

Rubber and LCLUC in Mainland Southeast Asia



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Outline of Talk

- Introduction—rapid land-use and land-cover change (LCLUC) in the uplands of Mainland Southeast Asia;
- Mapping change—expansion of tree crops (primarily rubber);
- Drivers of change—national policies and global markets (supply, demand, and price);
- Socioeconomic impacts of these changes—land, income, and labor;
- Summary—take home points.



Introduction

- Study area harbors globally important forests, multiple plant and animal species, and headwaters of major rivers;
- For centuries farmers practices shifting cultivation;
- Over last few decades rapid economic growth and national polices have driven the upgrading of roads, electricity and telecommunication networks, and the commoditization of agriculture;
- These changes have led to the replacement of subsistence agriculture with production systems linked to land, labor and commodities markets.



Hypothesis

- Boom crops are marked by both agricultural intensification (i.e. swidden land or agro-forests are converted to new boom crops (rubber, cashews, coffee) as well as agricultural expansion (i.e. deforestation).
- In MSEA we hypothesize that most (but not all) boom crops are marked by intensification that is not necessarily accompanied by deforestation, but the intensification may push subsistence land uses elsewhere.



Objectives

1. Map LCLUC

- Use MODIS to map LC in 2014 (tree crops) and changes in rubber between 2003 and 2014.
- Use LANDSAT to map LCLUC between 1990 and 2014 in 7 footprints;

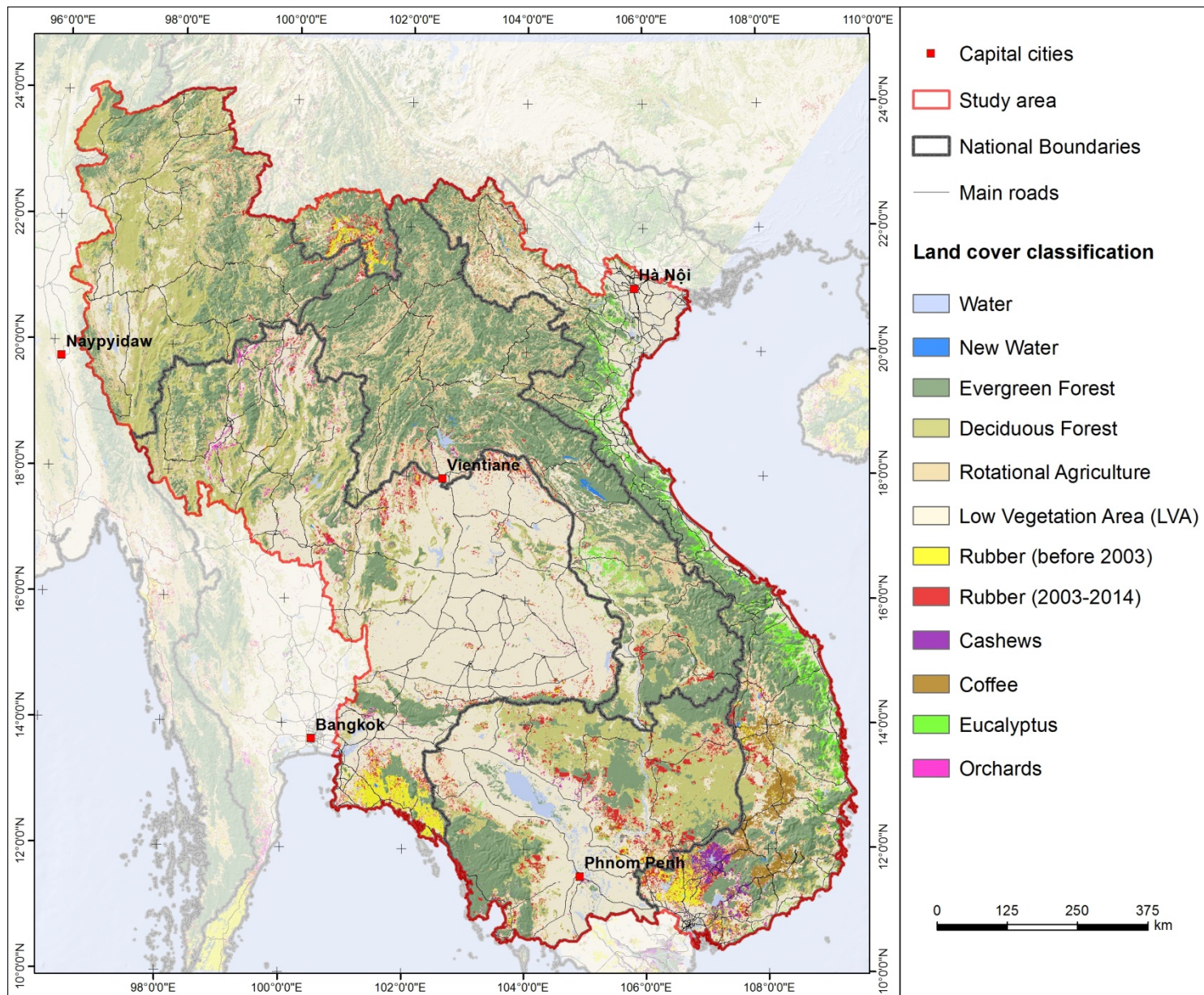
2. Explore some of the social and economic impacts of change on livelihoods—(Laos and Cambodia);

- Land and Income
- Labor

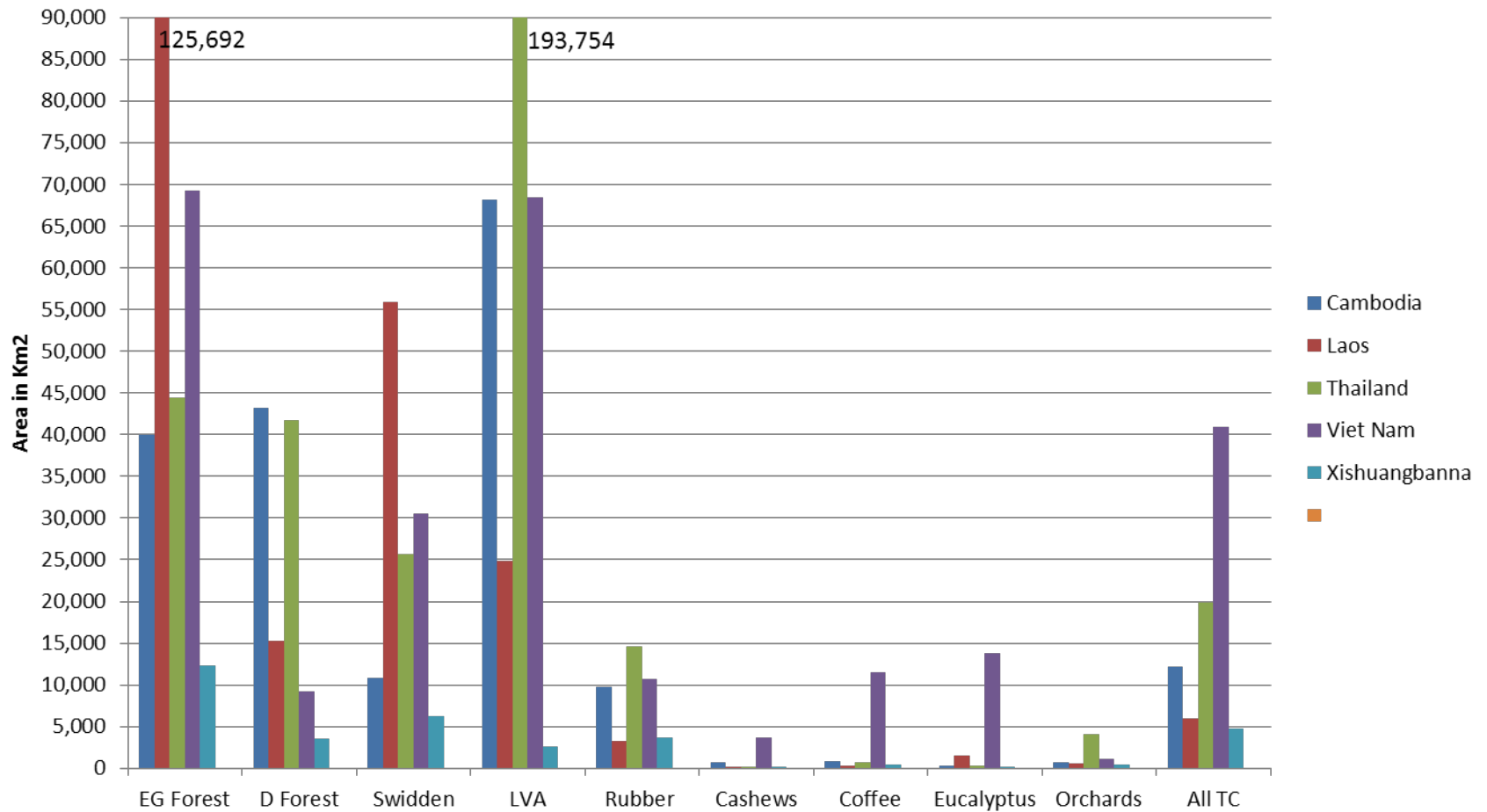
Tree Crops and Mainland Southeast Asia: Mapping at two scales.



MODIS map of LC in 2014 and changes in rubber between 2003 and 2014



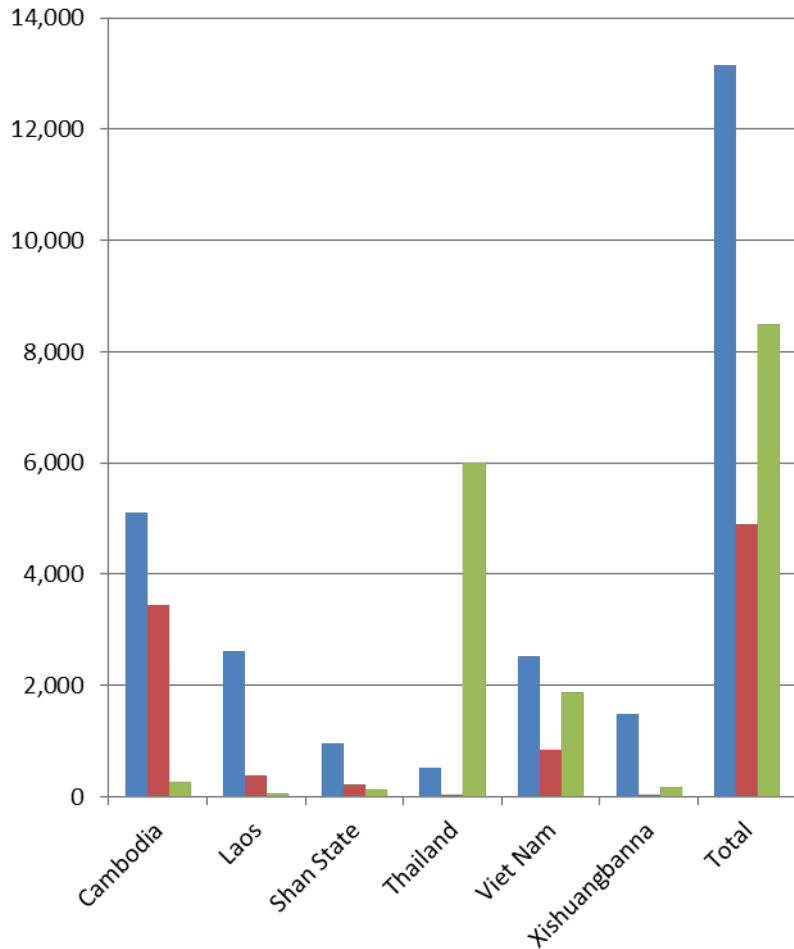
Land cover types (2014)



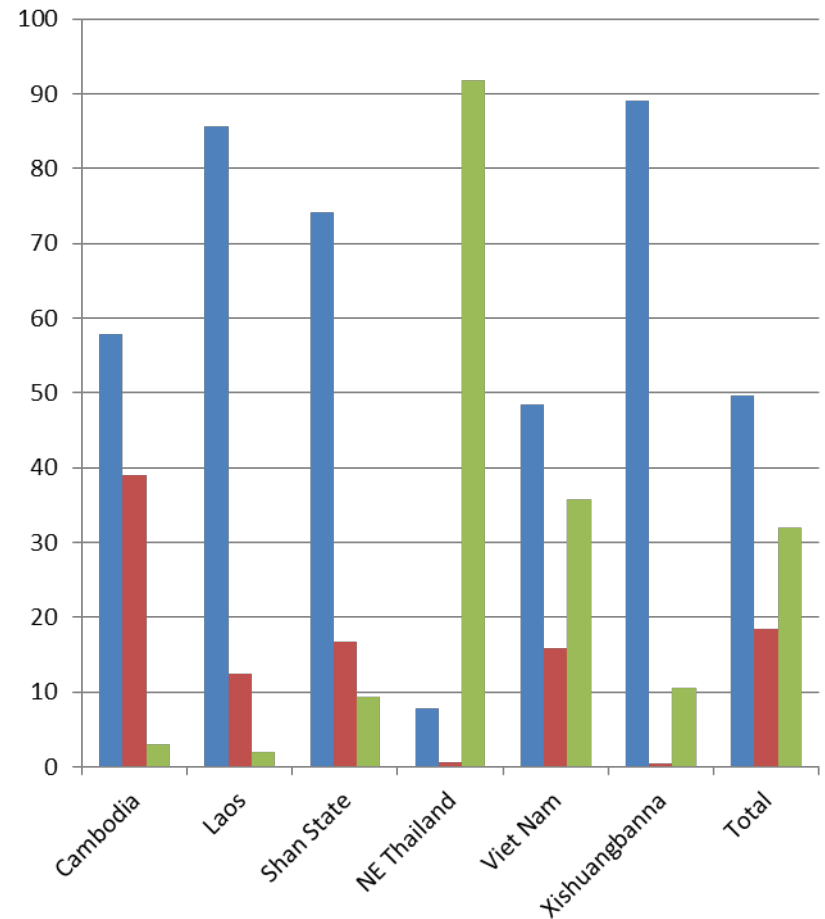
Land cover types (2014)

	Cambodia	Laos	Thailand	Viet Nam	Xishuangbanna	Total
Km2	Area (% total)	Area (% total)	Area(% total)	Area (% total)	Area (% total)	Area (% total)
Evergreen Forest	39,925 (22.92%)	125,692 (55.2%)	44,400 (13.65%)	69,297 (31.83%)	12,334 (41.71%)	337,709 (29.52%)
Deciduous Forest	43,144 (24.77%)	15,338 (6.74%)	41,689 (12.81%)	9,212 (4.22%)	3,596 (12.16 %)	169,367 (14.8%)
Rotational Agriculture	10,859 (6.23%)	55,921 (24.56%)	25,606 (7.87%)	30,512 (13.97%)	6,227 (21.06%)	168,924 (14.76%)
Low Vegetation Area	68,098 (39.09%)	24,830 (10.9%)	193,754 (59.55%)	68,479 (31.35%)	2,657 (8.99%)	382,277 (33.41%)
Rubber	9,744 (5.59%)	3,338 (1.47%)	14,642 (4.50%)	10,748 (4.92%)	3,681 (12.45%)	43,497 (3.8%)
Cashews	647 (0.37%)	226 (0.1%)	197 (0.06%)	3,666 (1.68%)	94 (0.32%)	4,854 (0.42%)
Coffee	813 (0.47%)	342 (0.15%)	725 (0.22%)	11,482 (5.26%)	461 (1.56%)	14,213 (1.24%)
Eucalyptus	324 (0.19%)	1,497 (0.66%)	300 (0.09%)	13,843 (6.34%)	77 (0.26%)	16,156 (1.41%)
Orchards	645 (0.37%)	538 (0.24%)	4,052 (1.25%)	1,163 (0.53%)	440 (1.49%)	7,088 (0.62%)
All Tree Crops	12,175 (6.99%)	5,940 (2.61%)	19,916 (6.12%)	40,902 (18.83%)	4,753 (16.07%)	85,808 (7.5%)

Land cover converted to rubber 2003 to 2014



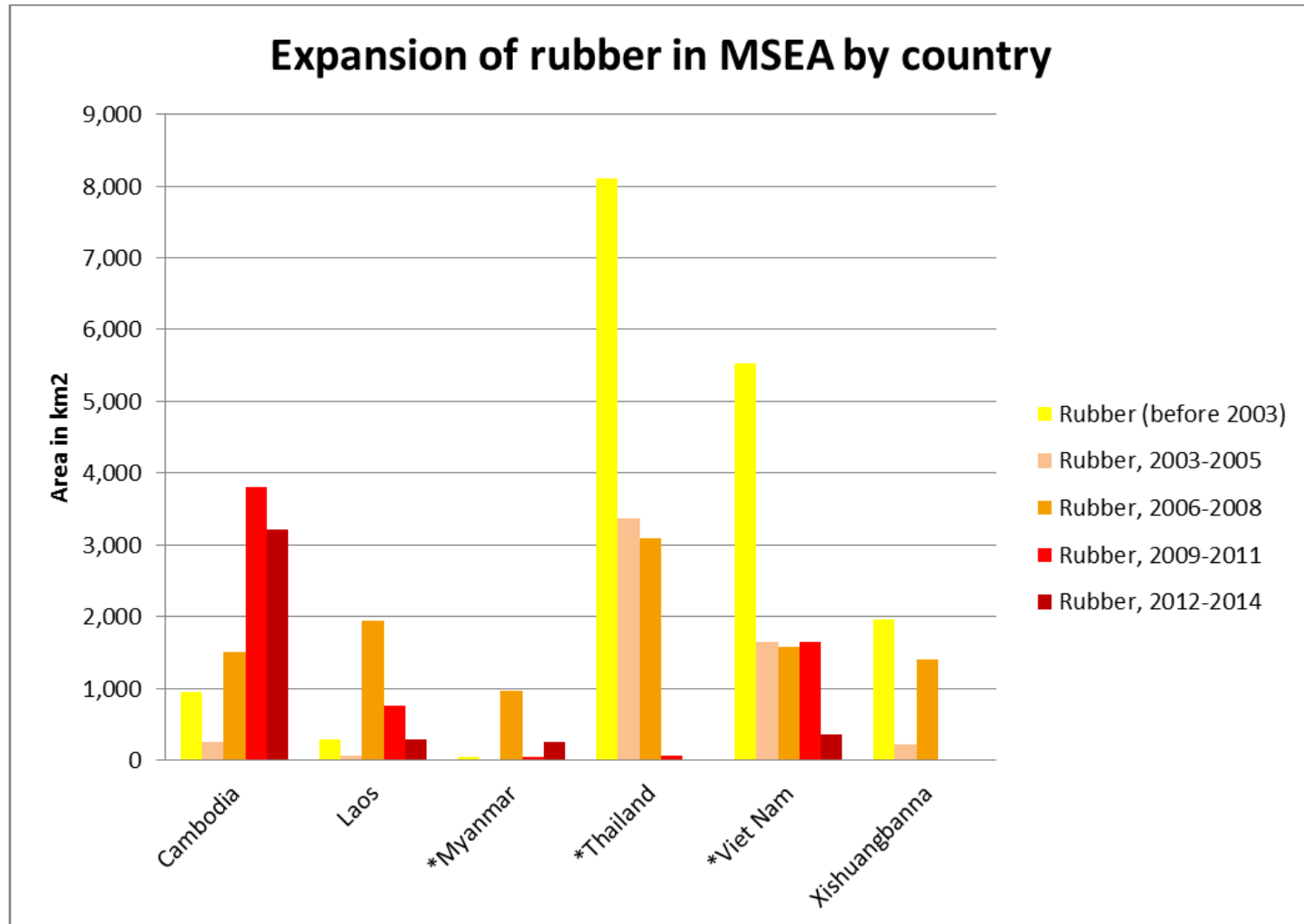
Rubber area in Km2 since 2003



Rubber in % of total rubber since 2003

Blue = Evergreen Forest; Red = Deciduous Forest; Green = Low Vegetation Area

Expansion of rubber 2003 to 2014



Summary of LCLU Changes

- 4.4 m ha of rubber have been planted since 2003;
- 50% of rubber is planted on former evergreen forest land;
- 18% on deciduous forest land;
- 32% on low vegetation area;
- Tree crops occupy about 8% of the landscape (half of that is rubber).
- Our hypothesis was wrong—tree crops do cause deforestation.

Summary of LCLU Changes

Due to the differences in their political and economic histories these countries display different LCLUCs:

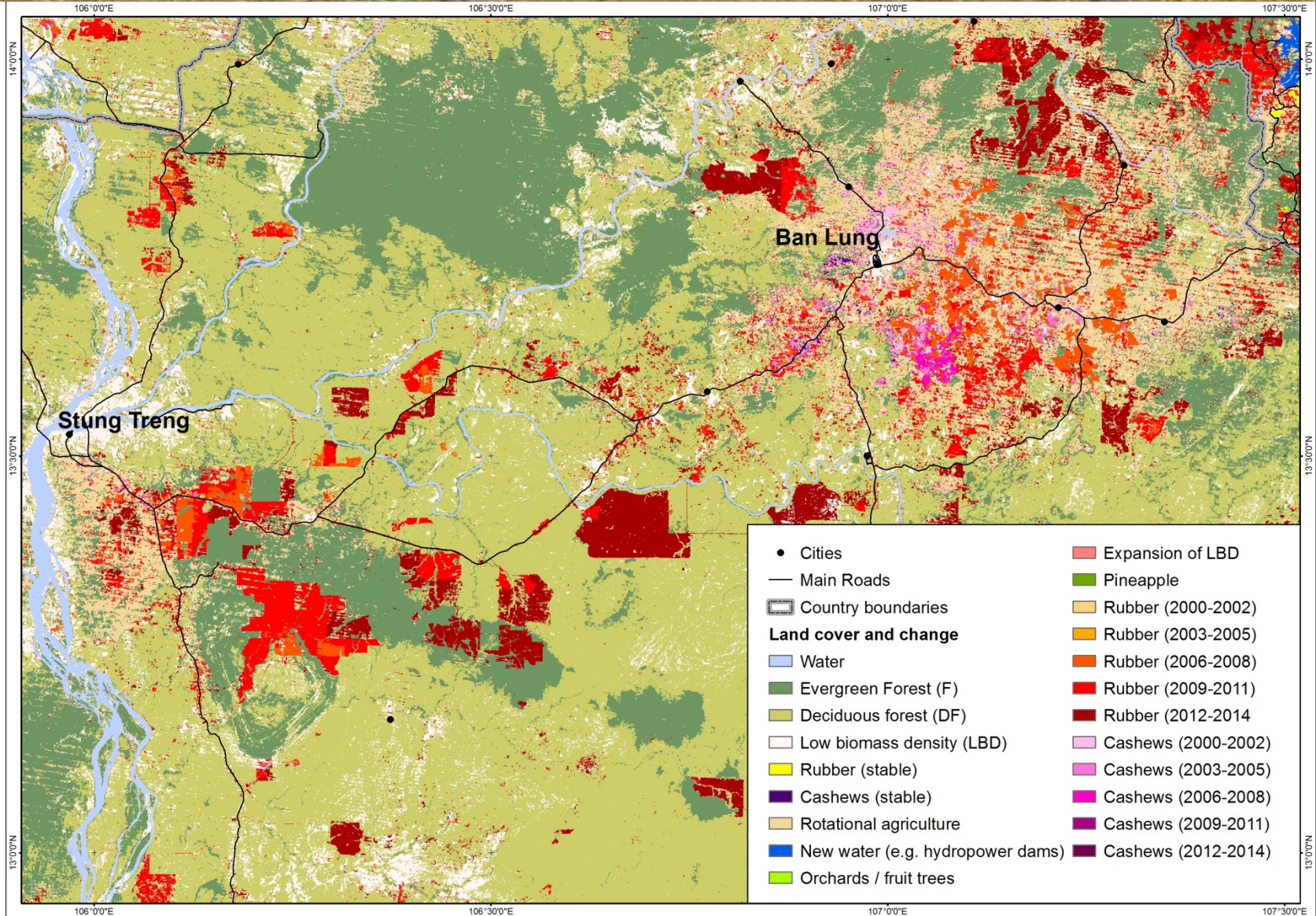
- In **northern Laos smallholder rubber plantations** dominate. Shifting cultivation is wide-spread in the uplands;
- In **southern Laos large-scale plantations** of rubber, coffee, eucalyptus, and sugarcane are widespread;
- In **Thailand** vast areas are covered by annual agriculture. **Fruit trees and rubber** are the prevailing tree crops and are mostly planted by **smallholders**;
- In **Cambodia large-scale rubber plantations** have expanded in recent years. Smallholder plantations of cashews and rubber occur;
- In **Vietnam small holder tree crops** (e.g. rubber, cashews, coffee) were already established before 2000, but since then have continued to expand.

Landat Footprints we classified

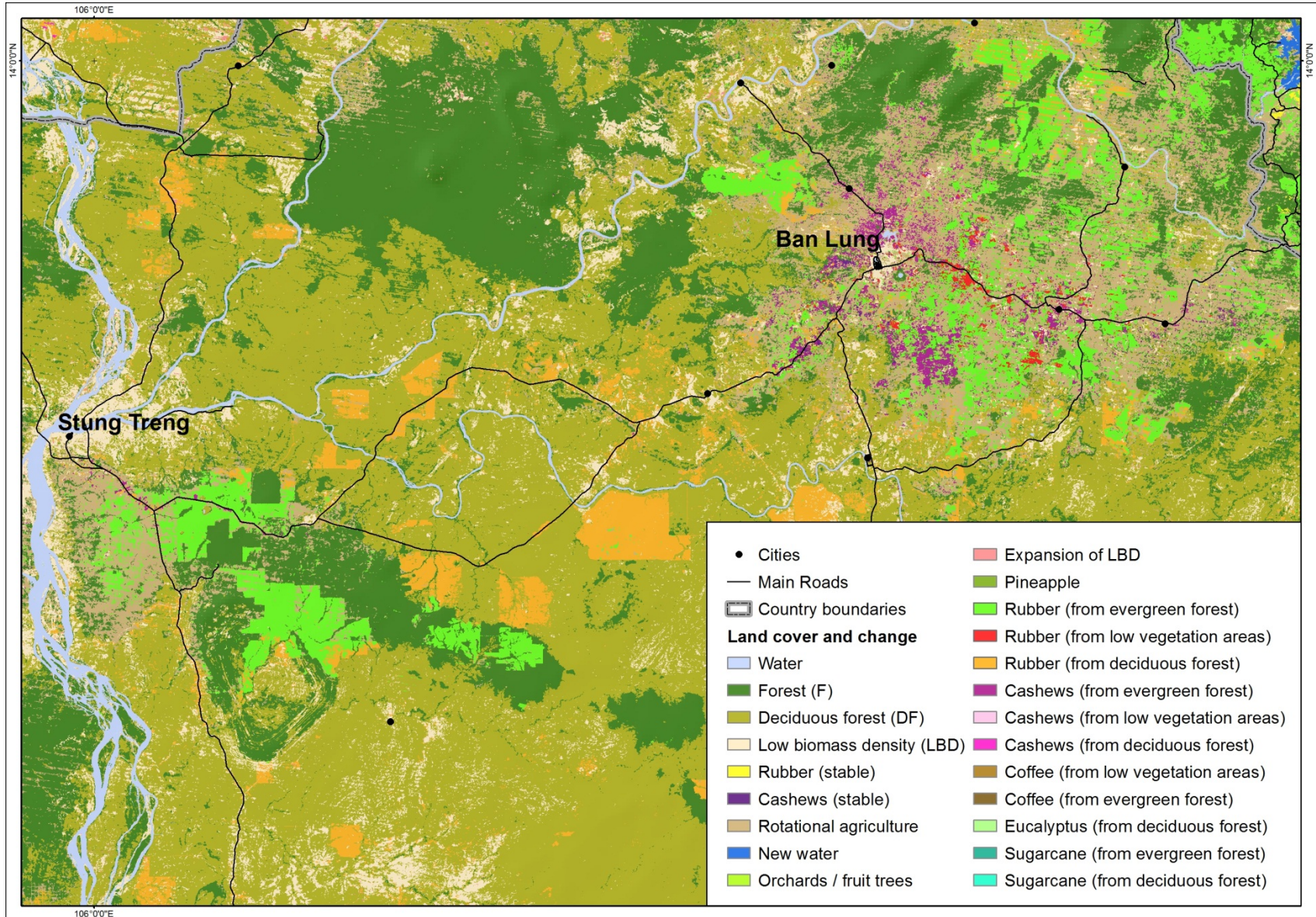
These footprints overlap with study sites and inventories of agricultural concessions (represented by yellow dots in Laos and orange polygons in Cambodia).



Landsat Classification: Year of land conversion



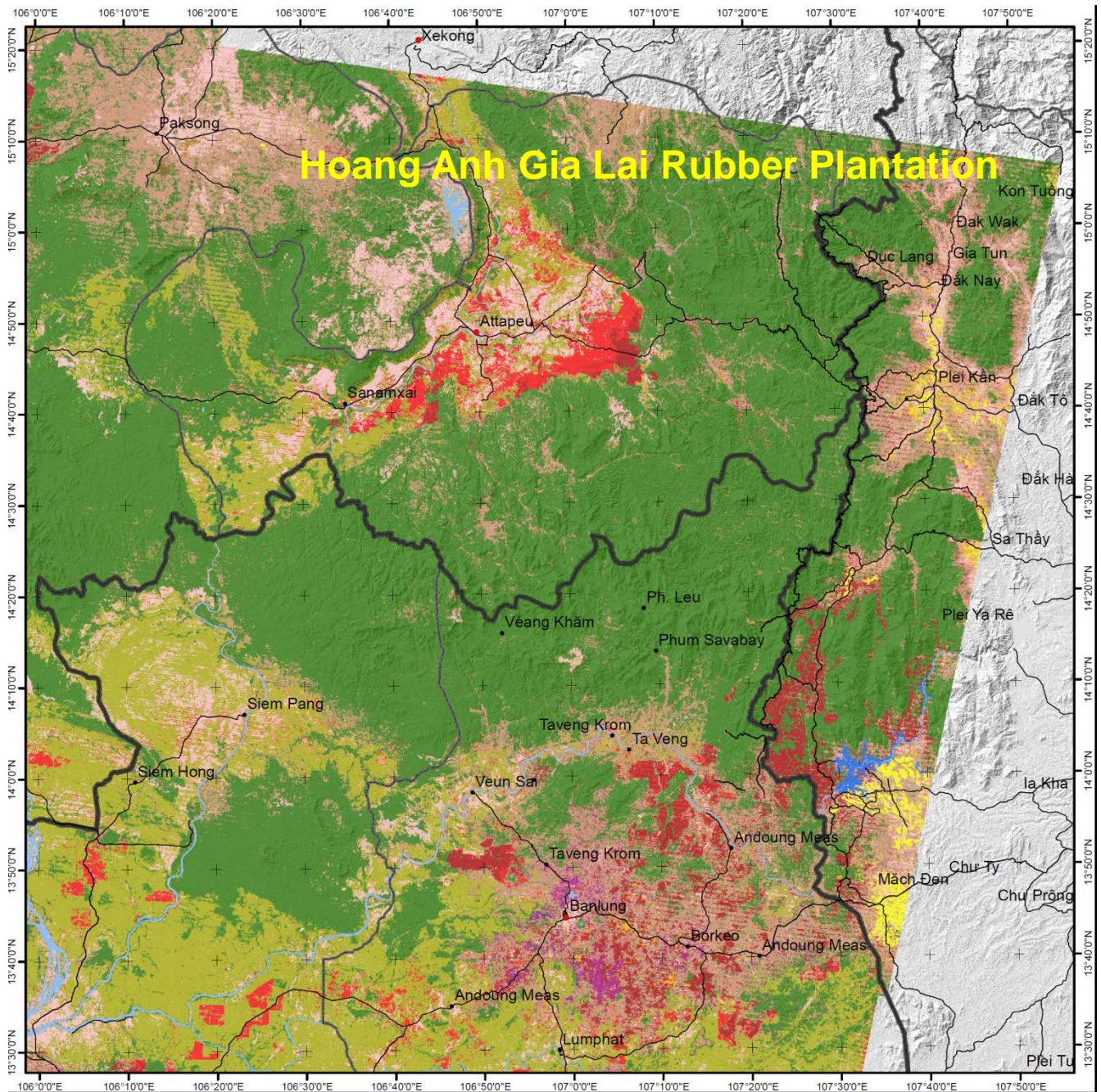
Landsat Classification: From—to conversion





National Policy as a driver of change: Laos

- Land law of 2003 and the 2009 Decree 135/PM Articles 2 and 4 established that national land could be granted as concessions for activities that “pay land concession fees, cost for national resources (royalties), tax, customs fees and other fees as specified in the [land] law.”



Hoang Anh Gia Lai Rubber Plantation



Cambodia: National Policy as a driver of change

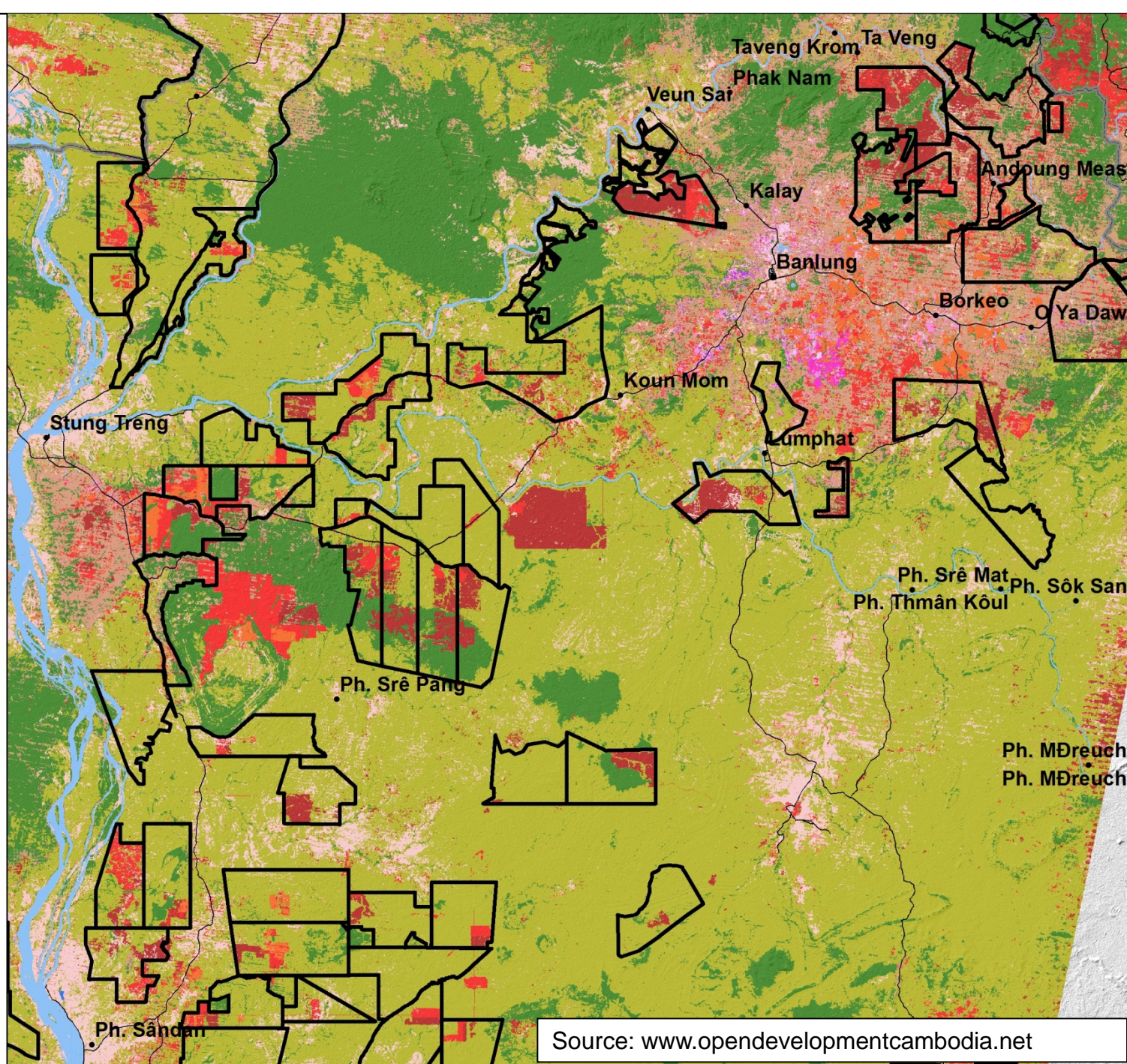
- Land law of 2001 developed a flexible and powerful doctrine of state land ownership, particularly when it comes to the allocation of concessions;
- Concessions can take two forms: economic land concessions (ELCs), aimed at cultivating large-scale investment, and social land concessions (SLCs) aimed at alleviating landlessness through provision of surplus state land.



National Policy as a driver of change: Cambodia

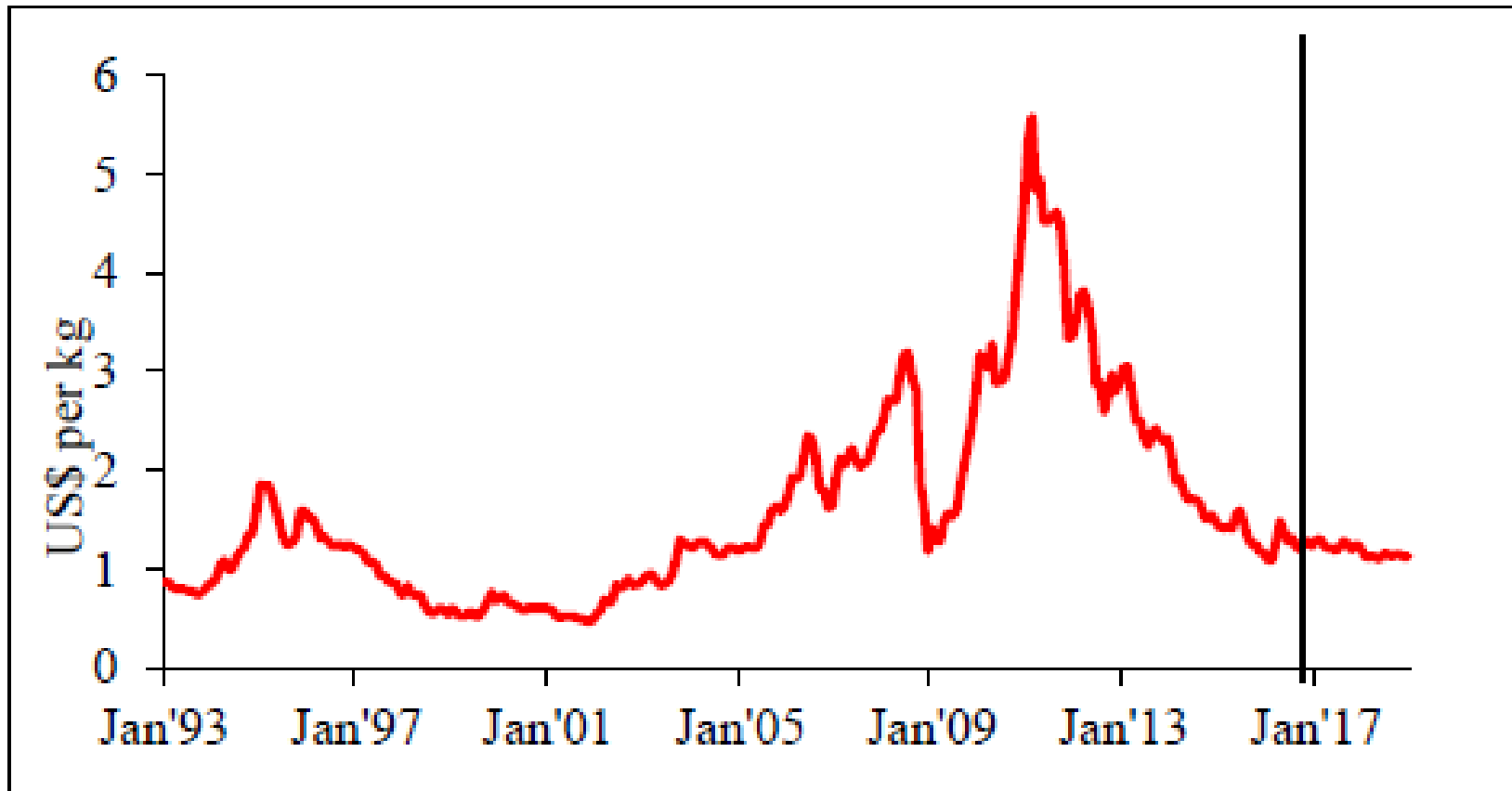
- ELCs have a maximum duration of 99 years, land must be put to use within twelve months, and impose a limit of 10,000 ha per concessionaire; Master plans requires continued expansion of planting area until limit is reached;
- 99% of land handed over as ELCs only 1% as SLCs;
- Unofficial 'Khmerization' policy aims to settle people of ethnic Khmer origin in ethnic minority areas.

- Water
- Forest (F)
- Deciduous forest (DF)
- Low biomass density (LBD)
- Rubber (stable)
- Cashews (stable)
- Rotational agriculture
- New water (e.g. hydropower dams)
- Expansion of LBD
- Rubber (2000-2002, from F)
- Rubber (2000-2002, from LBD)
- Rubber (2003-2005, from F)
- Rubber (2003-2005, from DF)
- Rubber (2003-2005, from LBD)
- Rubber (2006-2008, from F)
- Rubber (2006-2008, from DF)
- Rubber (2006-2008, from LBD)
- Rubber (2009-2011, from F)
- Rubber (2009-2011, from DF)
- Rubber (2009-2011, from LBD)
- Rubber (2012-2014, from F)
- Rubber (2012-2014, from DF)
- Cashews (2000-2002, from F)
- Cashews (2003-2005, from F)
- Cashews (2003-2005, from LBD)
- Cashews (2006-2008, from F)
- Cashews (2006-2008, from DF)
- Cashews (2006-2008, from LBD)
- Cashews (2009-2011, from F)
- Cashews (2012-2014, from F)
- Coffee (2002, from LBD)
- Coffee (2007, from F)
- Eucalyptus (2006-2008, from DF)
- Eucalyptus (2009-2011, from DF)
- Eucalyptus (2012-2014, from DF)
- Sugarcane (2006-2008, from F)
- Sugarcane (2006-2008, from DF)
- Sugarcane (2009-2011, from DF)



Source: www.opendevdevelopmentcambodia.net

NR price forecast to 2018



The Rubber Economist Quarterly Report. Third Quarter 2016 report



Livelihoods of tappers

- Beginning tappers receive approximately \$140 to \$150/month;
- Experienced workers \$200 to \$250/month;
- 25 kg rice/worker + 5 to 10 kg/child;
- Free housing, water, and electricity;
- Unpaid leave March through May for Khmer holidays + bus service to village;
- Right to plant crops on unused plantation land.



Labor and Rubber

Plantations:

- Find new laborers through friend and family networks of existing workers—most tappers recruited through family members;
- Labor is not currently a problem but all three managers foresaw labor shortages within 5 to 10 years;
- Labor (not land) will become the main constraint on agriculture in the region.

Migrants to rubber plantations in Stung Treng Province

	Sopheak Nika Plantation	Stung Treng Province		
	Converted before 2008 (Landsat)	Converted before 2008 (Landsat)	Converted up to 2014 (Landsat)	Granted concession area (ODC)
Area (ha)	1700	5360	22,906	93,841
Migrant tappers, farmers, and families	900	6400 - 14,400	11,500 – 32,000	40,000 – 125,000
2008 population	230	111,734	111,734	111,734
Percent change	395	6 - 13	10 - 29	36 - 112

Impact of Migrants

- The impact of large migrant populations on the landscape is not limited to the area of the plantation but will affect the larger landscape through shops and food outlets, schools, medical facilities, and other infrastructure.



Summary: Socioeconomic impacts of LCLUC

- Indigenous households lose access to land and are forced to relocate on to more marginal land;
- These households neither chose to be tappers nor are they sought out by rubber companies to be tappers;
- Tappers make a reasonably good income but the hours make it a young person's job;
- Labor is becoming a scarce resource and will eventually become more problematic than access to land;
- Rubber plantations are struggling with low prices.

Take home points

- Where the environmental and socioeconomic consequences of LCLUC are being documented and studied, they tend to be viewed individually (i.e., deforestation or spread of rubber; old farmers or young factory workers) not holistically, and not coupled with feedback loops;
- In reality these changes are related and their consequences may be greater than the sum of the individual parts.

Thank You



Area Tapped and Number of Migrants

Landsat classification of Stung Treng Province, Cambodia, overlaid with rubber plantations as mapped by Open Access Cambodia.

Open Access Cambodia records 12 plantations covering 93,841 ha.

Using Landsat data we mapped 22,906 ha as having been converted to rubber by 2014 (24.41% of plantation land)

- Sopheak Nika
Plantation (#3) covers
10,000 ha.
- Our maps show they
have planted about
4400 ha of rubber
- Approximately 1700 ha
of this were planted
before 2008 and can
be tapped now.

Impact of concessions on places elsewhere

- The migrants we interviewed originated from 8 provinces with the largest numbers coming from Kampong Cham (35%), Tbong Khmum (16%), and Kandal and Prey Veng (13%). Other provinces with few migrants included Kampong Thom, Svay Reing, Takeo, and Siem Reap.
- We know little about the impact of migrants from these places on the place from which they came.
- We haven't yet done any multi-site ethnography to follow up on the households from where migrants originated from.

LCLUC in Mainland Southeast Asia

- LCLUC is occurring rapidly across all of mainland Southeast Asia
- Some of these changes (consolidation, mechanization) are difficult or impossible to monitor from space
- Some of the changes are not being monitored in meaningful ways (expansion of fallow land, labor saving crops, high value crops)
- Drivers of change are diverse but capitalism and national policies are key
- In the less developed countries and the uplands we are witnessing a complicated instance of agrarian transitions to capitalism.

- Change in one place leads to changes in other places—changes in agriculture and industrialization are intertwined, so are rubber plantations and migrant laborers; This is telecoupling.
- Where the environmental and socioeconomic consequences of change are being documented and studied, they tend to be viewed individually (i.e., deforestation or spread of rubber; old farmers or young factory workers) not holistically, and not coupled with feedback loops.
- In reality these changes are related and their consequences may be greater than the sum of the individual parts.



Plantation Telecoupling Research

- In 2014 and 2015 we visited a number of large-scale rubber plantations in southern Laos and northeastern Cambodia in order to look for telecoupling in relation to large-scale concession plantations.
- Project is funded by NASA.
- Paper recently published in *Land* (with Ian Baird, University of Wisconsin, Madison)
- Our research is continuing.



Nearby Telecoupling

- In Bachieng District, Champasak Province, farming has been displaced to marginal areas.
- In Thateng District, Xekong Province, farmers have lost their agricultural land and have had to “borrow” land from neighboring villages.
 - They are allowed to cultivate for a year in exchange for developing it into lowland rice paddy. Then the original owner takes it back.
- Ethnic minorities often don’t move far due to a lack of distant social networks (some exceptions though, such as the Hmong).

Impacts of Migrants

- Landsat classification of Stung Treng Province, Cambodia, overlaid with rubber plantations as mapped by Open Access Cambodia.
- Open Access Cambodia records 12 plantations covering 93,841 ha. Using Landsat data we mapped 22,906 ha as having been converted to rubber by 2014 (24.41% of plantation land)

Sopheak Nika Plantation (#3) covers 10,000 ha. Our maps show they have planted about 4400 ha of rubber and approximately 1700 ha of this were planted before 2008 and can be tapped now.

Sopheak Nika Plantation

- The plantation manager reported they plant 550 trees per ha and 1 person can tap about 500 trees per day or about **1 person per ha**. The company currently employs **300** workers to tap 1000 ha of trees or **1 person per 3.3 ha**.
- The average rubber tapper at Sopheak Nika has a family of 4.6 members of which at least 2 people collect rubber. Hence for every rubber tapper we have an additional 1.3 people in the household, or a total of **700** tappers and family members
- In addition to rubber tappers there were approximately 49 households of farmers who had migrated nearby Sopheak Nika to buy land. Each household had 4.25 members suggesting a population of **210** additional migrants.

Sopheak Nika Plantation

- This suggests a population of approximately **900** people who have migrated to Sopheak Nika as a tapper or family member, or a farmer.
- The total population of Katot, the village whose land is occupied by the plantation is approximately **230** people.
- There are approximately **4 migrants for every original inhabitant** of the site.



Migrants to rubber plantations in Stung Treng Province

- We mapped **5,360** ha of rubber planted on plantations in Stung Treng province before 2008.
- This suggests a labor force somewhere between **1,625 and 5,360** tappers.
- With family members the total population of people who have migrated to Stung Treng as a tapper or family member is approximately **4,000 to 12,000** people.
- If each of the 12 plantations in the province also hosts approximately 200 farmers then these numbers increase by another **2,400** people.
- Total population of rubber related migrants today is approximately **6,400 and 14,400** people



Migrants to rubber plantations in Stung Treng Province

- We mapped 22,906 ha as having been converted to rubber by 2014; Open Access Cambodia records 12 plantations covering 93,841 ha.
- This suggests a migrant population of rubber tappers, family members, and associated farmers of approximately **11,500 to 32,000 people** for land already planted to rubber) or **40,000 to 125,000 people** for all concession land.
- The 2008 population of the province was **111,734** people. The migrants represent between **10% and 28%** of this population for land planted to rubber or **36% and 112%** for all concession land.



Impact of Migrants

- The impact of large migrant populations on the landscape is not limited to the area of the plantation but will affect the larger landscape through shops and food outlets, schools, medical facilities, and other infrastructure

Impact of concessions on places elsewhere

- The migrants we interviewed originated from 8 provinces with the largest numbers coming from Kampong Cham (35%), Tbong Khmum (16%), and Kandal and Prey Veng (13%). Other provinces with few migrants included Kampong Thom, Svay Reing, Takeo, and Siem Reap.
- We know little about the impact of migrants from these places on the place from which they came.
- We haven't yet done any multi-site ethnography to follow up on the households from where migrants originated from.



Remittances

- Remittances do not appear to be playing an important role on land-use practices elsewhere
- Overall, 40% of households reported sending remittances home at least occasionally. These remittances were used to pay bills (33%), education (33%), food (13), and farming (13).
- Rubber tappers--60% of tappers report sending remittances to family regularly.
- Farmers--25% of farmers report sending remittances to family—only 50% of these sent regularly.



Remittances

- We suspect that households receiving remittances are more dependent on the market for their food supplies (grow less of their own food than before) and hence may be at risks to downturns in rubber market and disease outbreaks.
- But about how agricultural land use is changing we know nothing. It could be intensifying—fewer people, consolidation of fields, and modernization; or it could be disintensifying—fewer people, abandonment of fields, perhaps conversion to an emphasis on livestock?



Conclusions: Telecoupling, and Large-Scale Plantations in Southern Laos and Northeastern Cambodia

- Rubber concessions in Southern Laos and Northeast Cambodia are affecting places elsewhere.
- We know something about how plantations affect places nearby—displacement of agriculture to marginal lands, short-term borrowing of land, reordering of landscape to meet the needs of migrant laborers.
- We know little about how plantations affect places at a distance—both domestically and internationally.
- This should be an important topic within land-use and land-cover research



Introduction

- Between 1990 and 2010 forest cover fell from 50.7 to 45.7%;
- Forests and shifting cultivation lands often replaced with commercial boom crops such as rubber, coffee, trees for pulp and paper (particularly eucalyptus and acacia), cashews, and fruits such as oranges, lychees, longans;
- The impacts of these transitions on livelihoods and human well-being, and the provision of ecosystem services are not well understood.

Dynamics of
shifting
cultivation in
Northern Laos
(decrease of
2.2% between
2000 and 2009)

(Hurni *et al.* 2013)

Policy implications

- Negotiating and reinforcing contracts may be a legal way to stabilize the rules of the game for the benefit of smallholders, but in many cases poor law enforcement,
- Need to explore different scenarios of change with multiple stakeholder groups,
- Learn from past experiences and monitor on-going arrangements in order to capitalize knowledge relevant to the negotiation process,
- Empower weak groups of stakeholders to make sure they can take part in the negotiations and influence their outcomes