



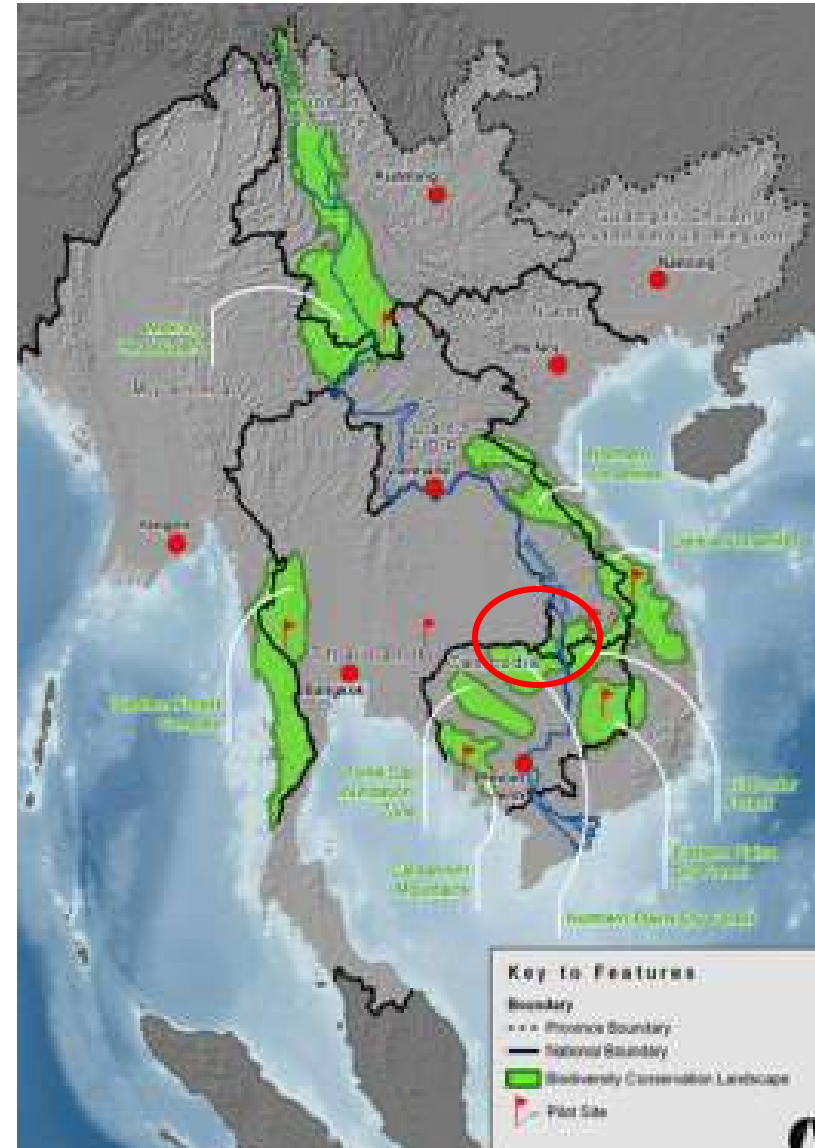
# ***Wildlife Habitats and Land use Modeling: An example from the Emerald Triangle Protected Forests Complex (ETFC)***

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**Regional Conference on Biodiversity Conservation  
in Tropical Forests of the Greater Mekong Sub-region  
Siem Reap, Cambodia  
March 23 - 25, 2016**

# The Emerald Triangle

- The largest remaining extensive **intact block** of a unique landscape of global importance for biodiversity conservation (**Indo-china Ecoregion**).
- One of the most important of the **Biodiversity Conservation Corridors** in the GMS.





# Iconic Wildlife Species



Rhino



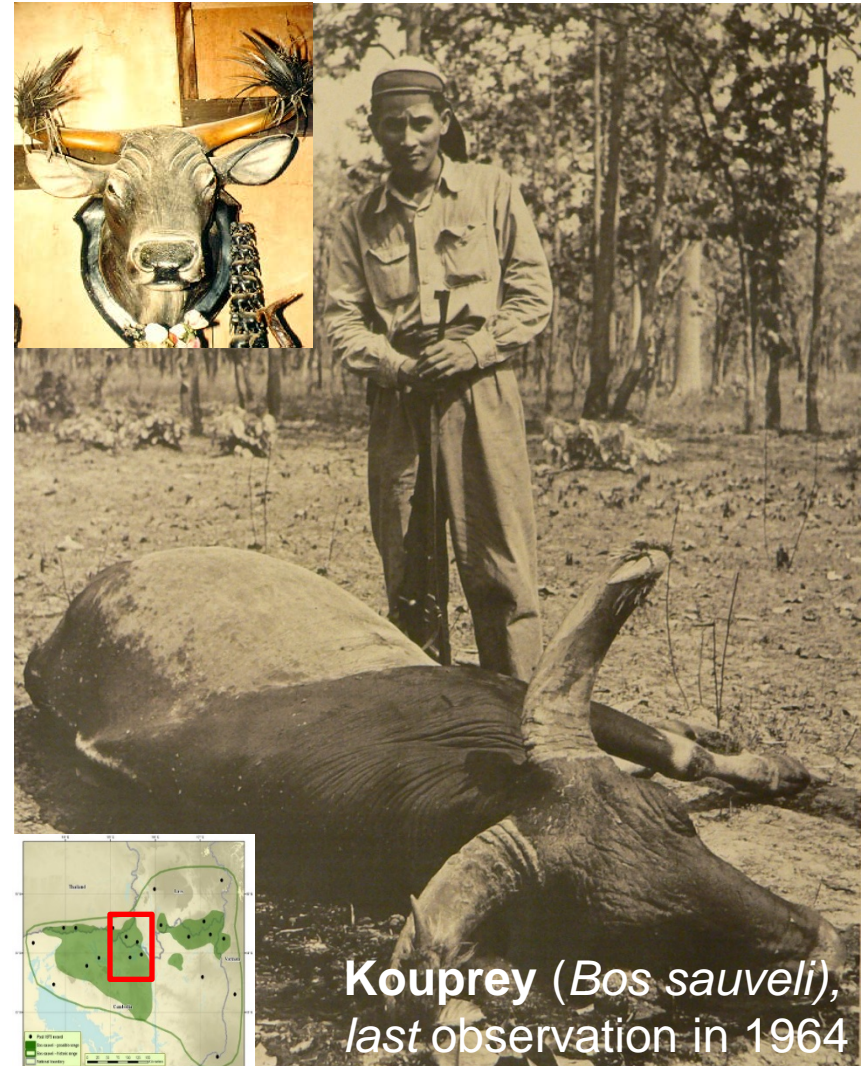
Eld's deer



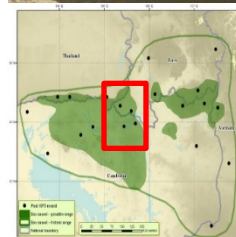
Giant Ibis



Sarus crane

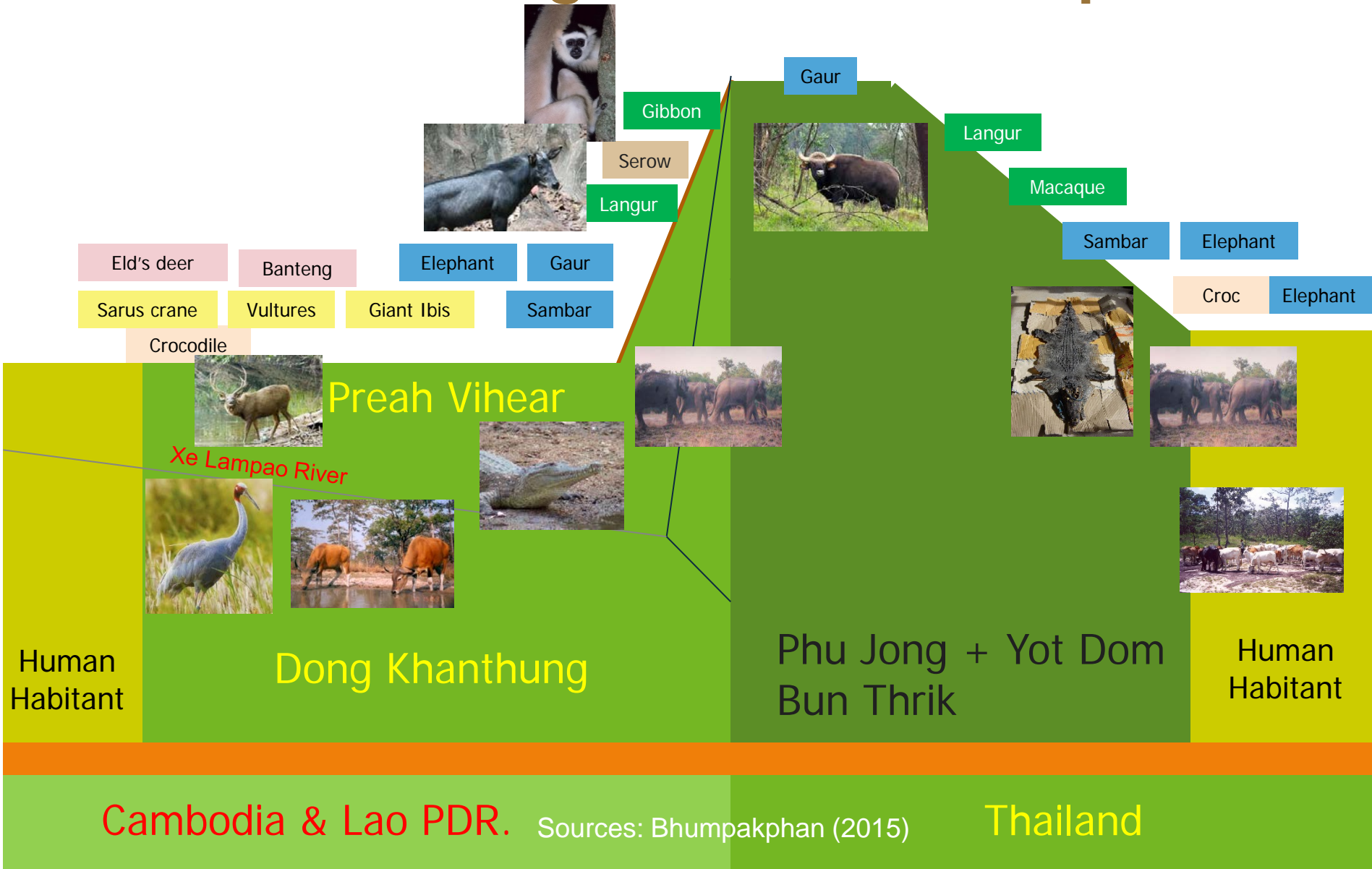


**Kouprey** (*Bos sauveli*),  
last observation in 1964



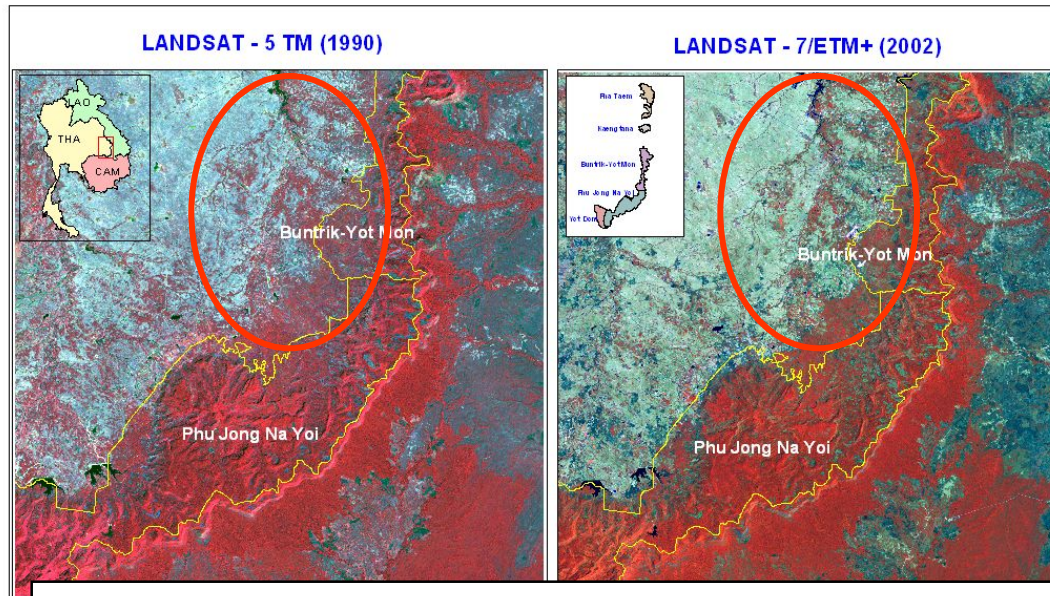
Sources: Bhumpakphan; Chheang

# Wildlife Distributions in Heterogeneous Landscapes

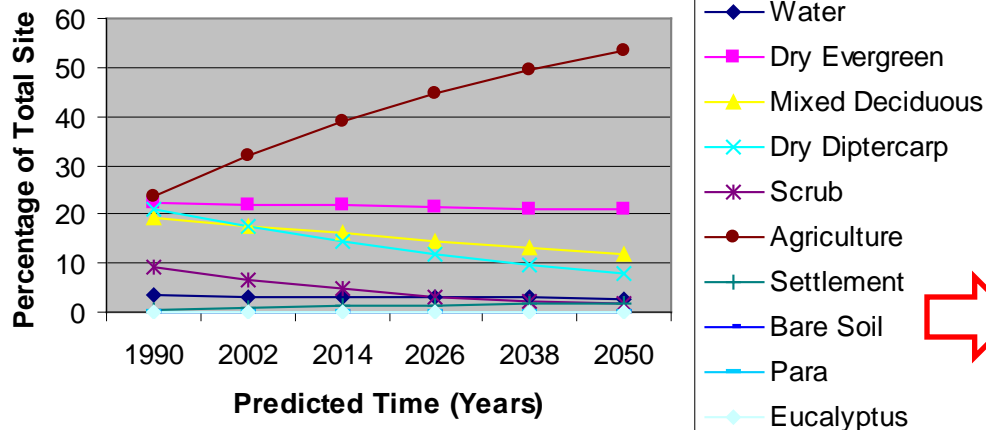




# Encroachment for Agriculture in the PPFC's Landscape (Phase I)

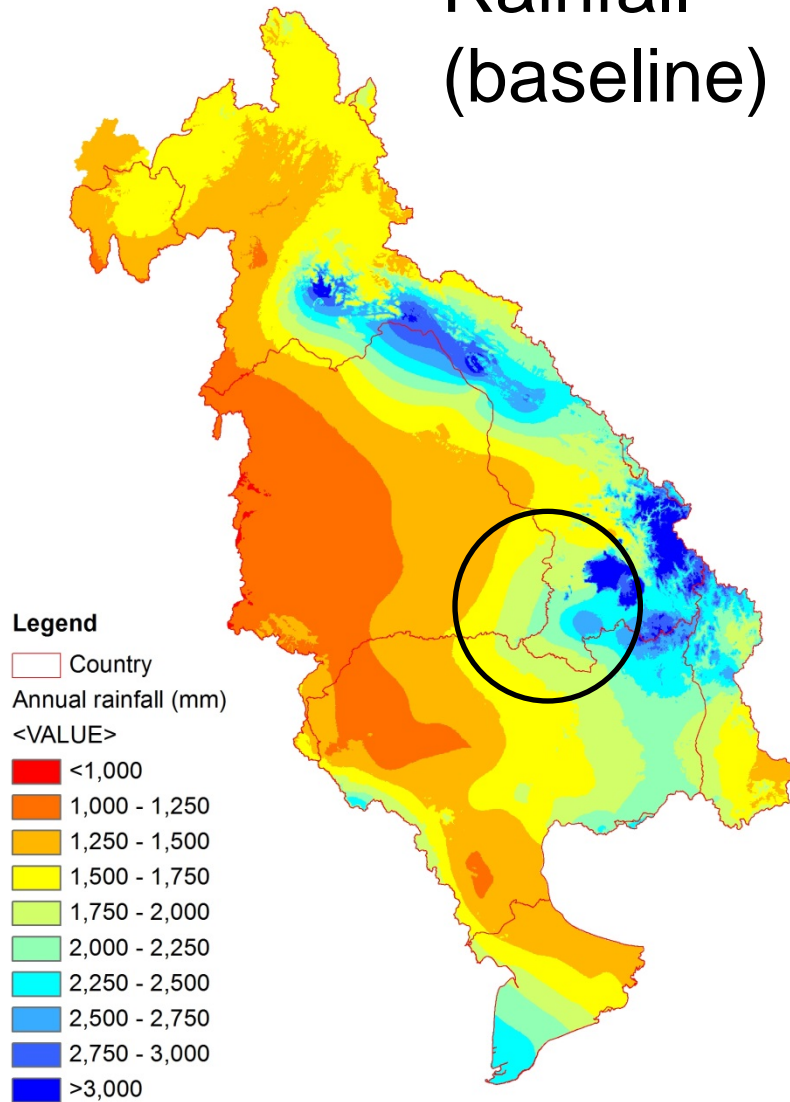


**Land Use Prediction 1990-2050**

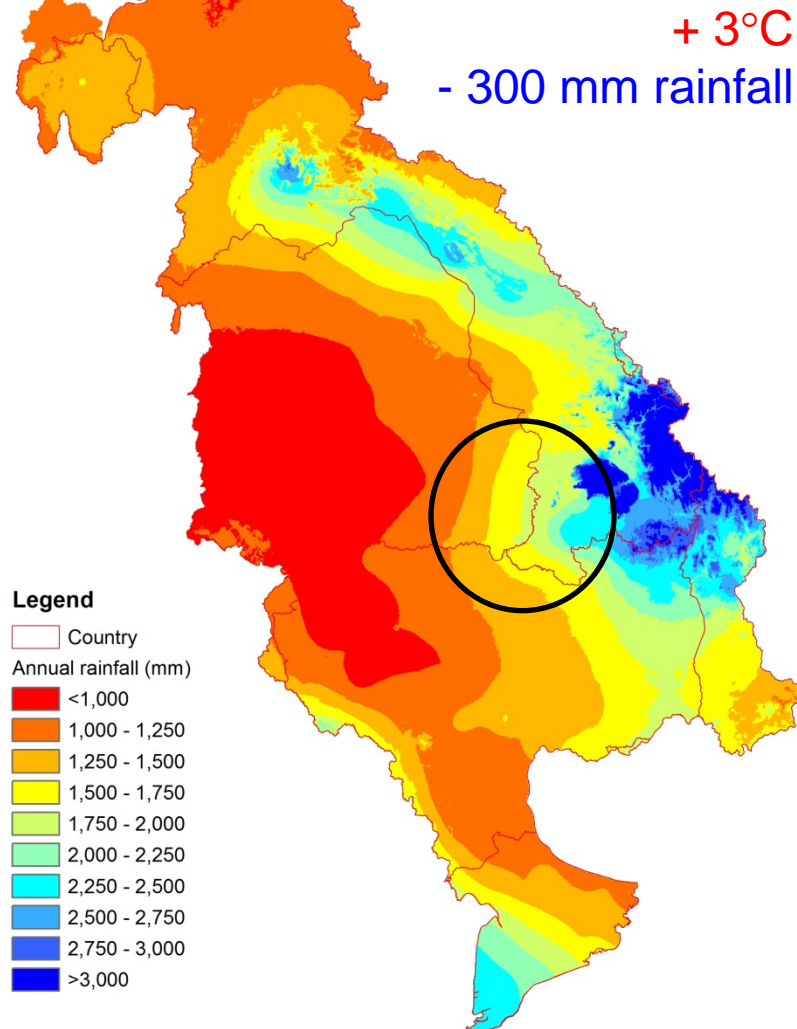


**Forests: 57% to 41%**  
**Agr. 23% to 53%**

## Rainfall (baseline)



## Rainfall (drier/high GHGs emission)





# Key Questions?

What are **key drivers** and **future land use** patterns?

Where are **good habitats** for landscape species in the ETFC?

What are the **consequences** of altered landscape structure **(+CC)** on **wide-ranging wildlife species** distributions in the ETFC?



# Joint Research & Common Vision



Long-term  
conservation of  
protected wide-  
ranging wildlife  
species

Ecosystem functions  
at landscape level  
maintained

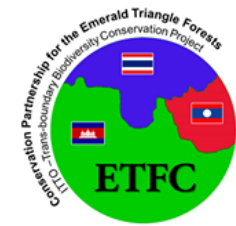
**To strengthen the protection of trans-boundary  
habitats of the protected wide-ranging species  
in the Emerald Triangle**

**Capacity of multi-  
stakeholders** in  
TBC and monitoring  
strengthened

Management plans  
incorporating **research**  
results on **wide-ranging**  
**species** established and  
implemented

Local communities  
empowered to  
implement  
activities linking  
**livelihoods**  
**improvement**

# Joint Wildlife Research and LU Training (Soft Coop.)



Class room training and field practices for technical staff of 3 countries

Source: Bhumpakphan





# Survey Methods



Bun Thrik – Yot Mon WS



Yot Dom WS



Yot Dom WS

Elephant, wild boar and Asiatic Jackal were obtained from camera traps.



# Species Selection Criteria



- 1) Having trans-boundary territory (>2 countries)
- 2) Regionally and nationally threatened status (IUCN)
- 3) Iconic or flagship for conservation
- 4) Adequate observation records ( $\geq 10$  points; Wisz *et al.*, 2008)

\* Important prey species

## 12 target species

Tiger

Leopard

Elephant

Gaur

Bantang

Sambar

Eld's deer

Giant ibis

Sarus crane

Lesser adjutant stork

Wild boar

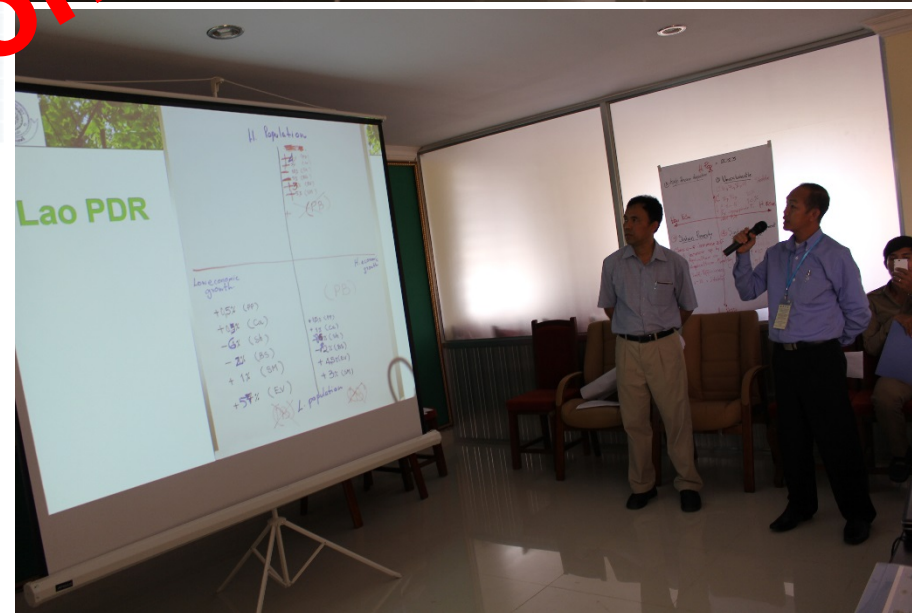
Barking deer



# Land Use Scenario & Modeling

Scenario II			Scenario I			Class
High Population growth						
C11:	1.25%	Up 1.06	C11:	1.00%	Up 0.81	Settlement
C10:	0.02%	Down 0.02	C10:	0.02%	Down 0.02	Water
C9:	0.01%	Down 0.01	C9:	0.01%	Down 0.01	Rockout
C8:	0.00%	Same	C8:	0.00%	Same	Riparian
C7:	23.75%	Down 12.98	C7:	25.50%	Down 11.23	EGF
C6:	7.45%	Down 2.00	C6:	7.45%	Down 2.00	Deciduous
C5:	6.14%	Up 6.09	C5:	8.14%	Up 8.09	Bare Soil
C4:	19.88%	Down 11.00	C4:	15.88%	Down 15.00	Shrubland
C3:	5.85%	Up 5.85	C3:	5.00%	Up 5.00	Plantation
C2:	6.15%	Up 5.99	C2:	10.00%	Up 9.84	Oil Palm
C1:	14.00%	Up 14.00	C1:	2.00%	Up 2.00	Cassava
C0:	27.45%	Up 27.45	C0:	7.00%	Up 2.52	Paddy
Low Economic growth			100.00%			High Economic growth
Scenario IV			Scenario III			Economic growth affected by:
C11:	0.58%	Up 0.39	C11:	0.85%	Up 0.66	
C10:	0.03%	Down 0.01	C10:	0.02%	Down 0.02	Paddy
C9:	0.02%	Same	C9:	0.01%	Down 0.01	Cassava
C8:	0.00%	Same	C8:	0.00%	Same	Oil Palm
C7:	30.39%	Down 6.34	C7:	29.25%	Down 7.48	Plantation
C6:	8.15%	Down 1.30	C6:	8.25%	Down 1.20	EGF

**Cambodia**

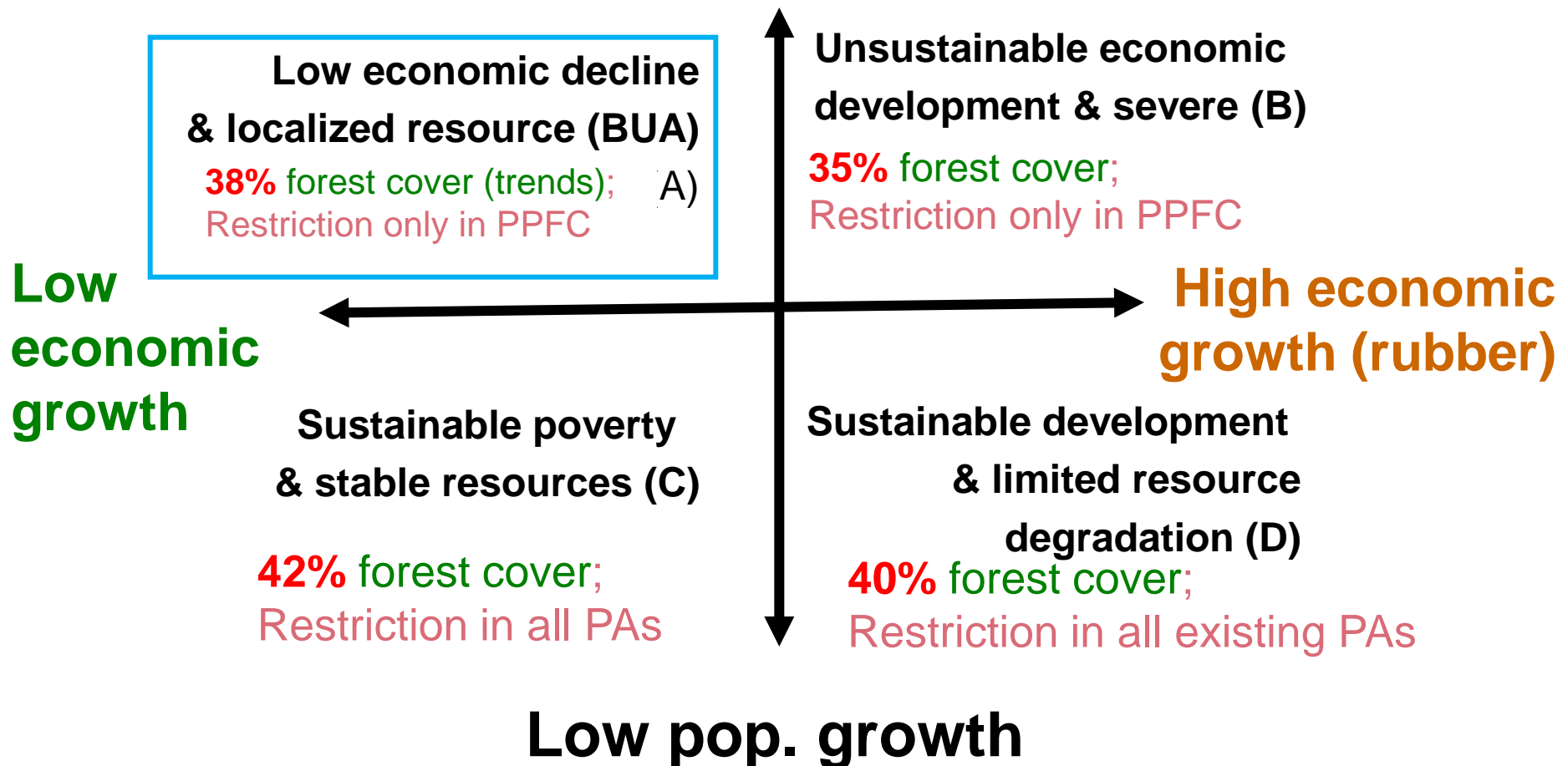


# LU Scenarios 2030 (Narrative)

*Remaining Forest 44%*

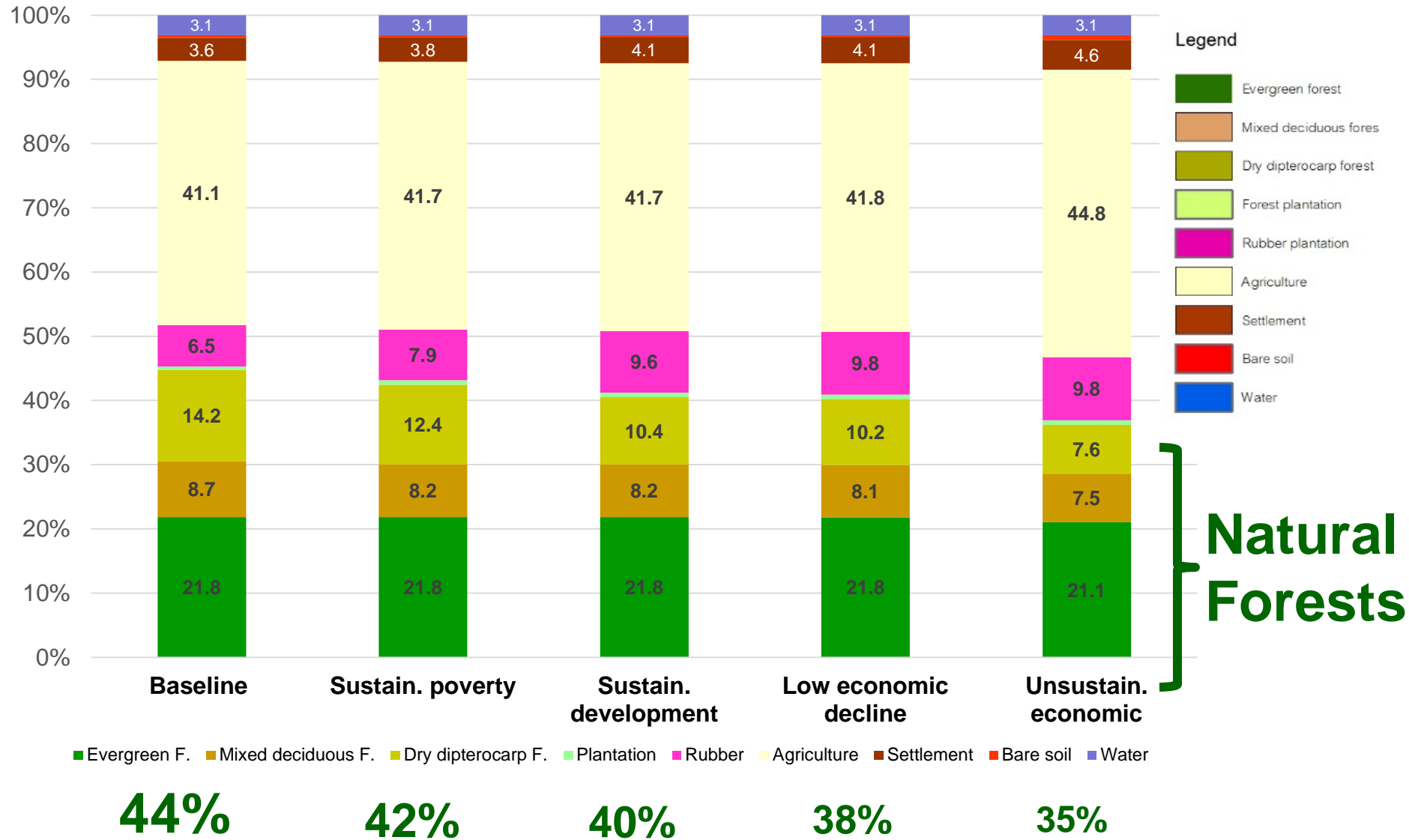


**High pop. growth & migration**



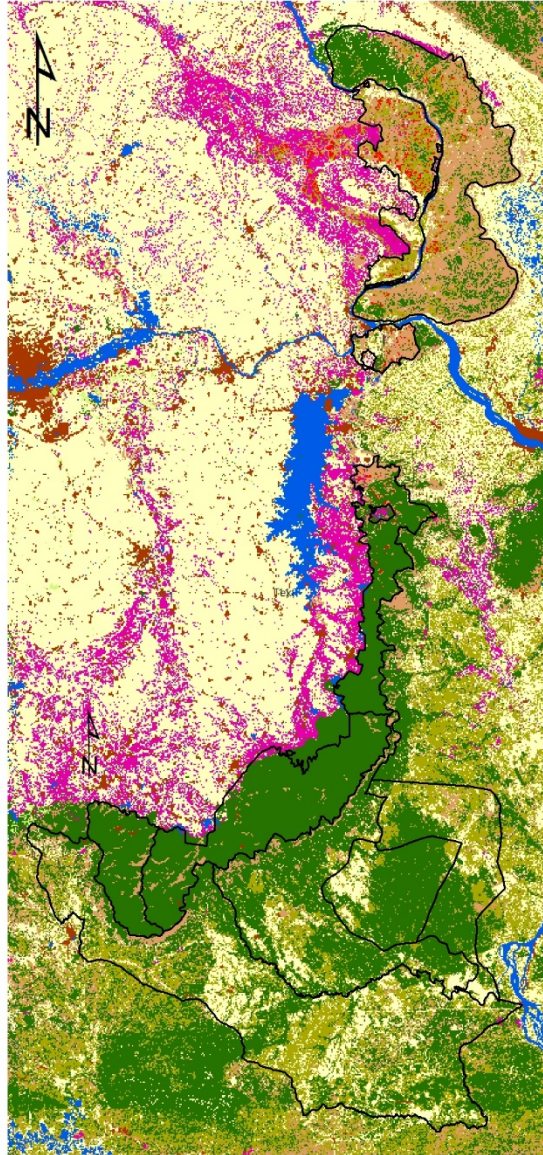


# Land Use Scenarios 2030 Using CLUE-s





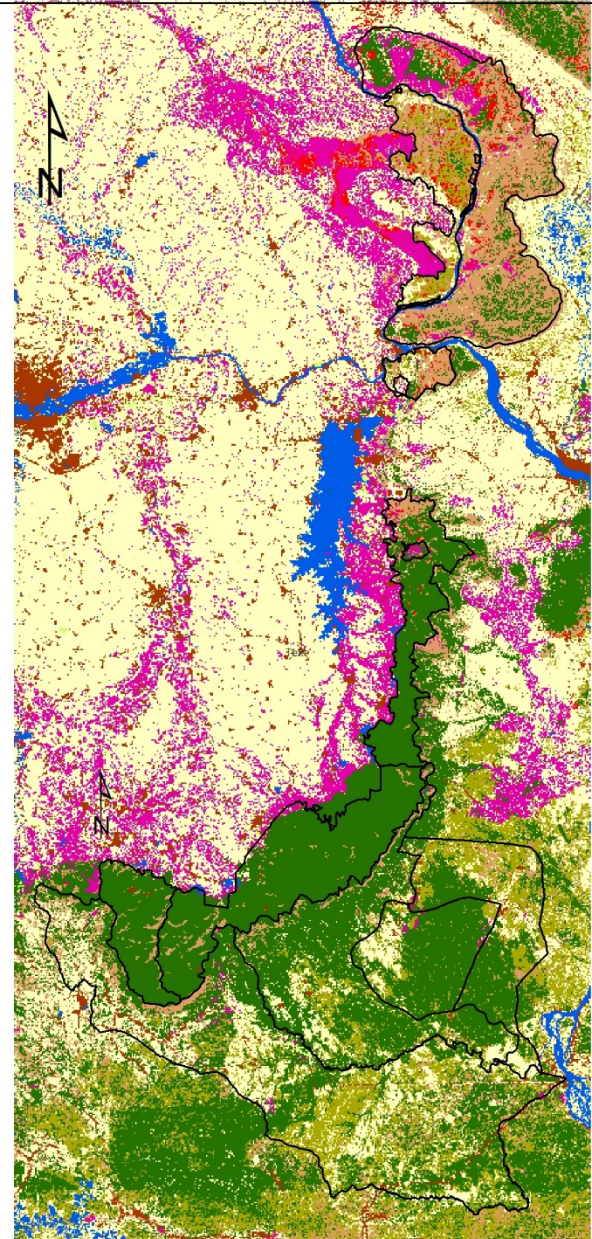
**Sustain. Poverty 2030**



**Legend**

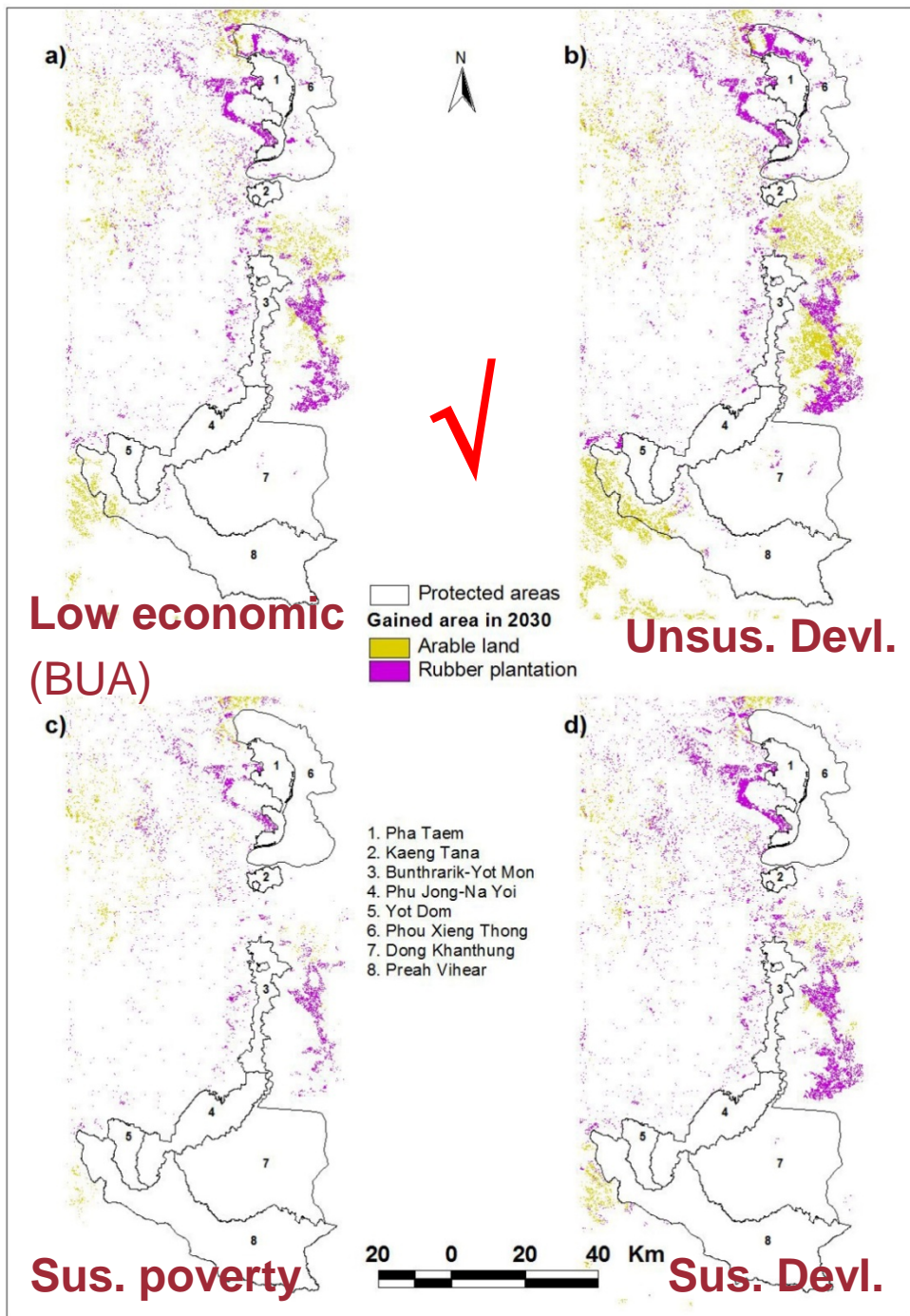


**Unsustain. Economic 2030**

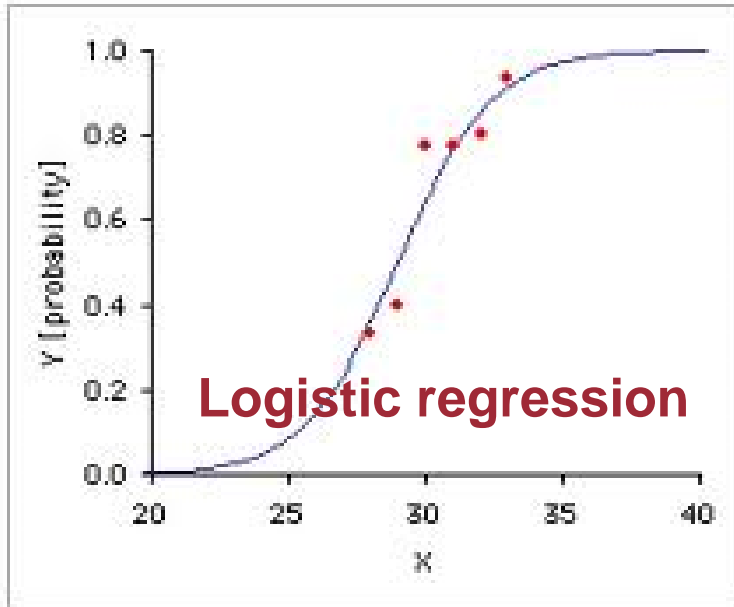




# Predicted Deforestation b/w 2013-2030



# Species Distribution Modeling: LU & Climate Change Impact

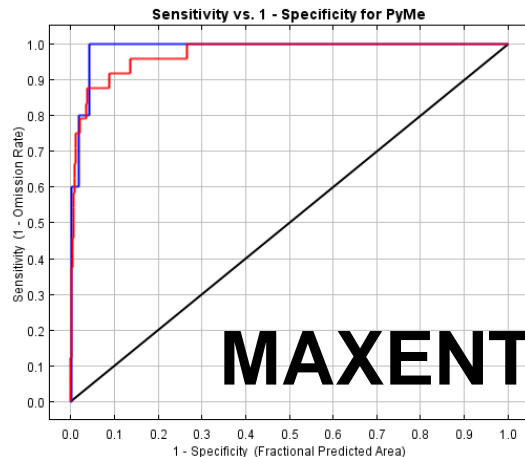


**Present**  
**2030**

- Sc. 1?
- .....
- Sc. 4?

## Habitat Factors

- Ann. Prec
- Prec in driest Q
- Prec in wettest Q
- Altitude
- Slope
- Aspect
- Road\_dist
- Stream\_dist
- District\_dist
- Population
- Land use
- Prey



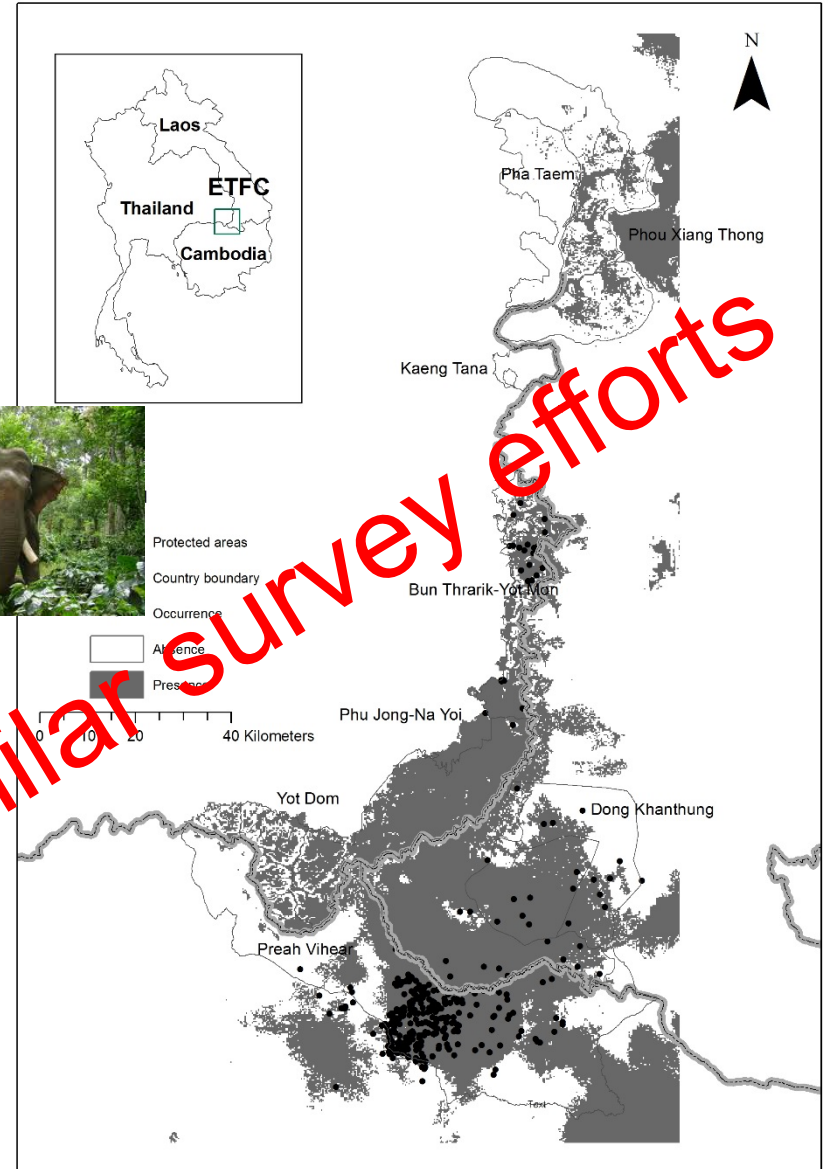
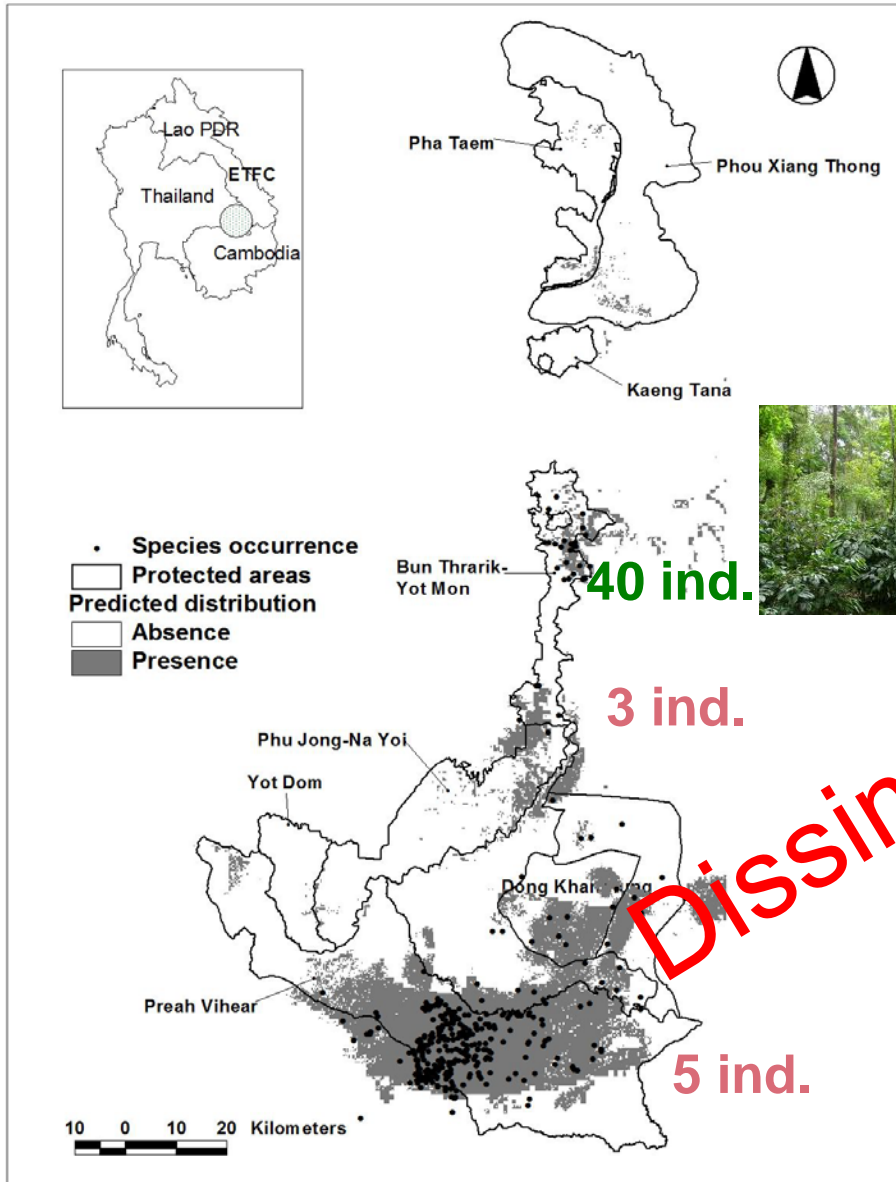
Training data (AUC = 0.973)  
Test data (AUC = 0.987)  
Random Prediction (AUC = 0.5)

## Why Maxent?

- require present-data only
- provide better accuracy
  - work well with small sample size

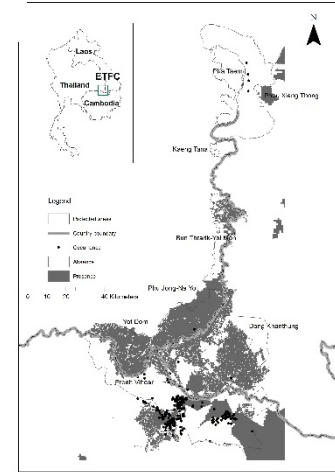
# MAXENT

# Logistic Regression





# Predicted distribution in 2030 (LU) & area



14.7%  
(73%)

15.2%  
(73%)

14.6%  
(73%)

c)

d)

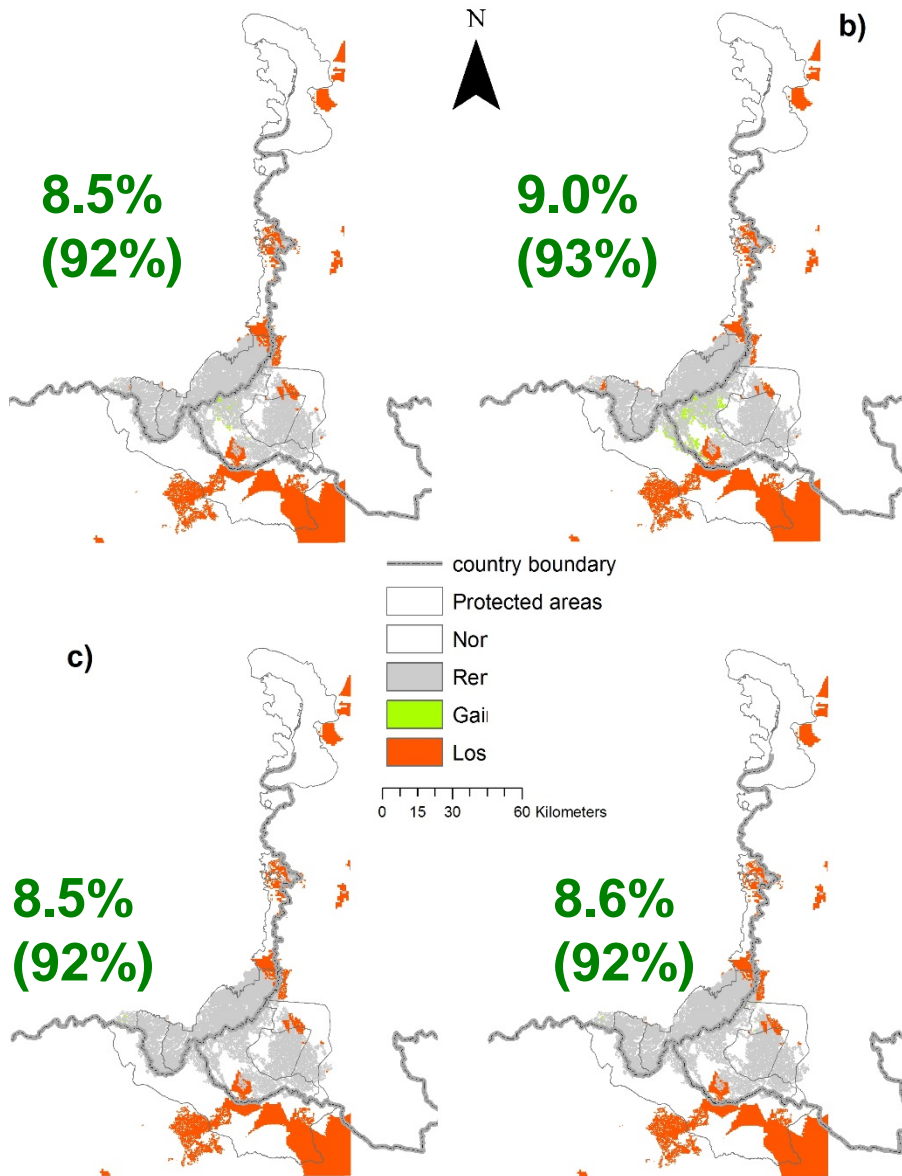
14.8%  
(53%)

15.4%  
(70%)

- a) low economic decline
- b) unsustainable development
- c) sustainable poverty
- d) sustainable development

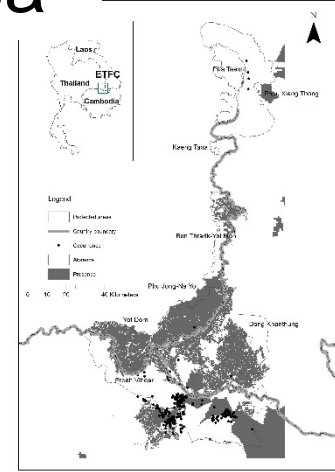


# Predicted distribution in 2030 (LUCC) & area



14.6%  
(73%)

- a) low economic decline
- b) unsustainable development
- c) sustainable poverty
- d) sustainable development



# Predicted distribution in 2030 (LUCC) & are

2.6%

2.5%

6.03%

c)

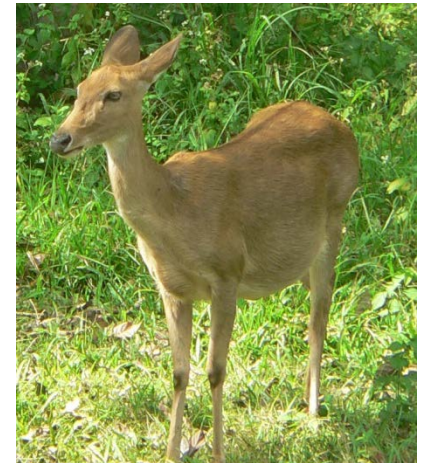
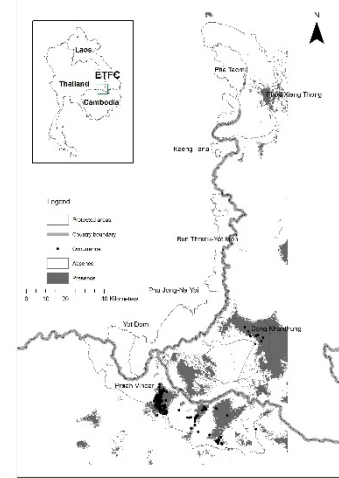
2.6%

2.6%

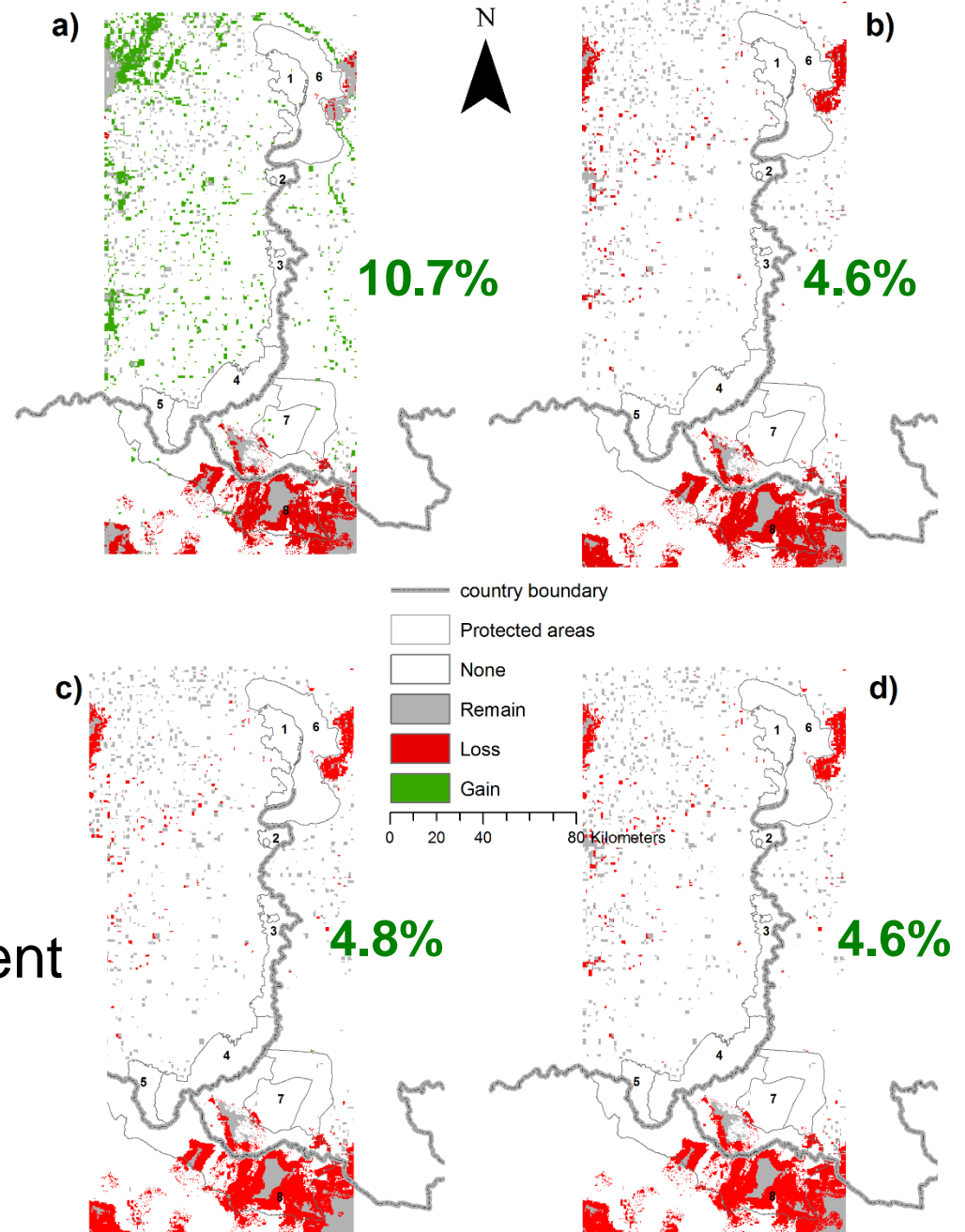
b)

- a) low economic decline
- b) unsustainable development
- c) sustainable poverty
- d) sustainable development

Eld's deer



# Sarus crane (12%)



- a) low economic decline
- b) unsustainable development
- c) sustainable poverty
- d) sustainable development



# Predicted suitable distributions



Species name	2013	BUA	BUA+CC	Sus. Pov	Sus. Pov + CC	Sus. Dev.	Sus. Dev. + CC	Unsus.	Unsus. + CC
<b>Gaur</b>	14.6	14.7	8.5	14.8	8.5	15.4	8.6	15.2	9.0
<b>Banteng</b>	15.6	15.8	19.0	16.0	19.1	16.3	19.3	16.2	16.2
Sambar	4.0	3.8	3.8	4.0	3.1	3.9	3.9	3.9	4.0
<b>Eld's deer</b>	6.0	6.0	2.6	6.0	2.6	6.0	2.6	5.9	2.5
<b>Elephant</b>	20.5	20.1	7.7	19.5	7.7	14.0	7.8	20.1	8.1
<b>Sarus crane</b>	12.0	12.7	10.7	13.4	4.8	12.7	4.6	12.7	4.6
Lesser adjutant stork	18.1	18.4	0.9	19.0	0.9	18.3	0.9	18.5	0.9
<b>Barking deer</b>	30.4	30.8	42.0	30.1	41.2	31.0	42.2	30.7	41.7
Leopard	6.1	5.9	6.1	6.1	6.6	6.0	6.2	5.9	6.1
Tiger	7.4	7.6	6.8	7.3	4.4	7.3	7.3	8.1	7.1
<b>Giant ibis</b>	8.2	8.2	0.5	8.1	0.5	8.1	0.5	8.1	0.5
<b>Wild boar</b>	25.6	24.8	41.4	23.5	39.9	25.4	41.7	24.7	40.8
Total habitat	45.7	45.3	55.8	44.0	49.3	46.1	50.8	45.0	49.9

# Possible Future in the ETFC



- BUA land use is most likely scenario in 2030 (44% to **38%** forest cover) due to lower rubber price and effective restriction in PPFC.
- **LU** change would cause **slightly effects** on selected spp. due to most suitable habitats are located in PAs.
- The combination of **LU & CC** will cause **severe impact** on wetland birds, moderate effects on tiger and guar but flavor other ungulate spp. (open woodland).



# Research & Capacity



## Goal & Common Vision

To increase the **conservation of trans-boundary biodiversity** and sustainable NR mgt. in the ETFC

**Needs** (*partnership implemented at landscape level*)

- **Rehabilitate** degraded habitats/reintroduce spp.
- Determine **migration routes/corridors**
- Quantify other **Ecosystem Services** derived from the ETFC landscape (e.g., water yield, sediment & nutrient retention, CO<sub>2</sub>)
- **Optimize resource allocation** for protection of trans-boundary species (**hotspots!**) & **ESs**