



Gender Perspectives on Adaptive Behaviors
of Fishing Households:

The Effects of Climate Change in Stung Treng, Cambodia

December 2011

The views expressed in study are those of the authors and are not necessarily reflective of the supporting partners

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EXECUTIVE SUMMARY

Climate Change as discourse has now become a key factor when discussing impacts to livelihoods and resources in developing countries. Not all people will be affected equally in a region by climate change. Climate change will have differential impacts on different social groups under specific geographical conditions with varying levels of dependency on natural resource stocks. The degree of vulnerability of these groups, their resulting levels of poverty and their adaptive capacities will combine to determine the severity of impacts of system changes as a result of increased climate variability in conjunction with other social, cultural, economic or environmental change agents.

This study looks at the social-ecological resource systems of two *Community Fisheries* in Stung Treng Province, Cambodia and began to assess the impacts of climate change on livelihoods, gendered activities and to outline key concerns and possible research and development actions to be taken in the future. This is a case study approach using different PRA tools and to synthesize the results into broader concepts such as linked *social-ecological systems, wicked problems and Ecosystem-based Fisheries Management*.

Climate change as a long term influence on livelihoods is poorly understood by the target groups. They have noticed changes, with an increase in temperature, increased erratic rainfall patterns with longer duration floods. Climate change is not seen as an important factor in their lives, but they do recognize the potential for increased hardships if flood-drought intensity.

Results showed that the high price of cassava, and to some extent rubber, is causing a movement of locals and migrants into either growing cassava or working as wage labor in economic land concessions in cassava. This is a short-term cash-based buffer to any negative impacts occurring. The key concerns are floods and droughts, with droughts being more important. Hot dry weather may lead to more animal deaths. The amount of fishing has declined because *catch per unit effort* is poor and there is more money in working with cassava. There is also local concern with over-restrictive fishing regulations further adding to reduced catch of preferred species.

Gender divisions on tasks/roles seem to be breaking down with both men and women doing all tasks including wage labor when beneficial to the household. Men are still primarily involved in fishing and farming (physical tasks) with women looking after household management and marketing, but these boundaries are fuzzy, especially with female-headed households. All members of the family work towards household sustainability. Neither gender expresses distinct climate related perceptions. A major concern by both genders is any relationship between warmer and/or wetter weather and increased livestock/poultry deaths. This will require more research and veterinarian work.

It will be important for any future work on poverty reduction in these types of natural resource dependent communities, undergoing quite profound changes, to begin with a better understanding of local perceptions and relationships concerning environmental and natural resource change. This requires better understanding of human agency and subsequent behaviors leading to more relevant and inclusive vulnerability assessments and hopefully to more *fair and equitable* climate change policies and actions for the rural resource users of Cambodia.

INTRODUCTION

Throughout the developing world the real and potential impacts from climate change (CC) have now become critical elements influencing the wider rural development discourse. The argument to whether these climatic “change events” is part of very long term natural, global process or is recently man-made, or some complex combination is now moot. These changes are happening now and 7 billion people, mostly located within 100 km of vulnerable developing countries coastlines and riparian zones will need to alter their livelihoods and living patterns or be prepared to undertake *environmental migrations*. The potential impacts of climate change for example, an increase in air and water temperatures, changing precipitation patterns, increase in the frequency and magnitude of extreme weather events, may leave long term negative effects on many sectors. The history of climate change in Cambodia shows that the climate has changed since 1960 in terms of rainfall patterns (more erratic) and temperature (general increase), and will continue to change according to greenhouse gas emission scenarios. Climate change is not happening in isolation, but is coinciding with many additional internal and external social and ecological stresses on livelihoods. This will intensify the challenges that natural resources dependent people and their communities will face given that their livelihoods, mainly agriculture, forests and fisheries, are sensitive to climate alterations. These communities are also made more vulnerable from the lack of adaptive capacity to changing climate and social conditions (UNDP 2010; Keskinen et al. 2010). Climate change scenarios for the Mekong region predict that by 2030 basin wide temperatures will have increased by of 0.79oC coupled with increased wet season precipitation. Critical impacts throughout the basin may include an increase in wet season flooding as well as increased variability and severity of drought. Cambodia is seen as *very vulnerable* not because of any one severe climate alteration or increased frequency of events, but due to its heavy reliance on agriculture and natural resource systems coupled with an overall low adaptive capacity (Geres 2009).

Societies throughout the world consist of gendered differences in lifestyles, access to resources, and **perceptions** of vulnerability to climate change (UNDP 2010). It is crucial to take into account the differential coping and adaptation strategies of both men and women in affected and vulnerable groups as climate change will challenge people's livelihoods in both the medium and longer terms. Climate change may have different impacts on men and women, so changing their roles or tasks in fishing communities. Women in rural communities in developing countries including Cambodia are more vulnerable to the climate change effects due to their poor access to resources, restricted rights, mobility, lack of education and access to information, and their lack of influence

“Cambodia’s population and economy are highly vulnerable to climate change. Food security is already a major concern in Cambodia, where 25 percent of the population suffered from undernourishment in 2004-2005, a higher proportion than in neighboring Southeast Asian countries (Shicavone 2010).¹ Some 80 percent of Cambodia’s population is rural and agriculture accounts for 35 percent of GDP (World Bank 2009). Two thirds of Cambodia’s population is economically dependent on agriculture (FAO 2010; Shicavone 2010), and most farmers are poorly equipped to adapt to climate change (Royal Government of Cambodia 2006)” (p. 1 Magnan and Thomas 2010)

in decision making within households and communities. Climate change will likely place more responsibilities and a higher work load on rural women. Men and women have different responsibilities and decision making positions within households and communities. They will then have different roles in their communities, use different resources, and have different perceptions of needs. This may lead to different gender-based coping strategies to ensure household sustainability in the face of climate change or other impacts. This research will begin explore if *there are any clearly discernable gender differences* in how CC is perceived and if these result in different responses in fishing communities in Stung Treng.

This project was to look at two villages situated on two different Mekong Basin Rivers in Stung Treng Province. The first village *Tboung Kla* (Ou Mreah Commune) is situated on the Mekong mainstream. For a general overview of village composition and resources see Israel et al. 2005. The second village, *Ban Bong*, is situated on the tributary Se San. These two villages have different demographics and thus experiences and reactions to their changing fisheries. This project is a preliminary look at the vulnerability of these two different villages and their Community Fisheries. These two villages, on different rivers, have had different experiences with their sets of assets, capabilities, thus framing their perceptions and concerns about *how their lives are changing* in the context of broader rural/resource transformations in Cambodia. This is a first start at looking how to better integrate lessons of *science, climate and gender policy* and practice to foster sustainable rural communities. This is in part due to the need to learn from the difference in what *we suppose or want things to be and how they actually are* in the complex social-ecological systems of Cambodian Community Fisheries.

Cambodian fisheries systems are under severe and multiple stresses. These fisheries systems are in fact coupled to broader terrestrial natural resources management (NRM) and need to be considered as examples linked social-ecological systems (SES) with the characteristics of high uncertainty and complexity. These are complex adaptive systems (Levin, 1998) in which memory and learning are essential processes for reducing vulnerability, designing adaptive response and steering change. In these SES; the

ecological sub-components have developed or “evolved” ranges of variability to which they are have become adapted or tolerant. The linked human systems have developed *ranges of response or actions* based on previous experience and knowledge. Climate change can be an extra factor which pushes these systems beyond these inherent tolerance levels leading to a collapse and subsequent re-organization (Perry et al. 2010). This re-organization may not necessarily provide the same important goods and services that the community depends upon. These ecological goods and services include but are not limited to providing sustenance (food, economic, social, cultural and spiritual), water/wastes purification via soil-wetlands, erosion control, transportation and riparian agriculture. On the other hand it may provide new opportunities for growth and development the previous system did not possess. It is this uncertainly via system re-organization that can be reduced by fostering resilient systems, within tolerance levels and thus preventing collapse and triggering uncertain pathways of re-organization. Riverine SES is already under multiple and diverse environmental stresses including climate, these are now compounded by interactions with forces of globalization including commodity markets. There is evidence on inland water temperature increases, and alterations on freshwater runoff patterns and the increased stratification of higher latitude lakes (Barange and Perry 2009).

Climate related system change and steering potential impacts via adaptive fisheries management can be seen as a *wicked problem* (Rittel and Webber, 1973, Ludwig, 2001 in Berkes, 2011). Coastal zone management and small scale fisheries governance may also be consider as *wicked problems* (Jentoft and Chuenpagdee, 2009 in Berkes 2011). Wicked problems are by definition difficult to define and separate from other interacting problems or issues, they are never solved only re-solved repeatedly there is no right or wrong solution but just arenas of adaptation.

Climate change in conjunction with vulnerability from rural poverty will pose new and different challenges for the Community Fisheries which currently serve as the key state management institution in Cambodia. This will be especially true for those rural communities with few *livelihoods options* to move away from declining or degraded fisheries. In those communities with livelihoods options we can find higher resilience to complex and uncertain changes. How can community fisheries institutions are developed with the flexibility and inclusiveness to respond to the changing social-ecological conditions?

Research Questions

The overall objective of this study is to better understand how men and women perceive and act differently with respect to climate change. To show how they are affected differently, their unique coping strategies, and how stakeholders and authorities are providing support to them in order to reduce vulnerability, combat climate change and to promote gender equality.

- 1 How do men and women in the studied villages perceive climate change?
- 2 How does climate change differently impact men and women? What are the similarities and differences?
- 3 What are the key coping strategies of men and women to these impacts?
- 4 What are the different types of supports being provided in the studied villages? How the supports benefit men and women?

Research Sites and Rationale

The selection of the community fisheries in Stung Treng to conduct this study will be consulted with provincial partners to get more of the information about the areas and will be considered according to the following criterion:

- *Experienced floods and droughts in terms of frequency, severity, and duration*
- *Changes in rice and fisheries productivity*
- *Experienced changes in environmental and ecosystem service*
- *Experienced changes in livelihood strategies*

From the provincial discussions and field preliminary visit to few communities in Stung Treng, Ban Bung community fisheries and Tboung Kla community fisheries are selected as target study sites located in different geographical areas. That is, one community is located along the Mekong tributary, Se San while another one is located along the Mekong mainstream. Main purpose of this selection is to understand the situation of the people in the communities on different river systems. According to the fact that they are located in two different river systems, the conditions of the ecological environment and dependency on fishery resources are also not the same. This will help to closely look on how climate change affects the livelihoods of the local people in those communities, and also to see how people are dealing with those effects.

Ban Bong Village

Ban Bong community fisheries is located along Sesan River which is the main source of water for consumption as well as for agriculture. The village is fairly small with 87 households with mixture of Khmer and Lao. They are all farmers and fishers who strongly depend on their crop land and the existing resources from the river. The village is connected by a countryside road, with houses along, which is approximately 40 minutes by car from the provincial town of Stung Treng. Rice farming is considered to be the most important source of household consumption and well-beings.



Road to Ban Bong Village

Tboug Kla Village

Tboug Kla community is located along the Mekong River in Siem Bok district, approximately 50 km from the provincial town. The village consists of 181 households, most of which are farmers and fishers. The village is affected by climate change recently causing difficulties in livelihood activities such as fishing and farming.



Ban Bong Village



Road to Tboug Kla Village

Methodologies

Data Collection

The data collection methods used in this research attempted to understand the difference between men and women over the present problem happening in the communities including climate situation and its effects, coping strategies, and perceptions of both sexes in order to best answer proposed research questions. Data collection process involved the usage of various tools as the following:

- Seasonal Calendar and Food Security tool was used to better explore the behavioral changes of income generation options throughout the whole year period. It was also to better understand the problem of food within the communities, what people think to be the causes, and their coping strategies and existing supporting capacities.
- Livelihood Profile provided further information on the changes of productivity of sources of household incomes options in 10 years times scale, and also illustrated the reasons of changes, if any, according to the local perception. This tool was used with both sexes separately, men and women. That is, the outcome from the tool clearly distinguished how men and women conceptualized differently on the same problem.
- Hazard and Vulnerability Profile was adopted from AIT-UNEP's study. It was introduced to both men and women group to visualize gendered different perspectives on how the hazard had affected their lives, and potential coping strategies they had employed dealing with challenges from the changing climate.



Focus Group Discussion in Tboung



SSI Ban Bung Village

- Ecosystem Services Change Matrix (15 years times scale) was performed in both villages and to both men and women group to see how men and women perceive differently of the existing resources they had or possessed, and how those natural resources had declined productivities during 15 years times. Similarly, it was to their understanding and believes to be the reasons or the causes of such variations.
- Focus Group Discussions (FGDs) were selected to use with elderly people (both men and women). The idea behind these group discussions was to track back the overall changes of the villages. Moreover, it provided conclusive evident of climate

change whether or not it existed in both villages. Others besides climate related changes such as environmental change, cropping choices and income generating options, and variations of important resources for livelihoods were also identified through this tool.

- Semi-structured Interviews (SSI) was performed in addition to the tools mentioned above in order to get single household views on the livelihoods and climate issues. It gave very local perception at household level on climate issue and their coping strategies. Furthermore, it provided gendered perspectives from both male and female headed household on their difficulties and coping strategies during and after the disaster such as drought, flood, and pests.

Reflection and Validation

Once the data was received from the field had been consolidated and preliminary conclusion had been made, reflection and validation was conducted in both communities to verify result and also to ensure accuracy and consistency of the conclusion. At the meantime, further comments were asked from participants to get more information adding to previously collected data.

Tables one and two indicate number of participants in the research and reflection workshops.

Table 1: Number of participants involved in tools used.

TOOL	TOTAL PARTICIPANTS	MALE PARTICIPANTS	FEMALE PARTICIPANTS
Ban Bung Village			
Hazard and Vulnerability Profile	17	05	12
Seasonal Calendar	19	08	11
Livelihood Profile	17	05	12
Hazard and Vulnerability Profile	17	05	12
Ecosystem Services Change Matrix	17	05	12
Tboung Kla Village			
Seasonal Calendar	14	09	05
Livelihood Profile	19	08	11
Hazard and Vulnerability Profile	19	08	11
Ecosystem Services Change Matrix	19	08	11
Focus Group Discussion (FGD)	12	06	06
Semi-structured Interview (SSI)	18	08	10

Table 2: Number of participants involved in tools used.

VILLAGE	TOTAL PARTICIPANTS	MALE PARTICIPANTS	FEMALE PARTICIPANTS
Ban Bung	17	08	09
Tboung Kla	15	08	07

Results & Key Findings

For the results of this study to have any real legitimacy, we first need to fully recognize the importance of situating climate change (CC) within the broader context of rural community; important aspects of fishing community *vulnerability* and the on-going processes of rural transformation in Stung Treng and wider Cambodia. These transformations involve diverse drivers of not only environmental change but are also mediated by wielding of gendered economic and political power across levels of social and political organization facilitating a the *cash economy*. Second we need to be clear about the relative importance of CC between village contexts as well within the livelihoods-natural resources dynamics that each village. There is a need to be clear about the current and potential CC pathways impacts on the local fisheries and how this affects any vulnerability assessments. In addition, the differential impacts of *in and out migration* must be considered in the light of cash economies and markets as a response or buffer to climate and other social-ecological drivers of change in these riparian communities.

Female headed households need to rely on finding new sources of cash/rice loans or relying on older children to provide incomes or food. Once again climate change was not considered unless it was shown to cause a food crisis within an overall HH risk environment.

“The drought is even more serious than the flood. If there is no water, all my crops die. I get nothing. There is still some yield left after the flood, but it is not so for drought.”

Farmer 13, 43 years, Tboung Kla

Tboung Kla (Mekong River) (N=17 HH interviews)

The community has experienced some natural hazards such as drought, flood, insect and heat wave which have greatly affected the crop yields and hindered other livelihood activities. Dealing with these hazards, villagers have used some useful coping strategies, particularly labor sales for private companies investing of cassava plantation.

A key concern was the decline of fishing CPUE (catch per unit effort) of up to 50%. There is no longer any value to fish except to get family food and now only in spare time. Time

is better selling labor. So how long will these river fisheries continue to be a viable source for family food and supplemental incomes as villages move deeper into supplying commodity markets? According to this research these fisheries have declined due to the increased fishing pressure due to in-migration, and the increased use of illegal and *modern* fishing technologies.



This village could not say if any of these changes were related to climate change, they are willing to suspect that more severe flooding and more erratic rainfall patterns are a result of CC but they are not sure. They think it is now hotter. They are very aware and curious about any factors contributing to an increase prevalence of livestock diseases causing death. The presence of algal blooms impeding boats traffic is also a problem and may also be related to increased water temperature, probably coupled with increased nutrient run-off from upland *chamkar* or rice farming. Most farmers started using short duration rice varieties about 6-7 years ago. It was noted by some that the most serious need for the village was to establish dry season irrigation.

The elder KIs (key informants) remember the serious floods of 1978, 1984, 1994, and since then there has been more serious bank erosion with up to 100m of lost shoreline. They are concerned about the run-off of pesticides from uplands but are not sure about their impacts or if they are present in their drinking water. They stated that the price they are getting for cassava up Rs 900/kg delivered in Stung Treng town is very good, so people are fishing less and investing in cassava production or selling their labor to plantations.

“ Before, people could go fishing easily when they do not have enough food from their field. However, the fish is so scarce that people cannot catch for daily consumption. ”

Farmer 13, 43 yrs, Tboung Kla

Ban Bong (Se San River), (N=9 HH interviews)

Moreover, fisheries are important sources of food for local people to help them to certain extent dealing with hazards with also various coping strategies. At the meantime, those resources are being threatened by climate change, illegal fishing activities and perhaps hydropower dams. The occurrences of flood, drought, and pest outbreak have hardened the food situation and income generation of the local people. Main natural hazards such

as flood and drought have left remarkable impacts to this community in the recent years. Both of these two main events destroyed their crops, and eventually led to worst livelihood situation.

“ Before people can go and harvest NTFP, but now NTFP is very scarce because the forest have been cleared for the private company. Likewise, people can fish easily 10 years ago, but now (5 or 6 years) there is much less fish in the river. Additionally, the water level is irregular compared to the past ”

Housewife, age 37, Ban Bong

There now seems to be less of everything, with more unpredictable weather leading to a consensus of increased food insecurity and a general decline in productivity from 2000-2010.

They commented on the drastic decline in river levels, how the pools in the Se San are shallower and show increased turbidity. They notice an increase in dry season water levels and suspect that it is due to releases from upstream Yali Falls dam. The decline in river water quality has forced its use to be replaced by wells. River water is not used for HH or personal use.

The key findings from this village include the perceptions of floods being of longer duration over time. In the early-mid 1980s floods lasted 3-5 days, in 1998-99 they last 2 weeks.

He said “ *most of his rice was damage because of cow and buffalo in their village that eat their rice, but the flood this year bring water to his rice field that make him have a good rice yield.*”

Farmer 11, Ban Bong

In 2009 a lot of livestock died, but this may or may not be related to CC as there are frequent livestock deaths. In 2010 there was severe drought with animal deaths and decline in rice yields. There is still no consensus if these deaths are climate related, some say it is more due to poor husbandry techniques and disease perhaps acquired in unsupervised “free-range” forest grazing.

Non-timber forest products (NTFP) have declined as a result of forest cutting by both the cassava and rubber companies but also a result of the in-migration of families from around Cambodia. Absentee claimants also cut forests in order to press future tenure claims.

Coping strategies mentioned in focus groups and HH interviews include children working selling labor in the cassava plantation, women taking loans. Everyone in the family contributes to securing cash or food. The wealthier families tend to rely on their own savings while poorer families need to borrow friends, relatives or finance institutions.

In the reflection meeting of Dec. 25, 2011, KIs in Ban Bong, described the decline in preferred fish species which included reduce catches of *Bangana (Labeo) pierrei Sauvage* 1880, (Pba sooang (Lao); *Mekongina erythrospila* Fowler, 1937 (trey Pa Sa-ee (Lao), Mekong Red-spotted Labeo), *Thynnichthys thynnoides* (Lesser Bighead Carp); *Homaloptera zollingeri* Bleeker, 1853 (trey tamor (Khmer), rock fish, black lizard loach, gecko fish); *Bagarius bagarius* (trey kabei (Khmer), buffalo fish, dwarf goonch). Kis lamented the fact that it is not worth their while to fish as long as the demand for cassava is high. Their time-labor is worth more in cassava than fishing where they can make Rs 15,000-20,000/day. Men make a higher daily wage than females.

Results show that this village also had poor understanding of what climate change was and how it *actually* affected their lives but have very real concerns over its possible impacts and what actions they could take and *who will actually help them*. Their main concerns are increasing food security and developing better rice farming and animal husbandry through better cooperation with NGOs and local government line departments.

Gendered Perceptions of Climate Change and Livelihood Impacts

This research in these two particular community fisheries in Stung Treng shows very poor distinction or separation between male and female perceptions on climate change or any real difference in resulting actions/behaviors. *Khmer men and women once had culturally distinct divisions of labor* based upon gender but these are now breaking down and men and women end up doing all tasks. The family unit will all pull together in coping with crises to ensure food availability *especially for younger children*. For poorer families, in times of crises, increased borrowing or wage labor is relied upon. Any increase in hardships due to CC is simply understood as another challenge to rural livelihoods in Cambodia. Life just becomes harder and more uncertain. In this case, regardless of the stress, both men and women do their roles with the explicit purpose to reduce overall family level risk to food security. Very generally, men focus on agricultural *production challenges* (difficult physical labor, fishing), while women tend to focus on *building social linkages for credit and marketing and household food and health security*.

Tboung Kla Women:

Women in this village see broader aspects of reducing family risk to food and health insecurity as their prime duty. Women, recognizing possible changes then focus on better HH financial management and market access. Their concerns are primarily with rice yields and the health of livestock and if their children will have enough food to eat.

Tboung Kla Men

Male KIs state that although there are no noticeable fish species extirpations, there are *less fish species actually available* to catch due to over-restrictive rules by FiA. They have good working relationship with the WWF on dolphin conservation programs. They are concerned with the causes of livestock and poultry deaths and the prevalence of rice pests. To them these conditions seem to occur in random years with little or no connection to climate change.

Ban Bong Women

They tend to focus on yields of agricultural products and getting them to market. Their concerns include the harvesting of forest products including bamboo shoots and mushrooms. They express uncertainty in the future over the impacts of forest loss.

Ban Bong Men

They discuss the frequent deaths of livestock, including poultry and ducks. The suspect warmer/damper weather to be an influence but they are not sure and would welcome more research and technical assistance. They are concerned with weather impacts on rice yields as there may be an association with weather changes and the presence of rice pests. They now fish only in their spare time as there is more money in wage labor with cassava or rubber.

Agencies, Networks and Social Organizations

Little information was extracted about the structure and process of social networks, but it is obvious from this research that rural people turn to family and friends for loans of food or rice in crises. There a number of state and non-state actors are involved in general rural development and crisis relief in the area. This research shows that in times of crisis, such as prolonged flooding the Red Cross and Provincial authorities provide food (rice, noodles), mosquito nets, and cans of preserved fish, sarongs, blankets and scarves. For some, financial support via loans from micro-finance and larger organizations such as ALCEDA and other banks can also be accessed. It is critical to understand the *vertical* (authority) *horizontal* (bridging and bonding social capital) linkages that are currently used by local people to best acquire the necessary resources and assistance to cope and adapt to different changes

DPA (Development and Partnership in Action) always along with MAFF, provide technical assistance animals including vaccinations and limited vet service. WWF works with Tboung Kla on issues of fishing and dolphin conservation. There seems to be a positive feeling among the participants about their work with the WWF.

What is not clear from the data is the overall importance of these different associations. They not doubt tend to differ in importance depending on the nature of crisis or opportunities. It was shown that in times of crisis HH borrow money and rice, first from family and friends, then turn to external agencies as a chief coping strategy. Wealthier HH tend to rely on their own savings, but with land as collateral, they can access the more formal financial institutions such as ALCEDA bank. ALCEDA bank is active in the area of local rural credit schemes.

Discussion

Climate change will impact and influence the ecological processes and in turn the adaptive capacity of accompanying social institutions and organizations which contribute to the sustainability of fisheries and aquaculture in the developing world. These impacts are extremely heterogeneous, and will have different impacts on different communities and their social-ecological system. The productivity, benefits distribution (availability) and the seasonality of fisheries systems may be impacted by climate change and thus affecting small-scale fisheries and their contributions to rural development. Small-scale fisheries are very dependent on the structural and functional integrity of these habitats which are being degraded by both human and climate induced changes. Conservation strategies that both improve habitat, fish productivity and human access are needed to restore fishing as a key livelihood option and not just an occasional food supplier or social safety net in bad times.

Climate change action research and subsequent recommendations must focus on key aspects of assuring *resilience* and *adaptive* capacity when framing potential impacts and response to CC on the local fisheries and agricultural systems. These changes are very difficult to predict and their differential impacts on gender will vary from locale and social-economic context (Miller et al. 2010).

Future attempts by any agency to build adaptive capacity in Community Fisheries, will need to start by assessing the broader social-ecological (community) vulnerability. There now needs a shift in the *philosophy* on how we (stakeholders) approach management of small scale fisheries and aquaculture. Any policy, management actions and regulations must be created to embrace the *realities of uncertainty and complexity*. These systems are characterized by the need to be adaptive; to steer change and to be ready for surprise as change will happen across different scale and levels of social and political

organization as well at *different rates for different groups* including men and women. This new management is by necessity adaptive (flexible) inclusive (of diverse groups, views and interests) and it incorporates the knowledge of resource users into learning and management actions (Berkes 2003).

Policy makers and influential individual and organizations must now begin to move beyond a discussion of climate change and potential impacts and work to frame these changes within the broader social-ecological system, taking into account, other cross-scale drivers of change which contribute to these communities vulnerability (reduced resilience). Understanding the relative impacts on CC on particular social ecological systems is only one piece of understanding why these communities are vulnerable in the first place. If we are to focus on poverty reduction, we need to understand the underlying factors and processes that make these communities and genders vulnerable in the first place. Realistically where does CC fit within a suite of contributing causes of community vulnerability?

Climate, fisheries and NRM: Creativity in Resolving *Wicked Problems*

One approach is to consider any potential climate change impacts on community fisheries and their communities as *wicked problems*. This requires a policy shift to a priority for adaptive co-management approach in which there are shared responsibilities and powers among all stakeholders including the village and commune level.

Wicked problems often arise from different use and activities occurring in the same space which competes with or impacts fisheries. In this case for example we have upstream hydropower development impacting downstream erosion rates impacting shoreline gardens, water levels and fisheries as well as

Ecosystem-Approach to Managing Climate Change and Fisheries: from Management to Governance

Resilience theory considers these natural resource based production systems as linked social-ecological systems (SES). Human agency (goals and objectives) and their resulting actions are essential components in understanding these systems and how they are changing over time. Researchers and resources managers need to be aware of important *feedback loops* which provide information on how the ecological subsystem is changing and its impacts on how the human or social sub-component is responding and what actions they are taken. This feedback of information and experience come from learning and adaption to drivers and impacts often originating for outside the SES. Climate change and the integration into a cash-based, export commodity market (Cassava and rubber) are two external examples from the Stung Treng sites. These two

villages are part of a shifting *river landscape*, where dams, pollution, overfishing are changing the ecological components and social-economic changes are changing the ways people make a living.

Resilience theory in *conjunction with* or informing an Ecosystem-based approach to fisheries management (EBFM) is a powerful way to deal with the high uncertainty, low predictability and the continued re-solving of these wicked problems. These problems which our communities are facing are a direct result of the interactions and synergies created by multiple, diverse and cross scale drivers of change. Therefore, when entering into a process for developing EBFM governance, actors must take into account the impacts of environmental drivers of change including local weather and climate pattern change; methods and rates of fisheries exploitation and the prevalence of unsustainable fishing methods; interactions and conflicts with national-level laws and enforcement; methods of decision making and *the role of science* in informing fisheries policy.

The only relevant and effective coping strategies will be based on this understanding, applied to reducing overall system vulnerability. Any coping or *adaptive* mechanism will need to be derived primarily from the household-village nexus with Commune Council and higher level government support. There needs to a full and complete commitment by all stakeholders in developing policy and actions. There is no understanding at the village level of where government policies and actions on CC fit into their lives and how any of this discussion will be translated into improving the conditions of their lives and communities. How are local adaptive responses in Stung Treng shaped by larger scale policies? One example is the national policy of economic land concessions for cassava export production pulls more rural people into the cash economy of wage labor. In the short term this cash influx may provide some resilience, but a cash economy based on a single export crop will not be resilient in the face of long term global market demands and its associated price swings.

There needs to be enhance coordination between government researchers and Fisheries Cantonment personnel, LI staff and other Cambodian development research agencies to address these issues especially how local power structures are facilitating or hindering the development of sustainable community fisheries. How is government policy on economic land concessions (Cassava and Rubber) impacting the allocation of time and resources to better conserve local community fisheries? These questions were beyond the scope of this study but are highly recommended for future research

Identify and reduce non-climate stresses such as illegal fishing, forest habitat destruction and water pollution from pesticides etc. and to determine how they may interact with CC to increase probability of uncertain system collapse and re-organization.

Develop participatory environmental assessment monitoring and modeling mechanisms to better track changes and potential system thresholds.

Create multi-stakeholder deliberative forums to increase communication among all actors and to create flexible institutions for helping steer through complex SES change, with the explicit goal to reducing the poverty of both genders.

New models of fisheries governance based on rights of resource access-benefits sharing and environmental quality. Governance based on the fundamental recognition of *no separation* between human and ecological systems and that all management should encompass local perceptions, knowledge and understanding of SES structure and functions. An ecosystem-based approach to fisheries and NRM will *require an integrated* approach to monitoring and evaluation as well as their inputs into developing sustainable fisheries and agriculture resource policy in Cambodia. Policies which enable reduced vulnerability and increased adaptive capacity to CC and other drivers of change can be developed from information from the responses of women, the very poor and other marginalized groups making up the fishing community (WorldFish 2009).

Integrated networks of research, civil society groups government and resource user representatives involved in joint research and monitoring. These networks will assist in incorporating diverse knowledge sets into any policy and management process. These processes must be able to integrate research, local ecological knowledge, and assessment into resource management and allocation decision making. These processes must have a long term perspective (reduced discounting and dissipation of resource rents) and incorporate cross-scale/level interactions and at the same time this challenge includes incorporating diverse points-of-view, agency, and *specific community needs*. These networks and their associated deliberative processes *must therefore be flexible and inclusive* of local knowledge, power and aspirations as well as any natural science results into relevant decision-making and effective actions centered on the primary goals reducing community vulnerability and increasing human and ecological well-being.

The sustainable management of community fisheries requires key authorities/actors to facilitate or enable the building of multi-level institutions linking local issues and concerns to influential global processes. These should have the explicit role of fostering increased participation of resource users in decision-making to build better adaptive capacity for both genders facing climate and other drivers of social-ecological change. These processes must be able *to learn from experience* and translate this knowledge into meaningful actions which will need to operate across differential temporal and spatial scales. The subsequent learning from actions such as using fishers knowledge, participatory monitoring and establishing community fisheries use rights can feedback

into an adaptive management process, in turn helping to develop more adaptive governance (higher level policy) approaches (Berkes, 2010).

Attempts by strong centralist governments to develop effective devolved natural resources governance has generally failed in Cambodia and around the world. This is due to the lack of real trust and commitment to including local fisheries and resource users in policy making and to stop local corruption and elite capture of power and decentralized resources. This policy making must be shaped by including lessons and knowledge from adaptive management actions, feeding back into democratic and deliberative mechanisms within true partnerships of sharing responsibilities and co-learning of all actors from the resource governance experience. In Cambodia as elsewhere market mechanisms are replacing stricter forms of centralist government “command and control” regulations for the access and benefits sharing of natural resources. Caution is needed for only those who have access and power in the marketplace tend to benefit from this neo-liberal approach. The state still needs to play a role in ensuring fair and equitable access and benefits sharing via a commitment to developing legitimate and functional devolved adaptive co-management processes.

The future will require more dedicated move by all key stakeholders towards a broader *human well-being approach* to managing fisheries and other commons resources. This approach will incorporate broader concepts of people’s values, aspirations and personal and collective agency. This includes the fundamental importance to governance of social capital and the diverse forms of formal and customary relationships that resource users have in their societies. Through this approach policy and other decision makers will get a better understanding of competing interests, tradeoffs and the roots of conflict which are currently undermining many attempts at developing sustainable fisheries and natural resources co-management regimes in Cambodia and elsewhere (Coulthard et al. 2011).

Visions and Visioning of Climate Change and Rural Development in Stung Treng Province

In this research we consider these natural resources communities as *linked social (human) and ecological (natural resources) systems* in which uncertainty and high risk are characteristics. They are vulnerable to system shocks from a number of diverse internal and external drivers. These are thus complex characterized by what we understand as *wicked problems*. This brief research clearly shows the diversity of these drivers and impacts on livelihoods and well-being in Stung Treng. These indicate the key forces influencing rural transformations. It is not a surprising result that the people of Stung Treng, as elsewhere in developing economies will “*do what they have to do*” to best survive, feed their families, provide health care of some form and to educate their children.. They adapt, and in the process, hopefully learning to improve their ways of better interacting with a rapidly changing natural world. Their perceptions change,

agency changes as they continue to build a resilient fish-forestry- agricultural community. These changes now include issues of *in and out migration and off farm wage labor* in economic land concessions. It is thus crucial for any subsequent research to begin to understand the role and impacts of the goals, aspirations and actions (agency) of rural resource users. *How are these people seeing their future and what actions do they take to meet their individual and household objectives?* Researchers need to understand **how** they want to live their lives and how they see their relationship to the natural resources they are dependent upon **before** trying to assess what they are doing and what external adaptive interventions may be desired or needed.

Once *agency* is outlined any study will require a preliminary vulnerability assessment of the target group or community. We have seen that both men and women are involved in a diversity of livelihoods activities. This is a risk spreading approach, known as a *livelihoods portfolio*. Household risk is spread out over time, space and reward type (food, money reciprocal exchanges, future gifts etc.) via different activities. In this case there does not seem to be a clear gender differentiation from the classic Khmer divisions of labor, except that women are also now (more) involved in off-farm labor selling. This is a widespread activity found in many agricultural communities moving into cash-cropping for export. Understanding begins outline how their relationship with “nature “is changing and this influence on how rural value systems change. These processes of transition or transformation (towards an entirely new system) have been on-going for some time in Stung Treng regardless of climate change. It is crucial to understand what adaptive capacities are built during these processes and what gaps still exist as these SES move into new phases. Determining the relevant roles of key stakeholder in fostering adaptive capacity and thus building resilient rural resource communities will be an on-going and deliberative process for the people of Stung Treng and in the wider Cambodian context. It starts with a deeper understanding how people live their lives and vision their futures.

Conclusions

Climate change is not a priority for these two villages unless you directly frame it regarding their uncertainty into the dynamics of rice pests (yield decline) and animal diseases outbreaks as related to increasing temperature-precipitation. This would require further extensive research. Anecdotally, the villagers do not see a connection between climate/weather and these outbreaks. To them they appear random or more realistically related to bad husbandry and un-supervised grazing.

The planting of Cassava has been criticized as being a destructive crop, especially as monocultures for ethanol production. But cassava is perhaps more useful when it is a component of an integrated farming system on degraded lands with its foliage as livestock feed and some cash sales which it is at the moment in these Stung Treng research sites (Preston refs).

In this Stung Treng study CC is a poorly understood by villagers and plays a relatively minor factor in their household decision making outside of short term weather changes. Key for future research will need to include the dynamics of climate impacts on livestock disease outbreaks. At the moment they seem random but there is speculation they occur with greater frequency in warmer weather.

There are only *subtle differences* in perceptions and understanding of climate change between genders. Climate change simply another poorly understood factor which makes the lives of *both genders more difficult*. The current economic policy promoting the export of Cambodian Cassava for Vietnamese or Chinese bio-fuel production while providing employment as a buffer to other local resource declines (fisheries and NTFPs) may be shortsighted (unsustainable) and could led to undermining the long term resilience of the social-ecological systems based on functioning forest and aquatic ecosystems to climate driven shocks (Adger et al. 2011). What will happen when the price of Cassava goes down? What back-up livelihoods can compensate? Will there be enough diversity in rural Stung Treng systems to facilitate adaptation while at the same time to take advantage of any new opportunities?

Gender issues in this study are almost entirely situated within a livelihoods or household economic sustainability context. Very generally, women seem to be more focused or concerned on *issues related to using market/commerce mechanisms to reduce risks* of all kinds including any impacts for possible climate induced droughts, floods, animal or crop pest outbreaks etc. Men are primarily focused on issues related to production such as rice pests, livestock deaths, cassava production and the decline of *catch per unit effort* in local fisheries.

Climate related actions for community fisheries can include the *Fisheries Administration*, Ministry of the Environment working together with other Ministries and Provincial counterparts in fostering the development of community-based fish sanctuaries, more effective enforcement of illegal fishing and fish habit conservation. Climate adaptation for small scale fisheries also requires better post-harvest processing and market access to ensure fisher present good quality and receive best prices for their aquatic products. But these also need to focus on providing better rural health care and funding for the education of fishers and their families especially for young girls. The implementation of “no regrets” climate adaptations need to be designed explicitly to *reduce social-ecological vulnerability, build resilience and increase general human or community well-being*.

Future work and Next Steps

- Research should be conducted to determine any causal relationships between the increased temperature and livestock disease outbreaks in these two villages.
- Research into the current state of community fisheries (CFis) in Stung Treng and their future roles as effective resource governance mechanism. How are CFis being transformed by wider market integration?
- What is the actual role of *social networks* in the area and how are these networks used by communities to deal with CC and other important drivers of social-ecological change?
- What are the real impacts of local rural value chains and markets? Do they help reduce poverty and increase in well-being for local resource communities?
- An assessment of what is *actually being done for CC adaptation* and what are the impacts of these actions on local community resilience?

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