Climate Change Impact and Adaptation Study for the Lower Mekong Basin

Mekong ARCC Background

The Mekong Adaptation and Resilience to Climate Change (Mekong ARCC) Project is a five-year program (2011-2016) funded by the USAID Regional Development Mission for Asia (RDMA) in Bangkok and implemented by DAI and subcontractors the International Centre for Environmental Management (ICEM) and the World Resources Institute (WRI). The project addresses information and policy gaps to provide communities in the Mekong River Basin with the guidance and support they need to develop sustainable integrated adaptation plans that will increase their ability to cope with the negative impacts of climate change. Mekong ARCC is headquartered in Bangkok and supports climate change research and adaptation initiatives in Thailand, Vietnam, Cambodia, and Lao PDR.

Climate Change Impact and Adaptation Study for the Lower Mekong Basin Approach

The *Climate Change Impact and Adaptation Study for the Lower Mekong Basin* study adopts a basin-wide, spatial approach in quantifying shifts in the geographical suitability of the key crop species and impacts on other livelihood sectors by 2050. Statistical downscaling of Global Circulation Models was used to regionalize global climate projections and coupled with a land use suitability assessment tool to examine the impacts of projected changes in climate on the suitability of six crops: *rainfed rice, soya, maize, cassava, robusta coffee and rubber*. The spatial approach applied in the Study not only highlights areas projected to experience major changes due to climate change but also identifies the priorities for adaptation response.

The Integrated Water Resources Management (IWRM) watershed model, developed by the EIA Ltd, MRC, World Bank, Aalto University and ICEM was applied for the whole Mekong Basin. The Land Suitability Evaluation Tool (LUSET), developed by IRRI, was adapted by the study and coupled to the IWRM model to assess the suitability of seven crop species when projections of future changes in climate are factored together with topographical characteristics. These crops are: ***rainfed rice, soya, maize, cassava, robusta coffee and rubber***. Lastly, the AquaCrop yield model developed by FAO was also coupled to the IWRM model to estimate impact of climate change on rice and maize yields in a number of locations across the basin.

<u>Identification Of "Hot Spot" Provinces for Vulnerabilty Assessment and Adaptation Planning</u>

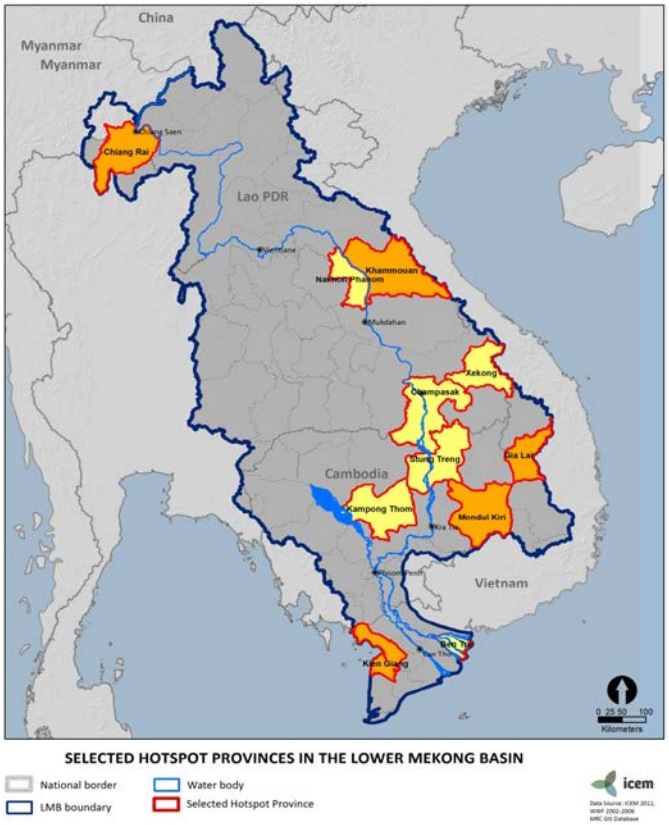
An important output of the study is the identification of climate change hotspots to better understand how climate change will alter ecosystems and impact the '*comfort zones'* of key crops and other community livelihood and subsistence options. Comfort zones are ranges where temperature, rainfall and soil conditions create favorable conditions for production. These will shift as a result of climate change making conditions unsuitable that are today thought of as ideal for certain crops, like the Central Highlands of Vietnam for coffee or Thailand's Chiang Rai Province for rice.

The *'hot spot'* approach integrates and orients study findings and provides a scientific basis for the selection of focal areas for the community adaptation initiatives that will be undertaken by Mekong ARCC in the next phase of the project. The Study team identified nine hot spot provinces that are: 1) representative of the ecosystems found across the Basin, 2) contain a mix of staple and commercial crops, fisheries and livestock that are common to the Lower Mekong Basin

(LMB), 3) are projected to experience the greatest relative increase in average temperature and/or rainfall, and 4) where such shifts would significantly impact a small number of important livelihood/subsistence options for communities. The selected Hot Spot provinces, therefore, share common traits with other provinces in the LMB, which will allow the new approaches to adapting and learning generated in field programs to be replicable and scalable throughout the Basin.

Hotspot provinces selected by Mekong ARCC Study

- Mondul Kiri - KHM
- Gia Lai - VN
- Chiang Rai - TH
- Khammouan – LAO
- Ken Giang - VN
- Kampong Thom - KHM
- Sakon Nakhon - TH
- Stung Treng - KHM
- Champasak - LAO

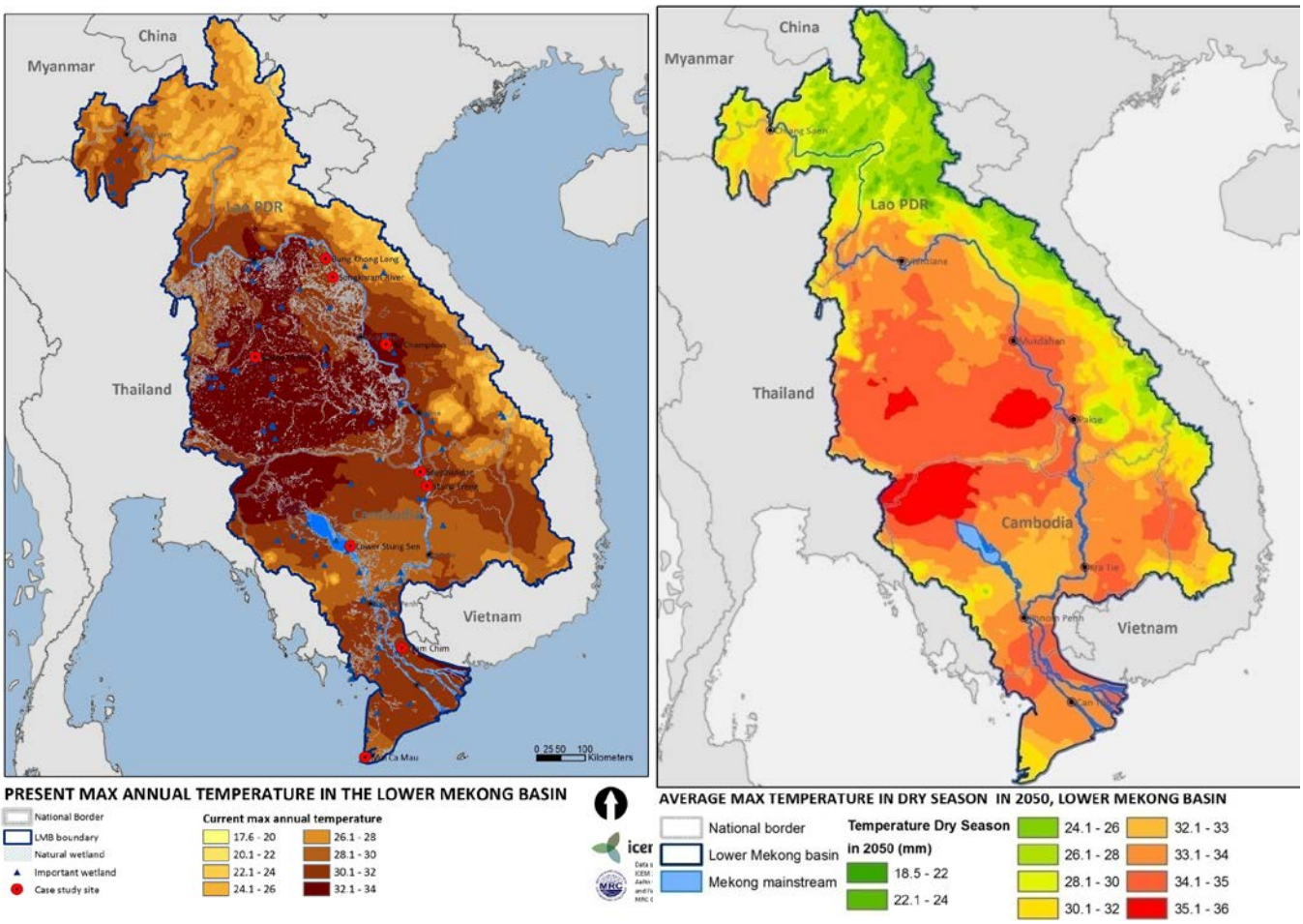


Initial Results from the Study

Projected Changes to Temperature and Rainfall

IPCC global climate change models utilizing a on middle range carbon emissions scenarios forecast an average annual temperature worldwide to rise 2 degrees celsius by 2050. But the impact and adaptation study forecasts a far more extreme future for the lower Mekong. As shown in the map below, some parts of the basin, including the eastern plains of Cambodia and parts of the central highlands of Vietnam, could see average annual temperature increases of 4C to 6C. This increase will mean dramatic changes in the comfort zone of crops and fish and livestock species, which could have serious negative consequences for the livelihoods, health and food security of the local communities in these areas.

Current LMB Maximum Annual Temperatures and Projected 2050 Maximum Annual Temperatures



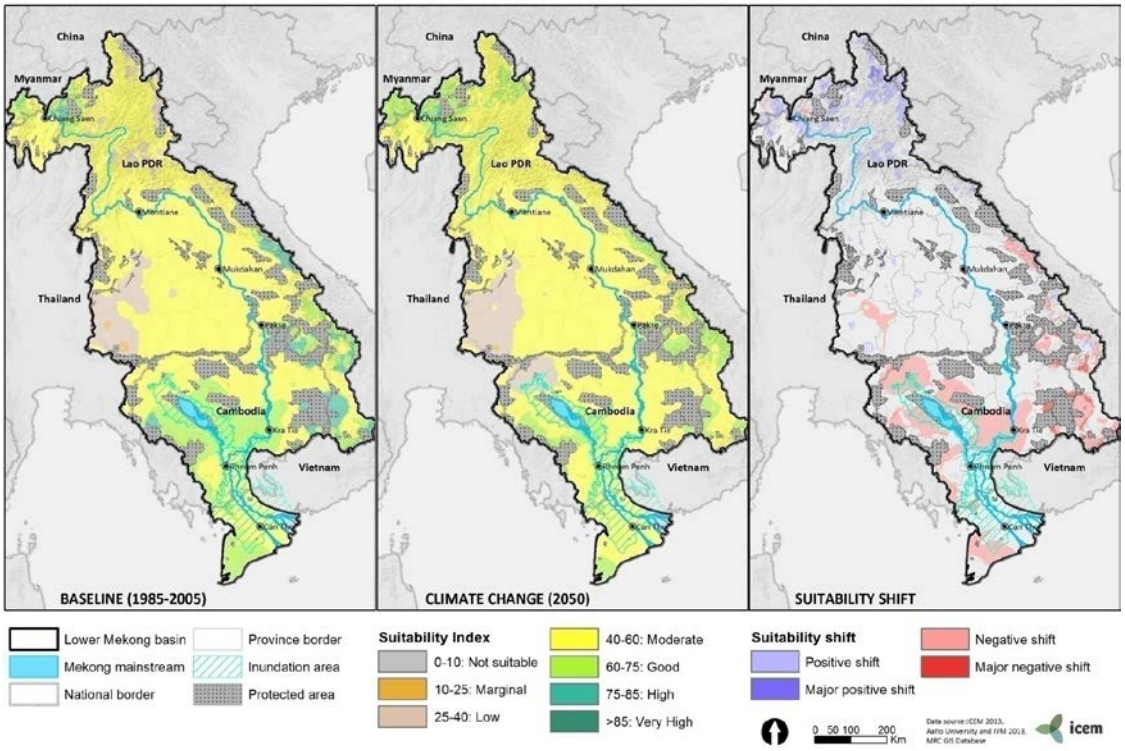
Projected Changes to Livelihood Sectors

Non rice Crops

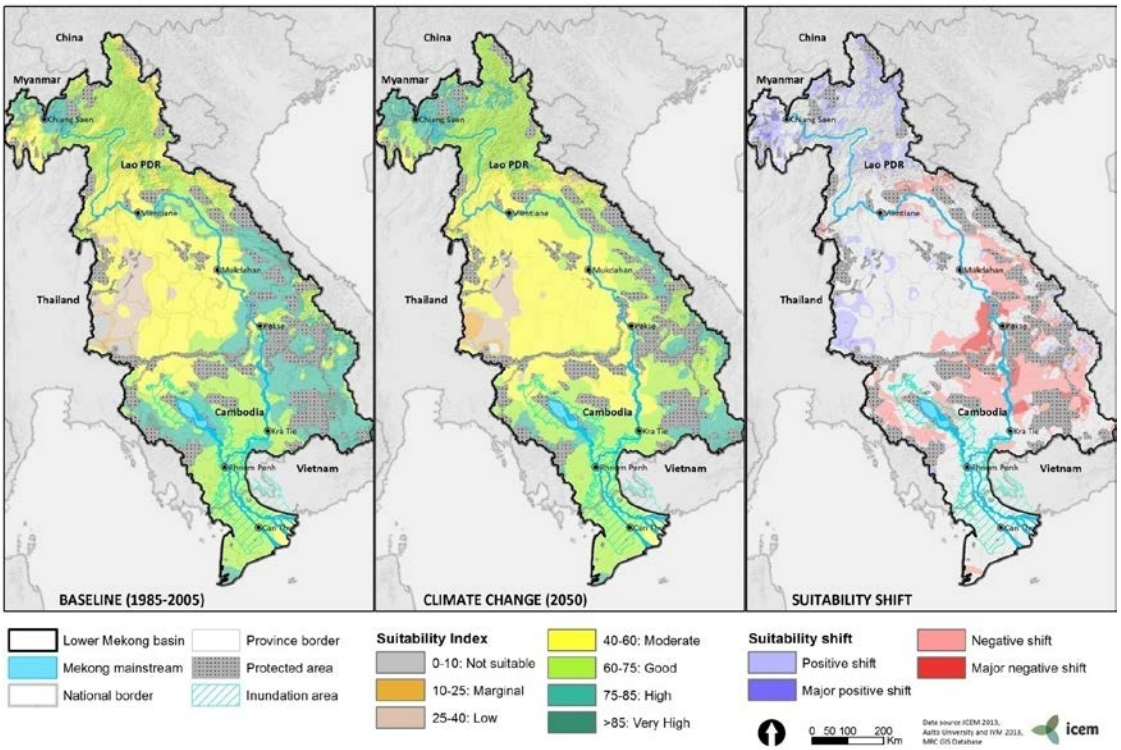
Climate change may induce geographical shifts in the suitability of the basin for several crop species assessed, including potentially:

- Suitability of industrial crops like rubber, robusta coffee and cassava shifting to areas of higher altitude with optimal suitability in 2050 centered on northern Thailand, northern Lao PDR and central highlands;
- Plains and lower altitude areas becoming less suitable for rubber, robusta coffee and cassava, especially in eastern Cambodia;

COFFEE ROBUSTA SUITABILITY IN THE LOWER MEKONG BASIN



RUBBER SUITABILITY IN THE LOWER MEKONG BASIN



- Dramatic increases in precipitation in central Lao PDR affecting cassava, soya and maize culture. For these crops, the rainfall suitability also decreases in central highlands and eastern Cambodia;
- An increase of suitability is projected in northeast Thailand due to an increase of rainfall during the crop;
- Maize yield projections show a general decreases across the basin, with Gia Lia (-12%), Mondulkiri (-6%), Kampong Thom (-6%) provinces being the most severely affected of the hot spot areas.

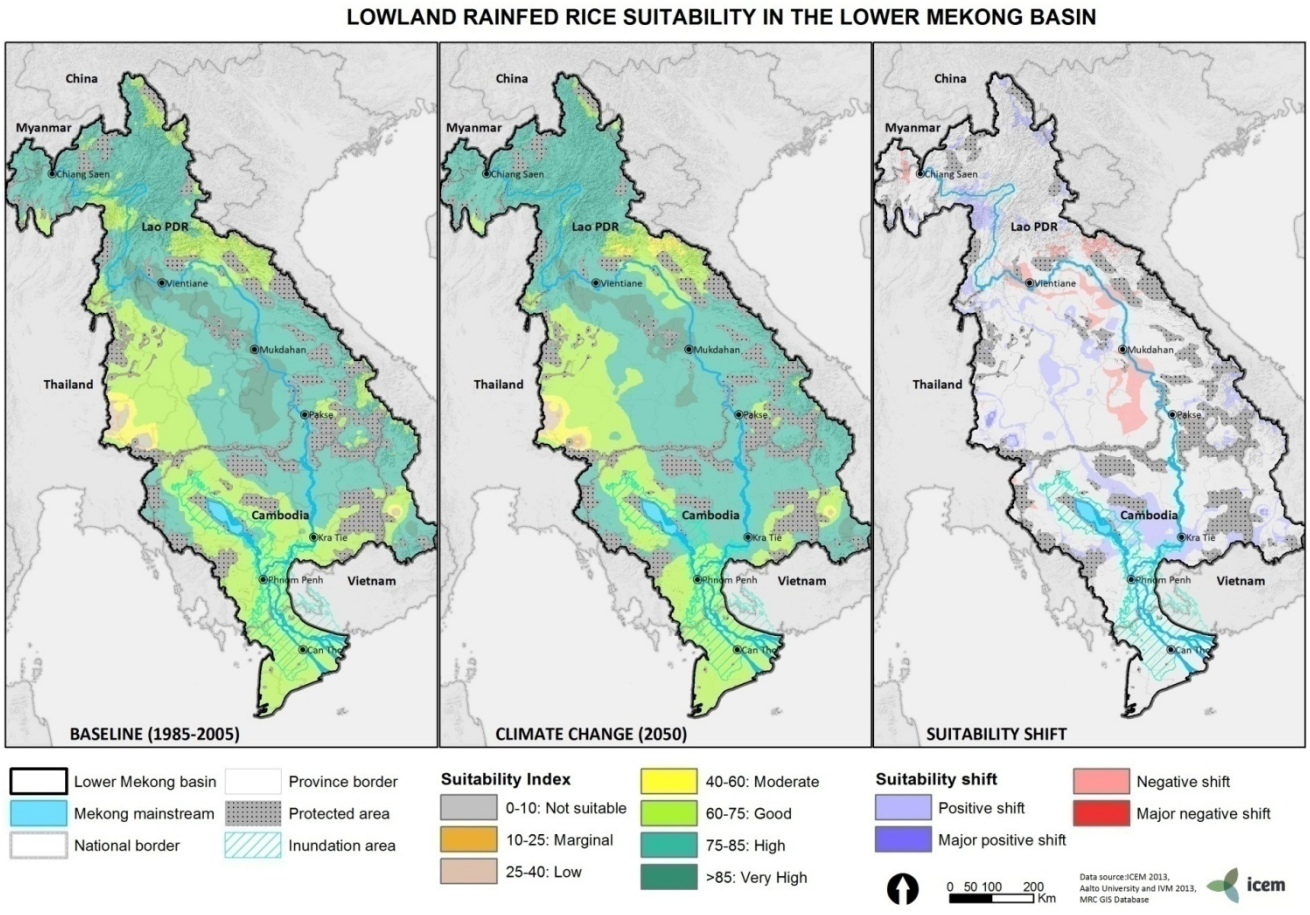
	Main change in Suitability	Location	Relevance to actual Agro-system
Rubber	Increased suitability due to increased precipitation	Northern Thailand (Chang Rai) and Northern Lao PDR (LoaungNamtha, Phongsali; Oudomxai)	High
	Decreased suitability due to increased rainfall	Cambodia (Kratie, PreahVihear) and Central and Southern Lao PDR (Champasack) and Chi Bun Basin In Northeast Thailand (UbonRatchatani)	Medium
	Increased suitability due to higher temperature	High elevation areas: Northern Thailand (Chang Rai), Lao PDR (LoaungNamtha, Phongsali; Oudomxai), Central Highlands (Kom Tum)	High (more area to cultivate)
Cassava	Increased suitability due to higher temperature	High and mid elevation eco-zone (Northern Lao PDR in Louangprabang, Louangnamtha, Xyaburi and Central Highlands, Kontum)	High
	Decreased suitability due to higher temperature	Low elevation eco-zones (Lao PDR, Cambodia and Central Highlands)	High
	Increased suitability due to increased precipitation	NorthernThailand (Chang Mai, Chang Rai)	High
	Decreased suitability due to increased precipitation	Low moist eco-zone, mid and high elevation eco-zone (Lao PDR in Champasack) and Cambodia (Stung Treng, PreahVihear, Battambang); and Central Highlands (Gia Lai)	High
Maize	Decreased suitability due to increased precipitation	Louangnamtha; Vientiane, Khamouane and Phongsaly province (Lao PDR),DakLak in Central Highlands (Vietnam)	Low
Soya	Decreased suitability due to increased precipitation	Low elevation (moist and dry) eco-zone: Kampong Chhnang, Battambang, PreahVihear, Pursat, Kampong Cham Siem Reap, Kratie and Kampong Thom (Cambodia)	Low in moist eco-zone; Medium in dry eco-zone (Cambodia and Northeast Thailand)
Robusta Coffee	Increased suitability due to higher temperature	Medium and high elevation eco-zones: Chang Mai, Chang Rai, North Lao PDR	High for Lao PDR (Northern regions)
	Increased suitability due to increased precipitations	Medium and high elevation eco-zones: Chang Mai, Chang Rai, North Lao PDR	High for Lao PDR (Northern regions)
	Decreased suitability due to higher rainfall and temperature	Medium and high elevation eco-zones:Lao PDR(Champasack and Attapeu) and Western Cambodia (Mondulkiri,	Low / Medium

Rainfed Rice Crops

Climate change will have less effect on lowland rain-fed rice than other crops, howerver it is vulnerable to increased temperature in the wet season, decreased water availability in the dry season, and salinity intrusion in the delta. Other potential climate impacts, both positive and negative, include:

- Positive changes for crop yield in Sakom Nakhon province in Northeast Thailand and negative changes in Gia Lai province, Vietnam, Champasak, Laos PDR, and Chang Rai province in Northern Thailand, and Khampong Thom, Cambodia.
- Increased rainfall in the wet season having a small negative impact in "wet" areas like Champasak, Gia Lai and positive impacts in a "dry" area like Sakon Nakhon;

Crop Yields	Baseline (ton/ha)	Change by 2050 (%)
Chang Rai	3.4	-4.8
Sakon Nakhon	2.1	4.6
Khammouan	3.4	-0.1
Champasack	2.9	-5.6
Gia Lai	3.3	-12.6
Mondulkiri	2.1	-3.0



Fisheries

- Black fish, which have limited migrations, appear more 'climate-proof' than migratory fish and upland fish and may be expected to increase in the proportion of fish catches as temperatures increase; and
- Aquaculture could be more vulnerable to climate change than capture fisheries, with flash floods causing a sudden drop in salinity and inviting disease of coastal shrimp ponds in Vietnam.

Livestock

- Higher temperatures will have little measureable impact on individual animals in low intensity systems but multiplied across villages to regions the impacts may be significant;
- Changes in rainfall will affect livestock units through feed and animal health issues. (Changes in the availability, quality and price of feeds are fundamental to all livestock production systems, as feed costs typically account for between 65 and 80 percent of production costs);
- Pathogens will likely be affected in terms of viability outside hosts and rates of proliferation by humidity levels and the quality and quantity of vector breeding sites. Wetter periods increase the likelihood of disease transmission through fomites, increasing the importance of employing effective biosecurity measures; and
- Wild species in the LMB – which are important genetic resources –will be threatened by climate change directly and indirectly through loss of habitat, hunting and the threat of infectious diseases.

Ecosystems

- Accelerating loss of populations and species due to extreme temperatures, coupled with drying, which is a significant driver of biodiversity loss;
- Reorganization of plant and animal communities and new 'problem' species entering communities;
- Geographic range shifts eastward and some perhaps upwards and range losses.

Non-timber Forest Products

- Productivity and fertility of NTFPs may be affected by increased temperatures, with dry season spikes impacting flowering, fruiting and seed dispersal; and
- Increases in temperature predicted for Mondulkiri could push Cardamom and Paper Mulberry beyond their absolute temperature range.