Transportation Corridor Development and Land-Use/Cover Changes in Southeast Asia: A case study of the East-West Economic Corridor between Da Nang, Vietnam and Khon Kaen, Thailand

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Overview

- Transportation routes and land cover changes – a review
- Case study: The East-West Economic Corridor
  - Objectives of the case study
  - Methods
  - Results
    - Urban changes (need new slides from urban analysis)
    - Rural changes
  - Discussion: multiple telecoupled systems
    - Urban-urban telecouplings, spillover systems, and land changes (figure 8)
    - Urban-rural telecouplings, spillover systems and land changes (new figure)
    - Rural telecouplings
- Conclusions

Transportation route development and land-use/cover changes; a review

- Methods: Literature Search
  - Combination of keywords: “Roads” or “highways” or “expressways” or “railways” or “logging roads” or “oil/mineral roads” or “transportation corridors” and “land-use” or “land-cover” or “deforestation” or “land cover change” or “land use change”
  - Reviewed results
  - Organized relevant articles
  - Categorized by land use/cover change
- 34 relevant articles (so far)

Results: Land-use/cover changes

Change in land use / cover associated with roads (or any of the other key words)	Number of studies*
Native (primary) Forest to general deforestation	20
Native (primary) Forest to agriculture/cropland	12
Native (primary) Forest to urban / built up areas	6
Forest to shrubland	1
Changes in agriculture (food crop to cash crop)	3
No change in forest area	5
Forest transition	4
Increased forest cover (in general)	2
Pasture or grassland to increased forest or tree cover	2

*articles mention more than one study

Does road development and improved connectivity enable forest transitions?

Developed countries

- Case of Europe
  - Forest transitions took place in 1800s and 1900s
  - Transition of farmers / rural population from farm work to off-farm work
  - Roads and transportation networks facilitated the flows of people to urban areas / off-farm work
- Case of the U.S.A.
  - Forest transitions took place in the early 1900s
  - Transition of farmers / rural population from farm work to off-farm work
  - Roads and transportation networks facilitated the flows of people to urban areas / off-farm work

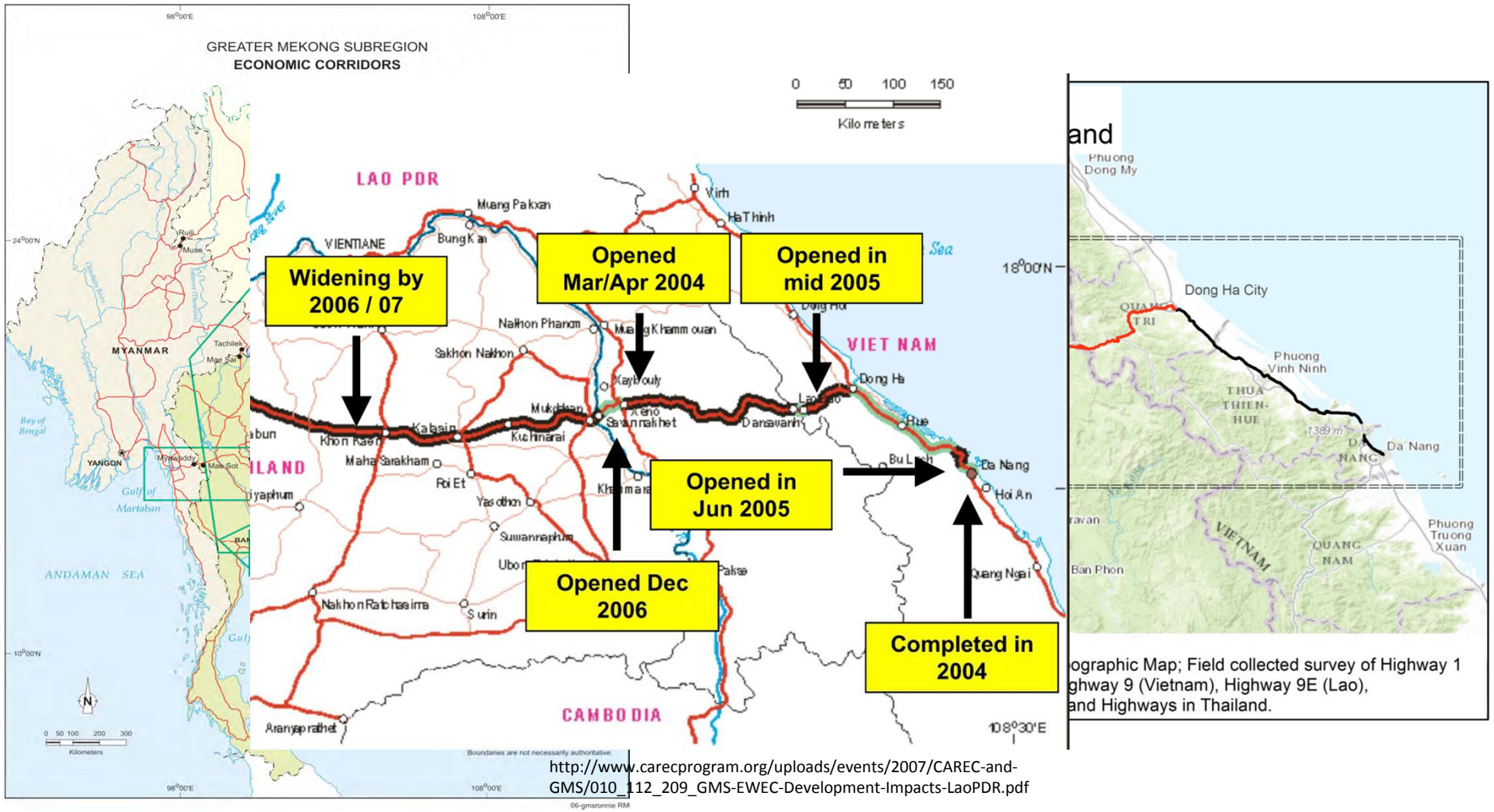
Does road development and improved connectivity enable forest transitions?

Developing countries

- Yunnan, China
  - Since mid-2000s documented forest transition
  - Economic pathway (more access to off-farm work)
  - Roads facilitated transition of people from farming to off-farm work
- Bhutan
  - Recorded a forest transition since 2011
  - Initial gains in forest cover were in areas of better accessibility / closer to roads
  - Roads facilitated access to markets (marketing of cash crops) and other forms of employment

Case Study:
The East-West Economic Corridor and land-use/cover changes between Da Nang, Vietnam and Khon Kaen, Thailand.

Background: Economic Corridor Development in SE Asia



http://www.carecprogram.org/uploads/events/2007/CAREC-and-GMS/010_112_209_GMS-EWEC-Development-Impacts-LaoPDR.pdf

Case Study Objectives

- Identify land-cover/land-use changes within the corridor
- Identify if similar changes are taking place in all three countries
- Identify what is driving these changes.

Methods

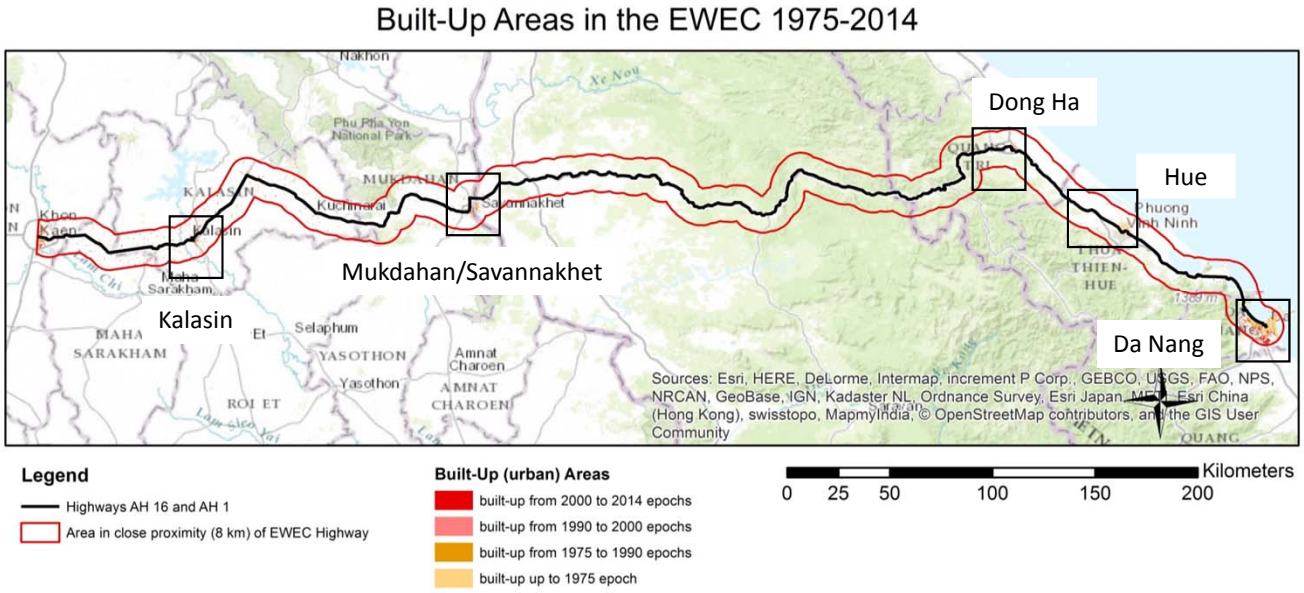
- Remote sensing to identify land-cover (and some land-use) changes
  - Hypertemporal analysis of 212 stacked MODIS EVI layers from 2000-2014 identified coarse scale changes
  - Landsat TM and ETM+ analysis of rural changes in Laos and Vietnam – finer scale changes in rural and some urban areas
  - Urban changes from Global Human Settlement Database (made using Landsat TM, ETM+ data)

- Fieldwork to identify drivers of land-use changes from local perspective
  - Interviews at Province, District, Commune, Village levels in Vietnam, Laos, Thailand
  - Transect walks in selected villages
  - Structured questionnaires focusing on livelihood changes (Vietnam and Laos)

- Literature review: government policies, ODA policies, etc.

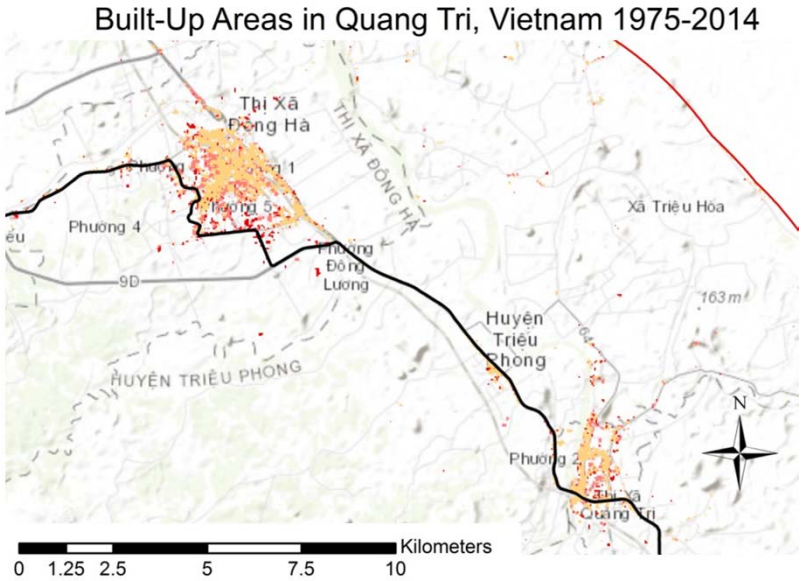
Results: Urban Land Cover Change

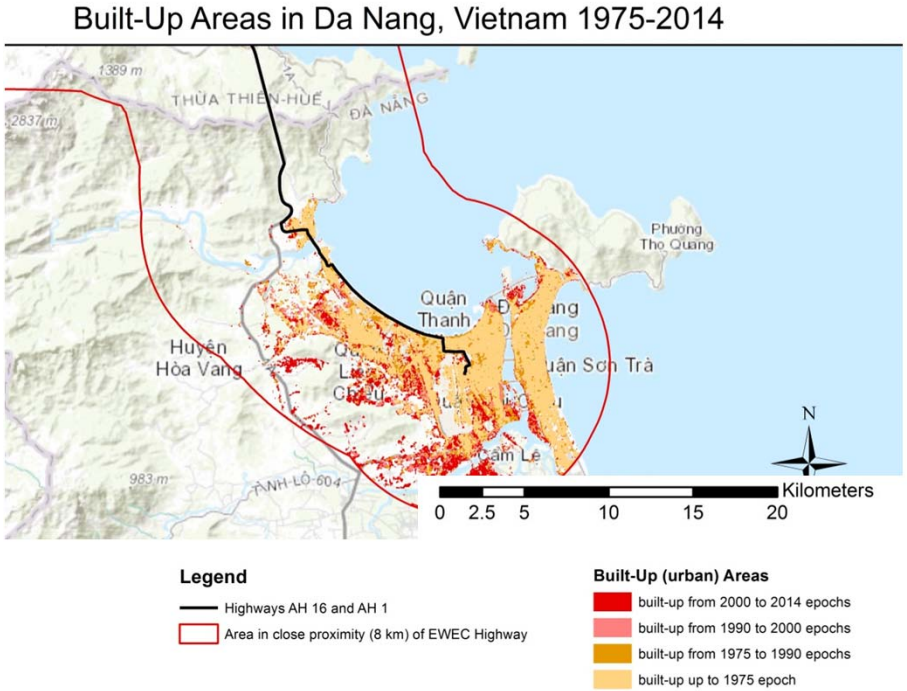
- Vietnam: increase from 97 km^2 in 1975 to 147 km^2 in 2014.
- Laos: least urban, increase from 1 km2 in 1975 to 7.5 km^2 in 2014
  - Mostly around Savannakhet City; very little in rural areas
- Thailand (between Khon Kaen City and Mukdahan): increase from 25 km^2 in 1975 to 128 km2 in 2014
- Infilling of existing urban areas; extension of urban built-up areas; transformation of 'rural' villages into areas with urban built-up characteristics



Change in Built-Up (Urban Area)	Thailand sq. km	Laos sq. km.	Vietnam sq. km.	Total sq. km.
Built-up prior to 1975	25.06	1.18	96.92	123.16
Built-up 1975-1990 change	57.57	3.68	11.94	73.18
Built-up 1990-2000 change	20.50	1.34	13.13	34.98
Built-up 2000-2014 change	24.97	1.28	25.18	51.43
Total in 2014	128.10	7.47	147.17	282.75

Urban Changes: Vietnam





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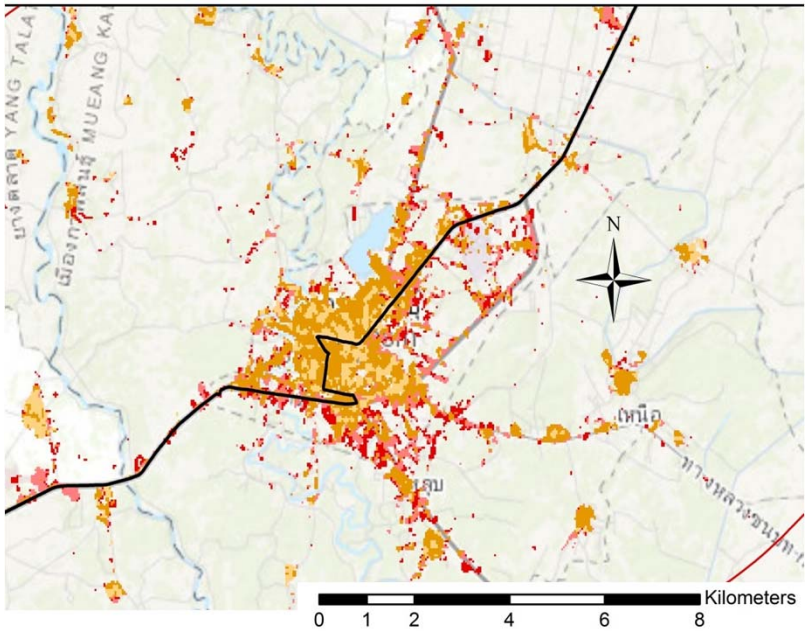
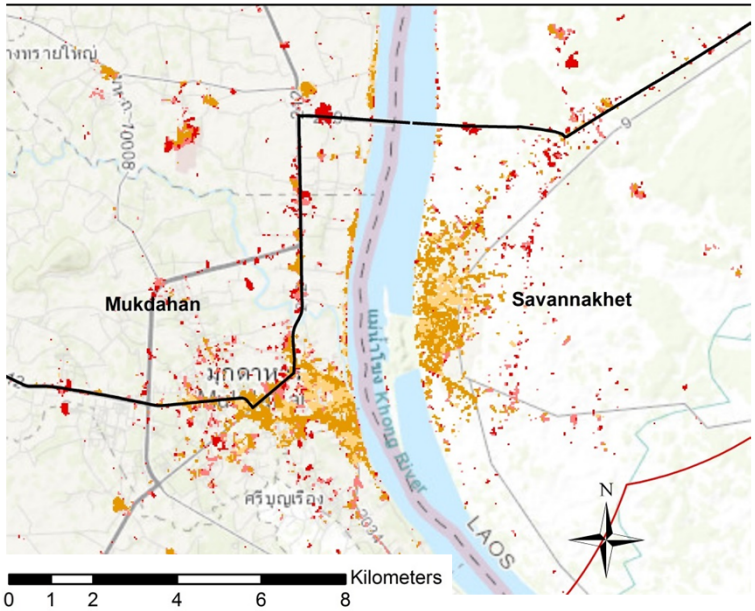
Urban Changes: Laos and NE Thailand

Built-Up Areas in Kalasin, Thailand 1975-2014



Change in Built-Up (Urban Area)	sq. km
Built-up prior to 1975	25.06
Built-up 1975-1990 change	57.57
Built-up 1990-2000 change	20.50

Built-Up Areas in Mukdahan, Thailand, and Savannakhet, Laos 1975-2014

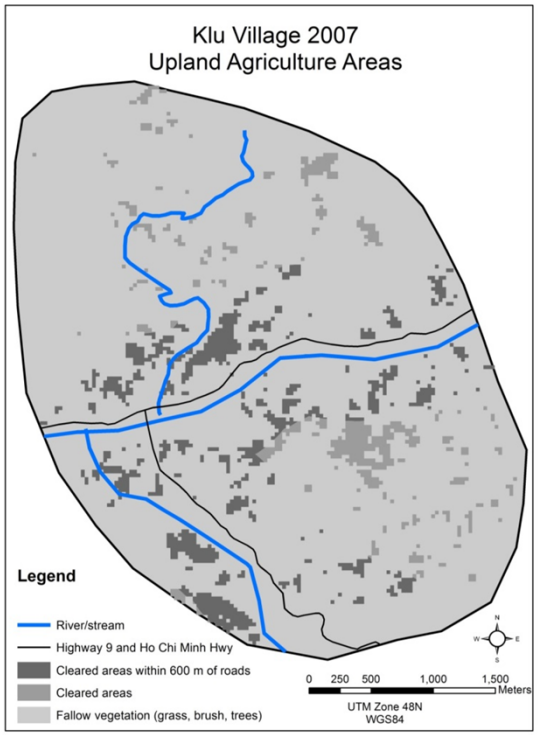


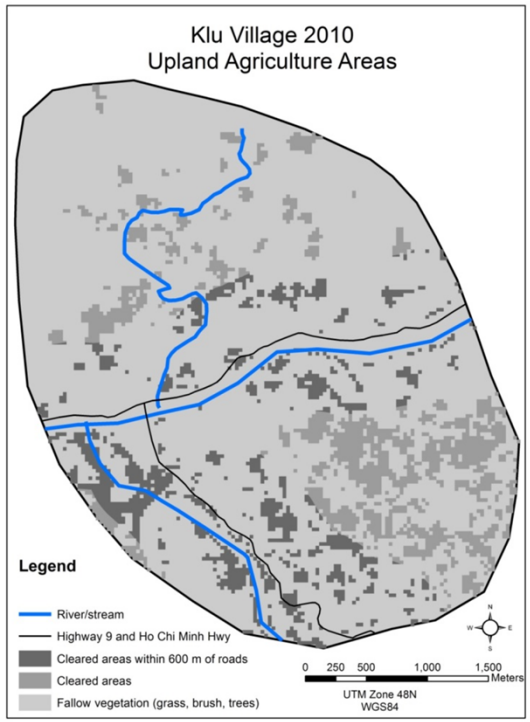
Change in Built-Up (Urban Area)	sq. km
Built-up 2000-2014 change	24.97
Total in 2014	128.10

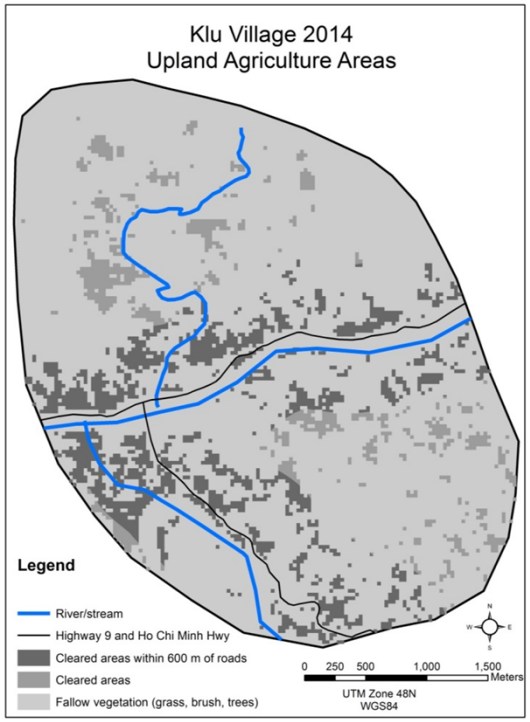
Results: Rural Land Cover Changes Vietnam

- Change in crops planted (less upland rice; more cassava' more tree crops)
- Distant land fallow for longer (in places)
- Change in placement of field locations
- Rural urbanization taking place along road in some rural villages

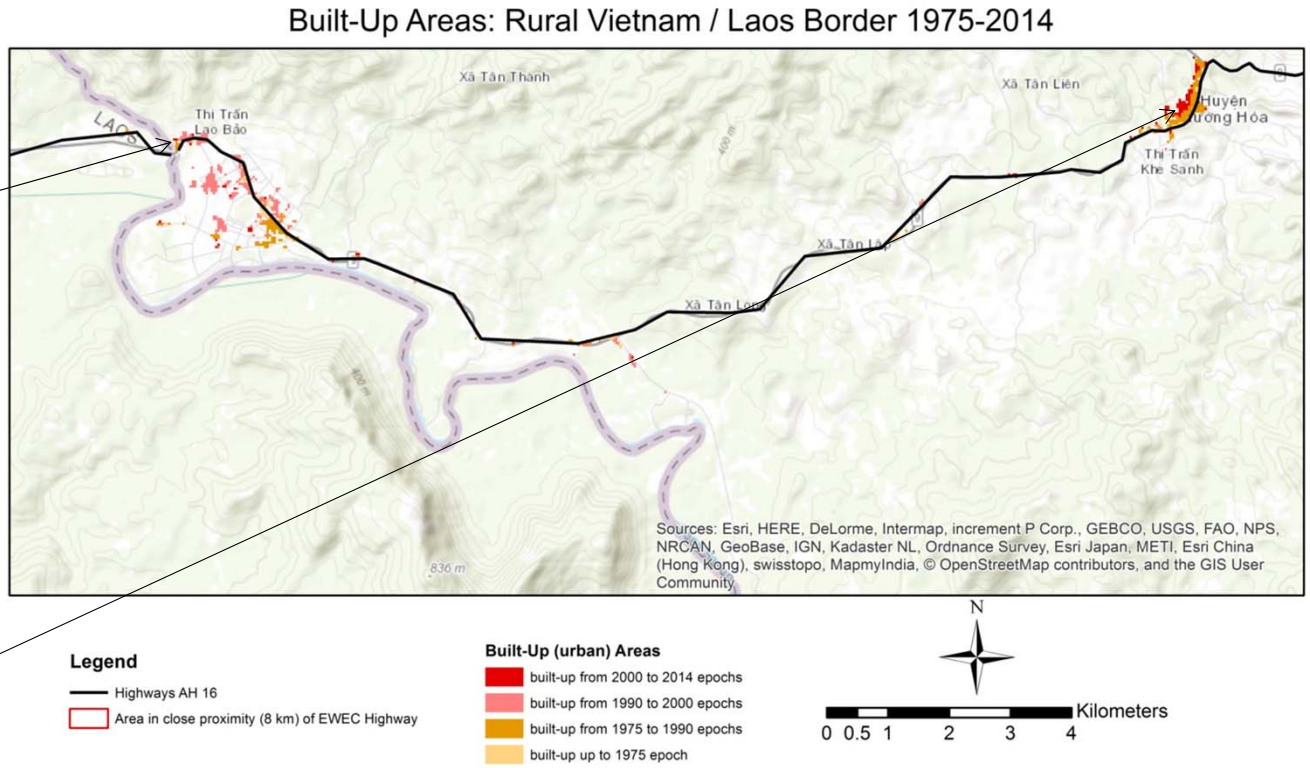
Rural Changes: Example of Klu Village







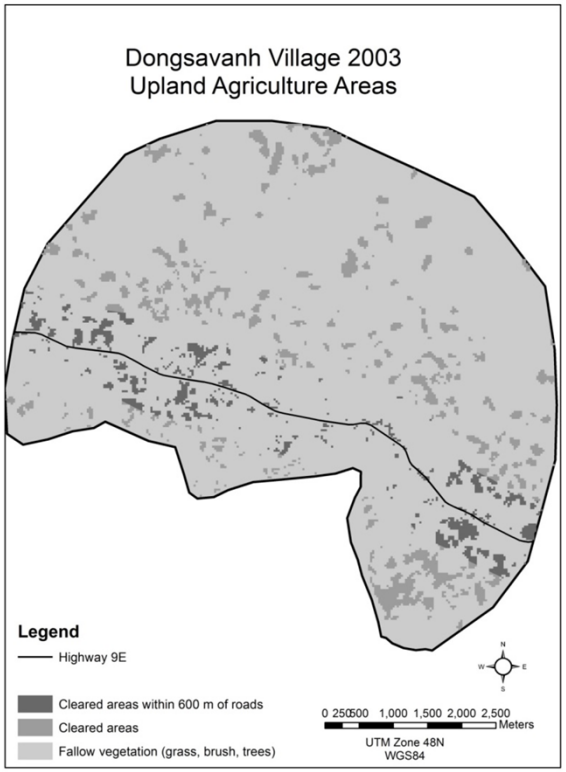
Rural Changes: Rural Urbanization in Vietnam

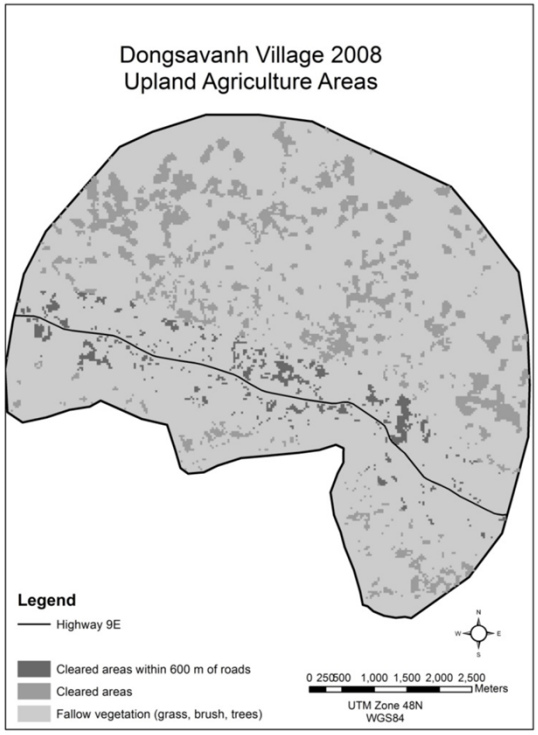


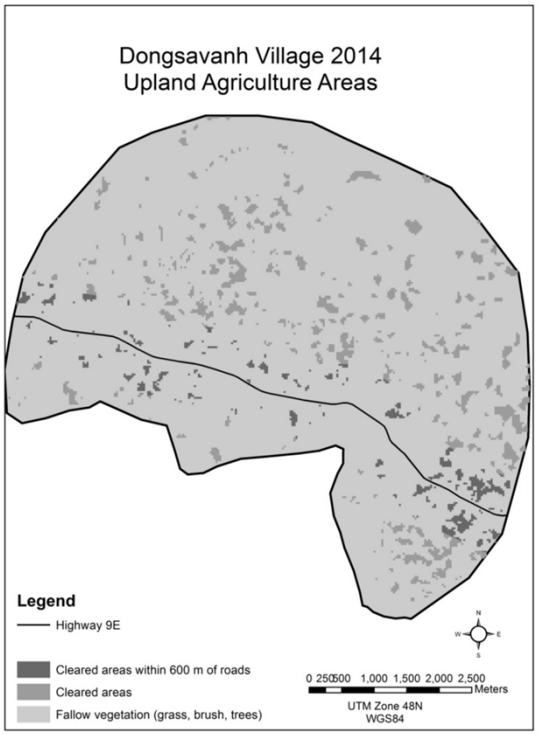
Results: Rural Land Cover Changes Laos

- Change in crops planted (banana, hybrid cassava, eucalyptus introduced)
- No significant changes in landscape (still dominated by swidden agriculture and associated land cover types)
- Along road some ‘rural urbanization’ but not as significant as in Vietnam or Thailand

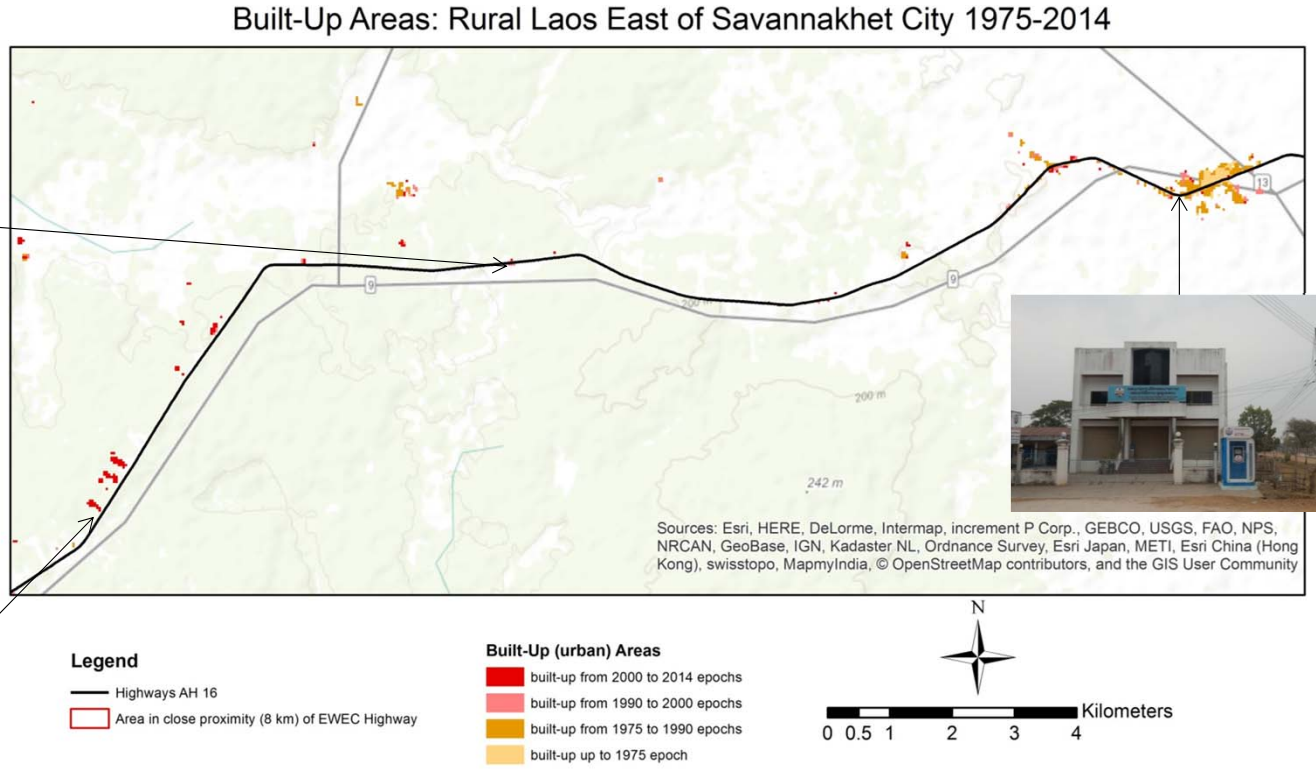
Rural Changes: Example Dongsavanh Village







Rural Urbanization in Laos

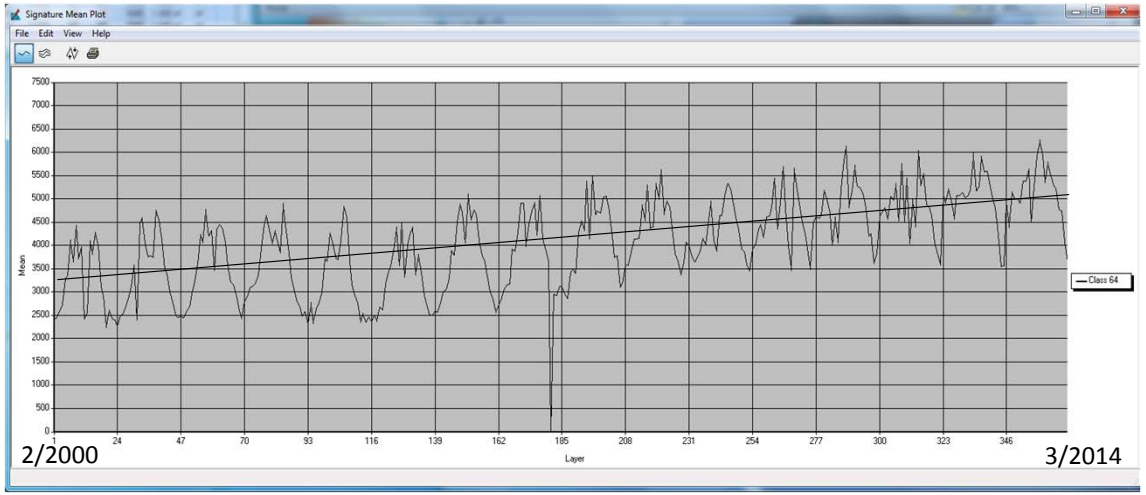


Results: Rural Land Cover Changes Northeast Thailand

- Evidence of increase in tree cover from MODIS hypertemporal analysis and village-level interview data
- Change in agricultural practices: less emphasis on rice growing, more on market oriented crops
- Rural urbanization taking place along road – increase in small and medium size enterprises near main roads

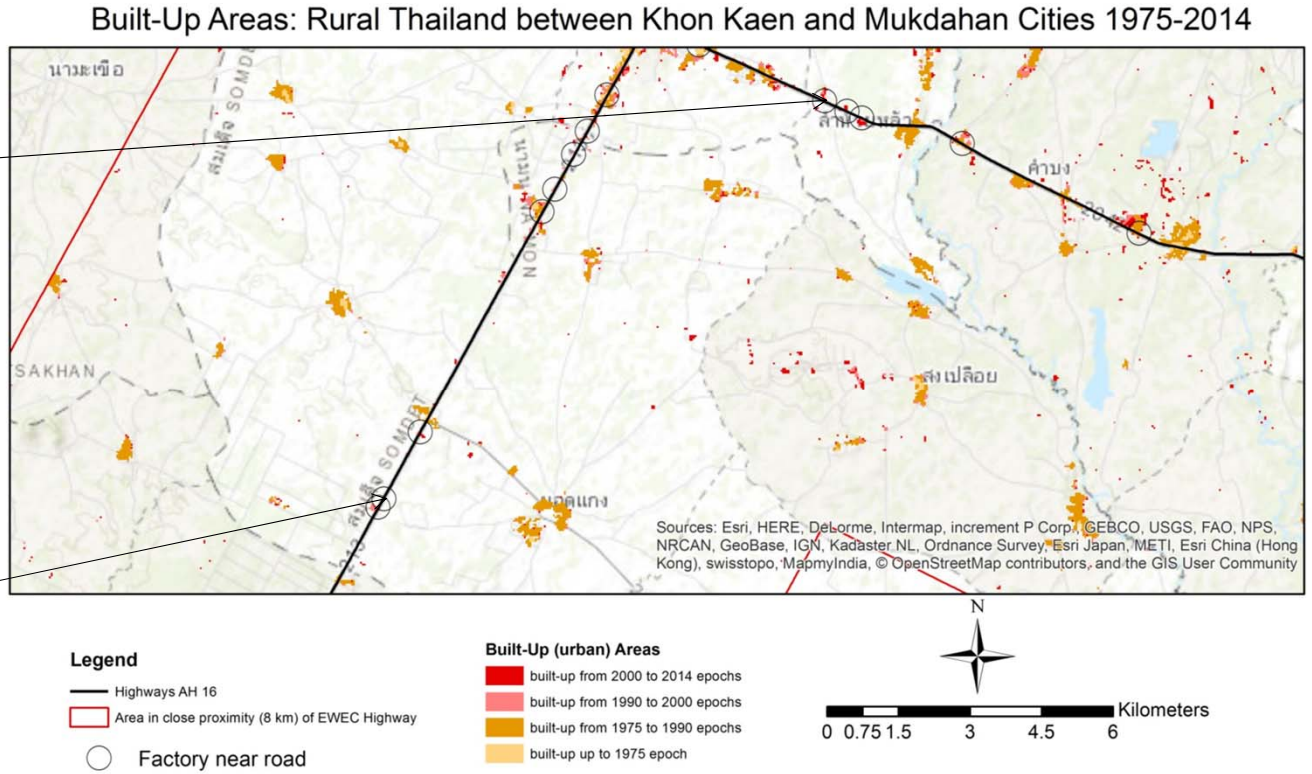
Rural Land-cover Changes Northeast Thailand

- Hypertemporal MODIS analysis for Vietnam and Laos identified
  - Urban expansion
  - Reservoir creation
  - Decreasing vegetation
- In Thailand analysis showed little change in vegetation except for two classes where vegetation increased



One of the two hypertemporal MODIS signatures indicating increasing vegetation per pixel between 2000 - 2014.

Land-Cover Changes: Rural Urbanization in Thailand



What is driving these changes?

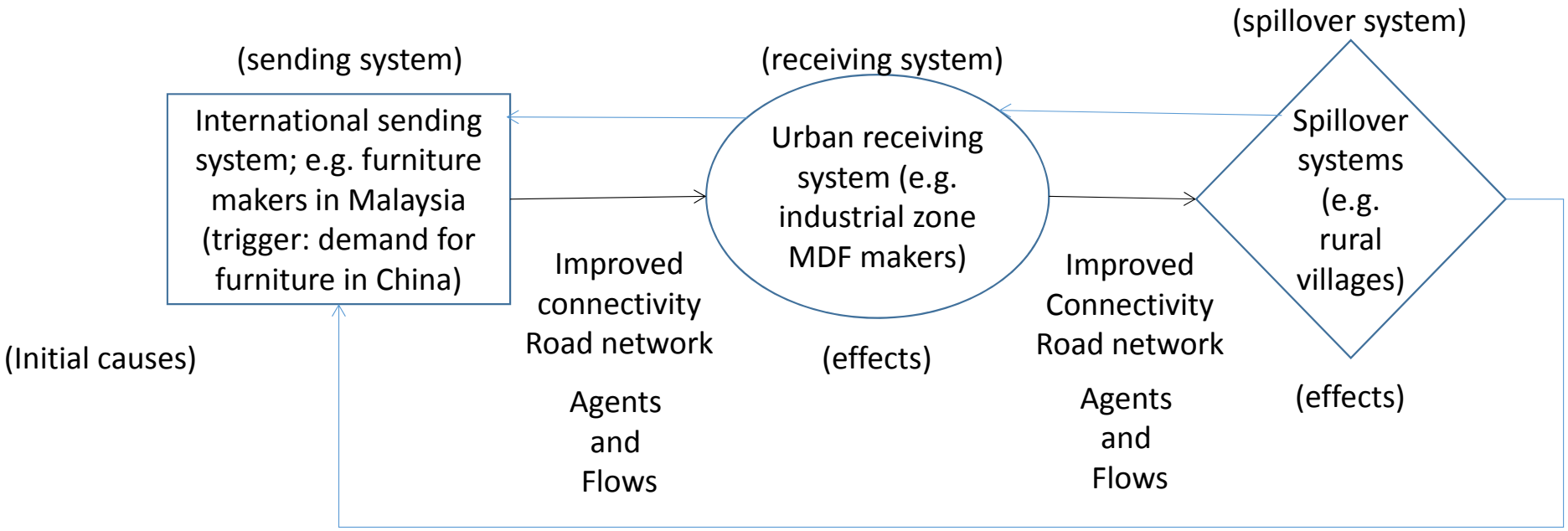
What is driving these changes? “Telecoupling”

What is driving these changes? “Telecoupling”

- Telecoupling conceptualizes linkages of local land-use change and related land-cover change to geographically distant events
- Analyzes feedbacks:
  - Between where land-cover/land-use changes are taking place; and
  - Where the drivers of the changes originate; and
  - Multi-directional flow of goods and services between these (and other) locations
- Telecouplings (based on Jianguo Liu et al. (2009)) are discussed in terms of “sending systems”, “receiving systems”, and “spill-over systems”, and the agents, flows, causes and effects of the telecoupling
- All facilitated through connectivity – both physical and ‘tele’

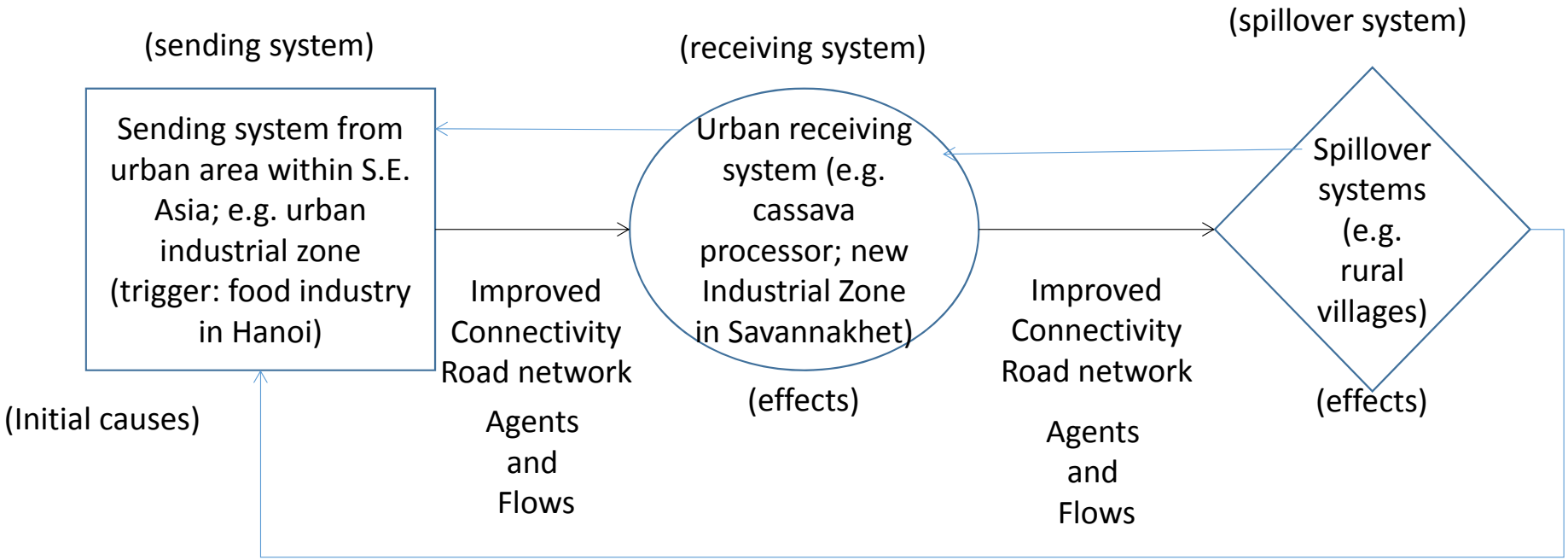
Discussion: Telecoupling

- Global to regional (urban areas in each country, the whole corridor)



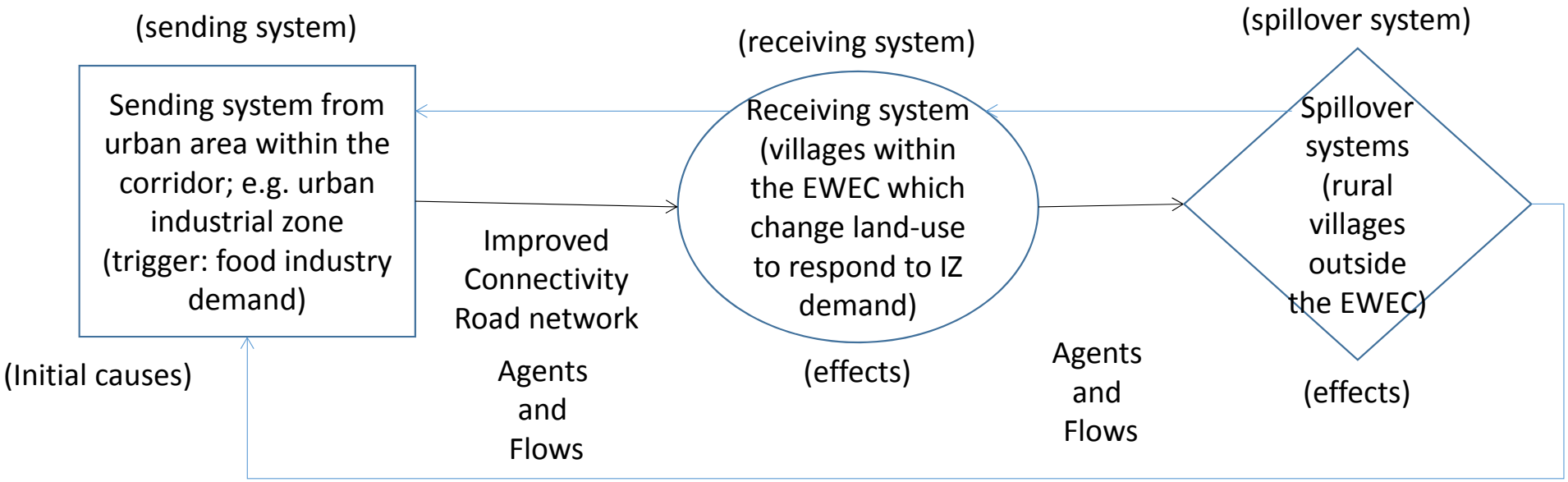
Discussion: Telecoupling

- Regional urban to corridor urban (in Thailand and Vietnam and across borders to Laos)



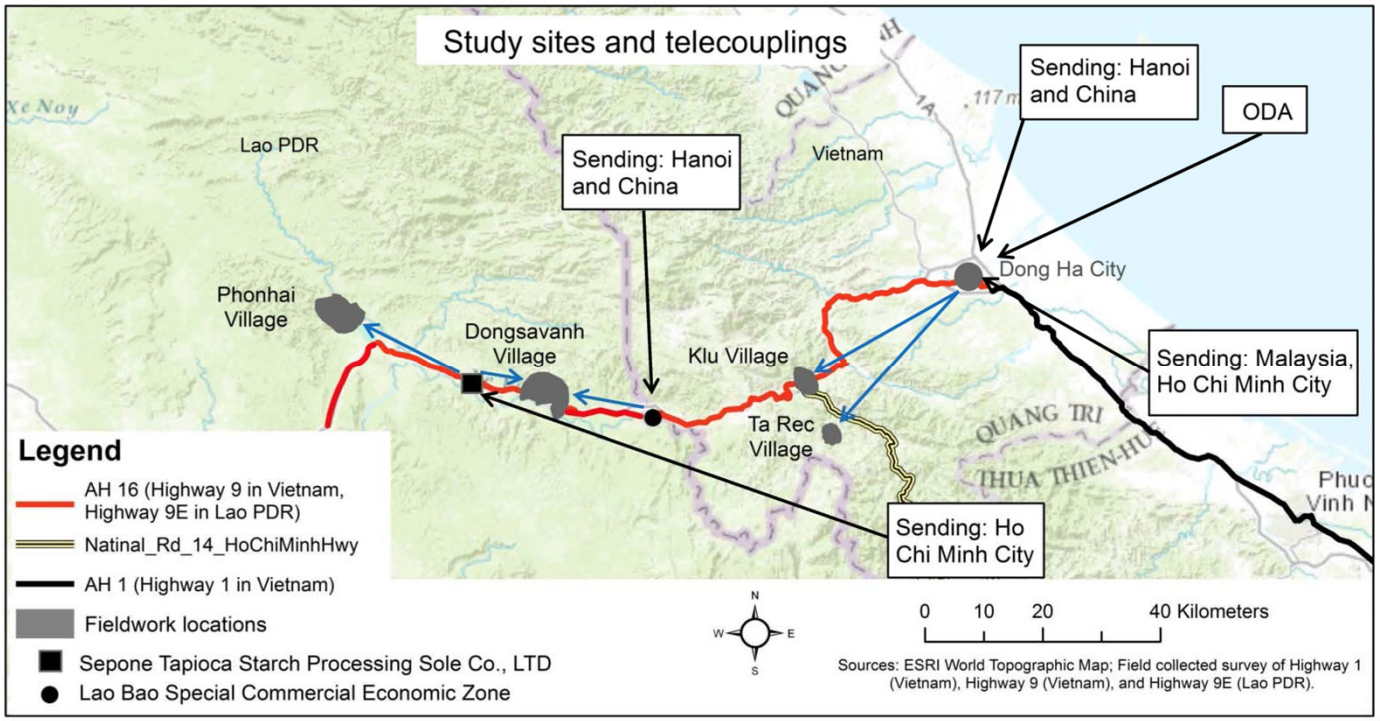
Discussion: Telecoupling

- Corridor urban to villages



Global and regional scale telecouplings driving changes in Vietnam and eastern Savannakhet

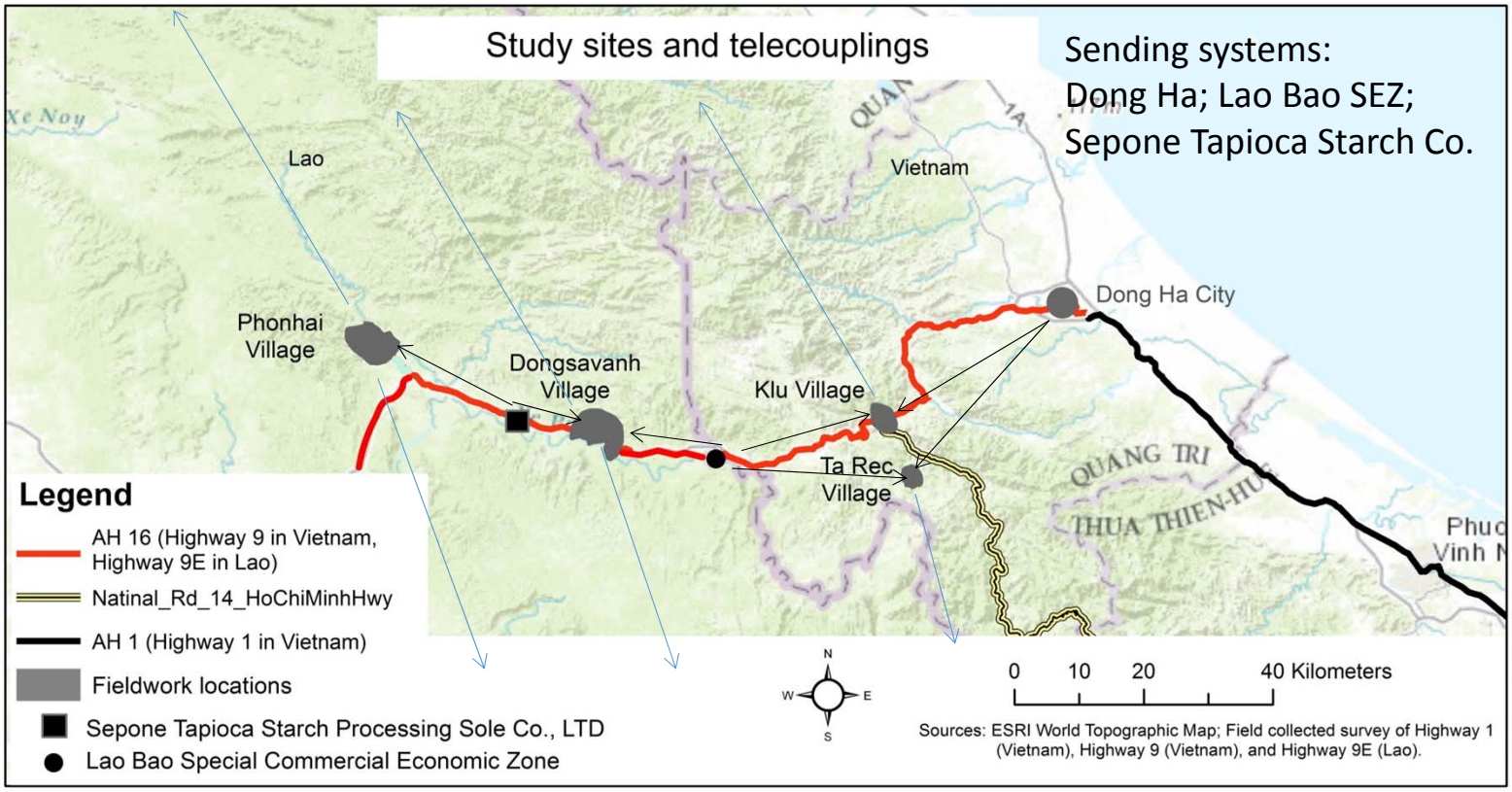
- Initial causes: policy and finance
- Sending systems are outside the EWEC
- Receiving systems are the urban areas and industrial zones within the EWEC
- Spillover systems are the villages which change land-use practices (and consequently land-cover) to respond to receiving systems' demand for products (e.g. cassava, softwood trees, bananas)



- Flows: capital, information, people, goods, ecosystem services, etc.
- Effects: livelihood changes, land-use changes, land-cover changes

Discussion: Local telecoupling within the EWEC – from urban to villages

- Initial causes: policy and finance
- Sending systems are within the EWEC
- Receiving systems are the villages within the EWEC
- Spillover systems are villages outside the EWEC which the receiving villages directly and indirectly compete with
- Flows: money, information, people, goods, ecosystem services, etc.



- Effects: livelihood changes, land-use changes, land-cover changes

Case Study Conclusions

- Land-cover/Land-use changes are complicated in the corridor
  - Evidence of both decreasing tree cover (mainly in urban areas, some upland areas) and increasing tree cover (planted, not natural forest)
  - Evidence of changes in upland field placement and agricultural crop growing; and evidence of changing fallow patterns
- Urban forms are being found in rural areas – changes in human settlements, land-use patterns and also human livelihood systems
- Changes are happening across three countries
  - Thailand changes are most advanced; Laos least advanced
- Improved road networks and improved connectivity in general, and the telecouplings enabled by these, are found across multiple scales within the corridor ranging from the global to regional to local (village to village) levels. These are at the base of the land use and land cover transitions and changes that are observed.

Overall Conclusions

- Road networks (local and regional) and (other) improved connectivity (international) are drivers:
  - Of land-use and land-cover changes in both rural and urban areas
  - In rural areas
    - If a “frontier” situation (initially low population), the literature points to improved road networks leading to deforestation and expanded agriculture
    - If an already populated rural area there are
      - Changes in crops (e.g. subsistence/food crops to cash crops)
      - Changes in spatial patterns of how land is used
      - Increased tree cover (increased forest area?)
      - Increased built-up areas
  - Urban areas
    - Urban expansion and urban infilling

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I would like to thank the many officials who participated in our interviews and patiently discussed the land-use/cover and system changes they are seeing, and also the villagers who allowed us to stay in their villages, answered our questions, and guided us through the research process.

Thank you