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## USAID Mekong Adaptation and Resilience to Climate Change (USAID Mekong ARCC)

# Vulnerability Assessment Report

IUCN Lao PDR

June 2014

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IUCN Lao PDR

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# INTRODUCTION

The USAID Mekong Adaptation and Resilience to Climate Change (USAID Mekong ARCC) project is being implemented by International Union for Conservation of Nature (IUCN) Lao PDR in communities in Khammouan Province. The goal of the USAID Mekong ARCC project is to bridge community knowledge and high level climate science in order to assist communities in developing livelihoods strategies in the face of climate change. Through the two-year climate study of the Lower Mekong Basin (LMB), Khammouan Province was identified as one of the eight ‘hot spot’ provinces based on climate modeling—one of the most highly exposed provinces to climate change threats.

IUCN is working in six sub-villages in Khammouan Province to implement the science based adaptation approach of the USAID Mekong ARCC project. IUCN will work with communities to identify specific climate threats to livelihoods and ecosystems within their community context. IUCN will then work with community members to implement adaptation strategies that are developed through a learning process.

This Vulnerability Assessment is part of the first phase in the USAID Mekong ARCC process to identify existing community vulnerabilities. It serves as a desk review and expert assessment that will guide the second ‘adaptation decision making’ phase of the project in which IUCN will work closely with community members to bring climate science into the local context. The Methodology employed by IUCN is described below. The report further details the climate change projections and vulnerabilities of Khammouan Province as modeled by the USAID Mekong ARCC Climate Change Impact and Adaptation Study. The report then details the specific community vulnerabilities based on existing knowledge and finally summarizes key findings and proposes potential adaptation options.

# METHODOLOGY

This vulnerability assessment was conducted during the period from February to May 2014. The IUCN team utilized a number of resources to assess the vulnerabilities of the communities in Khammouan Province:

- USAID Mekong ARCC Climate Change Impact and Adaptation Study
- Community Profile developed by IUCN livelihoods experts
- Awareness Survey conducted by IUCN in March 2014
- Literature review of existing eco-based adaptation studies conducted in Lao PDR or Khammouan, national development plans, existing programs in Lao PDR and the intergovernmental panel on climate change (IPCC)
- Information from the ARCUS project—a current three-year program implemented by IUCN in Khammouan Province

Weaknesses of the methodology in this report include a lack of on-the-ground development work (international or national) previously being done in Khammouan leading to a dearth of information. Development assistance, which has only recently begun to flow into the country in large quantities, has generally been targeted to other areas of Lao PDR. No previous assessment or livelihood development work has been done in this area at the time of this writing.

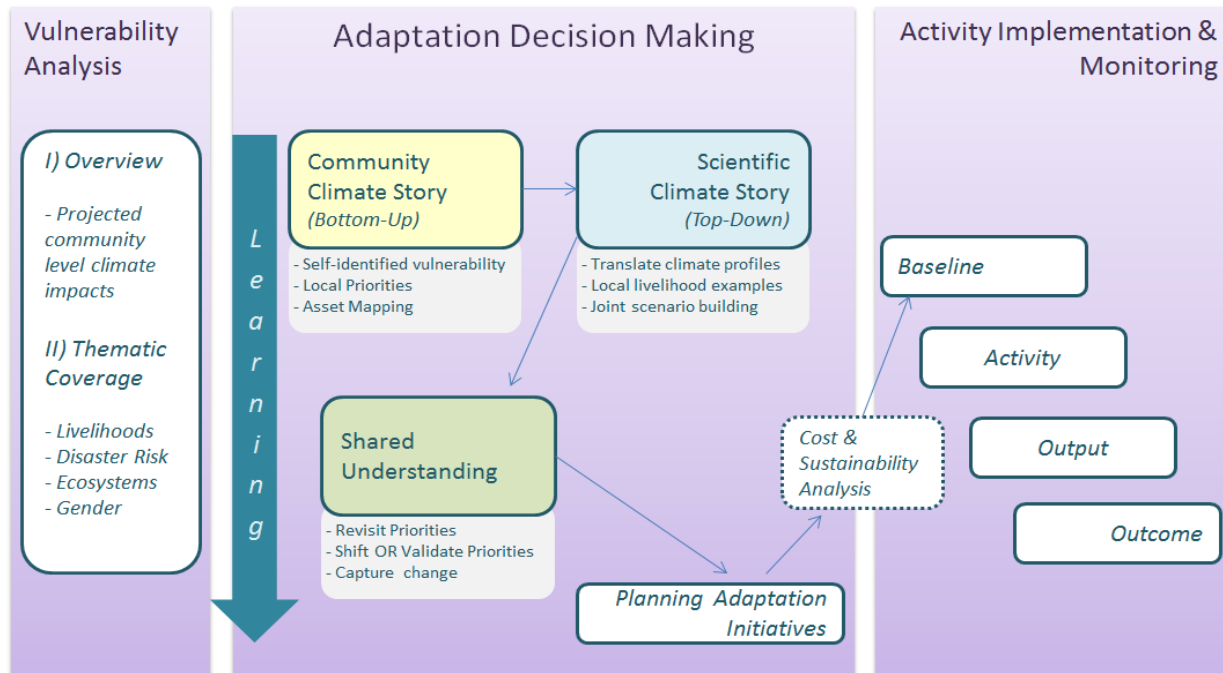
The USAID Mekong ARCC project uses a science-based decision making approach to bridge high level climate science with local community priorities to strengthen the community's ability to recognize and address climate change impacts. As shown in Figure 1, the first phase of the USAID Mekong ARCC approach is to conduct a Vulnerability Analysis to assess projected community level climate impacts. The Vulnerability Analysis will specifically address thematic areas of livelihoods, ecosystems, disaster risk and gender as these will be the focus of the second phase of the project.

IUCN conducted a survey from March 15-19, 2014 to set a baseline of understanding of the community's current awareness of climate change. IUCN also completed a Community Profile for each "Ban" or village in order to collect basic community information specifically with regard to the agriculture ecozones, important food and cash crops, and gender roles in livelihoods.

In the "Adaptation Decision Making" phase, IUCN will go through a learning process to understand community priorities and self-identified vulnerabilities, translate the climate science to the communities, and then develop a shared understanding of community vulnerability and livelihood priorities. Through this process, it is understood that community priorities could be validated or reformulated based on new information and understanding of future climate projections. At the end of this process, IUCN will help the communities develop an adaptation strategy to be implemented over the next 12-18 months.

The Vulnerability Assessment will serve as a guide and tool for IUCN to understand the climate change science in Khammouan Province and at the community level.

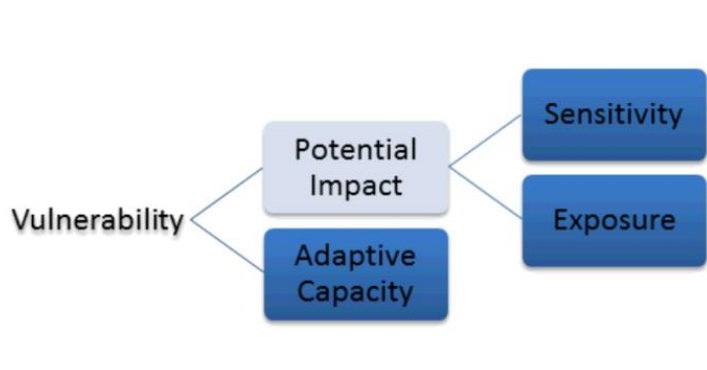
Figure 1: USAID Mekong ARCC Implementation Flow



Vulnerability can be described as a function of Exposure, Sensitivity and Adaptive Capacity to determine the ultimate Vulnerability of a system. This Vulnerability Analysis analyzes the sensitivity and exposure of the communities' livelihoods as well as their ability to adjust to climate change.

In order to assess exposure of a livelihood at the community level, IUCN reviewed the community profile and awareness survey to determine the most important livelihood options and then assessed the nature and degree to which these were exposed to a specific climatic variation. Sensitivity was assessed by determining the degree to which the livelihood is affected by climatic variability or change.<sup>1</sup> These two factors were combined to determine the potential impact of a given threat on the community, which is described in more detail in Table 13. The team then analyzed the community's adaptive capacity to manage, cope or moderate the climatic threat.

Figure 2: Assessing Vulnerability



<sup>1</sup> IPCC, Working Group II: Impacts, Adaptation and Vulnerability



# KHAMMOUAN CLIMATE PROJECTIONS

## OVERVIEW

Khammouan Province contains significant lowland plains and plateaus area (78%) as well as forested uplands (17%) and a floodplain (5%)<sup>2</sup>. Based on the USAID Mekong ARCC Study, the biggest climate change threats in Khammouan Province will be temperature and rainfall increases. These threats are further exacerbated by the fact that Khammouan Province experiences some of the highest levels of poverty in Lao PDR—already a very poor country, ranking 138 of 186 countries on the Human Development Index by the United Nations Development Program.<sup>3</sup>

The USAID Mekong ARCC findings regarding climate change threats in Khammouan can be seen in Table 1. Temperature increases will be moderate across the province—between 5% and 8% increase—except for the northeast mountains which will see increases up to 16%. Storms will increase in frequency and intensity which will cause flash floods throughout the province and particularly affect the lowland plains and floodplains.<sup>4</sup>

**Table 1: Climate Threats in Khammouan Province**

Temperature	Precipitation	Storms	Droughts	Soil Moisture
Under baseline conditions, daily maximum temperatures peak in April, averaging 28.4°C. With climate change, there will be a positive shift of 2°C in daily maximum temperature	Annual rainfall will increase from 2,610 mm/yr to 2,945 mm/yr (+335 mm/yr); in April, May, and September monthly rainfall will increase by more than 20%, while January will experience a -11% reduction in monthly rainfall	Large rainfall events (>100 mm/day) will increase in frequency and intensity, resulting in increased flash flooding	The historical dry season will see no significant change in the number and pattern of drought months	Soil moisture availability will experience a minor reduction during the dry season; but will see a large positive spike from May-July, reaching a maximum increase of 7% at the start of June

<sup>2</sup> USAID Mekong ARCC Study—Khammouan Provincial Profile  
<sup>3</sup> UNDP, Open Source Data, Multidimensional Poverty Index: <https://data.undp.org/dataset/Table-5-Multidimensional-Poverty-Index/7p2z-5b33>  
<sup>4</sup> USAID Mekong ARCC Study p. 117

According to the USAID Mekong ARCC Study, Khammouan Province will experience some of the largest relative increases in precipitation in 2050 as mapped below. Khammouan will experience 8% to 18% increases in precipitation. In total, annual rainfall is projected to increase by 335 mm by 2050 (from 2,610 to 2,945 mm/year).<sup>5</sup>

**Figure 3: Projected Change in Annual Average Precipitation**

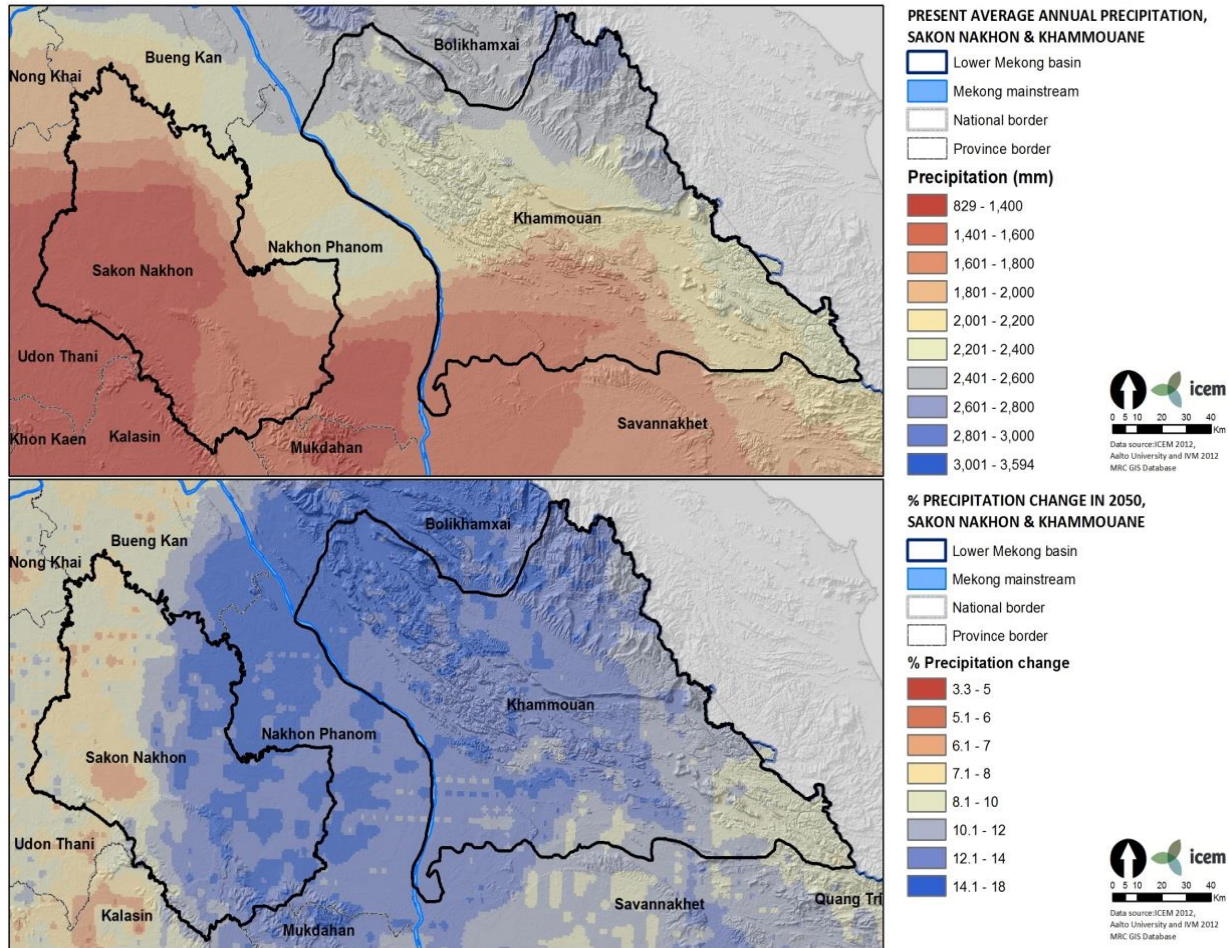


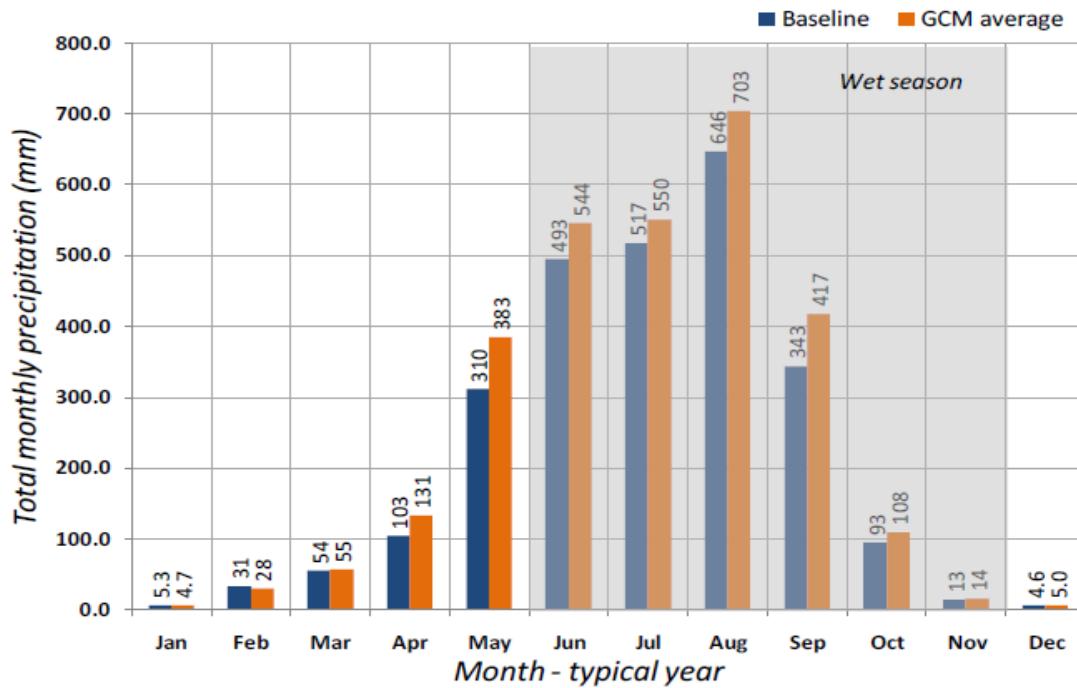
Figure 4 shows the baseline (1980-2005) typical monthly precipitation and that which is projected by global climate models (GCM) in 2050 for an uplands area in Khammouan Province. From this projection, it can be determined, that there will be an increase in precipitation every month, on average except in January and February. The most significant increases will occur in May, June, August and September. Of particular concern is the potential shift in the onset of the wet season, which would mean an earlier start to the growing season.

Furthermore, the risk of floods, landslides, and water logged soil is heightened with the overall higher amounts of rainfall projected under climate change.<sup>6</sup>

<sup>5</sup> USAID Mekong ARCC Study, Country Profile

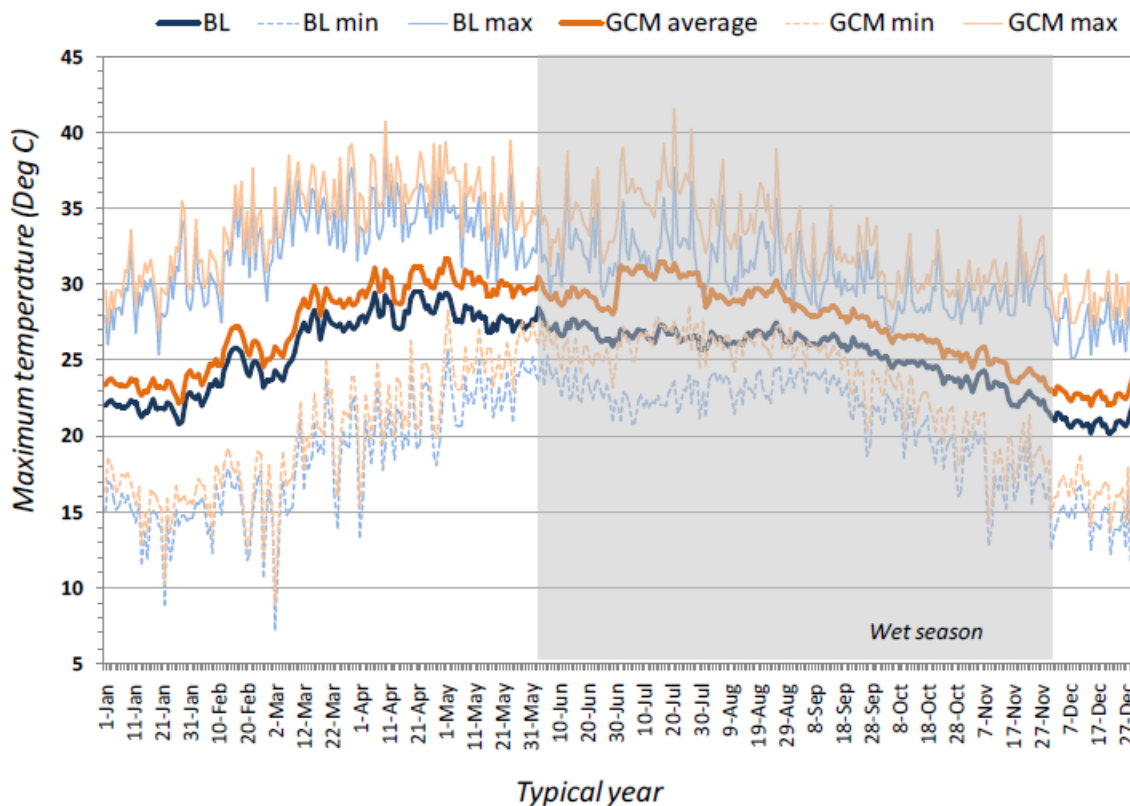
<sup>6</sup> USAID Mekong ARCC Study, Country Profile

Figure 4: Projected Change in Monthly Precipitation



On average there will be an increase of 2 degrees Celsius of daily maximum temperatures in Khammouan. In Figure 5 from the USAID Mekong ARCC Study, the average maximum baseline temperature is depicted by the solid blue line (1985-2005) (note: data represent forested uplands area). The solid orange line is the projected average maximum temperature in 2050 due to climate change. The wet season or typical growing season experiences the more significant increases in temperature in July and August, with potentially devastating implications on certain crops.

Figure 5: Maximum Temperature in Typical Year in Khammouan Province-Baseline and GCM



## THREATS AND VULNERABILITIES

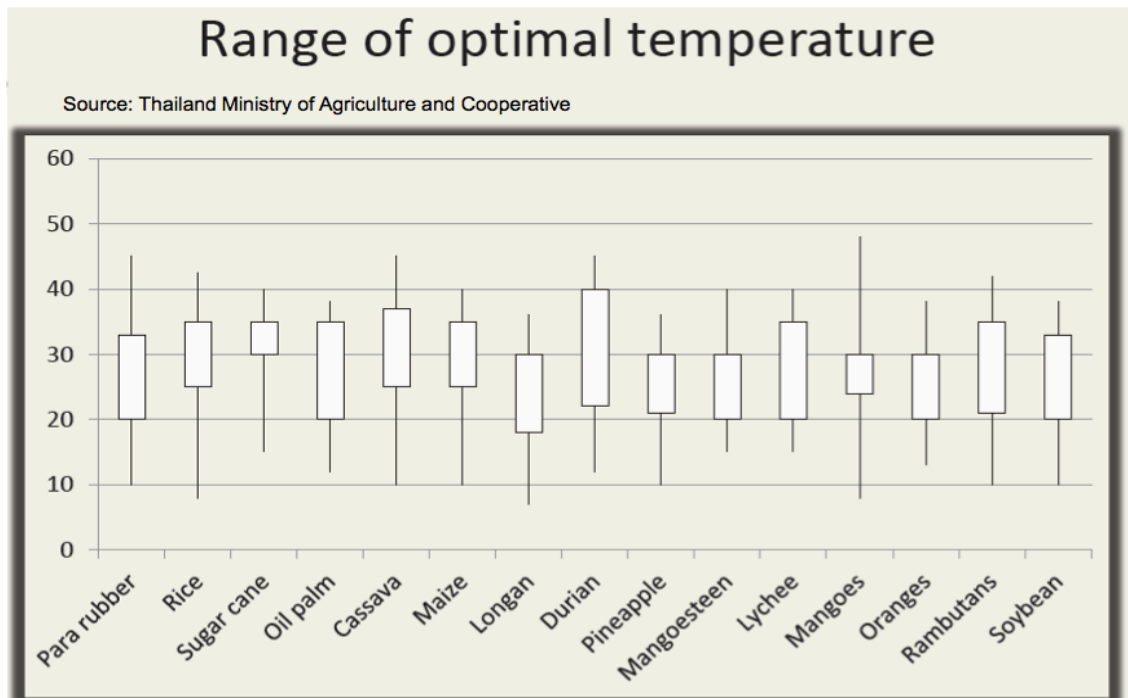
This section describes climate change threats and vulnerabilities of key livelihood sectors in Khammouan. The section also describes other non-climate change factors that could have potential impacts on community livelihoods in Khammouan. Specific livelihood sectors to the communities of Nakai District will further be discussed in the Community Vulnerability Analysis.

### Agriculture

Crops currently cultivated in Khammouan will be particularly vulnerable to the major climate change threats. The biggest factors are increase in temperature and precipitation. The most significant increases in temperature—up to 16% higher—will occur in the mountainous terrain in the northeast of the province.<sup>7</sup> Figure 6 shows the optimal temperature range for various crops. According to the USAID Mekong ARCC study, the most important food and cash crops in Khammouan are rain-fed rice, cassava, maize and sugar cane.

<sup>7</sup> Khammouan Site Info, available on: <http://mekongarcc.net>

Figure 6: Range of Optimal Temperature



Lowland rain-fed rice will produce lower yields with increases in average temperatures. As seen in Figure 5, average maximum temperatures during the growing season will consistently exceed 30°C in Khammouan in the midst of the growing season in July. In extreme years, these temperatures could exceed 40°C. Furthermore, flooding or flash flooding from increased precipitation and storms could wipe out entire crops in a season. Cassava and maize are highly vulnerable to increases in rainfall as indicated in Table 2. As monthly precipitation (Figure 4) could exceed 540 mm in June and July, and exceed 700 mm in August, the soil could become highly saturated with increasing likelihood of crop failure.

**Table 2: Agricultural Vulnerabilities in Khammouan** <sup>8</sup>

<b>Vulnerable Crop</b>	<b>Threat</b>	<b>Impact Summary</b>	<b>Vulnerability</b>
Lowland rain-fed rice	Increased temperature	Less than 30% of the daily maximum temperatures within the optimal zone. Increased temperature will induce sterility and lower yield.	High
Lowland rain-fed rice; Cassava, Maize, Sugarcane	Flooding, flash flooding, and storms	15 days per year with 100 mm of rainfall or more, with a maximum of 200 mm, and high storm frequency will increase the threat from rain events.	High
Cassava, Maize	Increased precipitation	Increased monthly precipitation of 5% to 27% between April and November, Monthly precipitation above 500 mm in June, July, and August (in August, monthly precipitation will reach 700 mm). Threat will be accentuated on heavy soil prone to water logging.	High

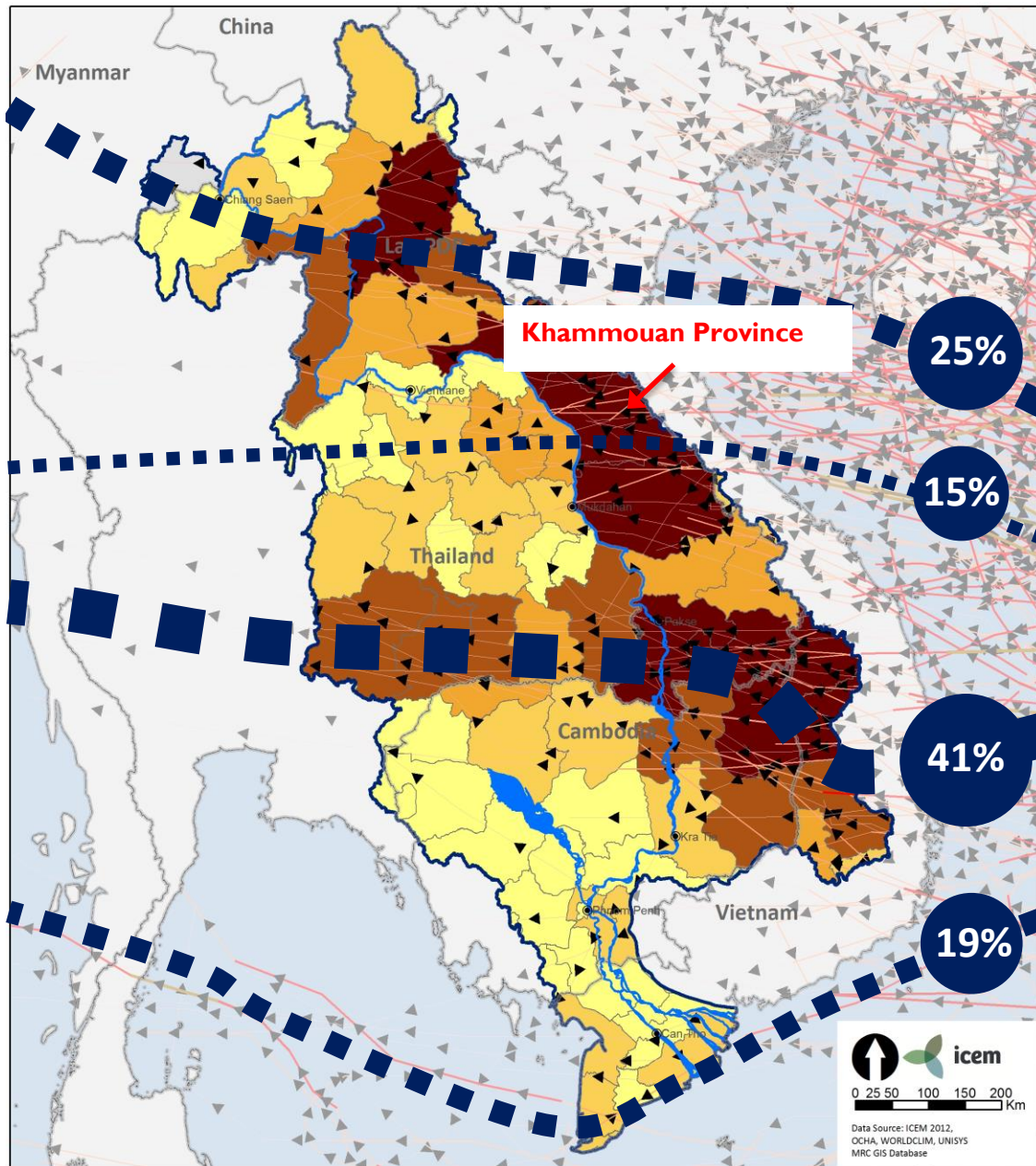
The LMB is located in the middle of two cyclone systems originating from the Pacific and the South China Sea.<sup>9</sup> As seen in Figure 7, Khammouan is directly in the path of the lower Pacific track. As storms increase in intensity and frequency, Khammouan, which is already highly vulnerable, will have to manage these natural disasters and the additional hazardous impacts to health and infrastructure.

<sup>8</sup> USAID Mekong ARCC Study—Agriculture Theme Report pg. 65

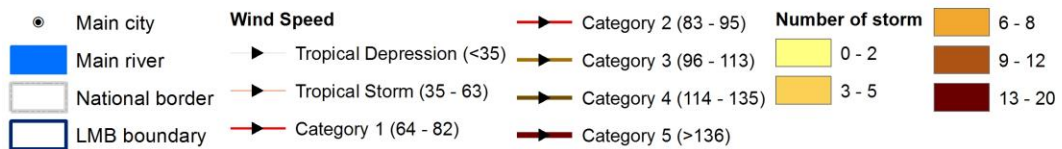
<sup>9</sup> USAID Mekong ARCC Study—pg. 100



Figure 7: Storm Systems in the LMB



**STORM IMPACT BY PROVINCES IN THE LOWER MEKONG BASIN**



## Fisheries

Based on the USAID Mekong ARCC Study, capture fisheries in Khammouan Province will not be particularly vulnerable to climate change threats as upland fish species and black fish (common in Khammouan) are not particularly vulnerable to changing conditions, though white fish appear to be the most vulnerable to increases in temperature.<sup>10</sup>

Other non-climatic factors will cause fisheries to become more vulnerable. Khammouan is particularly at risk from the number of hydropower plants (as detailed under *Foreign Direct Investment* below) queued to be contracted and built in the area. Hydropower plants inherently change the river, tributaries and streams, and ultimately the fish and aquatic species that rely on them for habitat.

The changing water flows from the construction of reservoirs and dams impact fish migration and reproduction patterns. Fish are prevented from migrating upstream to spawn which is critical to many species' lifecycles. Impact on fisheries is one of the biggest drawbacks for hydropower development.

Aquaculture is currently not common in Khammouan but could be a development option in the future to enhance community resilience. If so, communities should develop ponds and embankments in ways that could withstand heavy rainfall and storms. Communities could also develop protection plans for deep water pools in the Mekong that are essential to many fish during the dry season both in terms of survival and spawning grounds.

## Livestock

Livestock is important to most household livelihoods in Khammouan province with over 80% of families owning some form of livestock. The two main species of livestock are small-holder cattle (draft) and buffalo and small holder/low input pigs.

As with most livestock, the animals in Khammouan are vulnerable to significant temperature increases, which affect productivity and reproduction rates of the animals. In Khammouan, where poverty levels are high, livestock are undernourished, lacking protein in their diet. Malnourishment is most significant at the end of the dry season when food resources are low.<sup>11</sup> During the transition from dry to rainy season, the ground is often parched, unable to absorb the mass amounts of water which lead to flash floods. Livestock are generally free roaming in communities and are left to seek higher ground on their own. During these times, they are particularly vulnerable to drowning if they cannot retreat or find higher grounds.

## Non Timber Forest Products

Non Timber Forest Products (NTFPs) are critical to communities in the LMB and to Lao PDR in particular. In 2009, the estimated NTFP value in the country was US\$ 510 million, corresponding to 9.2% of total GDP.<sup>12</sup>

Based on the USAID Mekong ARCC Study, orchids and raisin trees in Khammouan are the most highly vulnerable NTFPs to the effects of climate change. Though red ants are adept to changing environmental

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<sup>10</sup> USAID Mekong ARCC Fisheries Report

<sup>11</sup> USAID Mekong ARCC Livestock Report

<sup>12</sup> USAID Mekong ARCC Study



conditions, these species nest high up in trees, which also makes them vulnerable to climate change threats that are expected to increase in Khammouan such as high winds and storms.<sup>13</sup>

Certain NTFPs in Khammouan are considered highly vulnerable to non-climate threats as well. Russula mushrooms, orchids, rattan, and resin tree will all decrease in availability in the future given other external pressures.<sup>14</sup>

### Eco-zones and Protected Areas

Khammouan is unique in the USAID Mekong ARCC study as it is the only priority province site located within a protected area. It also has both high elevation moist broad leaf forest and mid-elevation moist broad leaf forest. These ecosystems are highly vulnerable to flooding and storms. Low-mid elevation forest, where the target communities are located, is also vulnerable to temperature increases. The climatic threats will also present specific challenges to animal species in the province. Flooding can lead to population decreases

The country's steady economic growth has exerted pressure on its biological resources. Both the quality and quantity of forest declined markedly over the last 50 years as a result of population growth, encroachment, slash-and-burn cultivation, illegal trade in wildlife and forest products for food and traditional medicines, excessive timber harvesting, forest fires, and the effects of wartime bombing and chemical defoliation. Between 1940 and 2001 forested land area decreased from 70% to 41%. Since 2001, government policies to protect forested areas have encouraged an increase in forested area up to 52%, with an ultimate goal of forest cover across 70% of the Lao land by 2020.

*-USAID Mekong ARCC Protected Areas Theme Report*

Figure 8: Khammouan Eco-zone Vulnerability

Ecozone	Protected Area	Temp	Precip	H <sub>2</sub> O Availability	Drought	Flooding	Storm
High elevation moist broadleaf forest	Nakai-Nam Theun NBCA	Medium	Medium	Medium	Medium	Very High	High
Low-mid elevation moist broadleaf forest	Hin Namno, Phoun Hin Poun, Corridor Nakai Nam Theun, Phou Hin Poun	High	Medium	Medium	Medium	Very High	High

**Key:**

Very High	
High	
Medium	

<sup>13</sup> USAID Mekong ARCC Study p. 136  
<sup>14</sup> USAID Mekong ARCC Study p.138

## Health

In terms of health indices, Khammouan is the most vulnerable ‘hot spot’ province identified by the USAID Mekong ARCC report. Poverty is rated as ‘very high’ and food security ‘very low’ with human health also rated as ‘very low.’ Based on the most recent Lao Social Indicator Survey completed by the Lao PDR government in conjunction with the United Nations and USAID, 58% of households in the province use no water treatment with 33% only boiling water for drinking purposes. This leads to higher spread and prevalence of disease. Furthermore, Khammouan has one of the highest child mortality rates in the country with 138 deaths per 1,000 live births.<sup>15</sup> The province experiences very low life expectancy at 56 years for men and 59 years for women.

The threats of climate change on health by eco-zone are depicted in Table 3.<sup>16</sup> Forested uplands are most vulnerable to flash floods and landslides whereas lowland plains and plateaus and floodplains will be highly vulnerable to flooding. Most recently, Khammouan Province experienced severe flooding in 2011, which affected almost 200,000 families and required internationally coordinated emergency response efforts to ensure food distribution to those affected, contain disease outbreak, and clean up the damage.<sup>17</sup>

As the USAID Mekong ARCC climate change scenarios show, the wetter wet seasons and drier dry seasons will have secondary effects on health which have further repercussions on poverty and food security. Higher prevalence of vector- and water- borne disease, heat stress and reduced productivity of labor are just a few examples of how future climate change scenarios will negatively impact people’s health.

**Table 3: Health Vulnerability in Khammouan by Livelihood Zone**

Health						
Livelihood Zone	Temperature	Precipitation	Drought	Flooding	Flash floods	Landslides
Forested uplands	Medium	Low	NA	Medium	Very High	Very High
Lowland plains and plateaus	Medium	Low	NA	Very High	Medium	High
Floodplain	Medium	Low	NA	Very High	Medium	Medium

<sup>15</sup> Lao Social Indicator Survey 2011-12 Multiple Indicator Cluster Survey/Demographic and Health Survey access: <http://dhsprogram.com/pubs/pdf/FR268/FR268.pdf>. p. 195

<sup>16</sup> USAID Mekong ARCC Socio Economic Report

<sup>17</sup> ECHO Factsheet. Laos. Available: [http://ec.europa.eu/echo/files/aid/countries/factsheets/laos\\_en.pdf](http://ec.europa.eu/echo/files/aid/countries/factsheets/laos_en.pdf)

## Infrastructure

Infrastructure was determined to be ‘very low’ in terms of level of development and capacity to adapt to climate change impacts based on the USAID Mekong ARCC Study in Khammouan Province.

Infrastructure is very unsuitable to withstanding floods, flash floods, and landslides. Most roads are gravel or earth and most villagers have to travel at least 7km to the nearest paved road.<sup>18</sup>

**Table 4: Infrastructure Vulnerability in Khammouan by Livelihood Zone**

Infrastructure						
Livelihood Zone	Temperature	Precipitation	Drought	Flooding	Flash floods	Landslides
Forested uplands	NA	Medium	NA	Medium	Very High	Very High
Lowland plains and plateaus	NA	Medium	NA	Very High	Medium	High
Floodplain	NA	Medium	NA	Very High	Medium	Medium

Of significant note in infrastructure is the Nam Theun 2 Hydroelectric Project. This massive hydroelectric power plant was constructed between 2005 and 2010 with funding from the World Bank and Asian Development Bank. The Nam Theun River originates at the Nakai Plateau and runs through Khammouan and Bolikhamsai Provinces. The hydropower plant generates 1070 megawatts of power, which is primarily exported to Thailand.<sup>19</sup> During the construction phase, the Lao government displaced over 6,000 people and established them in resettlement villages. Furthermore, the project affects over 100,000 communities that live downstream along the Xe Ban Fai and Nam Theun rivers and depend on the water sources for their livelihoods.<sup>20</sup>

Climate change exacerbates the effects that resettlement has on communities. Resettling people in areas where they may not have the experience in fishing, farming or other livelihood options more suitable to their new areas, leaves them more vulnerable as they do not have the knowledge or skills to provide for themselves optimally. It also strains already scarce resources on the communities where people are integrated. Communities in rural Laos are already vulnerable to climate hazards and being ill equipped with knowledge and capacity to adapt increases their vulnerability.

## Disaster Risk Reduction

Poverty combined with high dependence on natural resources for livelihoods increases rural peoples’ vulnerabilities to natural disasters. In recent years, Lao PDR has experienced a number of natural disasters predominantly due to flooding and storms. In 2003, the National Disaster Management

<sup>18</sup> USAID Mekong ARCC Socio-Economic Report

<sup>19</sup> Nam Theun 2 Project in Brief. Available: <http://www.namtheun2.com/about-nt2/project-in-brief.html>

<sup>20</sup> Environmental Defense Fund “Environmental Defense Condemns World Bank Decision Support NamTheun 2 Dam in Laos.” Available: <http://www.edf.org/news/environmental-defense-condemns-world-bank-decision-support-nam-theun-2-dam-laos>

Committee adopted a Strategic Plan on Disaster Risk Management that looked toward 2010 and 2020. The plan defines implementation approaches for disaster risk management from the government to the community level and sets future goals. Currently a number of donor funded projects are working towards increasing education and awareness of disaster preparedness and building government capacity to implement the national strategy.<sup>21</sup> Specifically in Khammouan, GTZ has worked closely with the Provincial Disaster Management Office and MRC to develop flood preparedness plans.<sup>22</sup> Furthermore under the UN Development Program for Lao PDR, a draft national disaster management plan was prepared, which identified Khammouan Province as the most vulnerable to storms. It also identified the province as highly susceptible to landslides.<sup>23</sup>

Finally, it is important to note that Lao PDR was the most highly bombed country during the Indochina Wars. This has left the countryside with a vast amount of unexploded ordnances (UXOs) that continue to kill and maim people. Though not a traditional natural disaster, UXO's undoubtedly increase a community's vulnerability as in many areas land cannot be used due to the risk of UXOs remaining. Some districts in Khammouan have what is considered a very high density of UXOs ranging from 2-4 per square kilometer.<sup>24</sup> Climate change potentially increases rural people's vulnerability as suitability of land changes. People may be unable to access more 'profitable' land due to the prevalence of UXOs or they may take potentially lethal chances to push into these areas.

## Gender

Societal differences in terms of gender play a role in Khammouan Province. The roles are somewhat equal with regard to livelihoods with men and women assisting each other based on needs and family structure. That said, according to the Lao Social Indicator Survey, three quarters of women surveyed perceived domestic violence as justified in various scenarios such as going out without telling the husband, neglecting children, arguing, or burning food.<sup>25</sup> This reveals the underlying male dominance that is pervasive. Furthermore, according to this survey, roughly 42% of households do not have drinking water on the premises, leaving 61% of the women in households responsible for collecting water versus 26% of men.<sup>26</sup> As water sources become scarcer during longer dry seasons, this leaves women more vulnerable as the climate changes. Undoubtedly they will have to go further to find water as well as spend more time on this activity versus other occupations such as taking care of children or collecting NTFPs.

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<sup>21</sup> Global Facility for Disaster Reduction and Recovery. Available: <http://gfdrr.org/ctrydrmnnotes/LaoPDR.pdf>

<sup>22</sup> Lao PDR Country Progress Report. Strengthen Implementation of Flood Preparedness Program at Provincial, District and Commune Levels of the LMB (Phase IV). Available: <http://www.adpc.net/igo/category/ID322/doc/2013-diy3CO-ADPC-Lao-ECHO4.pdf>

<sup>23</sup> Lao PDR Draft National Disaster Management Plan 2012-2015. Available: [http://www.gripweb.org/gripweb/sites/default/files/draf\\_national\\_disaster\\_management\\_plan.pdf](http://www.gripweb.org/gripweb/sites/default/files/draf_national_disaster_management_plan.pdf)

<sup>24</sup> Lao PDR Draft National Disaster Management Plan 2012-2015.

<sup>25</sup> Lao Social Indicator Survey

<sup>26</sup> Lao Social Indicator Survey

## Foreign Direct Investment

In the past decade Lao PDR has experienced around 8% economic growth per year. As seen in Figure 9 taken from the Seventh Five-Year National Socio-Economic Development Plan (2011-2015), the agriculture and forestry sector accounted for 30.4% of GDP, industry 26.1% and services 37.2%.<sup>27</sup>

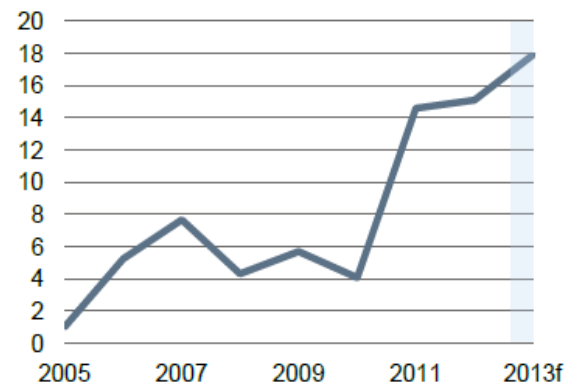
Figure 9: GDP of Lao PDR by Sector 2013



As seen in Figure 10, FDI has more than quadrupled since 2010. The increase has been predominantly due to investments in mining and hydroelectric power.<sup>28</sup> This trend could have impacts on Khammouan especially in the mining sector as gypsum and limestone are ubiquitous in the area.

The hydropower and mining sectors, while providing direct livelihood benefits and economic opportunities to local communities, come with costs to ecosystems. The impacts from these large scale infrastructure development projects often depend on the commitment of the developers themselves. As noted above, this area is home to two large hydropower installations, Nam Theun II and Theun Hinboun. Both projects initiated ground-breaking environmental and social development in both the concession agreements and the loan contracts. Both projects provided benefits to people impacted by the project. In particular, the people requiring resettlement received new housing and agricultural land. They also received shared benefits including schools, clinics, clean water supply, and waste management projects.

Figure 10: FDI as % of GDP



Source: IMF IFS

<sup>27</sup> The Seventh Five-Year National Socio-Economic Development Plan (2011-2015) p.11

<sup>28</sup> Lao PDR Frontier country report | March 19, 2013 Available: [http://www.dbresearch.com/PROD/DBR\\_INTERNET\\_EN-PROD/PROD000000000303384/Lao+PDR.PDF](http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD000000000303384/Lao+PDR.PDF)

The economic benefits need to be considered against the environmental impacts associated with these projects. Both projects created reservoirs from rivers, diverting water into a recipient river. This creates primary impacts on river flow and more intense flood events, recipient rivers widen with river bank scouring as the river adapts to the new regime. This also leads to increases in sedimentation in the river as well as chemical changes in water (predominantly methane, hydrogen sulfide and iron). Further impacts on fisheries from damming are outlined above.

## **Government Development Plans**

Based on the 7<sup>th</sup> National Socio-Economic Development Plan that spans from 2011 to 2016, the Government of Lao PDR has a number of economic drivers in Khammouan Province:

- Explore and process kali salt at Nahong Village, Thakack District, Khammouan Province (100 thousand tonnes per year) and expect to explore more kali salt in Nongboke village;
- Explore and process gypsum in Khammouan;
- Finish construction of kali salt factory;

It should also be noted that the Nam Theun 2 project included US\$ 1 million per year in support of a Water Management and Protection Authority.

As the government completes these plans in Khammouan, there could be consequences for the ecosystems that support villages in the province. Mining often requires the use of explosives in the mountain side as well as the deforestation of areas around the mines. These areas are usually zoned off but could be critical for the livelihoods of people in surrounding villages.

In addition, once the rock faces have been cleared via explosives, there can be major water quality impacts dependent on what is being mined. Copper mining brings acid rock run-off which needs to be contained and treated before the water is discharged. Also the waste water from production and processing can be very harmful and there have been instances of leakages which can prove harmful to both river systems and people. Lao PDR recently revised its Environment Protection Act (2010) and this contained new strict guidelines for water discharges.





## OVERVIEW

1. IUCN Lao PDR is focusing on six communities in two villages of Khammouan's Nakai District—Ban Kouane and Ban Xong. These villages are located in the narrow river valleys of the limestone mountains inside the Phou Hin Poun National Biodiversity Conservation Area.<sup>29</sup>
2. This area was chosen as a priority protected area representing the low-mid elevation moist broadleaf forest eco-zone in the USAID Mekong ARCC Study.<sup>30</sup>
3. The two village communities are Ban Xong and Ban Kouane. Ban Xong has three khoum bans including Khoum Xong, Khoum Yang and Khoum Donekeo. Ban Kouane also has three khoumbans including Khoum Kouane, Khoum Vanghin and Khoum Kouane Sam. These two bans were selected for the USAID Mekong ARCC implementation, because they are more likely to be vulnerable to the effects of climate change, including but not limited to drought, temperature increase, flooding, flash flooding, and storms.
4. The total population is 2,093 people (Male: 1,137 people; Female: 956 people). They consist of different sub-tribal groups: Bo, Meuy, Xam, Makong, and Kaleung. Bo, Meuy, and Xam are Lao Loum sub-groups and the Makong and Kaleung sub-groups are Laotheung. The total land area is 2,555.175 hectares. These communities rely on rain-fed rice agriculture, and capture fisheries for fish, crabs, and frogs. NTFP collection and livestock raising are also important components of their livelihoods.
5. Very little development work, research, or analysis has been done in Khammouan to date and particularly at the village level. The following vulnerability analysis of the IUCN sites is based on provincial projections given the locations of the communities, consultation with village heads, community profile data, and the USAID Mekong ARCC awareness survey to identify community priorities, livelihoods, and weather/climate concerns.

## BAN KOUANE & BAN XONG ANALYSIS

1. Ban Kouane and Ban Xong are located within approximately 10km of each other. In practice there is very little difference in terms of livelihoods and assets. Therefore, the 6 sub-villages that comprise Ban Kouane and Ban Xong were analyzed together. The majority of the land is community-use forest area (830 hectares) with agricultural area consisting of roughly 170 hectares. The communities are only accessible in dry weather. During the monsoon season, access becomes problematic with limited access only by tractor or boats through Konglor Cave. Usually road access is prevented due to flooding and landslides.
2. The communities living in this area are quite poor with an estimated 75% of villagers living below the poverty line (US\$22/month). Education is low with roughly 40% of the villagers having attended primary school.

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<sup>29</sup> Community Site Information, USAID Mekong ARCC Available: <http://mekongarcc.net>

<sup>30</sup> USAID Mekong ARCC Study p. 63



3. Food crops, livestock, and aquaculture products (grown/raised for the communities own consumption) are dominated by rain-fed rice production. This rice yield is critical to feed the whole community and is predominantly used for household consumption. Many family members own livestock such as chickens, ducks, pigs, goats, cows, and buffaloes. Of the 99 respondents surveyed in the community profile, 69% reported animal husbandry as a primary source of income (subsistence). Poultry, pigs, and goats supplement household nutrition. While the majority of crops and livestock products grown and raised are for consumption, people will take advantage of opportunities to sell when there are visitors to the community. Large animals such as cows and buffaloes are used to feed guests at cultural events such as weddings, funerals, and housewarming functions. They are also used to generate cash to pay for such events and for the purchase of more expensive consumer items and wood for housing.
4. The people in these communities also utilize the rivers and river banks to catch fish, prawns, crabs, snails, frogs, eels, and other aquatic species. Ecosystem management is critical as these communities heavily rely on what the forest provides for NTFPs for household consumption such as bamboo shoots, rattan species shoots, a local wild vegetable known as Melienthasuavis Pierre (known as 'sweet vegetable' in translation to English), various fungi, and other wild vegetables/herbs. Collection is for consumption predominantly, though this may be due to the distance between the communities and the market.
5. Within the villages there are a small number of commercial operations mainly run from the house fronts selling sundry toiletries, foods, and small household consumer items. Casual labor services are sold to adjacent villages on a day-to-day basis to assist in construction works and agricultural harvesting based upon supply and demand mechanisms. This is generally a barter arrangement of food for work or labor now for future labor in return and often within the family group. The distances traveled are seasonally dependent.
6. Per the awareness survey conducted by IUCN, 83% of respondents have noticed changes in the weather of which 61% reported noticing these changes around 5 years ago and 31% around 10 years ago. The top changes in weather noticed by respondents were change in temperature, change in rainfall and change in flood intensity. This reflects that communities are experiencing the weather changes in line with the primary climate shifts reported in the USAID Mekong ARCC study.
7. Communities in Ban Khouane and Ban Xong are fairly knowledgeable of climate change with 65% of respondents reporting that they know what climate change is. Though of those 65%, 97% reported only 'somewhat understanding' climate change. 97% reported that it will have an effect on their community in the form of more droughts, higher temperatures and increased diseases and pests. Increase in temperature was most concerning regarding the effects on the community followed by low crop yields and changes in rainfall.

## **VULNERABILITY ASSESSMENT**

Table 5 below summarizes climate threats and vulnerabilities to key livelihoods in the communities of Ban Khouane and Ban Xong as identified by the community profile, assessment of the site location, and available scientific information (USAID Mekong ARCC Study). The assessment uses Low, Medium, or High to measure Exposure, Sensitivity, and Adaptive Capacity of the target communities.

Table 5: Ban Kouane and Ban Xong Community Vulnerability Assessment

Livelihood Area		Threat	Exposure	Sensitivity	Impact Summary	Adaptive Capacity	Vulnerability	Potential Adaptation Options
Rain-fed Rice		Extended Drought	Medium	Medium	Longer dry season leads to delays in rice production. Main concern is more drought following early rains, which can ruin the first planting and require replanting.	Low	Medium	Better sources of weather prediction may provide some warning. Also, water storage for early rains to provide some irrigation.
		Increased Precipitation--flooding & flash flooding	High	Medium	Community located in narrow valley which can trap flood waters, but flood waters drain quickly into mountain area given the karst topography.	Medium	Medium	Encourage more use of flood resistant rice varieties in flood-prone areas.
		More Frequent Storms	High	High	Wind and rain damage during flowering and/or harvesting (2 susceptible times).	Low	High	Better weather prediction may avoid some harvest losses. Disaster risk management teams formed in community for support before/after extreme weather events.
Pigs		Increased Precipitation--flooding & flash flooding	Medium	Low	Pigs can swim, and normally stay in the community area. Usually sufficient food supply during wet season. May be susceptible to diseases. Pigs not commonly vaccinated.	Medium	Medium	Improve housing considering extreme weather events. Vaccination campaign.
		Extended Drought	Medium	Low	Lack of clean water can lead to disease; lower reproduction	Low	Medium	Pipe water from mountain area to watering holes. Water storage units (tanks, ponds etc.)
Cattle (bosindicus)		Increased Precipitation--flooding & flash flooding	Medium	Low	Cattle normally roam free to graze, usually near the mountains, and can be difficult to round up. Floods occasionally kill some cows which is a substantial asset loss for a farmer. Cattle are generally not vaccinated	Low	Medium	Improve housing considering location and design to minimize exposure to extreme events. Vaccination campaign for cattle. Organize farmer livestock groups to report disease outbreaks.

Livelihood Area		Threat	Exposure	Sensitivity	Impact Summary	Adaptive Capacity	Vulnerability	Potential Adaptation Options
					which may lead to widespread losses in the event of disease outbreak			
		Extended Drought	High	High	Lack of adequate feed and clean water reduce growth rates (even thinning), and increase susceptibility to disease.	Low	High	Pipe water from mountain area to watering holes. Encourage farmers to make silage for supplemental feed during the dry season.
<b>NTFPs</b>	Aquatic species (fish, crab, frog, etc.)	Extended Drought	High	High	Many streams and ponds dry up during drought, and aquatic species disappear. Water temperature increase can cause some species to die off.	Low	High	Monitor aquaculture ponds and harvest before temperature gets too high. Pond aeration.
		Flooding	High	Low	Flooding is generally good for aquatic species production in this area, but community access may be limited temporarily by flooding. Could be exploited by communities in times of crop loss.	Medium	Low	If aquaculture ponds are susceptible to flooding, then increase bund height or provide fencing and/or netting to reduce escape losses.
	Leafy Plants	Extended Drought	High	High	Plants show low or no growth rates during drought, and may even die back depending on the severity and duration.	Low	High	Micro-irrigation for home gardens. Greenhouses.
		Flooding	Medium	Medium	Access to wild plants may be limited temporarily during flooding, but there is generally good growth during the wet season.	Low	Medium	Forest Management plans to protect against over-harvesting
	Roots, Shoots and Stems (ginger, bamboo, rattan, etc.)	Extended Drought	Low	Low	Some species are seasonal (bamboo shoots), others are available almost year-round. Rattan is found on the mountains, and can be harvested all year.	High	Low	

Livelihood Area		Threat	Exposure	Sensitivity	Impact Summary	Adaptive Capacity	Vulnerability	Potential Adaptation Options
		Flooding	Medium	Medium	Access to wild plants may be limited temporarily during flooding, but there is generally good growth during the wet season.	Medium	Medium	
	Fruits	Extended Drought	Low	Medium	Delay in flowering and fruiting may reduce production.	Low	Low	
		Flooding	Low	Low	Community not dependent on fruits if can't access during floods	Low	Low	
	Mushrooms	Extended Drought	Medium	High	Emerge at the end of the dry season, which will see less rainfall and already have increased stress.	Low	Medium	Introduce mushroom culture.
		Flooding	High	High	Floods or storms may cause the wild mushrooms to rot.	Low	High	Introduce mushroom culture.

## OTHER CONSIDERATIONS

### 1. Gender

There are some gender differences within the communities of Ban Kouane and Ban Xong. Gender can play a role in what types of activities are done by men and women but might not be a major factor in targeting vulnerabilities within the community. Predominantly women and girls carry water. Women also collect NTFPs especially during the rainy season when men do much of the manual labor in the rice fields. Most families depend on rice as a major source of subsistence. In general, women prepare the seed beds, transplant, and harvest. Men do all other manual labor in rice production. Women will engage in small net fishing whereas men will use throw nets to catch more fish. Women collect mushrooms, bamboo, and other wild vegetables in the forest. Men will hunt though there is not much wildlife left in this area. Frequently they will set traps to catch rats, mice, and small rodents. Women do most of the domestic work in the home, care for the children and livestock and also collect firewood.

### 2. Disaster Risk Reduction

There is no disaster risk reduction plan in place in the target villages. This could be a potential area in which IUCN could provide support to provincial and district authorities.

### 3. Non Climatic

There are very few major non-climate threats identified in interviews with the village headmen in this area. It should be noted that one of the biggest non-climatic threats potentially facing this area village leaders might not be aware of, which is the numerous dams intended to be constructed throughout the region. As mentioned above, dams have major ecosystem effects even if physically located far from an area. Effects on the natural environment will result in consequences for the communities that depend on natural resources for their livelihoods making them even more susceptible to the climate change threats identified for their region.

## VULNERABILITY MATRIX

Table 6 quantifies the vulnerability of each livelihood. The main threats as determined by the Mekong ARCC Study in Khammouan are temperature, precipitation, storms, drought, and soil moisture. This vulnerability matrix reflects the main threats to key livelihoods to the communities where IUCN will implement adaptation strategies to climate change. The ranking is weighted and based on exposure and sensitivity of the community to the climate threats by livelihood. The ranking numbers represent the level impact on each livelihood by the climate threat: 1-not vulnerable 2-somewhat vulnerable and 3-highly vulnerable. The importance weighting is based on the community profile which ranks the importance of the livelihood to the community: 1-not important 2-somewhat important 3-critical. Adaptive capacity is based on expert assessment of what the communities capacities are to adapt to climate change and analyzed in terms of current adaptation strategies such as utilizing flood resistant rice, vaccinating livestock, community gardens etc.: -1-no adaptive capacity, -2-some capacity to adapt and -3-high capacity to adapt.

**Table 6: Livelihood and Threat Ranking**

Livelihood resources (ranked in order of importance)	Increased Temp	Drought	Increased Precip	Flash floods, landslides	Storms	Non-climate threats	Importance Weighting	Sub Total	Adaptive capacity (minus)	Total
Rain-fed Rice	1	3	2	1	2	2	3	14	-2	12
Pigs	1	2	1	1	1	2	3	11	-1	10
Cattle	1	2	1	1	1	2	3	11	-2	9
Aquatic Species NTFPs	3	3	1	1	1	2	3	14	-1	13
Leafy Plant NTFPS	3	3	1	1	2	1	2	13	-1	12
Roots/Shoots/Stems NTFPs	2	2	1	1	2	1	2	11	-1	10
Fruits	2	3	1	2	2	1	1	12	-1	11
Mushrooms	2	3	2	2	2	1	2	14	-1	13
Total	15	15	18	25	24	13				

# POTENTIAL ADAPTATION OPTIONS

1. Improve agricultural production
  - Improved water harvesting and storage methods
  - Introduce irrigation
  - Better sources of weather information to provide early warning
  - Introduce climate resilient crop varieties
  - Diversification of farming systems
  - Dry season fruit or vegetable cropping
  
2. Improve animal husbandry techniques, such as:
  - Improved water harvesting and storage methods
  - Fodder production
  - Introduce more stationary forms of animal husbandry
  - Domesticate wild animals for consumption
  - Diversify animal production
  
3. Implement measures that will improve the resilience of NTFPs, such as:
  - Introduce fire and drought resistant species
  - Improved general ecosystem management
  - Domestication of NTFPs
  - Integration of NTFPs into an ecosystem-based infrastructure
  - Forest management plans
  - Seasonal restrictions on harvesting



# CONCLUSION

Ban Xong and Ban Kouane are highly vulnerable communities to the effects of climate change. Not only are these communities completely subsistence-based, but are also highly inaccessible, poorly educated and currently have little or no adaptive capacity.

The major climate threats in this area of Khammouan Province are drought, flooding and storms. Due to the location of the villages in the valley, they are prone to flood waters being trapped. The karst Limestone Mountains are porous and steep which leads to flash flooding in the valley. Furthermore, not only is the temperature increasing, but the dry season is being prolonged which is detrimental to the production of rice on the communities.

These communities are highly dependent on the natural ecosystem and weather patterns, which means they are highly vulnerable to 'shocks' in the system. All villages analyzed were reliant on the same basic 4 livelihoods: Rice, Livestock, NTFPs and Fish. This analysis considered climate as well as non-climate factors that could affect villager's livelihoods. Most non-climatic factors will be exacerbated by climate change.

The approach of Mekong ARCC is to bridge high level science and community knowledge. This initial assessment is particularly relevant to understand not only the climatic threats in this area but other barriers to development as this increases the vulnerability of the community as the climate shifts. It also affects how IUCN intends to approach the adaptation decision making phase.

Although IUCN will plan and implement community-driven adaption options (outlined above), IUCN expects a few adaptation possibilities in these communities. This includes vaccination programs, better sources of weather monitoring and prediction, water storage and piping from mountain areas, and improvements in sanitation facilities. These will be finalized in an adaptation strategy after the community climate story, scientific story, and shared understanding are achieved.