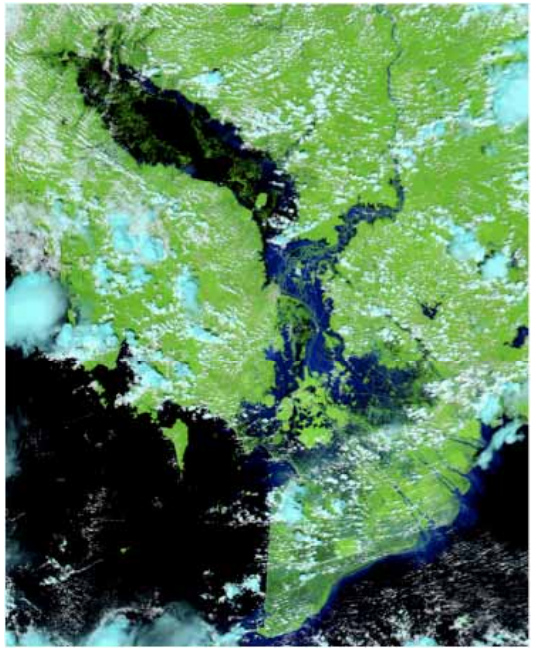
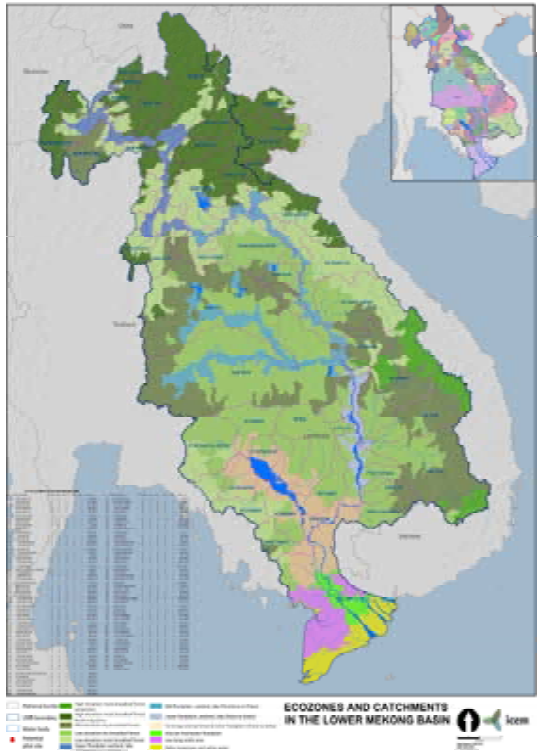
Vulnerability Assessment of Mekong Capture Fisheries & Aquaculture.

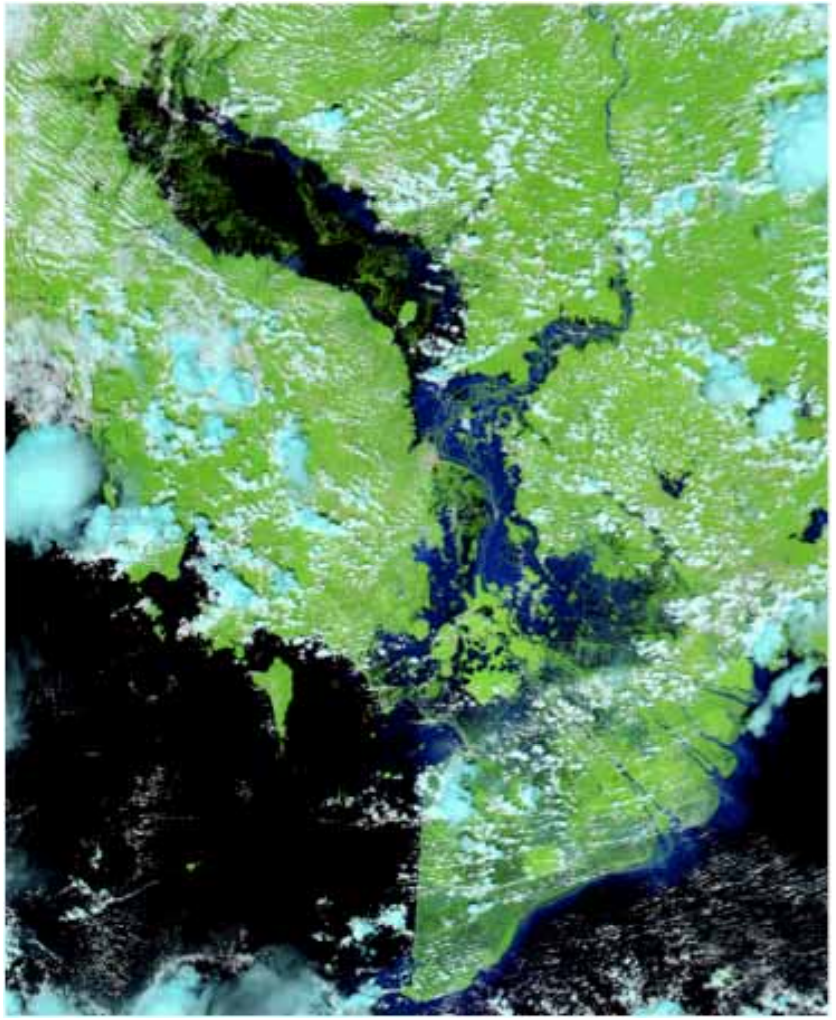




Rick Gregory ARCC Fisheries Specialist

Presentation Structure

- Overview
  - Capture fisheries
  - Aquaculture
- Climate Change variables affecting fisheries
- Capture Fisheries Vulnerability Assessments
  - Hotspots and species
- Aquaculture Vulnerability Assessments
  - Hotspots, species & systems



Overview

- **Fisheries & aquaculture are vitally important for food and for the livelihoods of people of the Mekong Region.** Virtually all rural families are involved in fishing at some time of the year and small-scale capture fisheries remain a 'livelihood of last resort' for many rural families. In recent decades aquaculture has boomed, providing livelihoods to hundreds of thousands of households.

- **Climate change will challenge these traditional and contemporary ways of life, at fundamental levels.**

Capture Fisheries

- **Biodiversity:** The number of fish species in the Mekong basin is estimated at > 1,200.
- **Productivity:** Stable, estimated 2 million tonnes per yr. (probably under reported).
- **Systems:** Traditional fishing gears and techniques.
- **FIshers**: Predominantly small-scale.
- **Importance for food security**: Supports Basin wide fish consumption levels of 30-40kg per person per year. Processed fish products important during lean periods. Also has a large influence on coastal marine fisheries. **Likely to stay an important food source.**

Aquaculture

- **Biodiversity:** Wide range of indigenous and exotic fish 'closed' and available.
- **Production:** Latest estimates 2 million tones. Exponential growth. Dominated by Pangasius culture in Vietnam's Mekong Delta.
- **Systems**: Extensive, semi intensive and intensive systems. Some systems still dependent upon capture fisheries for wild caught juveniles and low value fish, for feed
- **Farmers:** Predominantly small-scale
- **Importance for food security**: Important in urban markets and for small-scale farmers.

Climate change related threats for Capture Fisheries & Aquaculture

- Increased temperatures
- Decreased rainfall
- Decreased water availability
- Drought
- Increased rainfall
- Increased water availability
- Flooding
- Storms and Flash flooding
- Sea level rise
- Salinity changes

Understanding Synergies

- These threats should not just be considered in isolation or in a single farming system context.
- E.g. Increased temperatures + decreased water availability = tough conditions for fish
- E.g. in coastal areas, increased sea levels combined with higher rainfall will may exacerbate conflicts between shrimp farmers and rice farmers.

The challenge

- To develop a methodology that facilitates a robust vulnerability assessment of the Mekong's capture fisheries and aquaculture.

- In assessing the climate change vulnerability of fisheries, it appears to be important to **treat capture fisheries and aquaculture differently**.

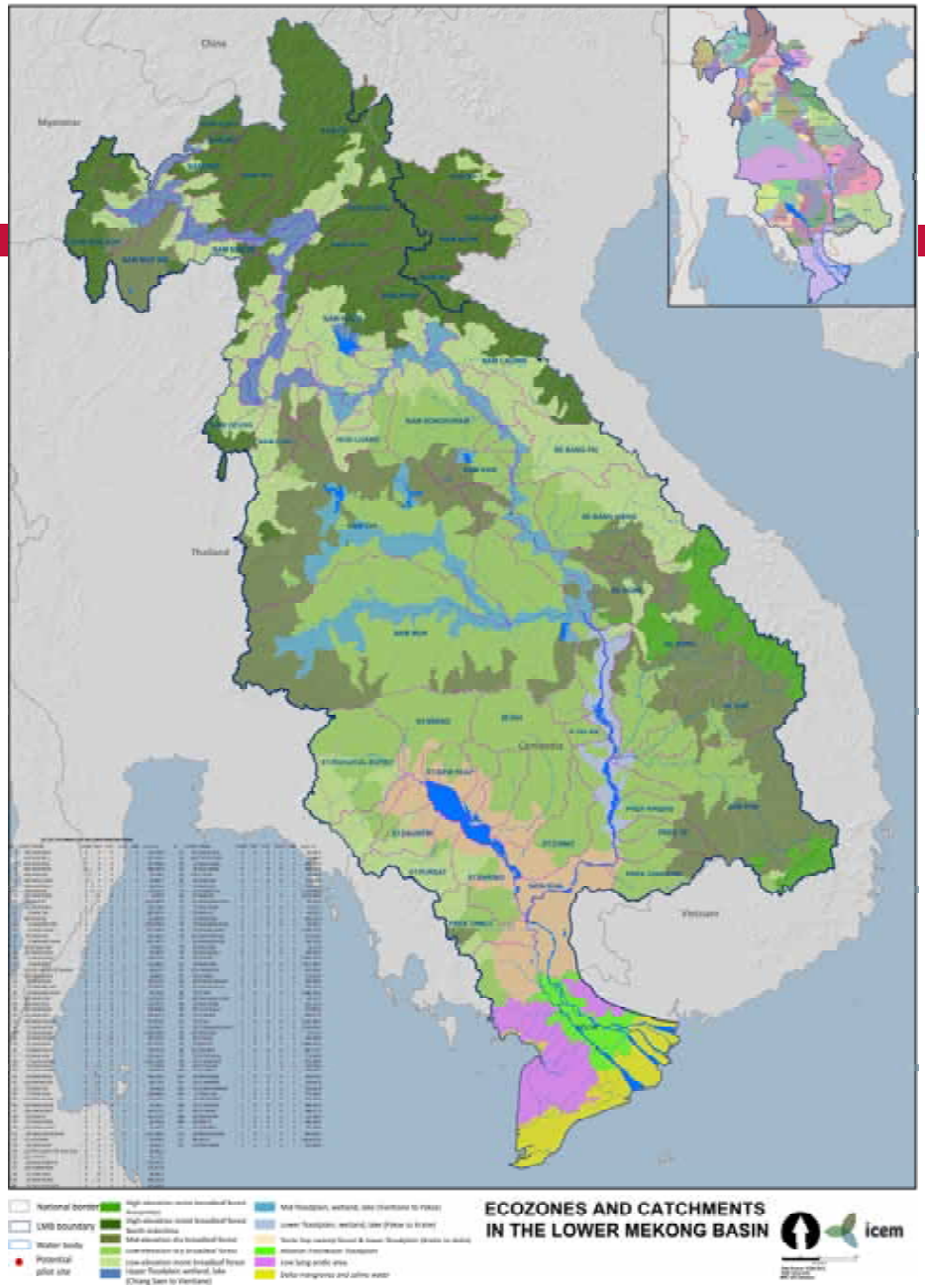
- **Capture fisheries** has been treated in a similar way to the ARCC NTFP component, i.e. focused on species.

- **Aquaculture** has been treated in a similar way to the ARCC Livestock component, i.e. focused on species and farming systems.

USAID
FROM THE AMERICAN PEOPLE

Mekong ARCC
Adaptation & Resilience to Climate Change

Mekong Eco-zones



- This is followed by
- Identification of key habitats in each Eco-zone
- Compilation of database describing indicator species and systems
- Verification of indicator species in eco-zones and habitats.

The ARCC Climate Adaptation & Mitigation Fisheries (CAM) Vulnerability Assessment.

- A mainly quality assessment framework which allows for a systematic appraisal of the threats and impacts on species and production systems, in the context of a geographic area, based on 2050 projections of new weather patterns and climate conditions.

Indicator species and hotspots

In the CAM framework a indicator species, for each of the fish groups is taken from a 30 aquatic species database which provides:

- A summary of bio-information available on the species
- The likely presence of the species in the hotspot area.

- Capture fisheries CAM Vulnerability assessments were carried out in 5 Hotspots;
- Chiangrai, Gia lai, Khammoune, Kien Giang, & Mondulkiri.

- CAM assessments were carried out through close collaboration with the ARCC Modeling team

Classifications of Fish Species

The Capture Fisheries CAM focuses on fish species and basic characteristics

- **Upland fish**: Inhabiting cool forest streams, these species are likely to be the most vulnerable to temperature increases and may well to shift their range to higher elevations.
- **Migratory (white) fish**: Sensitive to poor water quality and loss of connectivity of 'highways' and habitats.
- **Black fish**: Air breathing fish able to withstand harsh environmental conditions.
- **Estuarine fish**: Found in the Coastal and Delta areas of the Mekong in Vietnam.
- **Exotic fish**: Generalist, opportunistic species which have the potential to become established in the wild.

Some endangered Mekong Fish

Pangasianodon gigas

Probarbus jullieni

Finding the 'signal in the noise'.

- Finding a climate change 'signal' in Mekong capture fisheries is challenged by the 'noise' from other pressures and trends.

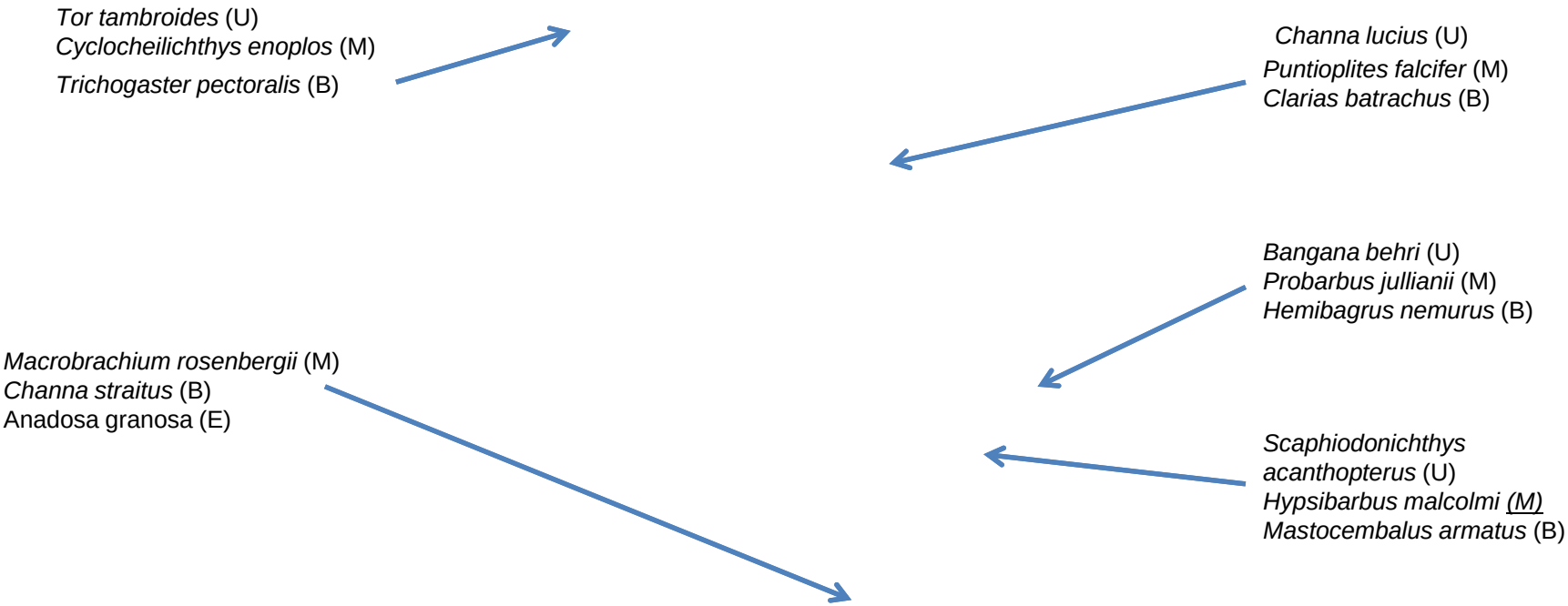
- The largest single threat to the diversity and productivity of the Mekong's fisheries is the **alteration of river morphology** caused by physical structures.

- A wide range of other threats exist.
  - Overfishing, resulting from increased numbers of fishers and sizes of gears.
  - Aggressive fishing methods, e.g. explosives
  - Loss of productivity through habitat destruction/change
  - Radical changes in land use patterns that change run off patterns from upland areas.
  - Establishment of exotic fish populations from aquaculture escapees.

USAID
FROM THE AMERICAN PEOPLE

Mekong ARCC
Adaptation & Resilience to Climate Change

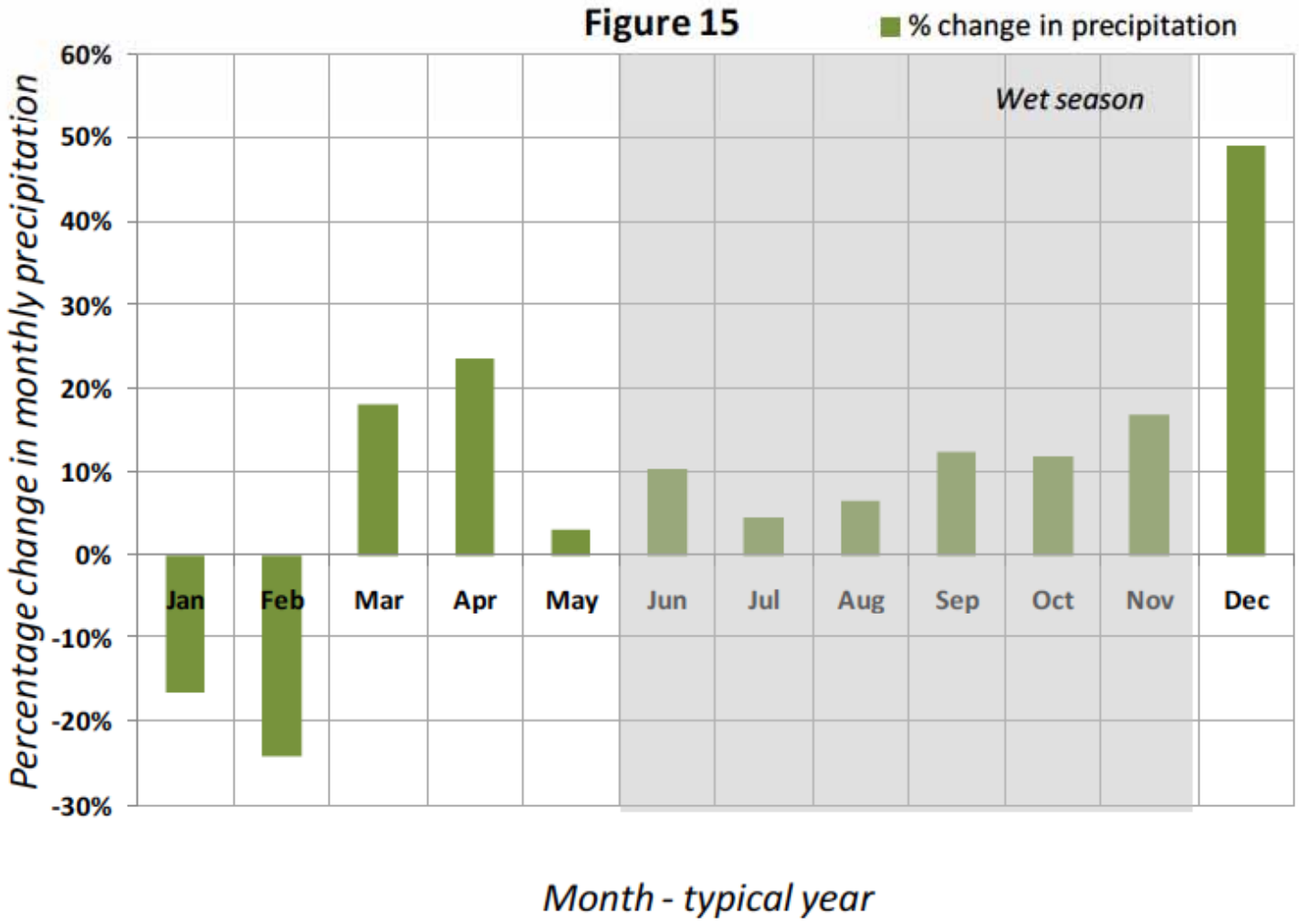
Capture Fisheries Hotspots and indicator species



How will the climate change?

An example from ARCC Modeling in Chiang Rai

Chiang Rai East – Precipitation



Capture Fish CAM Example. Chiang Rai

System component or assets	Threat	Exposure	Sensitivity	Impact Level	Adaptive capacity	Vulnerability
		refer to table			*refer to table*	*refer to table*
1. Tor tambroides UPLAND FISH, SOME MIGRATION, IMPORTANT FOR FOOD SECURITY IN SOME AREAS	Increase in temperature	Very High	very high	very high	low	**very high**
	Increase in precipitation	medium	high	medium	low	medium
	Decrease in precipitation	high	medium	high	low	**high**
	Decrease in water availability	low	high	medium	low-	medium-
	increase in water availability	-	-	-	-	-
	Drought	low	high	low	very low	medium
	Flooding	-	-	-	-	-
	Storms and Flash floods	medium	medium	high	medium	**high**
	sea level rise	-	-	-		
	increasing salinity	-	-	-		

CAM Result for Upland Fish in Chiang Rai

The CAM analysis suggests that the upland fish group will be

- Highly vulnerable to **increased temperature.**
- Also vulnerable to
  - **Decreased rainfall**, (dry season)
  - **Flash flooding**

Hampala sp from small upland stream

Other Conclusions from Hotspots

- Migratory white fish are less vulnerable, due to the longer and wetter monsoon.
- Black fish appear to be ‘climate-resilient’ and may increase in the proportion of fish catches.
- Estuarine fish, particularly the sedentary species, look highly vulnerable
- Several invasive species are likely to increase their range, under the changing conditions.

Assessing Aquaculture Vulnerability

- A similar process is used for assessing aquaculture vulnerability.
- Focuses on species AND culture systems.
- **Species** (from 30 species Database)
  - Indigenous species: E.g. Tiger shrimp, Blood cockle, Pangasisus
  - Exotic species: e.g. Common carp. Tilapia, (some invasive)
- **Aquaculture Systems** classified as:
  - Intensive (Ponds, Cages)
  - Semi intensive (Ponds)
  - Extensive (Ponds, Ricefields, Mudflats)

Aquaculture Hotspots and indicator species and systems

•INTENSIVE POND MONOCULTURE OF CATFISH
•SEMI INTENSIVE POND POLYCULTURE
•EXTENSIVE POND POLYCULTURE

EXTENSIVE POND CULTURE OF CARPS
SEMI INTENSIVE POND CULTURE OF TILAPIA
INTENSIVE POND CULTURE OF PANGASIUS

. CAGE CULTURE IN RESERVOIR OF CARP
. INTENSIVE POND AQUACULTURE CATFISH

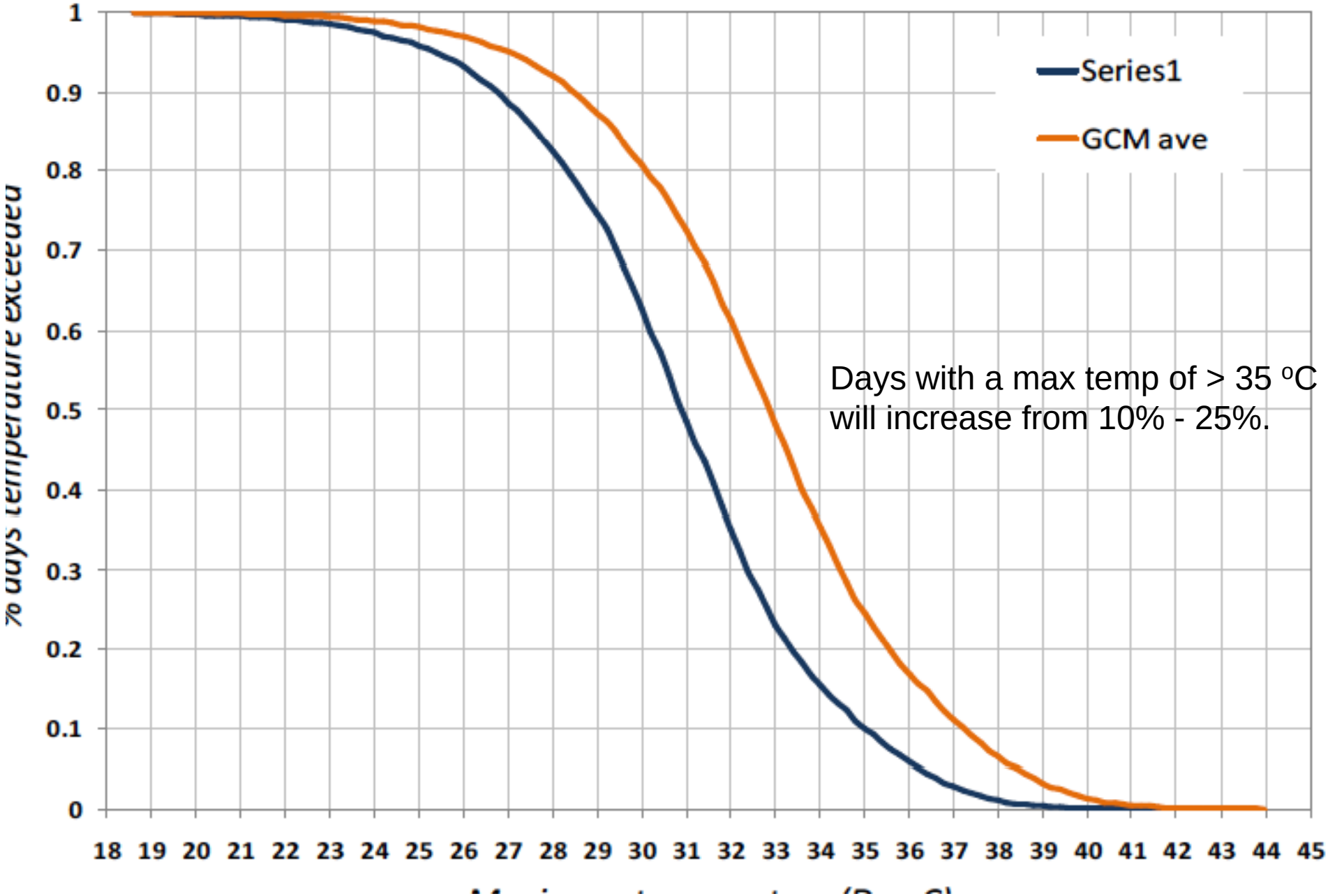
SEMI -INTENSIVE POND CULTURE OF CLARIAS CATFISH
EXTENSIVE POND POLYCULTURE OF CARPS & TILAPIA

SEMI-INTENSIVE POND AQUACULTURE OF TIGER SHRIMP
EXTENSIVE POND AQUACULTURE OF GIANT FRESHWATER PRAWN.

How will the climate change?

Another example from ARCC modeling of Chiang Rai

Figure 3


% days temperature exceeded
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Series1
GCM ave
Days with a max temp of > 35 °C will increase from 10% - 25%.

Aquaculture CAM for Chiangrai

		refer to table			*refer to table*	*refer to table*
SEMI INTENSIVE POND POLYCULTURE OF TILAPIA, SILVER BARB AND CARPS	Increase in temperature	high	high	high	low	**high**
	Increase in precipitation	medium	low	medium	high	medium
	Decrease in precipitation	medium	very high	high	very low	**very high**
	Decrease in water availability	low	medium	medium	medium	medium
	Increase in water availability	-	-			
	Drought	medium	very high	high	low	**high**
	Flooding	high	very high	very high	medium	**very high**
	Storms and Flash floods	medium	very high	high	low	**high**
	sea level rise					
	increasing salinity					

Hotspot Aquaculture Conclusions

- Aquaculture appears to be **more vulnerable to climate change scenarios** than capture fisheries, although it tends to have a high adaptive capacity.
- Intensive, semi-intensive and extensive aquaculture systems all appear to be vulnerable to climate change.
- Intensive aquaculture looks particularly vulnerable in lowland and coastal areas.
- Intensive systems have a high risk of failure but have the greater adaptive capacity
- Semi –intensive and extensive systems have a lower risk of failure but also have a lower adaptive capacity.

- So, whilst aquaculture may become possible or more viable in new (higher elevation areas) , this will not come close to compensating for the production losses from lowland areas.

Capture Fisheries & Aquaculture CAM results for Chiangrai

CAPTURE FISHERIES

Species	Threat	Vulnerability
1. Tor tambroides UPLAND FISH, SOME MIGRATION, IMPORTANT FOR FOOD SECURITY IN SOME AREAS	Increase in temperature	very high
	Increase in precipitation	medium
	Decrease in precipitation	high
	Decrease in water availability	medium-
	increase in water availability	-
	Drought	medium
	Flooding	-
	Storms and Flash floods	high
	sea level rise	-
	increasing salinity	-
2. Cyclocheilichthys enoplos MIGRATORY, MEDIUM, WHITE FISH IMPORTANT FOR FOOD SECURITY	Increase in temperature	Very high
	Increase in precipitation	medium
	Decrease in precipitation	high
	Decrease in water availability	medium
	Increase in water availability	-
	Drought	medium
	Flooding	-
	Storms and Flash floods	medium
	sea level rise	-
	increasing salinity	-
3. Trichogaster pectoralis NON MIGRATORY, SMALL BLACK FISH, IMPORTANT FOR FOOD SECURITY.	Increase in Temperature	medium
	Increase in precipitation	medium
	Decrease in precipitation	low
	Decrease in water availability	medium
	increase in water availability	-
	Drought	medium
	flooding	-
	Storms and Flash floods	medium
	sea level rise	-
	increasing salinity	-

AQUACULTURE

Syestem & species	Threat	Vulnerability
INTENSIVE POND MONOCULTURE OF CLARIAS CATFISH	Increase in temperature	high
	Increase in precipitation	low
	Decrease in precipitation	medium
	Decrease in water availability	very high
	Increase in water availability	-
	Drought	very high
	Flooding	very high
	Storms and Flash floods	high
	sea level rise	-
	increasing salinity	-
SEMI-INTENSIVE POND POLYCULTURE OF TILAPIA, SILVER BARB AND CARPS	Increase in temperature	high
	Increase in precipitation	medium
	Decrease in precipitation	very high
	Decrease in water availability	medium
	increase in water availability	-
	Drought	high
	Flooding	very high
	Storms and Flash floods	high
	sea level rise	-
	increasing salinity	-
EXTENSIVE POND POLYCULTURE OF CARPS & TILAPIA	Increase in temperature	medium
	Increase in precipitation	low
	Decrease in precipitation	medium
	Decrease in water availability	high
	Increase in water availability	
	Drought	high
	Flooding	high
	Storms and Flash floods	medium
	sea level rise	
	increasing salinity	

Capture? Culture?

Some final thoughts

- It should not be forgotten that fishing and farming communities in SE Asia are **extremely resilient** to the vagaries of the weather and seasons, which in the case of the Mekong River and floodplain are already extreme.

- However, **climate change will test the limits** of the Mekong's people's capacity to produce food and generate incomes.

- These communities must not be left to adapt by themselves. They must be supported to acquire:
  - Awareness of the changing conditions to come.
  - Techniques and innovations suitable for the changing conditions

The Mekong Farmer ? Fisher? Livestock rearer?


Thanks for listening