Initial findings of wetland and climate change impacts in Stung Treng wetland, Cambodia

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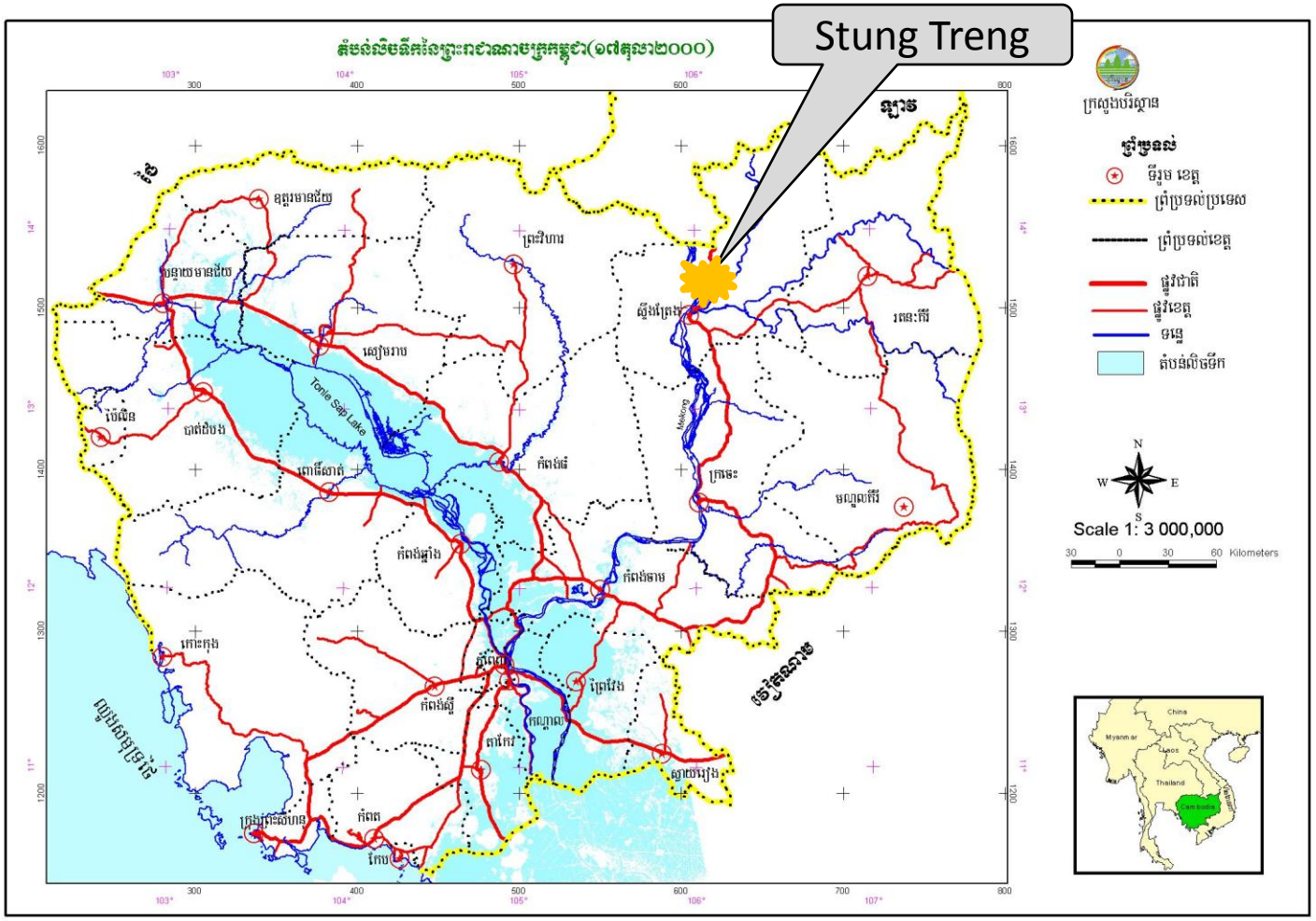
Please note that this presentation presents initial finding and work that is in progress. It was developed for workshop discussion only.

Outline

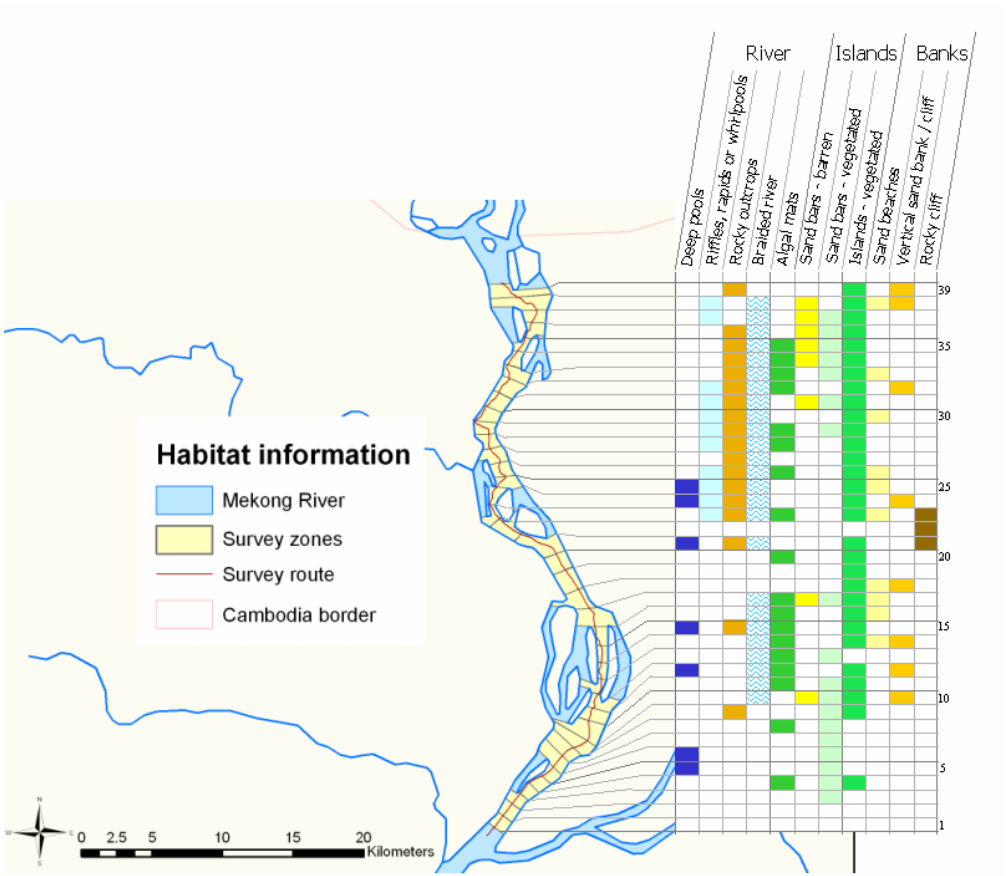
- **General overview of Stung Treng Ramsar Wetland site;**
- **Climate profile and climate change;**
  - **Impacts on biodiversity, habitats, ecosystem services and livelihood;**
- **Wetland valuation;**
- **Potential adaptation measures**

Location of Stung Treng wetland



General feature and main habitats of Stung Treng Wetland

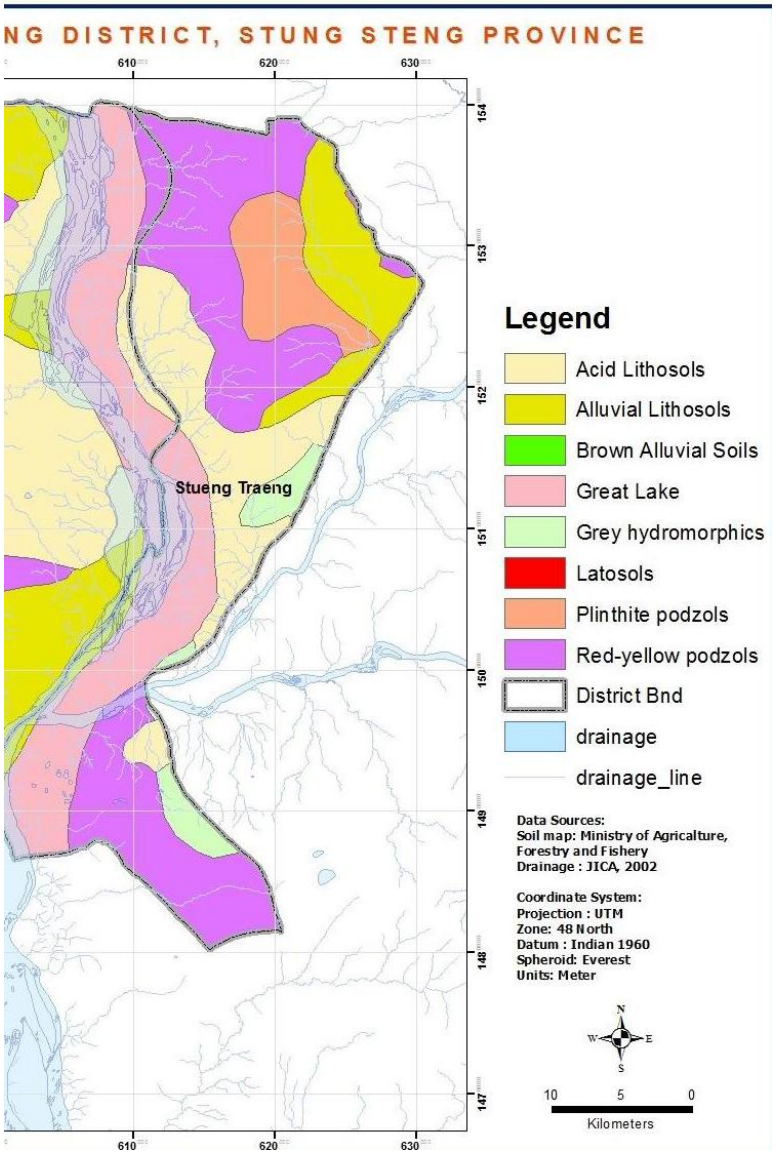
- Area: 14,600 ha, on 37 km stretch of Mekong River;
- 2 main sections: a single wide channel, and large islands & narrow braded channels;
- Much of the braided channels are shallow and exposed;
- On the east, its watershed extends about 10 km;
- On the west, the O'Talash tributary - about 60 km long with watershed about 5,000 km^2



Soil characteristics

Four major groups of soil:

- Shallow acid lithosoils from sandstone to 15 cm, pH: 4.5-6.5, poor soil;
- River alluvial soil, pH: 4.5-6.5, fertile;
- Brown alluvial soil, pH: 5.0-6.8, fertile;
- Red-yellow podzolic soil, pH: 4.2-6.8, poor;



Major habitats

– Aquatic habitats: fast flowing, and turbulent, shallow rocky substrate, deep pools and depressions,

- Sand bars and grasslands: Sand bars – non-stable, tall cane grasses – at high altitude, non-tolerant to flooding;

- Channel woodlands: Dominated by *Anogeissus rivularis, Barringtonia acutangula, and Eugenia mekongensis, Acacia harmandiana,*

Major habitats

– Channel bushland: *Phyllanthus jullienii, Telectadium edule, Homonoia riparia*

- Channel mosaic: heterogeneous substrates, where there is prolonged exposure and weak current – mainly Acacia and Barringtonia;

- River Channel Banks: dense shrub and small tree growth with many vines and lianas, with *Mimosa pigra*;

- Agriculture land;

Current climate

Parameter	2003	2004
Total annual rainfall (mm)	1373	1807
Annual average maximum temperature (oC)	33.0	36.5
Annual average minimum temperature (oC)	24.0	23.0
Average annual temperature (oC)	30.5	34.0
Maximum temperature (oC)	38.5	40.0
Minimum temperature (oC)	11.5	18.6

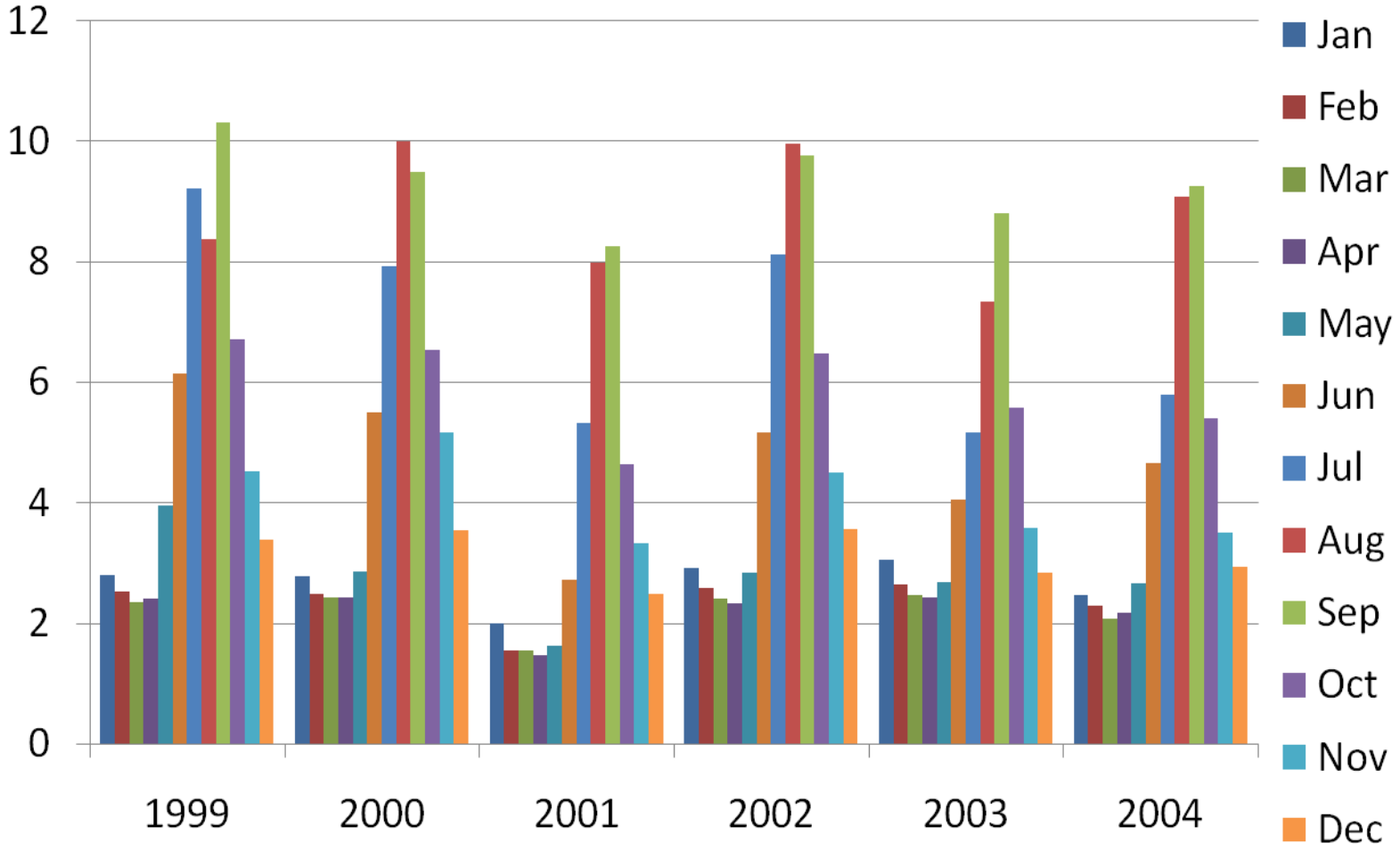
Source: Stung Treng Provincial Department of Water Resources and Meteorology, January 2005

Average rainfall for Stung Treng, 1994-2000

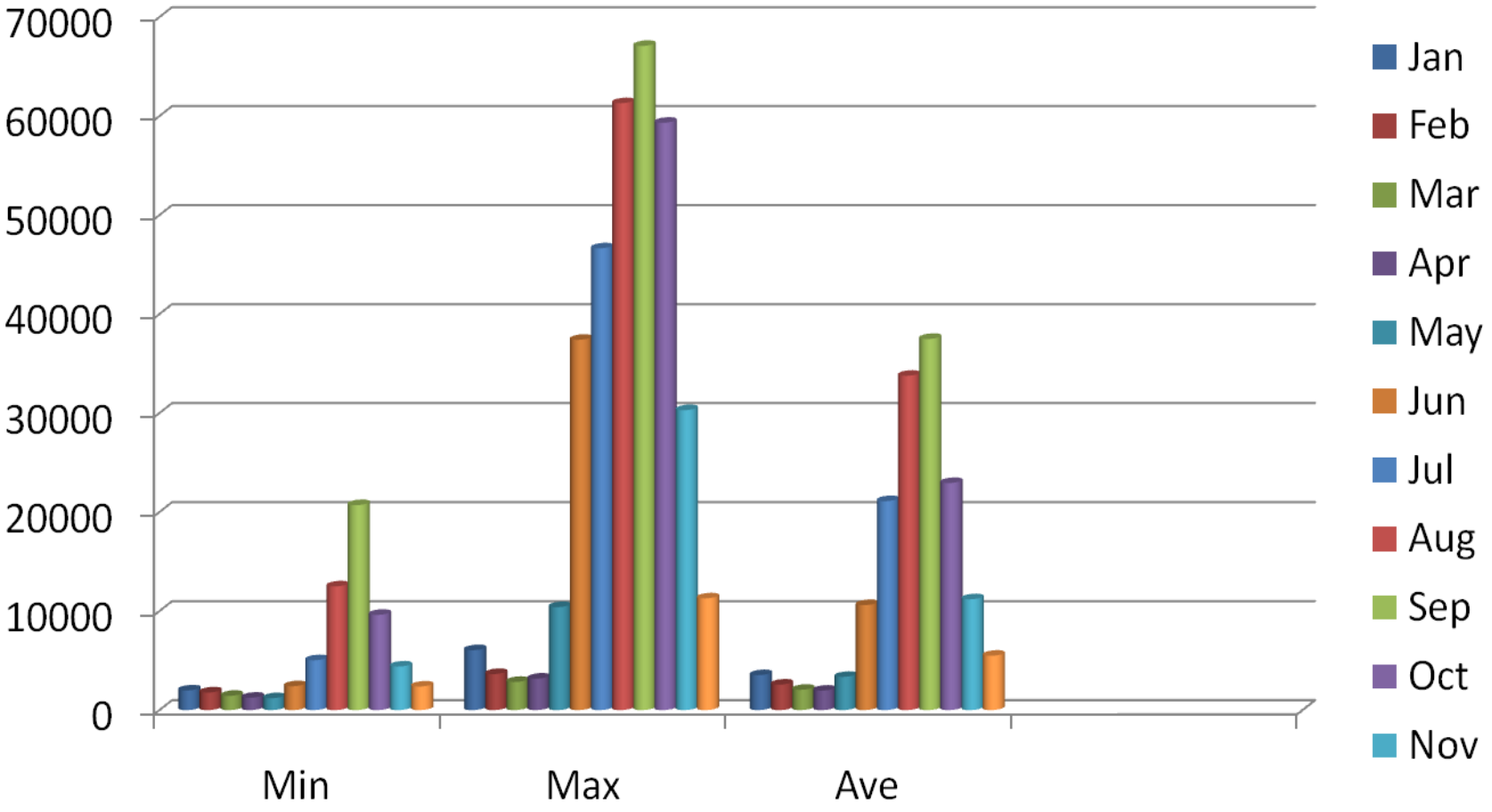
Month	Average Rainfall 1994-2000(mm)	% of Annual Average	Monthly Range 1994-2000(mm)
January	0.9	0.1	0-5.1
February	1.2	0.1	0-5.7
March	43.9	2.2	4.0-121.2
April	167.8	8.5	22-403.8
May	249.2	12.7	116.6-443.4
June	245.0	12.5	65.4-519.3
July	289.4	14.7	106.8-424.6
August	333.4	17.0	245.7-404.3
September	308.4	15.7	176.4-458.1
October	228.8	11.6	106.7-389.8
November	82.0	4.2	0-242.0
December	16.2	0.8	0-61.1
Annual	1966.2		1441.3-2600.2

Source: adapted from CTIA, 2000.

Water level at Stung Treng town by month (m)



Max, Min, Ave flow at Stung Treng, 1962-1988 (m^3/s)



Potential impacts of CC

- Change in temperature;
  - Means annual temp will increase by 0.6-1.05 Deg. Centigrade;
  - That result in:
    - Increase evaporation;
    - Number of hot days;
- Change in precipitation: Approx 10% increase equivalent to 200mm (A2)

Potential impacts of CC

- Change in average flow

- Dry season flow: increase 500-800m3/s, ~13% in vol and 0.5 m height,
- Wet season flow: increase ~3%, ~0.4 m in height;

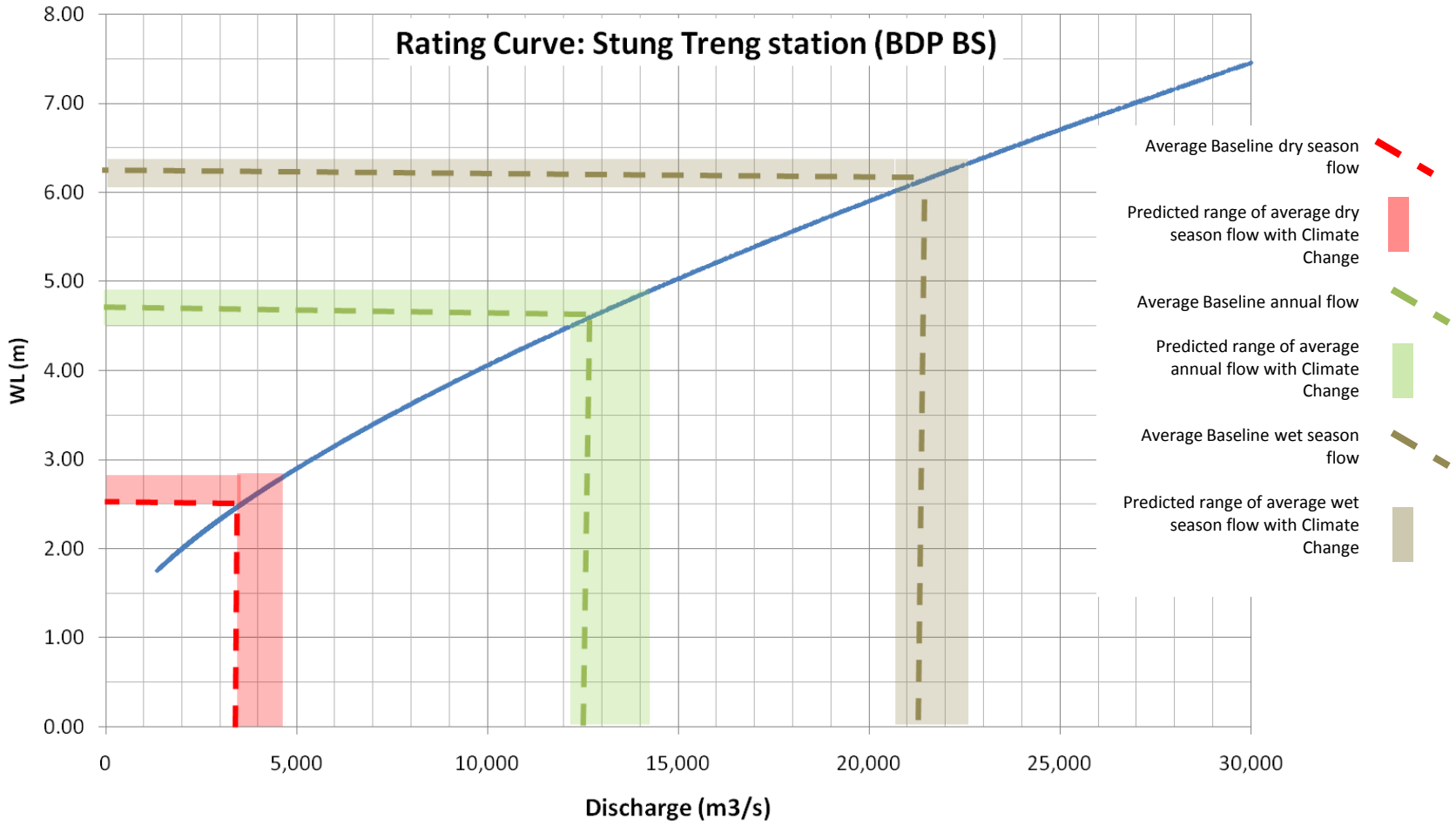
	Baseline	with Climate change					
average flow	**1986-2000**	**2010-2019**	**2020-2029**	**2030-2039**	**2040-2050**	***2020 - 2050***	***2010-2050***
Dry	3,521	3,608	4,421	4,367	3,940	*4,242*	*3,971*
Wet	21,322	20,922	22,468	23,811	21,192	*22,490*	*21,943*
annual	12,440	12,283	13,462	14,110	12,583	*13,385*	*12,976*
% change from baseline							
Dry		2.5%	25.6%	24.0%	11.9%	20.5%	12.8%
Wet		-1.9%	5.4%	11.7%	-0.6%	5.5%	2.9%
annual		-1.3%	8.2%	13.4%	1.2%	7.6%	4.3%

	Baseline	with climate change					
extreme flows	**1986-2000**	**2010-2019**	**2020-2029**	**2030-2039**	**2040-2050**	***2020 - 2050***	***2010-2050***
Dry season min flows	2,032	902	1,444	1,372	1,601	1,472	1,470
wet season peak flows	70,378	66,429	76,471	60,468	88,017	74,985	72,352
% change from baseline							
Dry season min flows		-55.6%	-28.9%	-32.5%	-21.2%	-27.6%	-27.7%
wet season peak flows		-5.6%	8.7%	-14.1%	25.1%	6.5%	2.8%

- Change in peak flow
  - Dry season min flow: drop 28%, → 1.75 m lower;
  - Wet season peak flow erratic between + 25% and – 14%

Source: ICEM analysis of MRC CC assessment

Rating Curve for Stung Treng Gauging Station 1986 – 2000. *Dashed lines show n average seasonal and annual flows under baseline conditions, while shaded areas shows the range in change expected with climate change for the period 2010 – 2050.*



Potential impacts on habitats

Wetland habitat	Potential impacts
Deep pools	• Increase in connectivity of deep pool systems; • Change in the fate and transport of sediments across the pools;
Rapids and riffles	• Reduce the time of the year when bed rock features are exposed; • Some of the features on the periphery of the perennial channel may become impassable under minimum flow; • Change in associated vegetation communities due to the level and pattern of exposure;
Sandbars and in-channels islands	• Decrease in in-channel features, terrestrial habitats associated with sand bars remaining permanently inundated during the dry season affecting the availability of terrestrial habitat; • The shallow water hole in the in-channel islands may dry out; • Change in current dynamic balance between erosion and deposition; • Change in sediment load/profile and their deposition resulting from change in peak flood;
Alluvial reaches	• Alluvial deposition may shift further down stream and only coarse sediment remains
Meanders and Oxbows	• Mainly occur as there is shift in dynamic of sandbar locations
Riverine flooded forest	• Marginal expansion of the flooded forest habitat; • Marginally increase the depth of flooding in near channel areas of the floodplain;
Islands and riverbanks	• Change in location and intensity of erosion and sedimentation may occur
Riparian vegetation zone	• Marginal upland migration of galley forests; • Some shrinkage in the size of gallery forest habitat; greater rates of evapo-transpiration increasing water scarcity to the system during the dry season

Potential impacts on key biodiversity

Species / assemblage	Potential impacts
Flora and vegetation	
Ceratophyllum demersum (herb)	• Those on the large channel may suffer from more turbid, stronger flow; and those in small isolated ponds may not survive as the water dry out.
Blachia siamensis (shrub)	• May suffer from stronger flow in the dry season, and limit to less rapid flow areas.
Phyllanthus jullienii (shrub)	• May suffer from lack of annual cycle of submergence and exposure but is resistant to extreme habitat condition; May shift to fringing areas to the water;
Telectadium edule (shrub)	
Homonoia riparia (Shrub)	• Same above
Anogeissus rivularis	• Its presence in more prolonged dry season exposure and an abundance of sand, thus may suffer shift in location due to change in fate and dynamic of sediment and erosion;
Acacia harmandiana	
Barringtonia acutangula	• May suffer from erosion and shift in sedimentation as they mainly grow in soil rich areas;
Eugenia mekongensis	
Cleome viscose (fern)	• The species common grows in sandy, seasonally inundated areas thus may suffer from high water level in the dry season.
Ficus sp.	• The presence depends on the availability of trees it can grows on, thus may change as the substrate altered.

Species / assemblage	Potential impacts
Fish	
Pangasianodon gigas	• Changed in seasonality, flood pulse that trigger migration; • Reduced foraging ability due to changed siltation from increased storms in the catchment; • Changed/damaged food supply due to change in quality of habitats and food availability;
Probarbus jullieni	• Same above, • Impacts from change in sand and gravel substrates, • Its intolerant of habitat alteration, particularly impoundment;
Catlocarpio siamensis	• Changed in seasonality; • Reduced foraging ability due to changed siltation from increased storms in the catchment; • Impacts from change in sand and gravel substrates; • Changed/damaged food supply due to change in quality of habitats; • Impacts from changes in feed availability; • Impacts from inundation of floodplain
Pangasius sp.	• Same as giant catfish; • Subject to change in crustaceans and presence of vegetable matter.
Mystus sp.	• Impact on spawning season; • Accessibility to floodplain; • Change in sediments that affects feed availability;
Mekongina erythrospila	• Impact on spawning seasons; • Change in sediments that affects feed availability;
Henichorhynchus spp	• Accessibility to floodplain; • Change in sediments that affects feed availability;
Cyclocheilichthys apogon	• Affected from presence of plankton and crustaceans; • Extend of inundation; • Flood pulse;
Cirrhinus microlepis	• Changed in seasonality, flood pulse that trigger migration, better access to floodplain • Changed/damaged food supply due to change in quality of habitats;
Himantura spp	• May suffer from change in sandy substrate; • Changed in sedimentation;

Species / assemblage	Potential impacts
Amphibians	
Polypedates leucomystax; Occidozyga lima; Rana erythraea	• May have to escape to shallow wet areas as many are deeply inundated; May have impacts on the sex ratio of their hatchling and mating;
Reptiles	
Crocodylus siamensis	• May suffer from change in pattern of channel habitats, partly fragmented; • Altered sex ratios + hatchling survivorship due to rising temperatures; • Loss of nesting beaches;
Giant Softshell turtle	• Altered sex ratios + hatchling survivorship due to rising temperatures; • Loss of riverbank and nesting beaches;
Birds	
Cormorant and Oriental Darter	• Reduced trees used for staging and feeding; • Change in feeding grounds as water stays higher in the dry season;
River tern and Great Thick-knees	• Loss/shift in sand beaches;
Green Peafowl	• Loss of forest and its feeding habitats due to risk of burning; • Loss of access to certain habitats as water channel pattern changes;
Grey-Headed Fish Eagle	• Loss of staging trees; Change in feeding habitats; Change in water quality;
White-shouldered Ibis	• Affect from loss of tree cover; • Higher inundation;
Mammals	
Long-Tailed Macaque	• Loss of channel forest; • Higher temperature may affect their mating behaviour; • Seasonal flooding;
Silvered Leaf Monkey	• Same above; and Risk of forest fire as temp raises up;
Eld's Deer	• Loss for forest cover; and Change in habitat pattern
Smooth-coated Otter	• Loss/reduction in channel forest; and Changed water quality;
Irrawaddy dolphin	• Change in fate of sedimentation, increased temperature, • Change in deep pool profiles;

Suggested adaptation measures

- Stronger coordination with upstream countries ensure a stabilized flow of the mainstream;
- Avoid disruption due potential physical structure development;
- Forging more flexible, adaptive, learning institutions for wetland management;
- Strengthen the management of existing Ramsar status;
- Integrated land use planning in the catchment.

Wetland Valuation

Population view on wetlands: Stung Treng

Trends	Stung Treng	Reasons
Wetland pollution	↑	1- Over logging 2- Over population 3- Over fishing,
Fish stock (wetland, river)	↓	
Natural forest	↓	
Fuel wood	↓	
NTFP	⇣	
Wild bird	↓	
Wild animal	↓	

Wetlands ecosystem services trends: Stung Treng

1- Provisioning services	Present importance	Future importance
Food production for fish and habitat	High	↑
Water retention for domestic and other uses	High	↑
Fuel wood, log, peat and fodder	High	↑
Medicinal plant	Medium	⇣
Ornamental species	Medium	↑

Wetlands ecosystem services trends: Stung Treng

2- Regulating services	Present importance	Future importance
Climate regulation/ sink greenhouse gas	High	=
Water regulation /groundwater recharge	High	=
Water purification/ natural treatment	High	=
Erosion protection, sediment disposal	High	
Natural hazard regulation/ Flood, storm control	High	

Wetlands ecosystem services trends: Stung Treng

3- Cultural services	Present importance	Future importance
Spiritual value	Medium	=
Recreation activities	High	=
Natural aesthetic	High	=
Educational activities	Medium	=

Wetlands ecosystem services trends: Stung Treng

4- Supporting services	Present importance	Future importance
Biodiversity/ habitat for species	High	=
Fish spawning and nursery area	High	=
Soil formation, sediments retention, accumulation of organic matters	Medium	=
Nutrient recycling storage, recycling, processing, and acquisition of nutrients	Medium	=
Pollination habitat for pollinators	Low	=

Socio-economic activities: Stung Treng

	1998	2008
No. of commune	4	
No. of villages	21	
No. of household	1,687	2,417
Total population	9,870	12,586 (2,46% vs 1.54%)
Poverty rate		47%
No. of migrants		20

Fishing activities	Amount	HH involved
Fishing as main job		16
No. of fishing boat		310
Aquaculture		8

Socio-economic activities: Stung Treng

	Area (ha)	Yield (t/ha)	Price ($/t)	HH involved
Rice production	3,170	1.7	160 - 270	1,922
Other crops: (Mung bean, Cassava, sesame, soybean, corn,	127	0.87		
	Amount (m3)			HH involved
NTFP				170
Timber				320
Fuel wood				2,471

2009 data from district NCDD report. Yield depends upon on climate pattern as no irrigation scheme. Historic data on yield are available (2000-2010)

Economic valuation: Stung Treng

1- Rice, crop production	**Stung Treng (2009)**	**Observation**
Cost (US$/year/HH)		
Seed	50	Two small sample size to get representative of the data, Secondary date to get from WB, 2005
Pesticide	0	
Fertilizer	0	
Hired labor	0	
Benefit (US$/year/HH)		
Own consumption		
Commercialized value	450-750	

Economic valuation: Stung Treng

Hypothesis: 16 HH: commercial fishermen, 90% of HH : fishing is secondary source of income. Method use: PRA (in 2005 US$ value)

2- Fishing activities	IUCN, 2005 (Voen Sien)	Hab, Bhattarai, 2007 (Koh Sneng)
Cost (US$/year/HH)		**3,381**
Fishing net (gillnet, cast net, bamboo trap, seine net		60
Boat & engine (capacity of 0.4 to 0.8 ton)		153
Gasoline		789
Opportunity own labor cost		1,500
Boat maintenance		114
Other costs		765
Benefit (US$/year/HH)	**425-650**	**6,913**

Considering family fisherman works 300 days per annum, 100 days for closed season and 200 days for open season

Livelihoods and Local Adaptations

Perceived Changes

- Drought: increase – frequency & duration
- Floods: change pattern
- Storms: destroyed houses
- River, streams, lakes, ponds – very shallow
- Water quality – muddy & dirty
- Significant water receding of the Mekong (2009)
- Largely increase of algae in the Mekong (2011)

Wetland Dependent Livelihoods

- Rice crops and fishing and followed by integrated farming, collection of NTFPs and aquatic resources, animal raising
- Rice crops: 0.5 to 2 ha – yield: 1,500kg/ha
- Integrated farms (fruit trees & vegetables): on the islands
- Vegetable gardens: river bank
- Fishing – local consumption and sale
- Markets at Lao border Veunkham and Stung Treng town.
- Animal raising: chicken, pigs, cows

Livelihoods Trends and Changes

- Rice crops damaged – prolonged drought
- Green grasshoppers – corns and beans destroyed severely (2009 & 2010)
- Animals face diseases and high mortality in April and May
- Human health – dengue fever, malaria, diarrhea during first quarter of the year.

Livelihoods Trends and Changes

- Fish catch - significantly decline compared to last 10 years
- 20 to 90 kgs caught per day each family – Jullien Mud Carp, Greater Black Shark, Common Silver Carp , etc. (2011)
- Illegal fishing using different forms
- Increase of outside fishers

Development Challenges and Trends

- 4 ELC companies: cassava, rubber, sugarcane
- Over 10,000 hectares
- Loss of access to NTFPs
- Some local people have worked as labour worker in last couple years BUT less interest recently due low salary and daily fee.
- Shift from rice and other crops to cassava by some local people (new forest clearance and existing farms)

Development Challenges and Trends

- **A number of infrastructure development in Ramsar site have been planned**:
- Port at the Cambodian-Lao border
- Border market
- Paved road, laterite roads, bridges
- Connecting from one province to the border
- Connecting from provincial and district towns to the border
- Increase of easy access and might put more pressures on Ramsar site and fisheries resources by outsiders
- Other social impacts caused by infrastructure development

Local Adaptive Capacity

- Community fisheries and community forestry, not well functioning
- Two community based ecotourism, one did not work
- Village veterinary trained, not functioned. Lack of vaccination.
- Government health services are critical at commune and provincial levels.
- Cambodian Red Cross - disaster emergency assistance. Capacity building of village and commune disaster management committees required.
- Bamboo processing – women's groups
- Sala Phoum research team

Proposed Adaptation Strategies

- Strengthen existing CFi and CF;
- Introduce and train local people on appropriate agriculture technology – resilient to drought;
- Rehabilitation of lakes, ponds and streams;
- Integrate ecosystem approach and climate change adaptation approach to infrastructure development planning;
- Strengthen existing disaster management committee at village and commune levels

Policy and Institutional Review
Wetlands and Climate Change

National and Sub-national Levels

Institutional Setup

- MOE, MAFF, MOWRAM, CNMC, Sub-national administrations play important roles in wetlands management and sustainable use.
- MOE – key player
- Department of Wetlands - wetland conservation, wise use and implementation of Ramsar Convention.
- Department of Climate Change – secretariat for National Climate Change Committee

National and Sub-national Levels

Institutional Setup

- MAFF – flooded forests, swamps, rice-fields, mangrove, seagrass, coral reefs, etc.
- MOWRAM – irrigation, flood control, hydropower, reservoir
- Cambodian National Mekong Committee (CNMC) has the role of coordinating, planning and managing wetland resource use.
- However, coordination among them remains weak
- Sub-national administrations (2010) – Provincial and district level – service delivery functions

National and Sub-national Levels

Legislations, Policies and Plans

- Draft National Wetlands Action Plan 1998
- Wetlands technical working group/task force – not functioning
- NAPA
- National Climate Change Alliance Programme (CCA) currently being implemented by National Climate Change Committee (MOE)
- National Capacity Building and National Climate Strategies and Action Plan preparation

National and Sub-national Levels

- Organic Laws – commune/sangkat administrative management & municipal, provincial, district, khan & capital administrative management
- 10 years National Programme on Sub-national Democratic Development – IP3 being implemented
- D&D framework – sub-national levels integrated planning, participatory decision making, transparency, accountability
- A framework for mainstreaming climate resilience into development planning at the national and sub-national levels will be developed under the CCA.

National and Sub-national Levels

There are no important wetlands governance instruments such as:

- Wetlands policy
- Wetlands legislations
- National wetlands strategic plan
- Guideline/guidance/best practice
- Sectoral guidelines
- Management plans of 3 designated Ramsar sites in Cambodia.

Vein Diagram – Institutional Analysis

Local Level – commune/village

- Ramsar site boundary demarcation and zoning done
- No management plan yet
- Ramsar rangers - no fund allocation
- Community fisheries & community forestry
- Community based ecotourism
- Village and commune disaster management committee
- Commune council - administrative management resource mobilization, local development & sectoral coordination

Discussions and Conclusions

- Limited financial resources for wetland management both from government and development partners;
- Unclear and overlapping roles and responsibilities among key players and sectoral players. Sectoral guidelines required;
- Potential role to be played under the current D&D framework in multi-sectoral coordination, planning, and management taking territorial/area approach;

Proposed Adaptation Strategies

- Use D&D framework as multi-sectoral planning, coordination and management mechanism for wetland management and sustainable use;
- Mainstreaming climate resilience into Ramsar wetlands management planning;
- National wetlands governance instruments should be developed with special attention of climate change;
- Capacity building of key stakeholders at national, sub-national and local levels on wetland management and climate change adaptation.