

# Land-use Change and Its Impact on Soil and Land Resources in Northeast Thailand

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A main factor causing the decline in soil quality is changes in land use from forest to agriculture.



Forest in  
Northeast  
Thailand declined  
from over 90% in  
the early 20<sup>th</sup>  
century

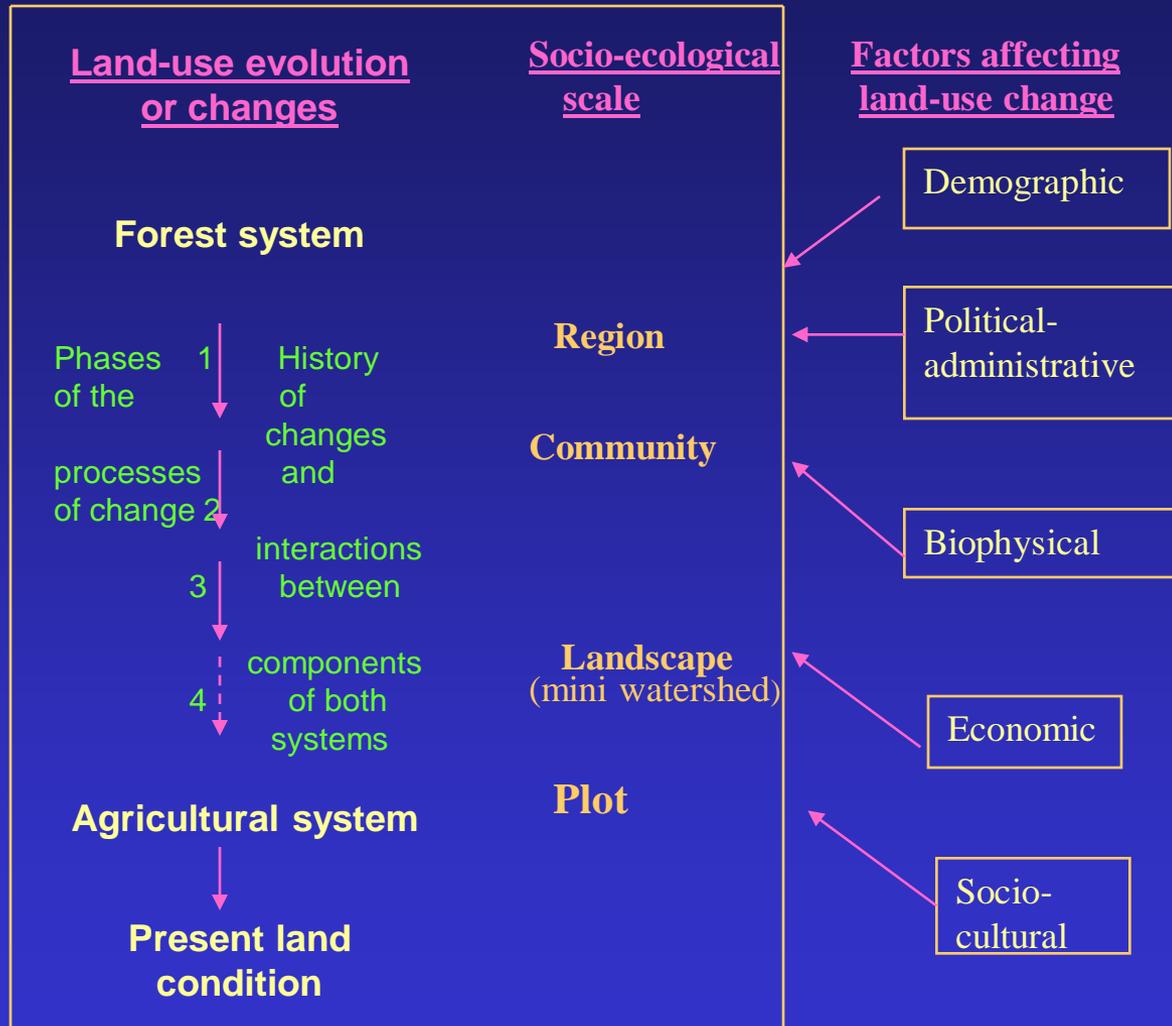
to less than 14% of  
the land area at  
present.



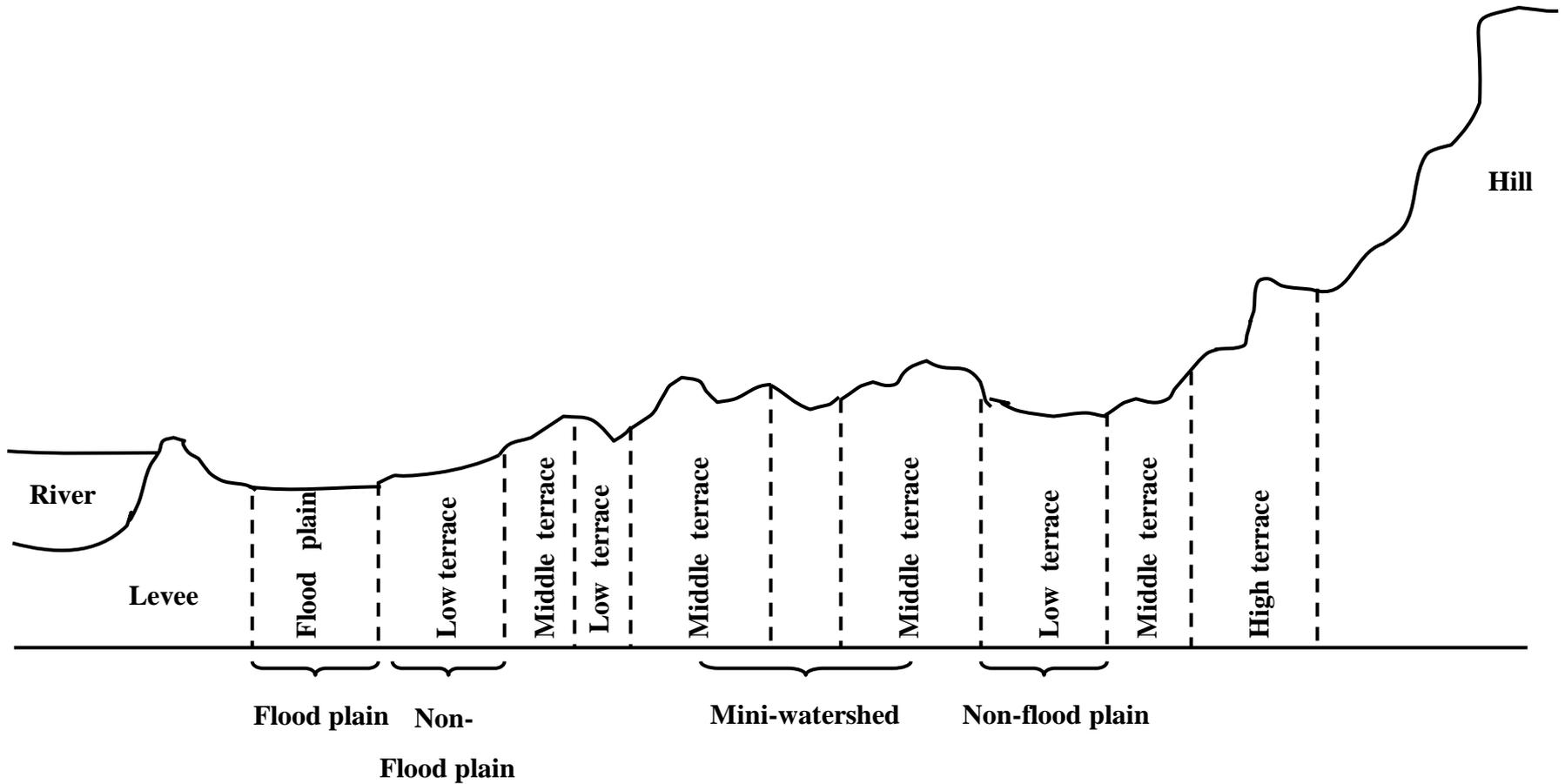
The objectives of this presentation are

- 1) To present an analysis of the history of land-use change in the Northeast at various spatial scales.
- 2) To identify factors influencing the change.
- 3) To analyze the present land conditions.

# Analytic framework



# Feature of undulating terrain of the Northeast



## Transect of a mini-watershed

Hamlet



Field shelter

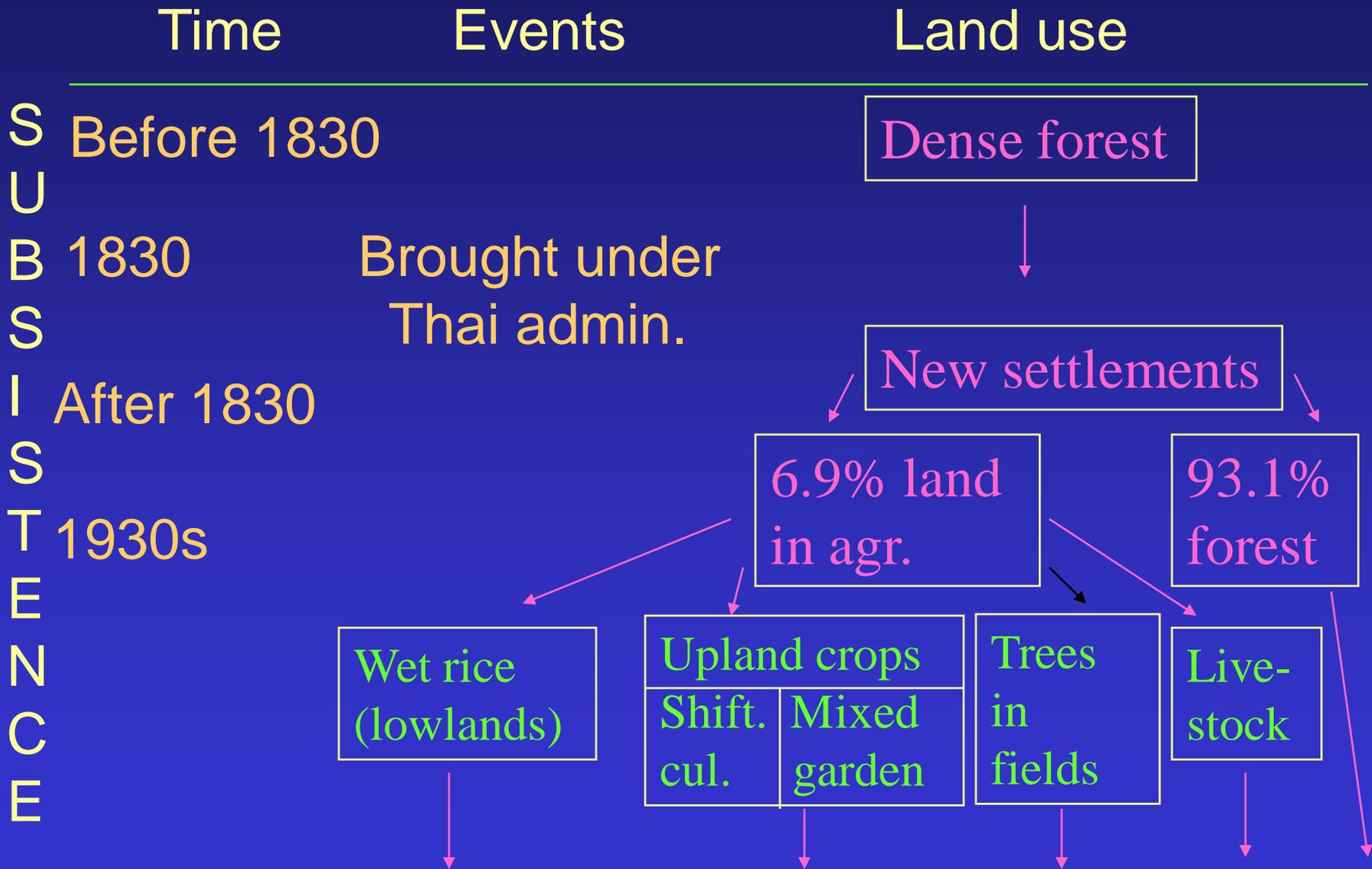


Direction of water flow



	Upland	Upper Paddy	Lower Paddy	Upper Paddy	Upland
<u>Soils</u>	Paleustult	Paleaquult/ Paleustult	Paleaquult		
<u>Crops</u>	Cassava Kenaf Sagercane Water melon	Rice, Cassava, Sugarcane	Rice followed by vegetables		
<u>Problems</u>	Drought Erosion	Insufficient water	Occasional flooding		

# History of land-use change at the regional level in the NE







Some forest survivors in upper paddy fields in  
Phu Wiang district of Khon Kaen.



# History of land-use change in the NE (con'd)

Time (con'd)

Land use (con'd)

C  
O  
M  
M  
E  
R  
C  
I  
A  
L  
I  
Z  
E  
D

1950s

Upland cash crops:  
Kenaf, peanut, maize

Late 1960s

Cassava

Trees

Live  
stock

For  
est

Mid 1980s-  
2000 +

Sugarcane  
+ Cassava

declined

31%

Late 80s-2000+

Eucalyptus

declined

14%

2000+

Rubber





Cassava  
← intercropped with  
rubber



↑  
Eucalyptus plantation



←  
Eucalyptus, sugarcane and paddy  
rice plots in an agric. landscape

# Land-use change at the community level

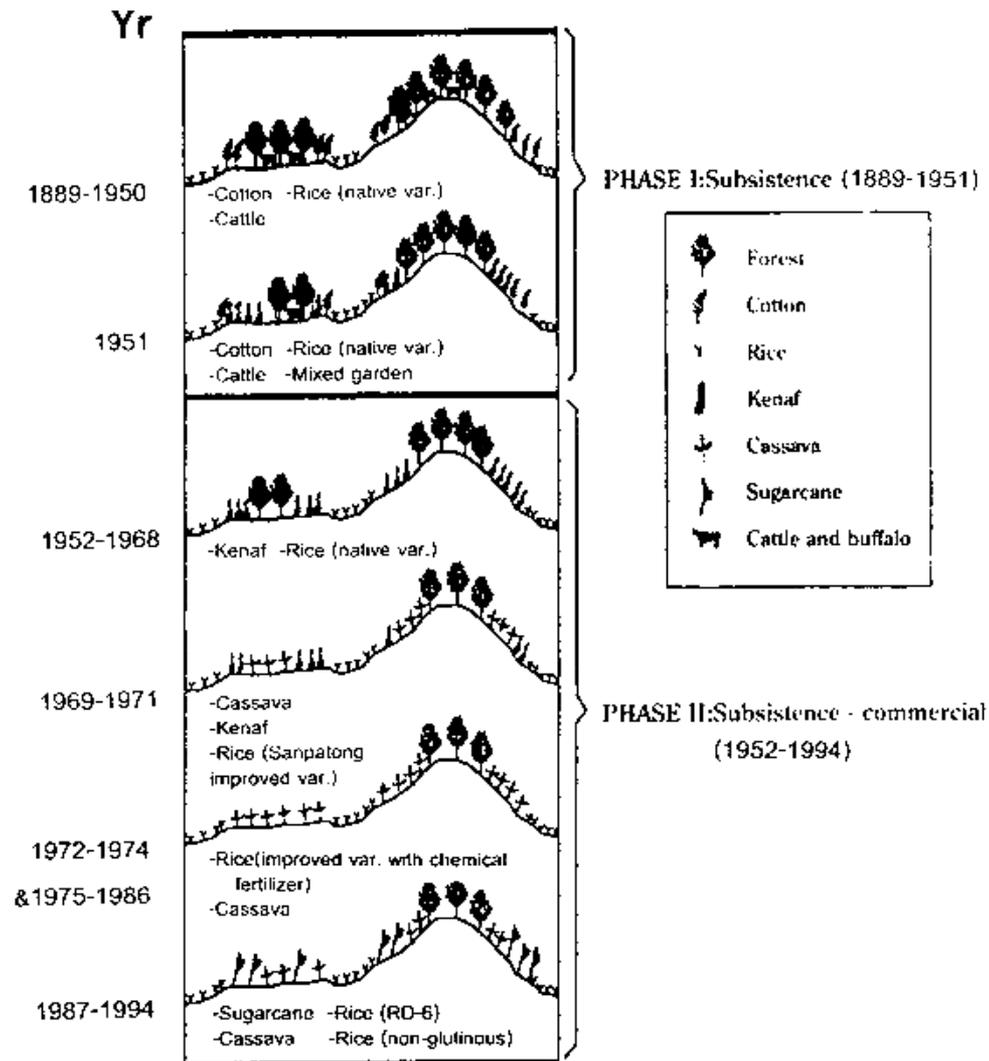
Establishment of a new settlement is a key process bringing about land-use change in the Northeast.



A **case study** of Kham Muang village:  
Situating 45 km north of Khon Kaen city.

Founded in 1889 by land pioneers who  
were livestock merchants-herdsmen from  
nearby areas.

# Phases of land-use change at the community level: A case study at Kham Muang village



## Factors affecting land-use change at the regional and community (village) level

### 1. Biophysical

Selection of land to develop at the founding of a settlement was decided initially on biophysical grounds, i.e., the most productive land is selected first.



## Factors affecting land-use change at the regional and village levels (con'd)

### 2. Demographic:

Population growth leads to land scarcity.

### 3. Economic:

Change from subsistence to (partially) market economy.

## Factors LU change at the regional level (con'd)

4. Socio political: Thai Government efforts to increase the Northeastern region's socio-economic integration into the Kingdom

19th century: Measures taken in response to the threat of the French imperialism

1950s: Enactment of the 1st Nat'l Socio-Economic Plans

Building of infrastructure: roads, dam

## Factors affecting land-use change at the village level (con'd)

### 5. Socio-cultural:

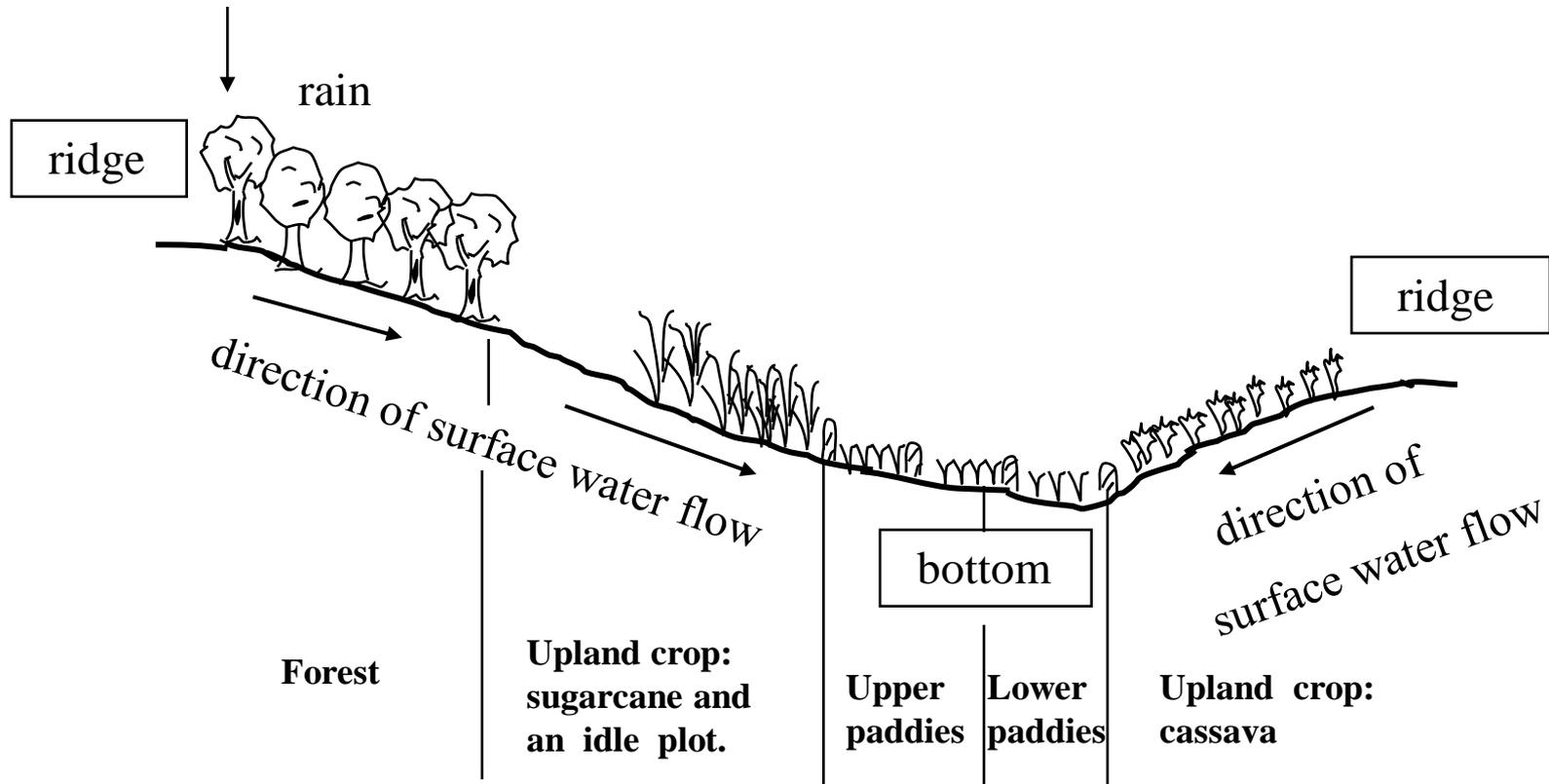
The 'land pioneering' habit of the people which led to establishment of new settlements in forest areas.

## Land-use change at the landscape level

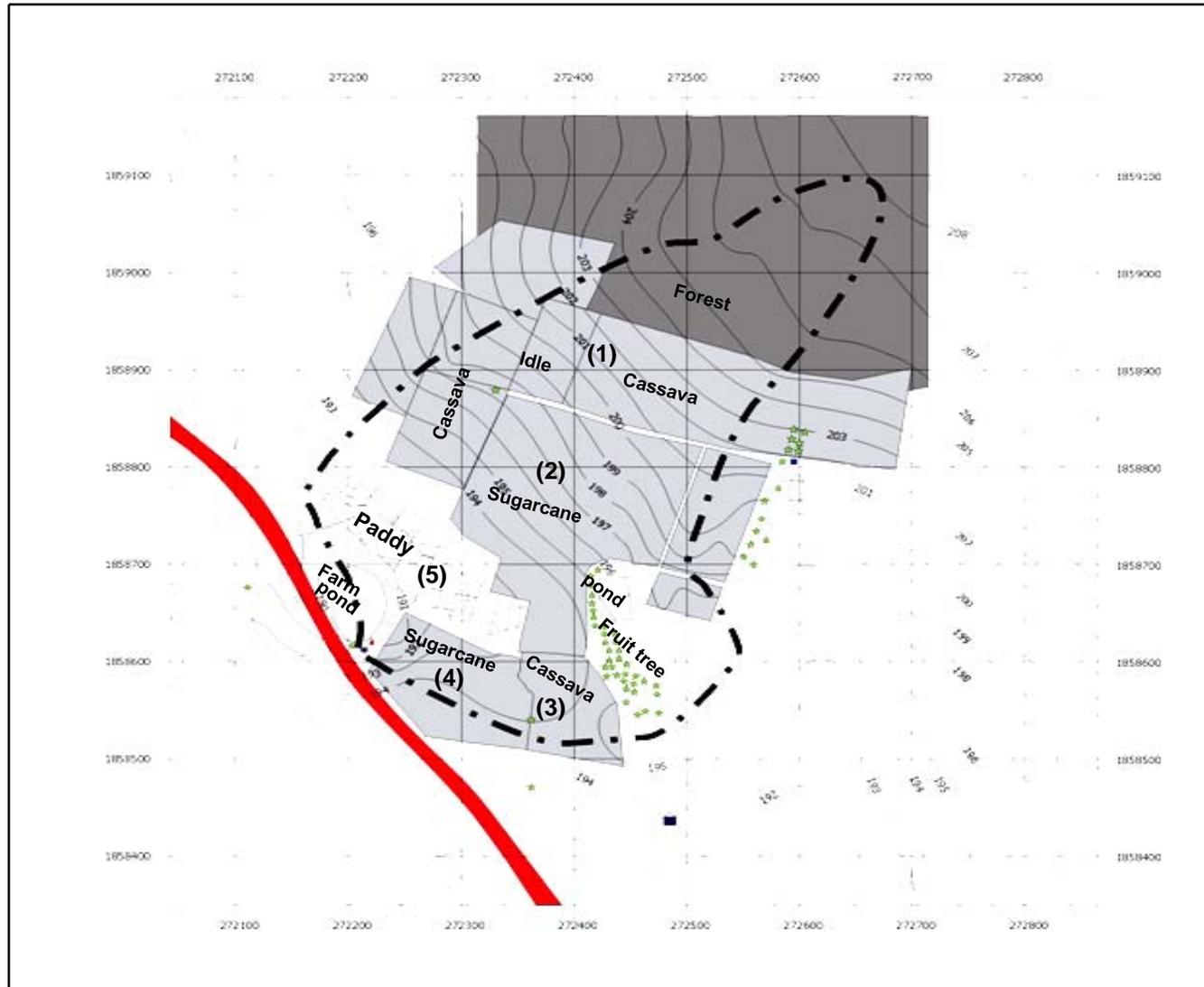
A mini-watershed was selected as a study site at the landscape level.

It is known locally as 'Hom Bak Heb' and situated in the Kham Muang village.

# Feature of a mini-watershed agroecosystem



# Contour and land-use map of the mini-watershed (locally known as Hom Bak Heb)



# Factors affecting land-use change at the landscape level

- 1) Biophysical
- 2) Economic
- 3) Socio-cultural

# Effect of land-use change on biophysical characteristics at the mini-watershed and plot levels

Soil erosion in the year 2000 in Hom Bak Heb mini-watershed

	Soil erosion (t/ha)	N ----(kg/ha)-----	P	K
Forest	1.8	1.5	0.2	0.6
Cassava	20	15.5	3.2	7.1
Sugarcane	20	8.2	1.2	3.3

## Soil organic pools and mineral nitrogen in soils under different land use in Hom Bak Heb mini-watershed.

Land use	Total carbon	Microbial biomass carbon	Litter (> 2 mm size) carbon	Particulate organic matter (1-2 mm) carbon	Humic acid carbon	Mineral nitrogen
	g kg <sup>-1</sup> soil					mg kg <sup>-1</sup>
Forest	5.5 a	116.1 a	1.13 a	0.40 b	2.93 a	0.75 c
Paddies	4.2 b	78.3 b	1.17 a	1.07 a	2.39 b	2.47 b
Cassava1	1.2 d	37.2 c	0.20 bc	0.15 b	1.14 d	2.89 b
Cassava2	1.2 d	33.5 c	0.15 c	0.17 b	1.25 d	2.34 b
Sugarcane (ratoon)	2.0 c	78.2 b	0.78 ab	0.14 b	1.82 c	2.71 b
Sugarcane (planted)	4.0 b	75.5 c	0.85 a	0.64 b	1.51 cd	15.37 a

# Conclusions

Analysis of land-use at different scales has revealed that the land was transformed from forest to cultivated fields by pioneering farmers.

In the earlier subsistence stage, land transformation did not lead to dramatic forest loss at any scale. After the region had entered the market economy and cash crops were cultivated, the transformation of forest to cultivated land was rapid.

## Conclusion 2

Land transformation began first in the lowlands and worked its way upward to the uplands. (Analysis at the community and landscape levels).

At the earlier stage, population growth was the leading factor bringing about land-use change from forest to agriculture. (Analysis of both the regional and community levels).

Economic factor came into play after the population factor. The change in economic orientation of agriculture from subsistence to commercial is the major factor of land-use change in both the regional and community levels.

The land use has resulted in severe degradation of the upland fields due to erosion and loss of soil nutrients and organic matter. However, paddy fields have suffered much less degradation.

## Conclusion 4

Ecosystems with a tree component tend to retard land degradation. In the Northeast, there are trees in cultivated fields at the plot scale, and patches of remnants of forest interspersed with cultivated fields at the landscape scale.

To restore the degraded agroecosystem and keep it productive and sustainable, a solution is to revert to polycultural agricultural systems, especially those with a tree component that mimic the natural system.