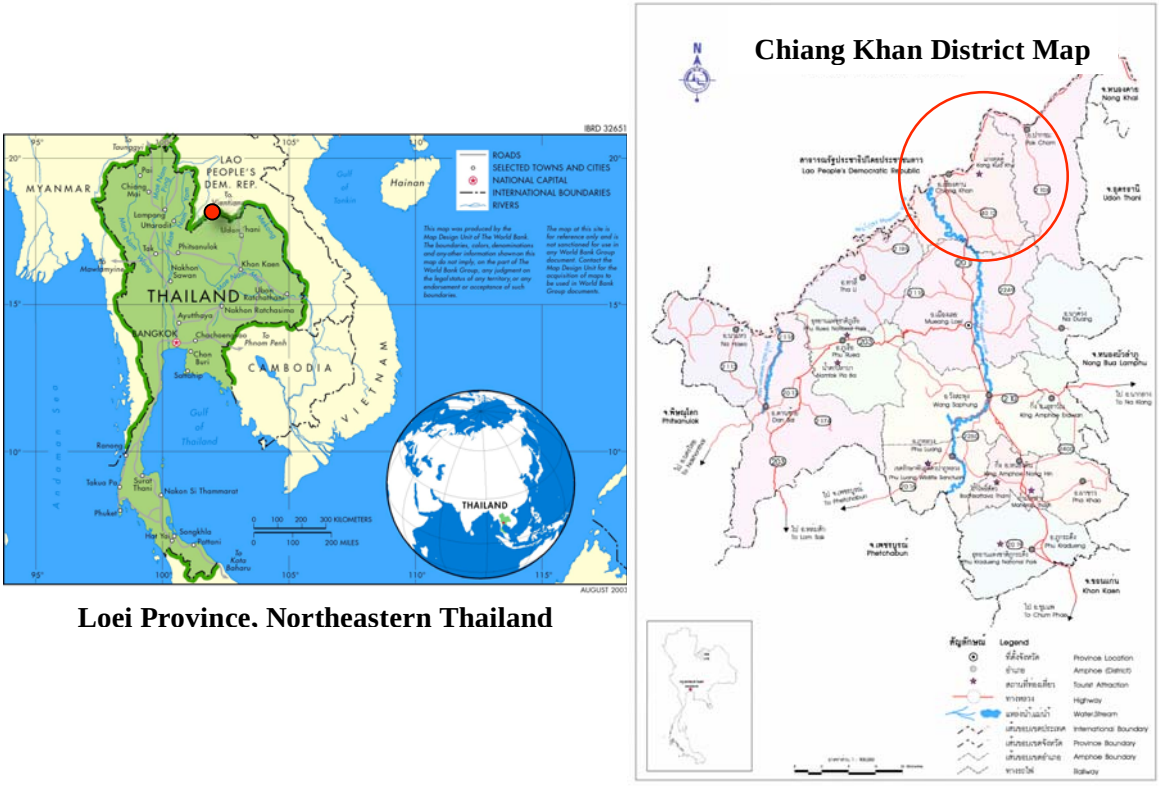
The Research Development Institute, Khon Kaen University, the main university in northeastern Thailand, has launched a preliminary investigation looking at the consequences of the 2010 Mekong water crisis, using a Participatory Rapid Appraisal (PRA), and identified several research areas including the impact of drought and changing water level during dry season in Mekong River Basin on community livelihood (KKU, 2010). It should be noted here that northeastern Thailand which includes Chiang Khan District, the area which is herein chosen for the case study, has been declared by Thai Government to be the 'Drought-disastrous zone' almost every year during the past few decades (Srisawong, 2011).

Despite significance of the issue, however, only a handful of publication has been found in the literature.

1.2 Research Questions and Outline

My main research question (RQ) is posed as: *'How does the drought in Mekong River affect community livelihood in Chiang Khan District, Loei Province, Thailand?'* In order to make an in-depth investigation, I focus my study on the community in Chiang Khan District, Loei Province, in northeastern Thailand, LMB (Fig.2) To fulfill the overall research aim, I have decided to address the three sub-RQs:

- What are the likely causes of drought in the Mekong River, Chiang Khan District, Loei Province, Thailand?
- Which groups of the Chiang Khan Community are sensitive to the drought, and how are their livelihoods affected?
- How do they adapt in response to the impacts?



Loei Province. Northeastern Thailand

Figure 2 Study Area: Chiang Khan District, Loei Province, Northeastern Thailand, LMB

Source: Map of Thailand, 2011; World Bank, 2011

The discussion and analyses are structured into the following five chapters. Chapter 2 presents background information of the study area. Chapter 3 discusses literature review, concepts and analytical framework. In Chapter 4, the research methodology is described which includes research design and methodological tools such as secondary data collection, semi-structure interview and observations. Chapter 5 discusses the results and analyses of the study which would provide the answers to all afore-mentioned RQs. The conclusion and recommendation are presented in Chapter 6.

1.3 Limitation of the Research Issues

The complexity of this research has been acknowledged from the outset. Firstly, Mekong is the transboundary river. Upstream nations' activities may impose transboundary impacts on downstream nations. In solving such transboundary water resource issues, there are many actors involved, let alone an issue of national sovereignty. Secondly, the hydrological process, which governs, and would have enabled us to understand, the drought mechanism, is complex. Solving such a problem would require a complicate hydrological model. Thirdly, the drought itself is also scientifically a very complex entity to handle. Variables are not only multi-dimensional but involve social implication, many of which are not quantifiable. As Peduzzi et al. (2009) put it,

> *'Drought is a complex process to model as it is not clear when a drought starts both in spatial and temporal terms. The same deficit in precipitation may not induce similar impacts depending on types of soil, vegetation and agriculture as well as on differences in irrigation infrastructures. Moreover, casualties are not directly induced by physical drought but rather by food insecurity which is not purely a natural hazard as it includes human induced causes (such as conflicts, poor governance, etc.). . .'*

Thus, I understand that there is a limit as to how much information I can get, and how much analysis I can do, for my thesis within a given time. I however decided to do my best within the timeframe of the Master thesis, hoping that I can achieve some interesting outcomes, and raise some interesting points for further investigation.

It is also understandable that, in order to answer the first sub-RQ in totality, it would be sensible that the underlying question, i.e., causes of the drought, be clarified. Given the size and complexity of the problem, however, it must be handled by additional separate researches. Besides, it is unlikely that it could be answered precisely within the timeframe of this study. I nonetheless contend that such a condition does not terribly impinge on the research. It is not necessary that the causes of the drought must be completely clarified prior to tackling the community livelihood issue. It suffices to anticipate various likely causes of drought and how it is manifested—in terms of severity and predictability. In fact, I would argue that it is necessary to tackle the community livelihood issue, even while the problem

regarding causes of drought has not yet been fully answered. What concerns us is how community should react when they encounter such an event, especially if we anticipate that the worst has not yet arrived, no matter what cause it. In this research, the impacts of the drought on the community livelihood, their adaptive capacities and vulnerability will be highlighted.

In fact, the first sub-RQ may not appear to be very much directly related to the overall RQ. I however contend that it is important to bring it in, because it has a strong bearing on how to proceed with adaptation, and—for a transboundary river—an international collaboration. Thus, its inclusion is crucially warranted.

Chapter 2 Study Area Background

This chapter presents background of the study area—the Mekong River and its basin, the people of Mekong, Chiang Khan District and its community.

2.1 Mekong River & Its Basin

As mentioned earlier, Mekong is the transboundary river, running across 6 countries: P.R. China, Myanmar, Thailand, Lao PDR, Cambodia, and Vietnam (Fig.3). The contributions of each section of the Mekong River to its total mean annual flow are shown in Table 1. It can be seen that the section of the Mekong River in China (into which most of the water is drained from the portion of MRB in China and to a much lesser extent from that in Myanmar) contributes only 16% of the total mean annual flow of the Mekong River. China has always argued that its activities contribute only minor impacts on the downstream Mekong River, especially with regards to the flow alteration, and that most water in Mekong is contributed from the LMB (MRC, 2010b). The east bank of Mekong River, from China boundary to Kratie in Cambodia, is within Lao territory; thus, according to Table 1, 55% of the Mekong mean annual flow is contributed by large tributaries in Lao PDR.

Figure 3 River Reaches along the Mekong River
Source: MRC (2010b, p.19)

Another interesting feature of the Mekong River is its diversified ecosystem, ranging from rapid reaches along very steep area in Tibetan Plateau, China, with sparse population in the UMB; flowing through mild slope area in Myanmar, Thailand and Lao PDR, then to the flat flood plain around the famous Tonle Sap in Cambodia and Mekong Delta in Vietnam (Fig.4) The topographic profile (steep slope) depicted in the figure also explains why China wants to build the cascade dams. Not only does the flow in the upstream portion of the Mekong River have very short retention time, it has high hydropower potential (Ratanachai, 2011).

Table 1 Contributions to Mekong Mean Annual Flow by River Reach (and divided into flows from east and west banks of each river reach)

River reach	East bank (%)	West bank (%)	Total (%)
1.China *	16		16
2.China boundary – Chiang Saen (Thailand)**	1	3	4
3.Chiang Saen – Luang Prabang (Lao PDR)	6	2	8
4.Luang Prabang – Vientiane (Lao PDR)	1	2	3
5.Vientiane – Nakhon Phanom (Thailand)	18	4	22
6.Nakhon Phanom – Mukdahan (Thailand)	3	1	4
7.Mukdahan – Pakse (Lao PDR)	4	6	10
8.Pakse – Kratie (Cambodia)	22	2	24
9.Tonle Sap (Cambodia)	9		9
Total	55	20	100

Note: * = Data in China cannot be precisely determined, and involve some estimation.
** = The section of the Mekong River from China boundary (with Myanmar and Lao PDR) to Chiang Saen (Thailand) flow along Myanmar and Lao PDR boundary. The MRB which drains water into this section of the Mekong River lies approx. 75% in Myanmar and 25% in Lao PDR

Source: MRC (2010b, p.20)

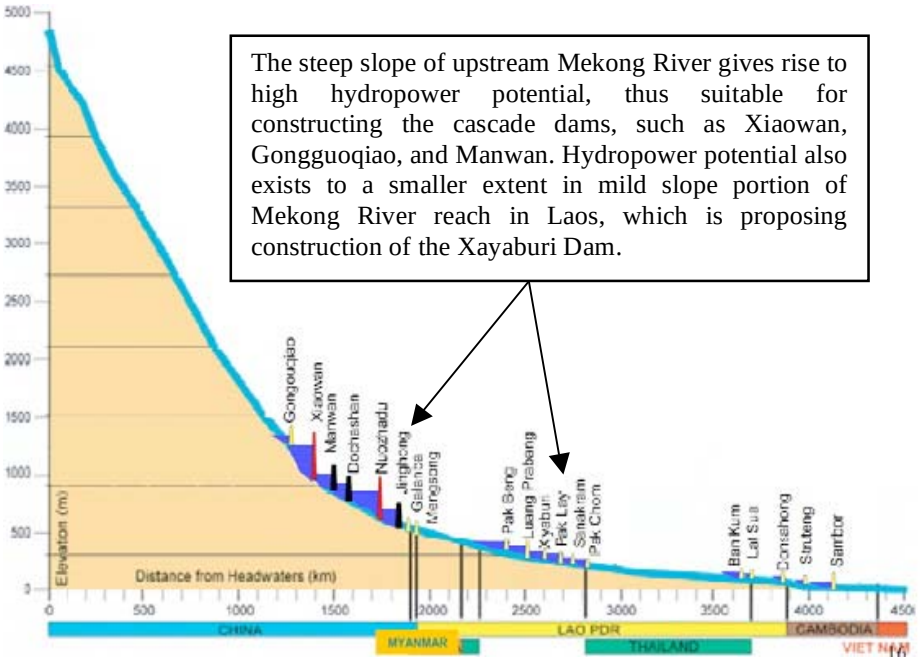


Figure 4 Longitudinal Cross-section showing profile of Mekong River from Upstream in China to Downstream in Vietnam

Source: MRC (2010c, p.8)

2.2 People of Mekong

Table 2 shows selected socio-economic data of four riparian countries in Lower Mekong Basin (LMB: Thailand, Lao PDR, Cambodia, and Vietnam). It can be seen that majority (68-78%) of population (with an exception of Thailand) are rural and poor, as indicated by some indicators. The level of education of people in the MRB region is generally low (Sunchindah, 2005, p.7), as indicated by 'adult literacy rate' in Table 2. Similar data in Upper Mekong Basin (UMB: P.R. China and Myanmar) are not available. It is however generally understood that, despite China's strong and sustained economic growth, poverty still persists in remote rural areas in the west which include the UMB region. Incidentally, in China, Mekong River is called Lancang River.

Table 2 Selected Socio-economic Data of the Lower Mekong Basin

Socio-economic data	Thailand	Lao PDR	Cambodia	Vietnam
Total area in LMB (km^2)	203,060	206,620	156,435	66,773
LMB Population 2007 (mil)	23.1	5.2	13.0	18.7
Pop growth rate (%, 2007)	0.8	2.1	1.9	1.2
Rural population (% of LMB pop in each country)	68	69	78	72
Life expectancy at birth (yr, 2007)	71	64	59	74
Adult literacy rate (%, 2007)	94	73	76	90
Malnutrition rate (%, 2007)	7	36	28	20
Access to clean drinking water (% of LMB pop in each country)	98	60	65	92
GDP per capita (US$, 2006)	3,000	674	648	900

Source: MRC, 2010b, p.32

The high per capita GDP figure in Thailand is somewhat misleading. Such a figure is averaged from 23.1 million population which live within the Thai portion of MRB, which includes people from a few comparatively more affluent cities. A great number of residents in small towns along Mekong River corridor are still categorized as rural poor. The residents in the study area, Chiang Khan District, for example, have an average annual income of US$1,100 per capita (Chiang Khan, 2011).

A large number of people in LMB depend on Mekong River water for their livelihoods, food security and income (MRC, 2010b, p.43). MRC (2010b, p.47) estimated that approx. 20 million people live within 5 km corridor of Mekong mainstream[2]. It also suggested that 63% of these people, or some 12 millions, are engaged in water resources-related occupations such as farming near river bank, fishing, collecting aquatic plants, aquaculture, boat repairing, etc. The same study indicated that about 49% of people, or about 10 millions, identified farming as their main occupation. Understandably, not all farming activities directly depend on Mekong River water resource.

Fishery resource significantly contributes to regional food security, as well as induce related income generating activities, such as fish sales, net making and boat repair. In 2003, it was reported that about two-thirds, or about 40 millions, of the LMB population were engaged, at least seasonally, in the Mekong's fishery (MRC, 2010, p.49).

Though the precise estimate of fishers is not readily available, The Social Impact Monitoring and Vulnerability Assessment (SIMVA)[3] study conducted by MRC (2010d as cited by MRC, 2010b, p. 47-51) study provides some indication. SIMVA (ibid.) reports that, in 2008, 6% of the total sample population identified fishing or related activities (fish processing, marketing, etc) as their main occupation; 12% of economically active population engaged in fishing as a secondary occupation. It is thus reasonable to estimate that at least 2 million people who live along Mekong corridor earn their living by fishing, either as main or secondary occupation. Though the number of fishers are much smaller than farmers, their livelihood activities are more dependent on Mekong water resource; thus likely to be more vulnerable in the advent of drought.

A substantial proportion of these people have no second occupation, implying their vulnerability to a decline in the resources on which their main occupation is dependent.

2.3 Chiang Khan District

Chiang Khan District, in Loei Province, northern Thailand (Fig.2 in Chapter 1) was chosen to be the study area. It is situated at about Latitude 18^{o}N and Longitude 102^{o}E, approximately 570 kilometers north of Bangkok, sitting on the stunning stretch of the Mekong River, bordering between Thailand and Lao PDR.

Physical and environmental characteristics: Loei's Chiang Khan District covers an area of approx. 940 square kilometers, about 60% of which is plain and about 40% is mountainous areas. Approx. 34.6% of the total area in Chiang Khan is an agricultural land; 64.2% is forest.

[2] MRC (2010b, p.47) reported '*. . . , with 25 million living within a 15 km corridor either side of the Mekong mainstream . . . 79 % of the 15 km corridor population live within 5 km of the mainstream. . .*' This translates to (79%) X (25 millions) = about 20 millions live within 5 km of the mainstream

[3] The SIMVA study was conducted by MRC in 2008–09. The study surveyed 1364 households living within 15 km of the upper flood limit of the Mekong mainstream, including Tonle Sap (MRC, 2010d as cited by MRC, 2010b, p.49). It is anticipated that this report will provide a lot of useful socio-economic data. At this writing, however, the report is not yet released to public, but it has been repeatedly cited by MRC (2010b).

Only about a little over 1.1%, is inhabited. Chiang Khan District has a typical tropical climate, with temperature around 15-35 degree Celsius, and annual average precipitation of about 1,300 millimeters (Chiang Khan, 2011).

Socio-economic : As of December 2010, Chiang Khan District hosts 59,606 inhabitants, 72.9% of which are in working age (15-65 years old); Elderly people (> 65 years old) accounted for 10.1% (Chiang Khan, 2011). Chiang Khan inhabitants earn their livings as farmers, fishers, and more recently tour operators.

Most farmers in Chiang Khan practice small to medium scale mixed farming, where they grow several plants in the same plot of land, including rubber, fruit trees such as orange, lychee, rambutan, and mango. Some also raise cattle, pigs, and chickens.

Historically a small village, Chiang Khan has recently become a new tourist destination. This quaint small town is full of traditional ways-of-life and beautiful riverside location. From my observation, tourism has made Chiang Khan inhabitants a little more affluent economically, but lives here remain slow, as do most rural areas in Thailand.

Most female farmers have second occupation. They form cooperative groups for raising silk worm, weaving textile, traditional handicraft, etc., so as to get socialized as well as earning additional income. (Chiang Khan, 2011).

Chapter 3 Concepts and Analytical Framework

This chapter introduces concepts and analytical framework that will be used in the analysis.

3.1 Drought, with Special Emphasis on the MRB

Several conceptual definitions of droughts are found in literature (e.g., Pacific Disaster Center, 2011). The most comprehensive and practical one was treated by Wilhite and Glantz (1985, as cited by Adamson and Bird, 2010, p.580).

Though drought occurs in various climatic zones, its characteristics differ from one region to another. Adamson and Bird (2010) argued that drought should not be viewed as simply a physical phenomenon, but its social and environmental impacts should be incorporated. Four definitions of drought have been proposed: meteorological, hydrological, agricultural and socio-economic, as follows (Wilhite and Glantz, ibid.; UN/ISDR, 2007, p.5-6):

Meteorological drought: refers to precipitation deficiency over a specified period of time. The thresholds can be chosen, say, 30% of normal precipitation over a three-month period. They can vary from location to location, depending on needs or applications (UN/ISDR, 2007, p.5).

Agricultural drought; focuses on precipitation shortages in relation to agricultural impacts, through deficiency in soil moisture. Plant water demand depends on climatic conditions, stage of growth and other plant specific characteristics. Insufficient moisture may result in low yield. UN/ISDR (2007, p.5) remarked that, *'Infiltration rates vary depending on antecedent moisture conditions, slope, soil type, and the intensity of the precipitation event. Soil characteristics also differ. For example, some soils have a higher water-holding capacity, which makes them less vulnerable to drought.'*

Hydrological drought; is defined by deficiencies in surface and ground water relative to average conditions at various time of the year. Although all droughts begin with precipitation deficit, hydrological droughts occur when this deficiency is reflected through the hydrologic system. Their occurrences, hence their impacts, usually lag behind meteorological and agricultural droughts. For example, precipitation deficit may result in an almost immediate depletion of soil moisture, but it may take several weeks before its impact on reservoir levels, which will in turn affect hydroelectric power production, is felt. Other factors such as changes in land use and the dam construction may also affect the hydrological characteristics of the basin, thus affecting hydrological drought.

Socioeconomic definitions of drought: reflects relationship between the supply and demand of some commodity or economic goods with either or all of the above droughts. Its occurrence depends on the time and space processes of supply and demand to identify

droughts. For example, if the water shortage occurs during paddy sprouts (rice seedlings) transplanting stage (Adamson and Bird, 2010, p.580), the event would be severe.

The meteorological drought is the prime mover of all other types of droughts. The first of the sequence begins with an accumulated precipitation deficit (meteorological drought), which leads to a reduction in soil moisture content (agricultural drought). It may take several weeks before precipitation deficiencies result in soil moisture deficiencies. Agricultural impacts vary from crop to crop. Precipitation and moisture deficit continue to accumulate for several months, before hydrological drought begins to manifest itself. Finally, drought is felt as a socio-economic drought when food price increases due to reduced farm output, power ration due to reduced electrical generating capacity, etc. (UN/ISDR, 2007, p.6; Adamson and Bird, 2010, p.582).

Drought in the Mekong River

The drought phenomenon in Mekong River has been discussed by Adamson and Bird (2010), based on the above definition. In most cases, drought is not perceived as devastating and catastrophic environmental hazard as are some other disasters such as flood or typhoons. Its impacts nonetheless cover wide spectrum, ranging from agriculture, water supply, industry, transport, fisheries, etc. The impacts can be worsened if the drought occurs at crucial time, such as during paddy sprouts (rice seedlings) transplanting stage (Adamson and Bird, 2010, p.580). Specifically in the LMB, where most inhabitants are rural poor and their livelihood is inextricably bound with the River resource, problems are exacerbated. It is thus a challenge for both central and local government agencies to develop practical strategy to effectively tackle this issue; in other words, to minimize capability deprivation, so that poverty can be alleviated (Sen, 1999, p.87).

Fig.5 depicts typical variation of water level in Mekong measured at the Chiang Khan monitoring station. The climate condition in MRB is influenced by the south-west monsoon which occurs between June and October and results in a distinct hydrological cycle of flood and dry seasons (MRC, 2011a). The low flow period typically occurs between mid-January and early May. Fig.5 shows that, around the end of March, there is a 50% chance that the Mekong water level at Chiang Khan will fall below 2.8 meter; and that, during such time, there is 5% chance (1 in 20) that it will fall below 2.0 meter. Based on this explanation, and this year data (shown in Fig.5 in red), the water level in the year 2011 fluctuates most of the time below average value, thus considered dryer than an average year. It is nonetheless higher than P80 (the water level which is exceeded 80% of the time, implying that it is not too dry (Suriyabutr, 2011; Ratanachai, 2011). More discussion on argument of the measure of significant and extreme drought is given below.

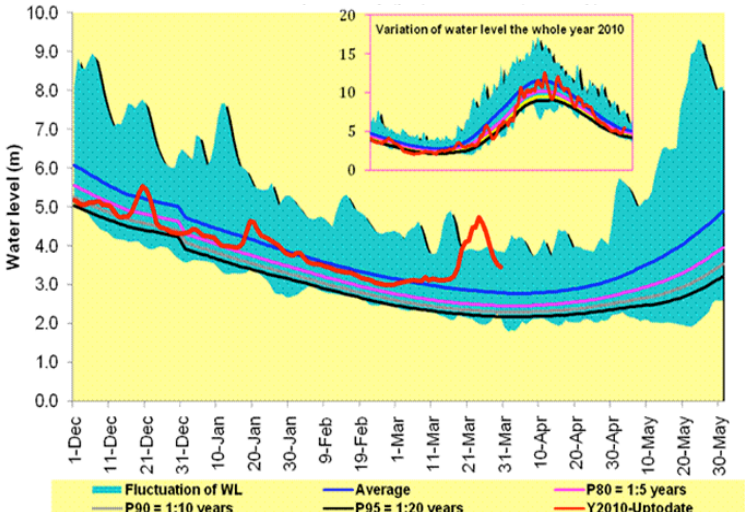


Figure 5
Mekong River Water Level in the Dry Season at Chiang Khan Station, showing probability of water levels being exceeded: 1961-2011 (till March)
Source: MRC (2011a)

Adamson and Bird (2010, p.586) proposed a simple definition of hydrological drought. Years with *either* "annual volume of flood hydrograph" smaller than "their mean value minus their standard deviations" *or* "annual peak flow" smaller than "their mean values minus their standard deviations" are classified as significant drought years; and years with *either* "annual flood peak" smaller than "their mean values minus twice their standard deviations" *or* "annual peak flow" smaller than "their mean values minus twice their standard deviations" are classified as extreme drought years. While Adamson and Bird (2010, p.587) demonstrated this definition in graphical form, it is herein expressed in mathematical terms (Ratanachai, 2011):

If Q_i = annual volume of flood hydrograph; P_i = annual peak flow of Year i;

And Q_M = mean value of annual volumes of flood hydrograph, Q_i, $i = 1, 2, 3, \ldots n$;

Q_{SD} = Standard deviation of Q_i

P_M = mean value of annual peak flows, P_i, $i = 1, 2, 3, \ldots n$;

P_{SD} = Standard deviation of P_i

Years with $(Q_M - 2*Q_{SD}) < Q_i < (Q_M - Q_{SD})$ **or** $(P_M - 2*P_{SD}) < P_i < (P_M - P_{SD})$ are ***significant*** drought years

Years with $Q_i < (Q_M - 2*Q_{SD})$ **or** $P_i < (P_M - 2*P_{SD})$ are ***extreme*** drought years

Adamson and Bird (2010, pp.586-587) reported that, by this definition, twelve *significant* and four *extreme* drought years have occurred since 1924 when the first observation was made. The four *extreme* drought years were 1955, 1988, 1992 and 1997 (MRC, 2010b, p.22).

It is noted here that such a definition is based on *'the annual flow volume and annual flood peak'*, which I would argue that it may not always reflect what is really happening in the

field. The five extreme drought years, as recorded by KKU (2010), were years 1993, 1995, 2008, 2009 and 2010. They are all different from the above. My interview result has confirmed that the year 2010, when the water level hit the lowest record in history, was considered by all respondents as the very severe drought year.

Based on the above definition, no matter how low the water level is during the dry season, if the rainfall is sufficiently heavy and results in sufficiently high peak and high volume during the rainy season, it may not be recorded as 'drought year'. The above definition allows 'rain' to be averaged out throughout the whole year. This is certainly not appropriate for defining the drought, knowing that the very low water level for extended period of time counts. Unlike flood, the effect of drought is place-specific and time-specific. The definition for the drought should therefore be place-based and time-based. For example, we should identify the threshold level in, say, Chiang Khan, to be *D* meter and persisting for at least *N* days. If the water level falls in such a criterion, then it is categorized as an extreme drought year.

The interrelation between drought and people's vulnerability is complex. UN/ISDR (2007, p.8) recommends that,

> *'One way to better understand vulnerability is through a livelihoods approach, especially if it captures both macro and micro factors and long-term trends that affect vulnerability and the impact of short-term shocks. . . . The essence of a livelihoods approach is that it puts people at the center of the analysis and is cross-sectoral, taking into account economic, political, and cultural factors.'*

The concept of livelihood framework is treated in more details in the section below.

3.2 Livelihood Framework

The concept of livelihood has long been central to poverty alleviation and rural development. Various definitions are found on literature. Most frequently cited definition was given by Chambers and Conway (1991, p.6) that

> *'A livelihood comprises the capabilities, assets (stores, resources, claims and access) and activities required for a means of living.'*

or in a shorter version that *'A livelihood is the means of gaining a living.'* (Chambers and Conway, ibid.).

Related to this is a concept of sustainable livelihood, which was defined as

> *'. . . a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels and in short and long term.'* (Chambers and Conway, ibid.)

The sustainable livelihood approach has been adopted as a means to help improving understanding of livelihoods of the poor (Scoones, 1998; IFAD, 2011). It illustrates the key factors which influences livelihoods of the poor people and inter-relationship among these factors (IFAD, ibid.).

According to Scoones (ibid.) and IFAD (ibid.), the sustainable livelihood framework is composed of the context condition, the livelihood resources or capitals, the institutional processes and organizational structure, the livelihood strategies and the livelihood outcomes. In their sustainable livelihood framework, shown in slightly different styles, people have access to a set of livelihood resources (natural, financial, human, social and physical capitals). Their access to these resources is strongly influenced by a set of particular context (policy settings, politics, socio-economic condition, etc.). This process results in livelihood strategies. There are also the institutional processes which coordinate implementation of strategies and overseeing the outcomes.

The livelihood resources have later been grouped into five capitals (adapted from Ellis, 2000, as cited by Nelson et al., 2009, p.3) including:

Human capital which refers to labor and influences on the productivity of labor including health, nutrition, education, knowledge and skills, capacity to work, capacity to adapt;

Social capital which refers to claims on others by virtue of social relationship, networks and connections such as patronage, neighborhoods, internet social network, and kinship, formal and informal groups, mechanisms for public participation;

Natural capital which refers to land, water, forest and wildlife, biodiversity and other ecosystem services;

Physical capital which refers to products of economic activity including infrastructure such as transport, shelter and buildings, water supply and sanitation, energy, communication, equipment and technology such as seed, fertilizer, pesticides, traditional technology; and

Financial capital which refers to savings, formal and informal credit and debt, pensions and wages.

Flexibility to substitute among different categories of capitals varies depending on external pressures (Ellis, ibid.). Households with more diversified capitals will have greater adaptive capacity because they have greater capacity to substitute among alternative livelihood strategies during times of stress.

3.3 Vulnerability

Vulnerability refers to the risk of harm (Schröter, 2005, p.1). Turner II et al. (2003a, p.8074), in their pioneering work on vulnerability analysis, conceptualized *'Vulnerability'* as

> *'the degree to which a system, subsystem, or system component is likely to experience harm due to exposure to a hazard, either a perturbation or stress/stressor.'*

From the above concepts, vulnerability is a function of exposure and sensitivity of the subject being exposed. Smit and Wandel (2006, p.286) further incorporated the adaptive capacity into consideration and broaden the definition as,

> *'. . . the vulnerability of any system is reflective of the exposure and sensitivity of that system to hazardous conditions and the ability or capacity or resilience of the system to cope, adapt or recover from the effects of those conditions.'*

The interplay among people of Mekong and natural resource and environment in the MRB can be thought of as a coupled human-environment system (Turner II et al., 2003b). Treating the drought as an *'Exposure,'* I find the IPCC (Intergovernmental Panel on Climate Change) framework (Tse-ring et al., 2010, p.51; Schröter and the ATEAM consortium, 2004) lends itself well to illustrating the concept (Fig.6). This framework was proposed by Schröter and the ATEAM consortium (ibid.) and has since been used by several other researchers (e.g., Smit and Wandel, 2006; ABARE – BRS, 2010). I find the model fit well with my research, especially with regards to the vulnerability assessment.

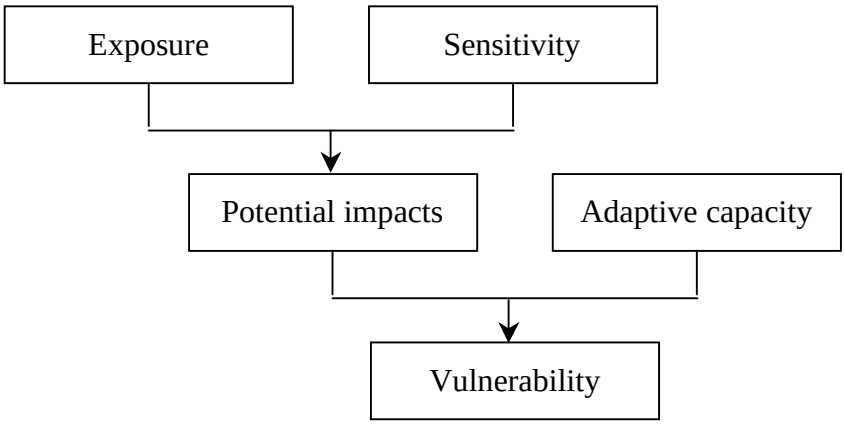


Figure 6 IPCC Framework for Vulnerability Assessment

Source: Tse-ring et al., 2010; Schröter and the ATEAM consortium, 2004

Exposure refers to *'the amount of external stress or change a community is likely to be affected by'* (ABARE – BRS, 2010, p.vi). For the focus of our study, an exposure was limited to drought and related factors such as land use and climate change. This study attempted to explore as to what extent communities have experienced the droughts in the past, and what would be anticipated in the future. The study also attempted to involve other relevant drivers, as far as practicable, such as climate change and China cascade dams.

Sensitivity is *'a measure of how dependent a community is upon the resource that is changing'* (ABARE – BRS, 2010, p.vi). According to my presupposition, there should be some farmers and fishers who are dependent on Mekong for their livelihood. This study attempted to explore such dependability in details.

Potential impact is derived from combination of exposure and sensitivity. In the context of this study, I paid close attention to the group of people who were highly dependent on Mekong River resource, and their livelihood, during the severe droughts.

How much loss is induced by the potential impact depends on the ***adaptive capacity*** of the community. Some community has more capacity to adapt than others. The adaptive capacity usually refers to the longer term capacity (Smit and Wandel, 2006). The adaptive capacity may have institutional involvement. It can also be extended from local level, to national level and regional level. Finally, the size of potential impacts and the community's adaptive capacity together determine the community's ***vulnerability.***

3.4 Adapted Framework Used in the Study

Fig.7 is the framework which has been developed to be used in this study. It is adapted from the previous concepts (Section 3.2-3.3), and aimed to address all sub-RQs. First, the likely causes of drought in Mekong River (Sub-RQ1) is incorporated, to which the people in Chiang Khan District are exposed. The framework then analyzes how their livelihood are affected by considering their water sensitivity (how their activities depend on Mekong River resource during the dry season), subsequently the impacts (Sub-RQ2) are assessed. The framework then looks into the adaptive capacity (Sub-RQ3) which links to the five key capitals from the sustainable livelihood framework (Section 3.2), which aim to improve adaptive capacities, so as to achieve sustainable rural livelihood (Scoones, 1998), and subsequently reduce vulnerability of people in Chiang Khan District.

This framework proved to be useful when used together with the interview questions. It helped me in covering all the RQs addressed.

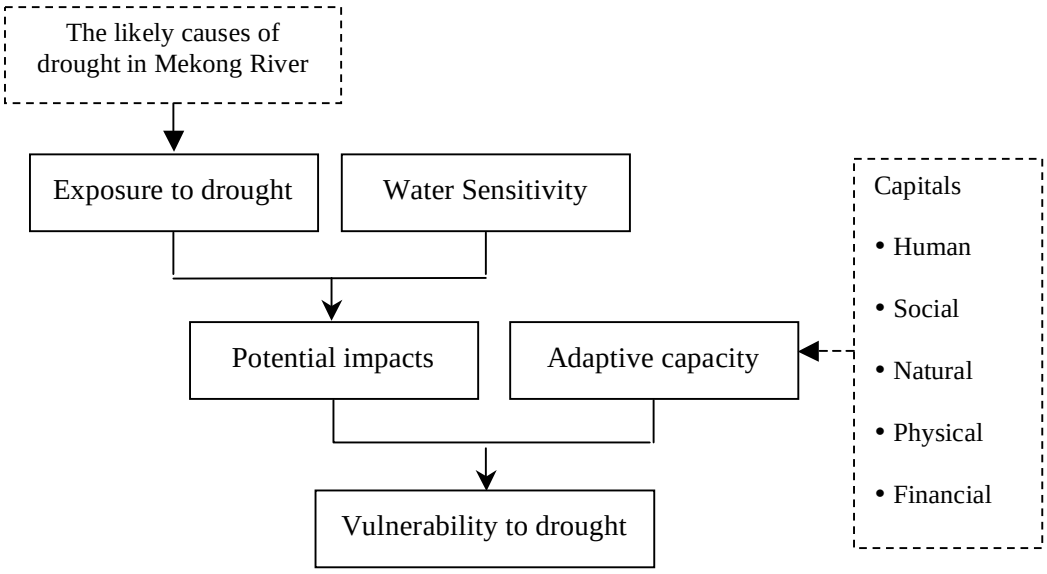


Figure 7 Adapted Framework Used for the Study (adapted from the IPCC Framework for vulnerability assessment[4])

Source: Adapted from Tse-ring et al., 2010; Schröter and the ATEAM consortium, 2004; Scooner, 1998

[4] This simplified framework should not disguise the system complexity. In reality, there are a lot of continual dynamics interplaying between 'boxes' (Brogaard, 2011)

Chapter 4 Research Methodology

4.1 Research Design

This study employed a case study approach and qualitative research tools including literature review, secondary data collection, semi-structured interviews and non participant observation and participant observation, which allowed me to gain insights regarding the current situation of the drought, as well as to intensively interact and discuss with numerous key informants at all levels—local, national and international. Hereinafter will discuss the selection of the case study and the methodological tools.

The case study method is chosen here based on Yin's (2009, p.2) suggestion that '*. . . case studies are the preferred method when (a) "how" or "why" questions are being posed, (b) the investigator has little control over events, and (c) the focus is on a contemporary phenomenon within a real-life context .'* Our research questions and characteristics of events embedded within very well comply with the stated criteria.

The research questions in this study posed questions of what (the likely causes of drought), and how (the community adaptive capacity). Even the question of 'which group' is not meant to be as specific as 'who' (in which the survey method would have been more appropriate). Needless to say, the investigator has no control over the drought (otherwise, an experiment would have been a viable choice). This study certainly focus on a contemporary phenomenon within a real-life context.

Selection of case study area

Bryman (2008, p.53) observed that *'the term 'case' often associates the case study with a location, such as a community or organization'* which also coincidental with the intention of this study, where Loei's Chiang Khan community was selected as my case study for my in-depth field investigation (Yin, 2009, p.4).

Elasha et al. (2005, p.9) suggested that the basic criteria of choosing a case study relate to community vulnerability to drought such as *'... involving past or on-going climate-relate events that are representative of projected future climate change; e.g., prolonged drought, available data, and feasible of conducting fieldwork…'* Thus, Chiang Khan would be a suitable case for this study. It was in fact screened from a few candidate areas during my reconnaissance survey.

Firstly, Chiang Khan District was selected because it lies along Mekong corridor and sizeable number of its inhabitants depended on Mekong River for agriculture, fisheries, etc. Most people in this District were rural poor, thus likely to have comparatively more difficulty in adapting their livelihood in response to drought. Thus, they were presupposed to be vulnerable to drought (Elasha et al., 2005, p.9).

Secondly, the District is depicted as drought disastrous zone by public authorities (Srisawong, 2011) and has had some prior experiences in dealing with impacts from prolonged drought (the situation which to some extent affected their livelihood).

Thirdly, Chiang Khan is the surrounded by a few mega-projects in mainstream Mekong River, such as the Xayaburi Dam, proposed to be built at Sanakam, Lao PDR, approx. 200 kilometers towards upstream of Chiang Khan, and Pak Chom Dam, proposed to be built at Tambon Haad Khampee, Pak Chom District, approx. 70 kilometers towards downstream of Chiang Khan. Chirawate (2011) advocated that if these dams are built, Chiang Khan community will face the mammoth disastrous change in ecosystem, and vulnerability for people livelihood, particularly fishers, will be tragically affected; because dams will obstruct the migratory fishes in Mekong River, not to mention other impacts such as Kaeng Khud-Koo, which is the main tourism place in Chiang Khan, will totally disappear. Meanwhile, the Thai Government is planning, as part of its drought mitigation measure, construction of the water tunnel to divert portion of the flow from the Mekong River at Loei River mouth to the northeastern part of the country. The starting point of the tunnel, the Loei River mouth, is located in Chiang Khan District. *Finally*, due to its great dynamism, there are some prior and ongoing studies of Chiang Khan community, which is uncommon for small communities in Thailand (e.g. LPFFS, 2011; KKU, 2010; KMUTL, 2011; TAT, 2011).

4.2 Methodological Tools

(1) Secondary data collection

Secondary data collection was acquired from search on past studies, reports, and articles. The data are divided into 3 groups which are physical and environmental, social and livelihood and economic data.

Physical and environmental data: necessary secondary data in this category are those relating to drought in Mekong River Basin and the study area. Examples include: geography; topography; Mekong water level; occurrence of extreme events and conditions of drought.

Social and livelihood data: Examples of secondary data in this category include: population; age; education; water uses.

Economic data: Examples of secondary data in this category include: income; employment (farmers, fishermen etc.); development activities within the study area and vicinities

The advice given by Bryman (2008, p.105) to caution about possible misleading information obtained from secondary literature sources has been well taken. The researcher thus paid careful attention on quality control of the information acquired, by using various methods whichever appropriate, such as trying to get the official published information which has been verified, getting same or similar data from different sources for comparison.

(2) Semi-structured interview

According to Bryman (2008, p.196), semi-structured interview referred to, *'. . . a context in which the interviewer has a series of questions that are in the general form of an interview schedule but is able to vary the sequence of questions. The questions are frequently somewhat more general in their frame of reference from that typically found in a structured interview schedule. Also, the interviewer usually has some latitude to ask further questions in response to what are seen as significant replies.'*

Brogaard and Xueyong (2002, p.221) also referred to the useful of using semi structured interview as *'Due to relatively open-structure of the interviews new issues of particular interest to the respondents could arise during interviews according to a semi-structured methodology'*

A semi-structured interview, designed in compliance with the above two definitions, was conducted in this study. Different checklists of questions were prepared for five categories of respondents: policy-makers; government officers; academics; NGO; and general public, totaling 45 people. Their names and brief details are listed in Appendix A. The pilot interview questions were tested for content validity with 10 volunteers. Some modifications were made after receiving feedback from the test.

Flexibility, as suggested in the above two definitions, enabled the researcher to obtain extensive information and data depending on the background and experiences of the respondents.

As indicated by several academics (e.g., Pratt, 2009), there is no definite rule on the number of interviewees. More important is whether it covers all likely stakeholders; and the above design does.

All interviews were conducted in Thai. They were tape and video recorded, note was also taken, and later typed in hard copies. All key information was also translated and summarized into an annotated English version.

(3) Non-participant Observation

Non-participant observation, as defined by Bryman (2008, p.257), is *'. . .a situation in which the observer observes but does not participate in what is going on in the social setting. Structured observers are usually non-participants in that they are in the social setting being observed but rarely participate in what is happening.'*

During the course of this study, I have conducted two non-participant observations. The first one was the public meeting which discussed about the Strategic Environmental Assessment (SEA) and the proposed construction of the Xayaburi Dam in Lao PDR. The meeting was convened at Chiang Khan District Office, by the Thai representatives of the MRC, on 10 February 2011. The second one was the inauguration meeting of the non-statutory Board of

Chiang Khan District. The meeting was convened by the Chiang Khan District, on 24 February 2011, where the board was inaugurated, the draft constitution was approved, and the administrative committees were elected.

(4) Participant Observation

Participant observation, as defined by Bryman (2008, p.697), is '*Research in which the researcher immerses him- or herself in a social setting for an extended period of time, observing behavior, listening to what is said in conversations both between others and with the fieldworker, and asking questions.'*

During this study, I conducted one participant observation, when I joined the training workshop for local people in Chiang Khan District. In this workshop, I immersed myself as one of the local resident who actively participated in the workshop.

The workshop was held on 26-27 February 2011 in Chiang Khan District which focused on public participation, capacity building, and local network building. It was organized by the Loei-Kong-Shee-Mun Program, Royal Irrigation Department. The objective was to prepare and strengthen the District's leaders, so that they are capable of identifying problems within their communities, and are capable of participating in the government's projects effectively.

During the workshop, the trainees were trained to prepare and analyze the seasonal calendar, mind maps, SWOT analysis. At the end of the workshop, the tentative strategic plan was prepared by the trainees based on the community-based information.

The experience gained from working with the Chiang Khan people was very instrumental in gaining insight into the in-depth understanding of these people and their adaptive capacity. This later proved to be very helpful in synthesizing the information in this thesis.

4.3 Role as a Researcher

The thesis was conducted during dry season, so it was suitable time to ask questions related to the drought. People were able to express their concerns based on the actual impacts that they faced at that moment as well as in comparison to the drought year (Year 2010). I as a Thai researcher with a formal Thai language sometimes had difficulties with the dialect of rural community. I was helped by local NGOs and the director of Loei Provincial Freshwater Fishery Station when conducting the interview with local fishers at the beginning of the field study.

Chapter 5 Results & Analyses

This chapter discusses the results of the study and their analyses, which have been synthesized from the result of the interview survey, selected previous studies, as well as my own observation. The discussion is presented, respectively, in response to all RQs posed in Chapter 1. While Section 5.1 presented an overview of human-environment interaction of the study area; Section 5.2 looked into the community's perception on likely causes of drought; Section 5.3, its impacts on community livelihood; and Section 5.4, adaptive capacity. The chapter is concluded with Section 5.5 which makes final analysis to identify community vulnerability.

5.1 Human-environment Interaction via Water Calendar

In general, the Chiang Khan community make beneficial uses of Mekong River in 3 major categories, as are found with most other water resources, i.e., (1) using the water while it is in Mekong River (e.g., fishery, transportation); (2) using the water by extracting it from Mekong River (e.g., irrigation, potable water supply production); and (3) using it to maintain ecological balance (Ratanachai, 1996, p.1)

The human-environment interactions of the Chiang Khan community during the dry season can be partially depicted in Fig. 8. It demonstrates how seasonal change of water level (which is dependent on water calendar pattern) influences community's livelihood. The community's livelihood activities have through the years been shaped to be in harmony with the seasonal change, which are herein denoted by water level fluctuation. While only fishery and agricultural activities are presented in this figure, other activities, such as transportation and tourism, may be included.

The top part of the figure displays the graphs of Mekong River water levels of the past five significant drought years, 1993, 1995, 2008, 2009 and 2010. It is noted that the significant drought years occurred more frequently in recent years. The period between mid-May and October is normally dominated by the southwest monsoon which brings with it heavy rainfall. The Mekong water level reaches its peak around August or September. Rainfall is low during the rest of the year, thus the water level starts to decrease sharply around November, and the actual dry season is observed during mid-January and early May (Adamson and Bird 2010, pp. 583-585). The figure illustrates selected fishers' and farmers' activities; such as Isok Barb's fishers catch Isok Barb annually around December to February which is its spawning period (Chatchawanchatree, 2011). The Isok Barb's complete life cycle is shown in the figure (ibid.). Farmers along the Mekong River bank can grow vegetable plants on the River bank and the floodplains for 3-4 crops annually, commencing when water level starts to decrease, around November.

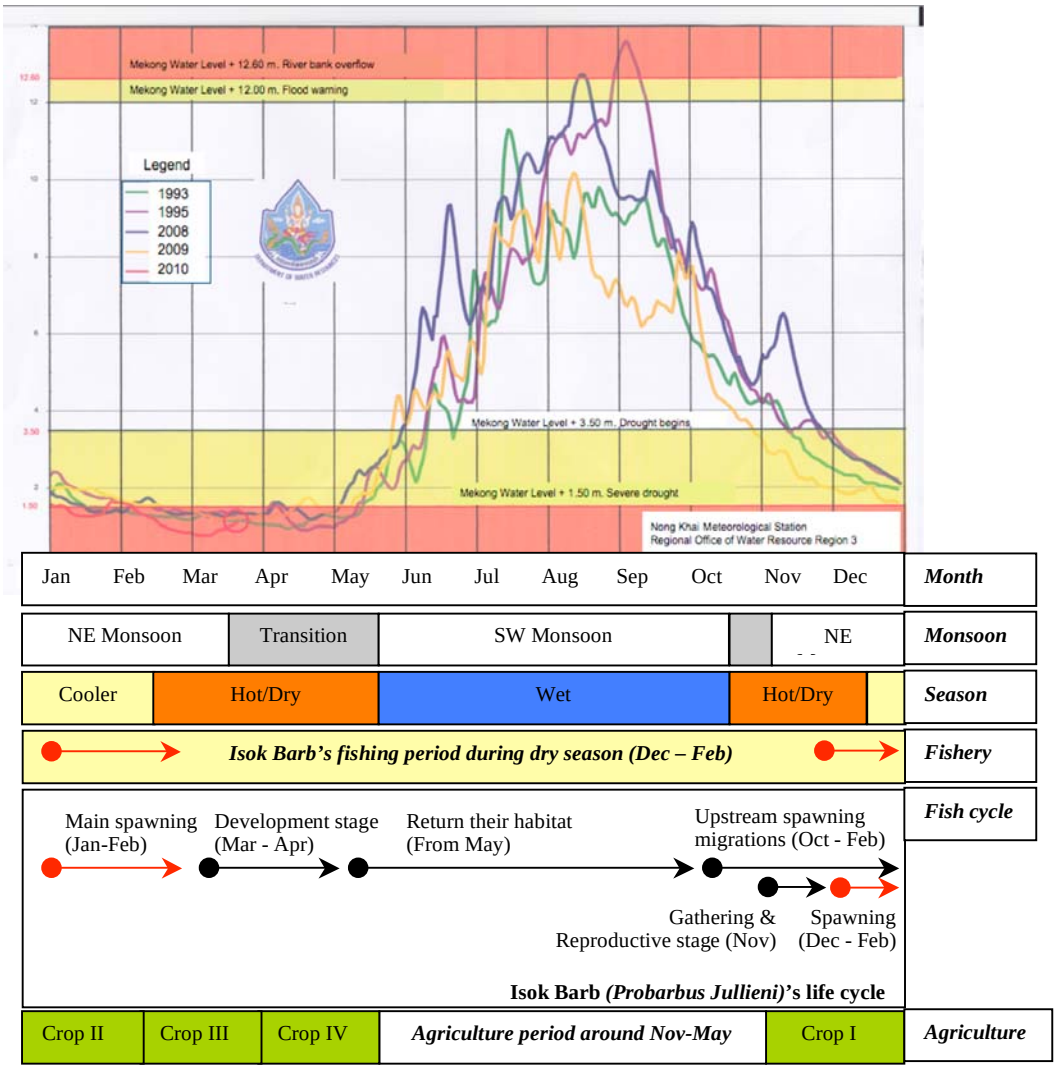


Figure 8 The Human-environmental Interaction of Chiang Khan Community Depicted via Water Calendar Based on Documentary and Field Studies.

Source: adapted from Gabrielsson et al., 2010; KKU, 2010; Adamson and Bird, 2010, p.583; MRC, 2011 and Chatchawanchatree, 2011

5.2 Community's Perception on Likely Causes of Drought in Mekong River

The study revealed that, though it may seem strange to some people to visualize the drought in the monsoon region, the droughts do occur in the LMB (Adamson and Bird, 2010, p.579). They can at times be very severe. In Thailand, drought is regarded as one of the natural disasters. MRC (2010b, p.121) reported that 63 of Thailand's 76 provinces were affected by droughts, and that some 9 million people suffered nationwide. It is interesting to note that, rural poor are much more directly affected by drought; as compared with urbanites. This is also supported by other findings (e.g., African Development Bank et al., undated).

To people in the LMB, droughts have in fact been part of their lives. Local people have very good knowledge about seasonal fluctuation of the Mekong River level. They know that Mekong River flow will dwindle between mid-January and early-May, thus always got prepared for it. It was the recent abnormality, such as the much lower than expected water levels or the drought which came unexpectedly early, which caused serious concerns and were viewed as disastrous to them and their livelihood.

With information acquired in this study, it is not possible to give a conclusive answer as to what caused the extreme drought in 2010. In other words, it cannot be proved beyond doubt that such an event was caused by the upstream cascade dams altering the Mekong River hydrograph, or naturally stochastic fluctuation, or effects of climate change. Some authors (e.g., Bryan et al., 2009; Kummu and Sarkkula, 2008; Stone, 2010) inclined to finger the cascade dams for the devastation, while others (e.g., Adamson and Bird, 2010) argued that it is likely a stochastic fluctuation. Hot debates between the two sides have been found in the media and literature:

> *. . . ones who blamed the cascade dam argued, 'the water level fluctuates about 60 centimeters in one day,' . . . while those who believed it was natural event said, 'China contributes only 16% of all water in Mekong River, therefore it cannot alter the amount of water in Mekong substantially.' . . . Then, the other side might argued back, 'Water from China is from snowmelt, thus comes during spring and dry season. Such natural contribution is important.'. . .*

At present, one can access the MRC website (MRC, 2011a) and obtain a series of graphs displaying water levels of the Mekong River at 11 monitoring stations, in Lower Mekong River, from Chiang Saen, northern Thailand, to Phnom Penh in Cambodia[5]. Liengcharoensit (2011), a respectable environmental engineering professor at Kasetsart University, Thailand, described these water level graphs as reasonably smooth. He cited, for example, the condition at Chiang Saen which is nearest to the upstream cascade dams. At the steepest slope, during

[5] Eleven hydrological monitoring stations are 1) Chiang Saen (Thailand); 2) Luang Prabang (Laos); 3) Chiang Khan (Thailand); 4) Vientiane (Laos); 5) Nakhon Phanom (Thailand) ; 6) Mukdahan (Thailand); 7) Kratie (Cambodia); 8) Pakse (Laos); 9) Stung Treng (Cambodia); 10) Kompong Cham (Cambodia); and 11) Phnom Penh (Cambodia).

11-12 December 2010, the water level rose about 1 m in 2 days. In this region, such a condition is not impossible after heavy rainfall onto the very steep upstream watershed (see Fig.4). Neither is it impossible that such a phenomenon could have been due to sudden discharge of the dam. The two upstream events (naturally massive runoff after heavy rainfall vs. sudden discharge of the dam) result in the similar scenarios downstream which are difficult to differentiate. More information about what happens upstream is needed in order to make conclusive judgment. With such limited information, therefore, there is not sufficient concrete evidence to put the upstream cascade dams under suspicion of altering Mekong hydrograph, and caused the extreme drought in 2010; neither that it can disprove accusation against China.

The information in Upper Mekong River is currently not available. Should this and other relevant meteorological data of the all MRB nations have been made available, it would have made analysis of the hydrological model more complete, thus reliable. It could then be proved more decisively whether the downstream flow behaved adhering to the natural rainfall/runoff relationship, or appeared to be regulated by the dams. There has been a lot of pressure from academics and international NGOs to have such information disclosed. Up to now, however, no progress has been made.

Such transparency is certainly necessary, especially for the transboundary river such as Mekong. The argument that dams can help regulating flow, i.e., delaying flow during flood and supplementing flow during droughts, sounds convincing (Adamson and Bird, 2010). It is however the question of governance. One can always question that China might establish the operating rule for the dam to regulate water the way they want, and often to serve their own priorities, especially in the advent of unexpected and undesirable events which may harm their citizen. The recent trend, possibly with an influence of climate change, has suggested that the flow of the Mekong River can be even more unpredictable, let alone extremity, in the future (Liengcharoensit, 2011). Without good explanation, one tends to finger China when problems occur downstream even when China does nothing wrong. It would in fact be beneficial to China to show sincerity by making information transparent, so as to avoid transboundary water use conflict.

In this regards, it is widely known that China prefers to enhance cooperation with the nations in ASEAN which include the riparian nations in the MRC. With proper diplomatic negotiation, and not treating Mekong as only water resource (Sneddon and Fox, 2006), I am optimistic that we will reach a compromised solution. In fact, the series of dams can be regulated so that multi-objectives can be reached, if so desired, i.e., the final dam can serve as the regulating dam (Ratanachai, 2011). This is only possible if diplomatic negotiation is successful, all information is disclosed, and all parties are allowed to monitor the dam operations. Until more information become available, which may enable the widely held suspicious accusation to be disproved beyond doubt, it should not be dropped from consideration.

At this point, we still have to conclude that, with information available today, the likely cause of drought remained inconclusive. Most academics I have consulted with have expressed similar opinions that it is still premature to drop any candidate suspects from consideration,

and we should, for the time being, assume that the likely cause is some combination of a seasonal stochastic fluctuation, the upstream cascade dams, and climate change (Hungsapruek, 2011; Liengcharoensit, 2011; Ratanachai, 2011).

5.3 Impact of Drought

The interplay among drought - impacts - adaptive capabilities - vulnerability found in this study seems to behave like the conceptual frameworks suggested by Tse-ring et al. (2010) and Smit and Wandel's (2006, p.288). The discussion in Sections 5.3-5.4 are thus based on such a framework. Section 5.3 (5.3.1 – 5.3.5) centers around various Impacts, while adaptive capacity and vulnerability are treated in Section 5.4. The discussion begins with the present situation at a local scale, as a point of departure. Thereafter, attempts will be made to predict likely scenarios in the larger (national and MRB) scale, as well as in the future, based on other relevant information.

5.3.1 Impact on Fishery

> *'If more dams are built in Mekong River in the future, fish won't just be decreasing; there will be no fish left at all.'*
>
> ... Buppa (2011), fisher

Most respondents have expressed similar concerns that the fish stock has been declining in recent years, especially in the dry seasons, fish stock appeared to be noticeably decreased as compared with what it used to be. Such phenomena have been supported by the routine surveillance conducted by the officers in local Office of Fishery who found that fish behavior has changed. It appeared to them that mating, thus spawning, of fishes have not taken place during the time (seasons) they used to do in the past. They postulated that it was due to the ecosystem alteration, which in turn caused habitat and food availability to change. Most observable recent changes have been rapid change in Mekong water level, more frequent and more severe droughts.

When asked specific question about the drought, most respondents articulated their thoughts that, though the droughts have been familiar to them, the recent droughts appeared to be more severe. Most respondents expressed their concerns that the abrupt changes of water level during the previous dry season were unnatural or abnormal. In some instances, the water level rose and fell abruptly in short time. Many believed that such phenomena were impacts of the cascade dams on upstream Mekong River; while some thought it was due to climate

change. Some academics believed that climate change may be the cause of abnormal fluctuation, as well as extreme conditions, of weather (Pleum-Kamon, 2011)

Nonetheless, regardless of causes of drought, most respondents, especially farmers and fishers, seem to agree that the droughts appeared to be more severe and unpredictable. Fish arrivals have been unpredictable. The fishers could not plan to catch the fish as they could in the past. This might be responsible for the decrease in number of fishers (those who fish as their primary occupation).

Many fishers interviewed expressed their serious worries that the droughts may get worse and affect their livelihood to the point that they have to change their occupation, and their way of life. That would be disastrous for them, since they do not have any other skills. Such worries are understandable knowing that these fishers have very limited adaptive capacity, especially with regards to their human and financial capitals (Ellis, 2000, as cited by Nelson et al., 2009, p.3). Some fishers have already adapted themselves by taking second jobs, mostly as unskilled farm labors.

Figure 9 Iensu or Isok Barb *(Probarbus jullieni)*
Source: LPOFF, 2010

Notable among all fishery resources is Iensu or Isok Barb[6] *(Probarbus jullieni)*. Iensu is a migratory fish species of very high scientific and social significance. Scientifically, it is listed in the IUCN Red list of Endangered Animals, as well as in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Appendix I. (MRC, 2010b, p.107; CITES, 2011). Socially, it is one of the most significant economic species in Mekong River. Hogan (2011, p.6) reported that, until 1989, Iensu in Mekong River was extremely abundant, and thereafter gradually dwindled. Such report agreed with Chatchawanchatree (2011) who confirmed that typical Iensu was found to be about 1.0 – 1.3 m., and weighed about 40 kg. The LPFFS's (2011) survey reported that typical Iensu caught during 2007 – 2011 weighed about 15-20 kg. According to the local respondents, Iensu meat is currently

[6] Iensu is the English common name. In some areas, the local name , "Isok Barb" is also used.

sold about US$3.30-4.30 per kg which is comparatively high by local standard. Fig.9 depicts a typical Iensu.

All Thai and Lao fishermen alike complains that fish stock of Iensu, which is usually found in the dry season (December - February), has greatly declined during the past several years. Besides, Iensu does not come during the 'normal' season as they used to. They seem to come in batches at unexpected time, making it more difficult to catch. Catches drop sharply (Hogan, 2011; LPFFS, 2011). Fortunately, price has increased making total income almost unchanged. According to local officers of Department of Fishery, this fish species is a good bio-indicator reflecting good water quality.

5.3.2 Impact on Agriculture along the Mekong River Bank

> *'Even vegetable planters have to be on the alert at all time, because they don't know when water will rise or fall. . . In the past, all they need to do was preparing plots then planted vegetables. Now they began to worry that their plots might be flooded anytime'*
>
> . . Kongpin (2010), The Mayer of Chiang Khan Tambon Municipality raised his voices after having received concerns from farmers

Agricultural practice along the Mekong River bank has historically been way-of-life of farmers who live along the Mekong corridor. The study showed that, under current situation, this group of people have not been much affected by drought. They have been quite capable to adapt to drought situation. In fact, most of them have managed to turn the *'lack of water resource'* into *'gain of fertile land resource'* for agriculture, thereby turning the *threat* into *opportunity.* They would make use of the flood plain which become available after the flood period, i.e., during November to May. Nutrient brought with sediments made this area highly fertile. Commonly found include long bean, garlic, lettuce, cabbage, chili pepper and tomatoes (Intra, 2011 and Kanjana-Komon, 2011).

The study showed that, in general, farmers along the Mekong River bank are experienced and highly adaptive farmers. A lot of local wisdom has been witnessed. They make advance planning, they know when they should plant if extended drought is anticipated. The study showed that their planning include: (1) Planting low water-demanding and shorter-lived plants such as vegetables, or other drought-tolerant plants; (2) Preparing reserve water resources such as shallow well and/or water containers; and (3) Preparing water pumps and pipes for drawing water from Mekong River.

Another reason which made these farmers more adaptive, hence less vulnerable, was because they possessed diversified capitals. To these farmers, agricultural practice along the Mekong

River bank usually serves only as secondary jobs providing additional income to them during the dry season (US$ 1,000 – 1,300 per 5 months' work depending on crops and market demand). Most of these farmers have mixed farms which typically include fruit trees and vegetable. Typical farmers in Chiang Khan are poor in terms of monetary income, but most of them have a little more than subsistence farming, i.e., they have at least a small piece of land for plants and occasionally small-scale animal husbandry.

Some problems, which could not be remedied, did exist. The abnormally sudden rise of Mekong water levels, experienced during the previous dry seasons, damaged their vegetable plots. Some farmers need to pay more for pumping costs—longer pipes and more energy needed. Most farmers, however, expressed concerns about the decrease of water level. They fear that the drought might get worsened, such as more prolonged and more severe (dryer), which could lead to plant disease and subsequently impair productivity.

Despite the above, I would be reluctant to conclude that, in the long term, these farmers will not be detrimentally affected by the droughts; especially in the advent of other changes in socio-economic, political and institutional settings over time, including climate change. These changes can affect the system's adaptive capacity and coping ranges (Smit and Wandel, 2006, p.287).

Besides, despite their high adaptive capability, the farmers began to worry noting a few recent extreme drought years which appeared to be more severe as well as more unpredictable. It should also be noted that some farmers are a little wealthier than others. There are some poor farmers who have no other pieces of land, thus limited adaptive capacity as compared with the wealthier farmers. They are vulnerable. Their livelihoods greatly depend on availability and predictability of these seasonal available floodplains.

5.3.3 Impact on Domestic Water Use (for potable water supply)

> *'The trend of water shortage in dry seasons is getting worse. We know that because we have been distributing more and more water, year on year. The way we tackle the problem now is only reducing, but not solving, the problem.'*
>
> . . Srisawong (2011), Deputy Head for Disaster Prevention & Mitigation, Chiang Khan District

Approximately 55% of Chiang Khan population (a little over 32,000 people) live in urban area and use potable water from Loei's Provincial Water Works Authority (PWWA). Loei's PWWA pumped raw water from Mekong River, purified it with a coagulation process, sand filtration and chlorination, and then distributed the water through the city's piping system.

The potable water supply system worked well for the past 20 years of its operation, until 2009. In 2010, the extreme drought year, Loei's PWWA encountered raw water shortage for the first time. The water supply could not meet demand during April 2010. The problem occurred so suddenly and unpredictably that they needed to solve the problem *impromptu* by dredging the river bed in order to acquire additional water supply (Yowa, 2011).

The remaining 45% of Chiang Khan population, on the other hand, rely on either deep ground water or shallow wells for their domestic water supply. They face water shortage every year. Water shortage a few weeks per year for deep groundwater users, and a few months per year for shallow well uses, during the dry season have become their ways of life. During such period, they receive water distributed to them by the Loei's Provincial Office of Disaster Prevention and Mitigation (PODPM) (Srisawong, 2011; Tansawad, 2011). Ironically, these more vulnerable groups of people are more capable to live with small amount of water distributed by trucks for extended period of time, as compared with the less vulnerable urbanites who have difficulty living without plenty of clean water for just a day. As above mentioned, the city had to go through massive dredging operation so as to meet their demand.

It is the responsibility of PODPM nationwide to pre-survey relevant information and, if needed, prepare the drought prevention and mitigation plans for all provinces. Loei is no exception. As a result of the survey, Chiang Khan District has been declared 'Drought-disastrous zone' almost every year during the past few decades, and water shortage has been more severe (Srisawong, 2011). The short- and long-term plans have been prepared which covered several issues, from providing alternative agricultural water supply, providing potable water supply.

Provision of potable water supply is a good example of adaptive measure subsidized by the government (in this case, through PWWA and PODPM). Thai Government places high priority in public sanitation and hygiene, therefore puts every effort in trying to reduce people's vulnerability to health hazard by providing clean water supply. Producing clean water, especially from low quality water available during the drought period, is an expensive operation. Without the Government's subsidy, only wealthy people have capacity to cope with it. To reduce vulnerability for public-at-large, the government intervention is necessary. After all, it is the responsibility of the decent government to provide their citizen with basic human right such as access to health care, sanitation and clean water (Sen, 1999, p.15)

5.3.4 Impact on Transportation

> *'Last dry season saw water level lowered more than ever in history. Lots of rocks surfaced making ship navigation difficult and dangerous. . . In the past, when water level lowered, ships managed to move. . . Now large ships have to call to a halt.'*
>
> … Jiarapong (2011) formerly engaged in truck delivery business along Mekong River

To the people in Chiang Khan, water transportation has been used primarily for transporting agricultural products and construction materials. There is no bridge across Mekong River in Chiang Khan District. Workers and general public occasionally commute between Thailand and Laos by boats. Import to Thailand through customs at Chiang Khan included timber, bamboo, sesame and hemp, valued approx. US$ 0.9 million. Export from Thailand valued approx. US$ 3.7 million (Chiang Khan, 2011).

From the interview, several transportation-related problems have been experienced by Chiang Khan residents during the drought. Boats and ships could be operated only through the deep navigating channel of Mekong River. The ferry operator had to deploy a buoyant deck so that ships could be parked; and had to build temporary roads so that pick-up trucks could be brought as close to the ships as possible, to facilitate cargo unloading. Labors for manually carrying cargos were on high demand; labor cost went up because of the increased hauling distance (Samatanares, 2011).

KKU's (2010) study reported that the drought in 2010 made the Mekong River so dry that mobility was enhanced, leading to incredible yet significant social impacts in several parts of the Mekong corridor, including labor movement from agricultural sector to industrial sector and drug trafficking. There is a ferry with an immigration office and a 'temporary control point' next to it. While the former operates as a normal immigration office, the latter can authorize both Thai and Lao residents who live near the border to temporarily cross border without passports.

During the drought, especially in the extreme drought years, illegal trespassers can cross Mekong River literally anywhere. Chiang Khan has approx. 60 km border with Laos, thus it is very difficult to patrol the border, especially at nights. An estimate of about 300-400 people have been smuggled across Mekong at Chiang Khan annually. Almost all of them continue their journey to Bangkok or other provinces. Thus far, this social impact, indirectly caused by the drought, cannot be remedied (Chiang Khan, 2011).

5.3.5 Impact on Tourism

> *'The beach at Kaeng Khud-Koo usually surfaces around March every year. Last year, it came a little early—in December, meaning the water level lowered earlier than usual. We had more visitors on the beach. Tourism-related activities are our secondary jobs, supplementing income for our families in the dry seasons.'*
>
> …Bussayapong (2011) Head, Chiang Khan District described the situation during the past dry season.

A wide variety of water-borne tourism in Mekong River is available. The smallest scale are small 5-10 passenger boats operated in the vicinity of cities; larger boats are served with cuisine. Luxury 100-200 passenger cruise ships along Mekong River are also available. The trend of number of tourists coming for the cruises are increasing (MRC, 2010b, p.194). The survey showed that these activities have been adversely affected by the drought. With limited navigation channel capacity available during the drought, these tourists' boats and ships have to give way to ships transporting construction materials and industrial products.

On one specific case, some residents see the droughts during the dry season as an opportunity (positive impact), as they can have more land available. An example is evidenced at Kaeng Khud-Koo, in Chiang Khan District, which refers to a very large piece of land—over 10 hectares—which surfaces only during the drought and forms a very large beach and become one of the most popular tourists' attractions within the area. Until recently, this seasonal beach had surfaced during March and April. Nowadays, the beach begins to be formed since December, or January at the latest.

At Kaeng Khud-Koo, vendors and community make use of the available land for setting up stalls for food and other goods; and it has become widely known tourists' resource during the droughts. The local government also stepped in to improve the landscape and necessary infrastructure. This is an exceptionally incredible example of how people adapt to cope with the drought. They do not see the drought as a problem; they earn benefit from it.

Being aware that the water level may unexpectedly rise, the vendors and community together develop the physical plan to identify as to where the stalls and tents should, and should not, be erected. Warning signs were posted near the River bank to alert the public as to where they should perform their activities with special caution. These precautionary measures have been very efficiently implemented. In fact, an incidence (of unpredictable and unnatural fluctuation of water level) did occur in the recent extreme drought years, and the damage, which would have otherwise been very detrimental, was prevented (Mater, 2011 and Wong-Art, 2011).

5.4 Adaptive Capacity

The discussion thus far showed that the community livelihood has been dreadfully impacted by the drought, such as depletion of fishery resource, reduction of water resource for agriculture, shortage of potable water supply. The situations have been quite severe in the extreme drought years.

In tackling with some of those impacts they have experienced through the years, people have developed their adaptive capacities at individual, household and community levels. Selected examples gathered from the study include:

1) *Individual level:* Fishers adjusted their fishing behavior. In the past, according to most farmers interviewed, fish arrivals almost always followed the lunar calendar. Given that fish arrivals have recently been (and likely to be so in the future) unpredictable, thus fishing cannot be properly scheduled. Fishers therefore put more time and efforts in fish surveillance. Some fishers who used to catch only large fishes have switched to catching smaller fishes including other aquatic animals such as prawn and shellfish (Khunsir, 2011 and Pongsa, 2011).

2) *Household level:* Fishers took secondary jobs in increase their income, so as to compensate with the loss, including planting vegetables on the River bank, working as unskilled labors carrying cargoes at the ferry, or selling products at the temporary market place in Kaeng Khud-Koo.

3) *Community level:* Fishers improved their fishing gears. New fishing-nets have smaller mesh size and selectively designed to suit with specific species of fish to be caught during each period (Meesuk, 2011 and Mapia, 2011). Though being aware that such practice is not environmentally sound, they had to do so to maintain amount of catches for their families' survival only during the hard times.

4) *Individual and household levels:* Farmers along Mekong River bank have been very creative and have adapted themselves in many ways as earlier mentioned; namely, using floodplains made available during drought, and planting low water-demanding and shorter-lived plants such as vegetable, or other drought-tolerant plants.

It is noted that individuals, households and even communities have very limited capitals, thus limited adaptive capacities with limited coping range. Fishers, for example, possess only skill in fishing (human capital). Most of them are rural poor, thus limited financial capital. At the time of drought, when their natural capital is impaired, there hardly be any alternative options as to what they can do. In other words, their livelihood is disastrously impacted. All their adaptation efforts have been centering around fishing techniques and fishing gears. They even did what they were aware that it would hurt them in a long run (employing fishing nets with smaller mesh). If not fishing, the next thing they can do is only working as unskilled labors.

The farmers are in a little better situation. They too are rural poor, thus limited financial capital. Their skills (human capital) are however more diversified; thus they can adapt better.

The adaptive capacities of both fishers and farmers seem to have been developed only at individual level, and to small extent at community level, thus coping ranges are limited.

As for the impacts on domestic water use, no adaptive capacity—neither individual's or community's levels—has been observed. Adaptation has been public sectors' effort. Similarly for the impact on transportation, no adaptive capacity at the individual's or community's levels have been observed. Adaptation has been the company's effort.

It is noted that Thai communities have in the past been used to being too dependent on the government. They relied on numerous governments' services including water resource management. As a result, the community as a whole become relatively weak, i.e., having low social capital. Paradoxically, local government agencies hardly have knowledge and skills in water resource management (Tipparos, 2011; Harnphachern, 2011).

The past several years, in some instances, have seen encouraging phenomena which reflect community's strength and self-reliance. Of specific interest which have been observed during this study was the Board of Chiang Khan District, which was formally established on 24 February 2011. I was fortunate to join their inauguration meeting.

This non-statutory Board is composed of 20 board members elected from various occupations, chaired by a very senior and respectable Chiang Khan resident. The Board plans to meet every 1-2 months to discuss, among other things, community's problems and issues, short-term and long-term planning, and relevant initiatives, including monitoring local and national government's projects and activities. From my observation during this study, this City Board seems to be very efficient and effective form of local public participation, which currently is at a very low level in Thailand (Arnstein, 1969). The Board meeting was attended by several active local residents, as well as local government staff. The discussion was very critical yet constructive.

The discussion in the meeting reflected community's intent for improving community's adaptive capacity to cope with the drought, especially that which seems to be beyond coping range of the individuals' and households'. This includes organizing necessary skill training (to improve human capital); improving the micro credit community bank (to improve financial capital). The Board itself will improve social capital by establishing and empowering the social network, which can help each other during trouble times. The Board also encourages establishing the long-term strategic plan for sustainable development of Chiang Khan, which will delve into the strength, weakness, opportunity and threats of Chiang Khan; and search for community's consensus how they want to shape their community.

From my observation, I have noted that the community leaders are enthusiastic and have good intention to work together for their community. This is a good sign of enhancing social capital, which in turn will improve community capability.

5.5 Community Vulnerability

The finding discussed thus far suggested that the drought did have impacts on people's livelihood; and that the rural poor, as opposed to urbanites, are the ones that were most impacted. The study also illustrated that different groups of people had different levels of capitals thus different adaptive capacities when exposed to drought. In the Chiang Khan community, fishers—who were most sensitive because their livelihood is inextricably bound to natural resource—had the least adaptive capacities, thus most vulnerable.

The Chiang Khan community conducted the SWOT (Strength-Weakness-Opportunity-Threats) analysis (Chiang Khan, 2011), and identified various *'capitals'* collectively existed in their possession. Those which are relevant to an issue of drought impact on community livelihood are listed below.

Human capital: Chiang Khan people's education are in general at par with the national average. The community nonetheless noted that university graduates have been decreasing. Fishers and farmers however have been well equipped with fishery know-how and agricultural know-how.

Financial capital: Apart from regular commercial banks, there are 2 important financial institutions which work closely with the community. They are the Bank for Agriculture and Agricultural Co-operatives, and the Micro-credit community bank. The former is the public bank with specific objective to strengthen farmers. The latter has been operating continually, healthily and efficiently for several years. It should be cautioned that the natural resource-based income is depleting, due to declining fish catches.

Natural capital: Once pristine wilderness, Chiang Khan's natural resources and environment are deteriorating. Forest land has been encroached by rubber plantation (Bussayapanpong, 2011). A lot of River bank erosion has been observed. Fishery resources in the Mekong River are declining.

Physical capital: Chiang Khan is well connected by decent roads to the rest of the country, as well as water-borne transport via the Mekong River. It has reasonably well operated water supply system and communication technology. There is sufficient land available per capita for agriculture.

Social capital: Chiang Khan is a typical Thai rural society where kinship, friendship, as well as neighborly relation, play very important roles. The Chiang Khan community tries to preserve the traditional way-of-life. The community is well bound together by tradition and culture. Majority of people regularly attend Buddhist Sabbath[7] (Kongpin, 2011; Bussayapanpong, 2011). Connection among NGOs' network is reasonably good. They discuss and exchange views and ideas, co-operate their works, particularly on Mekong issues (Wong-Art, 2011; Wongla, 2011). Public services (performed by both local and government agencies) have been reactive, without proper long-term planning. The assistance extended to

[7] Referring to the days Buddhists warship the Lord Buddha. They are defined by lunar calendar, four days a month: the days with full moon and dark moon; and two days with half moon.

drought-affected people was insufficient, and appeared to reach only selected group of people (in this case, the potable water users—the less vulnerable group).

Though only selected groups of the Chiang Khan community are severely impacted by the drought, they are part of the community. Besides, the impact on fishery is so severe that there are indications of fishers giving up their occupation. The fishers alone do not have sufficient capitals to cope with the impacts acted on them. Unless the community decides that it can survive without fishers, it has to extend assistance to reduce the fishers' vulnerability.

It is quite clear from the above analysis that the community cannot be very hopeful about the assistance obtained from the government in the advent of drought. They must find ways to empower themselves. An emerging non-statutory Chiang Khan Board appears to be promising.

Chapter 6 Conclusion & Recommendation

6.1 Conclusion

The study has managed to tackle the research question which addresses three issues posed at the outset. *Firstly,* it is concluded that, with information available today, the likely cause of drought is assumed to be a combination of seasonal fluctuation, the upstream cascade dams, and climate change.

Secondly, the study revealed that the drought significantly impact community livelihood in Chiang Khan, by imposing impacts on four key issues: fishery, agriculture along Mekong River bank, domestic water use; and transportation. Impact on fishery included declining of fish stock in recent years and unpredictable fish arrival. Notable among all fishery resources was the decline of Iensu or Isok Barb *(Probarbus jullieni),* the most significant migratory fish species of the region. Impact on agricultural practice along the Mekong River bank was less detrimental. Most farmers have managed to compensate themselves by making use of the flood plain which become available after the flood period. Some farmers faced the problems of abnormally sudden rise of Mekong water levels which damaged their vegetable plots. Impact on the potable water supply system occurred in the extreme drought year of 2010 for the first time, when the water supply could not meet demand during April 2010. The problem came so suddenly and unpredictably that they needed to solve the problem *impromptu* by dredging the river bed in order to acquire additional water supply. Impacts on transportation and tourism are comparatively minor, as compared with the aforementioned three.

Thirdly, the study remarked that different groups of people have different levels of capitals thus different adaptive capacities when exposed to drought. Fishers are have the least adaptive capacities, thus most vulnerable. Individual fishers have adjusted their fishing behavior, given unpredictable fish arrival, by putting more time and efforts in fish surveillance. At the community level, they improved their fishing gears mostly by using smaller mesh size and selectively designed to suit with specific types of fish to be caught during each period. The farmers along Mekong River bank have adapted themselves in many ways as earlier mentioned; namely, using floodplains made available during drought, and planting low water-demand and shorter-lived plants such as vegetable, or other drought-tolerant plants. It is noted that individuals, households and even communities have very limited capitals, thus limited adaptive capacities.

The study also discussed community vulnerability with regards to human, financial, natural, physical and social capitals; both under current situation and anticipated future.

6.2 Recommendation

The study indicated that some forms of adaptive capacities have been developed by local community—including fishers and farmers—at individual level, and to small extent at community level. Due to limited capitals (mostly financial and social capitals), their adaptive capacities are limited. The following are the ideas and recommendations aiming at improving the adaptive capacities, at community, national and MRC levels.

(1) Plan to achieve "Sustainable Livelihood for Chiang Khan Community" should be established. Chiang Khan can very well volunteer to be a model. Based on Scoones's (1998, p.4) framework, we have equipped with most information about 'context, conditions and trends' and 'livelihood resources', and can acquire more if needed. We have Chiang Khan Board which can serve as mediator among Chiang Khan people, local government officers, other relevant stakeholders, making use of the available information. Through appropriate public participation process, we should arrive at some workable set of objectives to ensure sustainable livelihood, such as 1) ***Poverty reduction,*** including minimum income guarantee, especially for fishers and farmers; 2) ***Improved adaptive capacities*** by improving all capitals as far as practicable, such as improving education and skills, improving local financial institutions, strengthening social network; 3) ***Systematic drought management plan*** by establish short- and long-term plans for dealing with drought.

(2) Mekong River has been reported to be *'. . . second only to the Amazon in terms of biodiversity importance, and is the most productive inland fishery in the world.'* (MRC, 2010b, p.75). The shocking news that some fishers decided to leave the occupation which has fed them for generations implied that the drought has severely threatened their livelihood. All involved parties—including governments—must make concerted efforts to maintain fishery sustainability which includes improving fishers' adaptive capacity. The measures should include improving their basic education and some special employable skills, establishing minimum income scheme for fishers (guaranteed and subsidized by respective governments). All available social capitals (government and non-statutory institutions) should be mobilized to help fishers. Recognizing importance of food security in the future, all tangible and intangible assistance to sustain fishers and fishery will prove to be extremely valuable in future. A long-term plan must be developed to protect and manage fishery resource and biodiversity.

(3) People who live along Mekong corridor are among the poorer, if not poorest, groups of each riparian nation. The goal and missions of the development strategies, programs and projects, should be place-based, and geared towards the sustainable livelihood of these people, and not just the overall benefit of the nations. Many families in this area live at subsistence level. Food and energy mean more to them than what is calculable in monetary term, to other higher income groups.

(4) There have been enough lessons from many failure stories of Mekong water resource mismanagement by fragmented watershed approach, where upstream and downstream nations not working together. It is time six riparian nations seriously teamed up and be more cooperative. Mekong is the transboundary river which must be jointly managed by all stakeholder nations. In fact, this approach was agreed upon in the MRC conference, on 11 March 2011, where the Chiang Mai Summary was declared,

> *'. . . International experiences have demonstrated the value of using "living river approaches" in watershed management aiming at maintaining ecosystem functions, such as providing flood protection, fisheries resources and water supply.*
>
> *Management of watersheds affects downstream areas, the cumulative effects of which in the Mekong River context potentially can lead to effects beyond national boundaries. Hence, regional collaboration in watershed and river basin management is critical'* (MRC, 2011b)

(5) The study showed that, while significance of socio-economic and ecological systems of Mekong has been repeatedly mentioned, very little important information is found in literature. For example, we should have had complete information about the uses of Mekong River water resource. As of now, even the most authoritative source of information, 'State of the Basin Report 2010' (MRC, 2010b), has to estimate number of people who live within 5 km, 10 km, 15 km, along Mekong corridor, and still cannot precisely estimate water quantity used, because the estimation was done with no relation to land use and occupation (Hungsapruek, 2011; Chirawate, 2011; Harnphachern, 2011; Ratanachai, 2011). Sneddon and Fox (2006, p.185) remarked that MRC has historically focused their attention too much on water resource and energy development aspects. There are now very efficient real-time flow monitoring stations along Mekong River (MRC, 2011a). Yet we know very little about the livelihood of the indigenous people of Mekong (Vorratnchaiphan, 2011). There is thus an urgent need to establish a comprehensive database which compile all types of information—engineering, environmental and socio-economic. It is the socio-economic information that is most lacking (Jufamanee, 2011). MRC (2010d as cited by MRC, 2010b, p.47-51) is currently conducting a basin-wide Social Impact Monitoring and Vulnerability Assessment (SIMVA) baseline for LMB, which will hopefully serve to fill such need. The climate change aspects will also be incorporated into the study.

REFERENCES:

Adamson P, and Bird J. 2010. The Mekong: A Drought-prone Tropical Environment?. International Journal of Water Resources Development. http://www.informaworld.com/smpp/title~content=t713426247 .[Accessed on 25 January, 2011].

African Development Bank et al. undated. Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation.

Al Jazeera. 2010. Mekong waters hit record low. Asia-Pacific news. Al Jazeera website. http://english.aljazeera.net/news/asia-pacific/2010/03/20103884320526422.html

Arnstein SR. 1969. A Ladder of Citizen Participation. Journal of the American Institute of Planners, **35**(4): 216-224.

Australian Bureau of Agriculture and Resource Economics – Bureau of Rural Science. 2010. Indicators of community vulnerability and adaptive capacity across the Murray–Darling Basin—a focus on irrigation in agriculture.

Bangkok Post. 2010. Mekong decisions need civil society input. News on 17 December 2010. http://www.savethemekong.org/news_detail.php?nid=175. [Accessed on 25 January, 2011]

Brogaard S, and Xueyong Z. 2002. Rural Reforms and Changes in Land Management and Attitudes: A case Study from Inner Monolia. China.Ambio. **3** (3):219-225.

Brogaard S. 2011. Personal Communication. Assistant Professor. Dr. in Physical Geography, Lund Uniersity.

Bryan T, Braun Y, and He D. 2009. Social impacts of large dam projects: A comparison of international case studies and implications for best practice. Journal of Environmental Management. **90**: S249–S257.

Bryman A. 2008. Social Research Methods.Third edition. Oxford University Press.U.

Bussayapong P. 2011. Personal Communication. Head, Chiang Khan District.

Chambers R, and Conway G. 1991. Sustainable rural livelihoods: practical concepts for the 21st century. IDS Discussion Paper no. 296, Institute of Development Studies, University of Sussex, Brighton, UK.

Chatchawanchatree T. 2011. Personal Communication. Director of Loei Provincial Freshwater Fishery Station, Chiang Khan District, Loei, Thailand.

Chiang Khan. 2011. Summary report of Chiang Khan District. Loei Province. 25 January 2011. (in Thai)

Chirawate S. 2011. Personal Communication. Senator & Chair of Thai Senate Sub-committee on Water Resources. Thailand.

CITES. 2011. CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) website. http://www.cites.org/eng/app/appendices.shtml [Accessed on 20 February, 2011]

Cronin R. 2009. Mekong Dams and the Perils of Peace. Survival **51**: 147-160.

Elasha BO, Elhassan NG, Ahmed H, and Zakieldin S. 2005. Sustainable livelihood approach for assessing community resilience to climate change: case studies from Sudan. AIACC Working Paper No.17 August 2005. www.aiaccproject.org.

Ellis F. 2000. Rural Livelihoods and Diversity in Developing Countries. Oxford: Oxford University Press. 296.

Gabrielsson S, Brogaard S, Alkan-Olsson J, and Olsson L. 2010. Seasonal patterns of climate vulnerability and adaptati on in the Lake Victoria basin: Identifying needs and opportunities using a multi-stakeholder approach. Poster. Centre for Sustainability Studies. Lund University. Sweden.

Global Geopolitics & Political Economy. 2010. SOUTH-EAST ASIA: Thailand Faces Flak for Backing Mekong Dams. Geopolitical and Economic News and Analysis. http:// globalgeopolitics.net/wordpress/2010/07/29/south-east-asia-thailand-faces-flak-for-backing-mekong-dams/. [Accessed on 25 January, 2011].

Harnphachern R. 2011. Personal Communication. Director of RDI, Khon Kaen University, Thailand.

Hogan Z. 2011. Imperiled Giant Fish and mainstream dams in the Lower Mekong Basin: Assessment of current status, threats, and mitigation. University of Nevada, Reno. USA.

Hungsapruek S. 2011. Personal Comunication. Ex-Director General, Department of Water Resources. Thailand.

International Fund for Agricultural Development (IFAD). 2011. The Sustainable Livelihoods Approach. http://www.ifad.org/sla/index.htm [Accessed on 13 May, 2011]

Intra C. 2011. Personal Communication. Head of Chiang Khan District Agricultural Office.

Jiarapong S. 2011. Personal Communication. Portable water user and formerly engaged in truck delivery business along Mekong River. Chiang Khan District.

Jufamanee P. 2011. Personal Communication. A Senior officier of Department of Water Resources, the Thai representatives in MRC.

Kanjana-Komon S. 2011. Personal Communication. Farmer on Mekong River Bank. Chiang Khan District.

Kasetsiri C, and Khamkhun A. 2000. The Mekong: from Dza Chu – Lancang – Tonle Thom to Cuu Long. Toyota Thailand Foundation. Thailand. (in Thai)

Khon Kaen University. 2010. Mekong Water Crisis project. Draft report. Research Development Institute. Khon Kaen University. (in Thai)

Khunsir S. 2011. Personal Communication. Fisher & Farmer on Mekong River bank and Chair of Mekong River Fishers Group (Chiang Khan). Chiang Khan District.

King Mongkut University of Technology at Ladkrabang. 2011. Conservation of old houses community in Chiang Khan District. Faculty of Architecture, King Mongkut University of Technology at Ladkrabang. Bangkok. (in Thai)

Kirby M, Krittasudthacheewa C, Mainuddin M, Kemp-Benedictc E, Swartz C, and de la Rosa E. 2010. The Mekong: a diverse basin facing the tensions of development. Water International. Routledge. **35** (5): 573-593.

Kongpin K. 2011. Personal Communication. Mayor of Chiang Khan Tambon Municipality, Chiang Khan District.

Kummu M, and Sarkkula J. 2008. Impact of the Mekong River flow alteration on the Tonle Sap flood pulse. Ambio. **37**: 185–192.

Liengcharoensit W. 2011. Personal Communication. Associate Professor in Environmental Engineering. Kasetsart University, Bangkok, Thailand.

Loei Provincial Office of Freshwater Fishery (LPOFF). 2010. Annual field survey report. Provincial Office of Freshwater Fishery. Loei. (in Thai)

Loei Provincial Freshwater Fishery Station (LPFFS). 2011. Survey for Conservation of Iensu 2007-2011. Loei Provincial Freshwater Fishery Station. Loei. (in Thai)

Mainuddin M, and Kirby M. 2009. Spatial and temporal trends of water productivity in the lower Mekong River Basin. Agriculture Water Management **96**: 1567-1578.

Map of Thailand. 2011. Tourist Map of Loei Province. http://www.mapofthailand.org/tag/loei-city-map/ [Accessed on 3 May, 2011]

Mapia S. 2011. Personal Communication. Staff of Loei Provincial Freshwater Fishery Station, Chiang Khan District.

Mater J. 2011. Personal Communication. Tour business operator. Chiang Khan District.

Meesuk S. 2011. Personal Communication. Fishers and Staff of Loei Provincial Freshwater Fishery Station, Chiang Khan District.

Mekong River Commission. 2010a. First MRC Summit & International Conference. Hua Hin. Thailand. 2-5 April 2010. http://www.mrcsummit2010.org/index.html [Accessed on 25 January, 2011]

Mekong River Commission. 2010b. State of the Basin Report. 2010.

Mekong River Commission. 2010c. Strategic Environmental Assessment (SEA) of hydropower on the Mekong mainstream.

Mekong River Commission. 2010d. Social Impact Monitoring and Vulnerability Assessment (SIMVA). Regional report and database (draft report).

Mekong River Commission. 2011a. MRC website on water level report. http://www.mrcmekong.org/water-level/chiang-khan.htm. [Accessed on 3 March 2011].

Mekong River Commission. 2011b. MRC website on Chiang Mai summary. www.mrcmekong.org/MRC.../Chiangmai-Summary-9-11mar11-final.pdf [Accessed on 13 March 2011].

Nelson R et al. 2009. The vulnerability of Australian rural communities to climate variability and change: Part II—Integrating impacts with adaptive capacity. Environ. Sci. Policy. doi:10.1016/j.envsci.2009.09.007.

Pacific Disaster Center. 2011. Pacific Disaster Center website. http://www.pdc.org/iweb/drought.jsp?subg=1 [Accessed on 27 April 2011].

Peduzzi P, Dao H, Herold C, and Mouton F. 2009. Assessing global exposure and vulnerability towards natural hazards: the Disaster Risk Index. Nat. Hazards Earth Syst. Sci., **9**: 1149–1159. www.nat-hazards-earth-syst-sci.net/9/1149/2009/

Pleum-Kamon W. 2011. Personal Communication. Director of Water and Environment Institute, Faculty of Engineering, Khon Kaen University, Thailand.

Pongsa S. 2011. Personal Communication. Fisher & Farmer along Mekong River bank. Chiang Khan District.

Pratt MG. 2009. From the Editors for the Lack of a Boilerplate: tips on writing up (and reviewing) qualitative research. Academy of Management Journal. **52** (5): 856–862.

Ratanachai C. 2011. Personal Communication. Associate Professor in Environmental Engineering. Prince of Songkla University, Hat Yai, Thailand.

Ratanachai C. 1996. Water Quality Management. Bangkok: Chulalongkorn Press. (in Thai).

Samatanares W. 2011. Personal Communication. Deputy Head for Rural Area, Chiang Khan District.

Schröter D. 2005. Vulnerability to Changes in Ecosystem Services. CID Graduate Student and Postdoctoral Fellow Working Paper No. 10. Cambridge, MA: Science, Environment and Development Group, Center for International Development, Harvard University.

Schröter D and the ATEAM consortium. 2004. Global change vulnerability – assessing the European human-environment system. Potsdam Institute for Climate Impact Research. unfccc.int/files/meetings/workshops/other_meetings/ application/pdf/schroeter.pdf.

Scoones I. 1998. Sustainable Rural Livelihoods: A Framework for Analysis. IDS Working Paper 72. Institute of Development Studies.

Sen A. 1999. Development as Freedom. London: Oxford University Press.

Smit B, and Wandel J. 2006. Adaptation, adaptive capacity and vulnerability. Global Environmental Change. **16** 282-292.

Sneddon C, and Fox C. 2006. Rethinking transboundary waters: A critical hydropolitics of the Mekong basin. Political Geography. **25:**181-202.

Srisawong W. 2011. Personal Communication. Deputy Head for Disaster Prevention & Mitigation, Chiang Khan District.

Stone R. 2010. Severe Drought Puts Spotlight on Chinese Dams. Science. **327**:1311. www.sciencemag.org [Accessed on 25 January, 2011]

Sunchindah A. 2005. Water Diplomacy in the Lancang-Mekong River Basin: - Prospects and Challenges. presented in Workshop on the Growing Integration of Greater Mekong Sub-regional ASEAN States in Asian Region. Yangon, Myanmar. 20 – 21 September 2005.

Tansawad S. 2011. Personal Communication. Portable water user and souvenir shop operator. Chiang Khan District.

Tipparos S. 2011. Personal Communication. Former Director of Loei Education Region, and Chair of Board of Chiang Khan Community (non statutory), Chiang Khan District.

Tourism Authority of Thailand (TAT). 2011. Conservation of Chiang Khan community way-of-life for sustainable tourism. Tourism Authority of Thailand. Bangkok. (in Thai).

Tse-ring K, Sharma E, Chettri N, and Shrestha A. (eds.). 2010. Climate Change Impact and Vulnerability in the Eastern Himalayas – Synthesis Report. International Centre for Integrated Mountain Development. Kathmandu. Nepal.

Turner II BL et al. 2003a. A Framework for Vulnerability Analysis in Sustainability Science. Proceedings of the National Academy of Sciences of the United States of America. Vol. 100. **14.** pp. 8074-8079. http://www.jstor.org/ stable/3139882 [Accessed on 25 January, 2011].

Turner II BL et al. 2003b. Illustrating the Coupled Human-Environment System for Vulnerability Analysis: Three Case Studies. Proceedings of the National Academy of Sciences of the United States of America. **100** (14**):** 8080-8085. http://www.jstor.org/stable/3139883 [Accessed on 25 January, 2011].

UN/ISDR. 2007. Drought Risk Reduction Framework and Practices: Contributing to the Implementation of the Hyogo Framework for Action. United Nations secretariat of the International Strategy for Disaster Reduction (UN/ISDR), Geneva, Switzerland.

Vietnam National Mekong Committee (VNMC). 2011. The Mekong River Basin Map. http://www.vnmc.gov.vn/Images/map.gif .[Accessed on 30 April 2011].

Vorratnchaiphan CP. 2011. Personal Communication. Senior Director, Thailand Environment Institute, Bangkok, Thailand.

Wang A. 2010. Rising Tensions In Mekong Basin. Business Monitor International. http://www.marketresearch.com/vendors/viewVendor.asp?VendorID=304 [Accessed on 15 November, 2010].

Wilhite DA, and Glantz MH. 1985. Understanding the drought phenomenon: The role of definitions. Water International. **10:**111-120.

Wong-Art K. 2011. Personal Communication. NGO “Rak Thin Thai Loei Group”. Chiang Khan District.

Wongla C. 2011. Personal Communication. NGO and Chair of Board of Chiang Khan Tambon Municipality Community (non statutory).

World Bank. 2011. Thailand Map. Map Design Unit of the World Bank. http://www.worldbank.or.th/WBSITE/EXTERNAL/COUNTRIES/EASTASIAPACIFIC

EXT/THAILANDEXTN/0,,menuPK:333304~pagePK:141132~piPK:141121~theSitePK:333296,00.html [Accessed on 28 April, 2011].

Yin RK. 2009. Case Study Research, Design and Methods. SAGE Publications, Inc.

Yowa S. 2011. Personal Communication. Engineer, Regional Potable Water Work Authority: Chiang Khan Branch.

APPENDIX A : List of Interviewees:

No.	Name	Position/Role in the community
1)	Dr. Siripongse Hungsapruek	Ex-Director General, Department of Water Resources (Interviewed 15 February 2011)
2)	Hon. Surajit Chirawate	Senator & Chair of Thai Senate Sub-committee on Water Resources (Interviewed 10 February 2011)
3)	Dr. Chamniern Paul Vorratnchaiphan	Senior Director, Thailand Environment Institute (Interviewed 31 January 2011)
4)	Mrs. Phakawan Jufamanee	A senior officer of Department of Water Resources who heads the Thai representatives in MRC (Interviewed 28 January 2011)
5)	Assoc. Prof. Dr. Chatchai Ratanachai	Assoc. Prof. in Environmental Engineering, Prince of Songkla University (Consulted regularly)
	RDI (Research Development Institute) Team Mekong water crisis project, 2010	
6)	Miss Chutima Mekwan	RDI researchers, Khonkaen University (Interviewed by phone 25, 26 February 2011; then in person 1,2 February 2011)
7)	Mr. Dilok Sarawadee	RDI researchers, Khonkaen University (Interviewed by phone 25, 26 February 2011; then in person 1,2 February 2011)
8)	Assoc. Prof. Wichien Pleum-Kamon	Director of Water and Environment Institute, Faculty of Engineering, Khon Kaen University (Interviewed 2 February 2011)
9)	Assoc. Prof. Sunee Leopenwong	Director of Research Center for Mekong Regional Tourism (ReCMeRT), Khon Kaen University (Interviewed 4 February 2011)
10)	Dr. Kaewta Chandranusorn	Center for Research on Plurality in the Mekong Region, Faculty of Humanity, Khon Kaen University (Interviewed by phone 4 February)
11)	Assoc. Prof. Dr. Rawee Harnphachern	Director of RDI, Khon Kaen University, who was the head of Mekong water crisis project in 2010 (Interviewed 24 February 2011)

No.	Name	Position/Role in the community
	Stakeholders at the Study Area, 1. Local Government officers	
12)	Mr. Pisut Bussayapanpong	Head, Chiang Khan District (Interviewed 21 February 2011)
13)	Mr. Kamol Kongpin	Mayor of Chiang Khan Tambon Municipality, Chiang Khan District (Interviewed 21 February 2011)
14)	Mrs. Saowapa Wongla	Deputy Mayor of Chiang Khan Tambon Municipality (Interviewed 22 February 2011)
15)	Mr. Winai Samatanares	Deputy Head for Rural Area, Chiang Khan District (Interviewed 21 February 2011)
16)	Mr. Wasan Srisawong	Deputy Head for Disaster Prevention & Mitigation, Chiang Khan District (Interviewed 21 February 2011)
17)	Mr. Surachai Meesuk	Staff of Loei Provincial Freshwater Fishery Station, Chiang Khan District (Interviewed 22 February 2011)
18)	Mr. Somkiat Mapia	Staff of Loei Provincial Freshwater Fishery Station, Chiang Khan District (Interviewed 22 February 2011)
19)	Mrs. Chantana Lekha-Watana	Head of Hydrological Office Region 8, Chiang Khan District (Interviewed 23 February 2011)
20)	Mr. Theerachai Suriyabutr	Field Technician, Hydrological Office Region 8, Chiang Khan District (Interviewed 23 February 2011)
21)	Mr. Jan Sareesingha	Head of Field Technicians, Hydrological Office Region 8, Chiang Khan District (Interviewed 23 February 2011)
22)	Mr. Chamnarn Intra	Head of Chiang Khan District Agricultural Office (Interviewed 24 February 2011)
23)	Mr. Thanawat Chatchawanchatree	Director of Loei Provincial Freshwater Fishery Station, Chiang Khan District (Interviewed 24 February 2011)

No.	Name	Position/Role in the community
24)	Mr. Sudsakorn Suwanasingha	Head, Sub-district 1, Chiang Khan Village, Chiang Khan District (Interviewed 24 February 2011)
25)	Mr. Suwanchai Senaphrom	Head, Chiang Khan Village, Chiang Khan District (Interviewed 26- 27 February 2011)
26)	Mr. Seksan Yowa	Engineer, Regional Potable Water Work Authority: Chiang Khan Branch (Interviewed 1 March 2011)
	2. Non-Government Organisation	
27)	Mr. Sutep Tipparos	Former Director of Loei Education Region, and Chair of Board of Chiang Khan Community (non statutory) (Interviewed 21 February 2011)
28)	Mr. Chanarong Wongla	NGO and Chair of Board of Chiang Khan Tambon Municipality Community (non statutory) (Interviewed 22 February 2011)
29)	Mr. Kan Wong-Art,	NGO "Rak Thin Thai Loei Group" (Interviewed 26-27 February 2011)
	3. Local people: fisherfolks and farmers along Mekong River	
30)	Mr.Sutas Khunsir	Fisher & farmer on Mekong River bank and Chair of Mekong River Fishers Group (Chiang Khan) (Interviewed 22 February 2011)
31)	Mr.Song Pongsa	Fisher & farmer along Mekong River bank (Interviewed 22 February 2011)
32)	Mrs.Nhan	Fisher & farmer on Mekong River bank (Interviewed 22 February 2011)
33)	Mr. Udorn Ruendam	Fisher (Interviewed 22 February 2011)
34)	Mr. Songkrant Tasri	Fisher (Interviewed 22 February 2011)

No.	Name	Position/Role in the community
35)	Mrs. Thongdee Chantapang	Farmer on Mekong River bank (Interviewed 22 February 2011)
36)	Mr. Chate Meesri	Fisher Kaeng Khud-Koo (Interviewed 22 February 2011)
37)	Mr. Sak	Fisher Kaeng Khud-Koo (Interviewed 22 February 2011)
38)	Tao Gu Maliwong	Lao Fisher, Ban Kaeng Mai, Vientiane, Sanakam, Lao PDR (Interviewed 25 February 2011)
39)	Tao Kreu Raj-Sima	Lao Fisher, Ban kaeng Mai, Vientiane, Sanakam, Lao PDR (Interviewed 25 February 2011)
40)	Mrs. Paeng Raj-Sima	Lao Fisher, Ban kaeng Mai, Vientiane, Sanakam, Lao PDR (Interviewed 25 February 2011)
41)	Tao Mangkorn Buppha	Lao Fisher, Ban Pha Lad, Sanakam, Lao PDR (Interviewed 25 February 2011)
42)	Mrs. Saa-Uen Kanjana-Komon	Farmer along Mekong River bank (Interviewed 28 February2011)
	4. Others	
43)	Mrs. Jiraporn Mater	Tour business operator (Interviewed 22 February 2011)
44)	Mr. Seri Tansawad	Potable water user and souvenir shop operator (Interviewed 1 March 2011)
45)	Mr. Somwongs Jiarapong	Potable water user and formerly engaged in truck delivery business along Mekong River (Interviewed 2 March 2011)

APPENDIX B: Interview Questions

The following is a list of questions used as guides for the interview. The questions center around exposure, water sensitivity (water dependence), impacts and adaptive capacities. They are meant to guide the discussion along the frame set by the RQs. In the actual discussion, there were several more follow-up questions which led to much more in-depth answers.

1. Farmers and fishers

1) What types of beneficial uses have you been making from Mekong River during the dry seasons?
2) Have the droughts had any impacts on your livelihood during the dry seasons?
3) Have the lowering of water level in the past ten years appeared to be natural? Please elaborate.
4) Please compare the droughts and impacts between normal years and Year 2010 when it was the extreme drought year. Were they much different?
5) How have the droughts that you have experienced in the past affected your livelihood?
6) Have you had to make any adaptation in performing your principal job? What have you done?
7) How have you prepared yourself in the drought years?
8) How have the droughts that you have experienced in the past affected your family, your household?
9) Have you had to make any adaptation at the household level? What have you done?
10) How have the community responded to the impacts of the droughts?
11) Have there been any agencies and/or someone stepped in to help you? What and How did they help? Were they sufficient? If not sufficient, what kind of help and how much help do you want?
12) What do you think the droughts will be like in the future? How do you think it will affect livelihood? And how should we adapt ourselves to deal with the impacts?
13) Do you have any suggestion? Recommendation? Additional remarks? Comments?

2. Local government

1) What kinds of help have you given to the people during the droughts?
2) Which professions (occupation groups) are most vulnerable? Which are second most vulnerable? Why? Have you paid special attention to these vulnerable groups? How?
3) Are there any short-term plan and long-term plan for drought mitigation within the area? Are there any problems/obstacles in the plan implementation? Please elaborate.
4) Has the problem solving in the past satisfied the community's need? And How? Have you received any complaints/recommendations from public about the help they want?
5) Do any external agencies come to help mitigating the problems?
6) Do you have any suggestion? Recommendation? Additional remarks? Comments?

3. Academics

1) In your opinion, what were the causes of the extreme drought in 2010 which resulted in the record low of the Mekong River?
2) What were the impacts on people's livelihood? How much?
3) How have the community adapted themselves when confronting with the droughts? Especially in the year 2010?
4) How should the community prepare themselves in the advent of drought?
5) Which government agencies do you expect to come and assist community in the advent of drought? What kind of help do you expect from them?
6) What are the key problems and obstacle in tackling drought problem in the Mekong region in Thailand?
7) How do you see the trend of the problem? Is it going to be more severe? If so, how much more? And how should we prepare?
8) Are there any issues that we need more studies?
9) Do you have any suggestion? Recommendation? Additional remarks? Comments?

4. Policy makers

1) What is your view regarding the drought in Mekong River? Please give your opinion on the causes; the problems; and the impacts on community livelihood?
2) How should we go about and solve the problem? What should we do?
3) Please tell us about the drought problem in the area along Mekong River corridor, and specifically in Chiang Khan, as you perceived, in the past, present and future.
4) What is the future plan for Thailand? For Mekong River corridor? For Chiang Khan?
5) Do you have any suggestion? Recommendation? Additional remarks? Comments?