Urban-Rural Teleconnections within borders and across borders: The case of Vietnam and Laos within the East-West Economic Corridor

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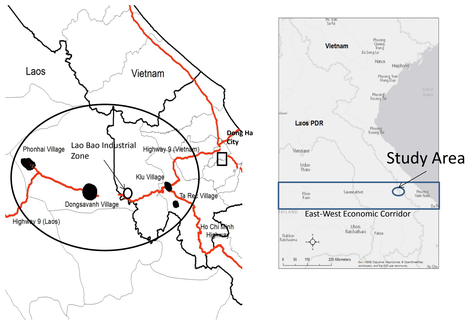
Aim of this research:

Address the following questions:

(1) What are the land-cover/land use changes taking place in the urban and rural communities of the East-West Economic Corridor (EWEC) along the Laos/Vietnam border?
(2) What are the drivers of these changes?
(3) Is there evidence of urban-rural teleconnections on both sides of the border?

Introduction: The Study Area – Quang Tri Province, Vietnam; Savannakhet Province, Laos



Methods

Socio-economic and historical data collection

Urban: Semi-structured interviews with officials from the City's, District's and Province's People's Committee, Department of Planning and Investment, Department of Environment, Department of Agriculture and Rural Development, and Department of Foreign Investment. Focus: economic growth over the past twenty years, development plans, historical growth patterns, growth of the economy by sector (agriculture, industry, and service), demographic growth, and foreign investment.

Villages: Semi-structured interviews, historical interviews, focus group interviews, transect walks, and participatory village mapping were carried out in each village. Focus: livelihood activities, farming activities, demographic information, and land-use information. Sketch map of each village detailing land use / land covers in each village, village boundary measurement. Transects were walked to collect ground truth points, observe and record land-cover/use, validate sketch maps.

Satellite Image Interpretation

Landsat TM, ETM+, and OLI high level surface reflectance data for the years 1991, 1996, 2002, 2004, 2006, 2007, 2010, and 2014 for the Vietnamese villages and for Dong Ha City.; and 1988, 1994, 1998, 2003, 2008, 2009, and 2014 for the Laos villages . Scenes were downloaded for the months of March-July in order to best identify swidden agriculture fields that are cleared and burned between February and April. The Normalized Difference Vegetation Index (NDVI) and the Normalized Burn Ratio (NBR) were calculated for each scene. A stack of 16 near cloud-free satellite layers (8 dates, 1 NBR and 1 NDVI per date) for the Vietnamese and 14 near cloud-free satellite layers (7 dates, 1 NBR and 1 NDVI per date) for the Laos villages corresponding with the aforementioned years were successfully identified and utilized for analysis.

A binary study area mask of each village (based on village boundaries) was created. Using this binary mask to limit the study area, an unsupervised ISODATA classification was carried out in ENVI utilizing the 16 or 14 layer stack. The input settings for the unsupervised classification were: 50 classes, 2 percent change threshold, and 25 iterations. The resulting unsupervised classification was interpreted using the temporal NBR and NDVI signatures of each output class to identify trends in land cover change and in conjunction with fieldwork the land use changes. Interpretations were supplemented by ground truth data collected during fieldwork, Google Earth historical imagery, and true color Landsat images. Classes that included swidden agriculture (i.e. slash and burned areas) were the primary focus for this interpretation, but other land cover changes linked with infrastructural expansion were also detected in these classes.

Urban area change analysis was done using the TM, ETM+ and OLI images for Vietnam. Thresholding of the NDVI output for each year was done to separate areas where new building had taken place in and around Dong Ha City. The output was validated against ground truth points collected during fieldwork, interview data from city officials, and Google Earth historical imagery.

Results and Discussion

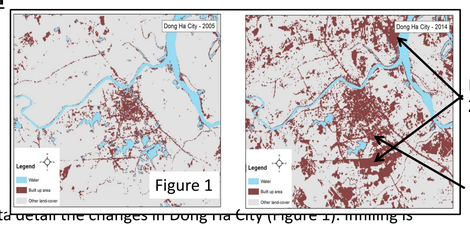


Figure 1

Industrial Zones

New government offices

Urban changes:

Analysis of the Landsat TM data detail the changes in Dong Ha City (Figure 1). Infilling is taking place in the core of the city, while new urban growth is extending the city area to the south and northeast. Drivers of change include: (1) domestic and foreign investment in new industries (cassava starch factories, wood processing factories) in industrial zones south and northeast of the city center; (2) Government services; (3) the domestic real estate market; [(4) ultimately demand for starch and wood products from China and Malaysia.]

Rural changes

Klu village's livelihood system revolves around swidden / fallow rice. In 2010/11 hybrid cassava production for the cassava factory in Dong Ha started. Hybrid cassava production concentrated near the newly improved Highway 9. Overall cultivated field area expanded. After initial increase, upland cultivation further from the road decreased and acacia trees were introduced into those fallow areas (Table 1 and Figure 2).

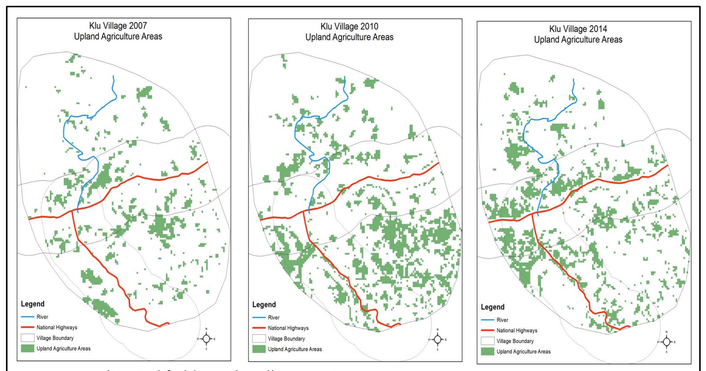


Figure 2. Cultivated fields in Klu Village, Vietnam.

Drivers of change:
1) Hybrid cassava production for the starch factory in Dong Ha City
2) Introduction of acacia trees for the wood processing factory in Dong Ha City
3) Improved market connections via Highway 9

Table 1

Year	Cleared land for upland agriculture (in square meters)	Cleared land for upland agriculture within 600m of both Highway 9 and the Ho Chi Minh Highway (in square meters)	Percent of agriculture land near roads
1996	857700	240300	28%
2002	1225800	195300	16%
2004	1695600	221400	13%
2006	1398600	522900	47%
2007	1398600	512100	47%
2010	2635200	504000	34%
2014	2290500	920700	51%

Note: roads were upgraded/built in 2006/7

Ta Rec village's livelihood system revolves around swidden / fallow rice production, small areas of maize production, and small areas of irrigated rice. Villagers started producing maize, cassava, and acacia trees for the market after being connected via a new bridge and secondary road to the Ho Chi Minh Hwy after 2007. In 2010/11 hybrid cassava production for the cassava factory in Dong Ha started. Fields near roads were expanded for hybrid cassava production. Overall cultivated fields expanded in the village. Acacia trees have been planted in fallow areas. Figure 3 shows the distribution of areas cleared for agriculture and Table 2 shows the area of upland crops.

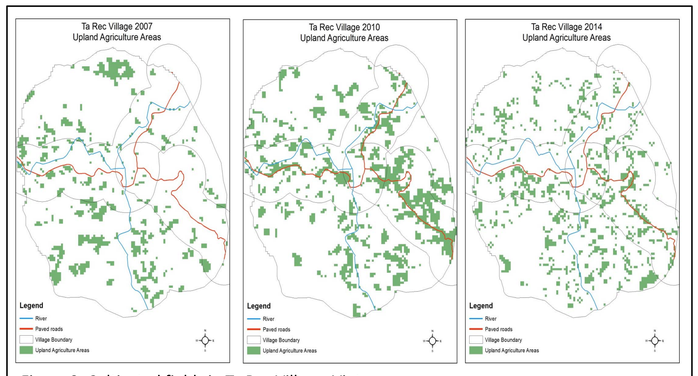


Figure 3. Cultivated fields in Ta Rec Village, Vietnam.

Table 2

Year	Cleared land for upland agriculture (in square meters)	Cleared land for upland agriculture within 350m of secondary roads in the village (in square meters)	Percent of agriculture land near roads
1996	279000	77400	28%
2002	442800	220500	50%
2004	609300	235800	39%
2006	624600	264600	42%
2007	521100	102600	20%
2010	1054800	576900	55%
2014	892800	427500	48%

Note: roads were upgraded/built after 2007

Drivers of change:
1) Introduction of hybrid cassava production for the starch factory in Dong Ha City
2) Introduction of acacia trees for the wood processing factory in Dong Ha City
3) Improved market connections via secondary roads

Dongsavanh village's livelihood system is based in swidden/fallow cultivation of rice. National Highway 9E runs through the middle of the village and upgraded in 2007 as part of the EWEC project; border crossing protocols were simplified at the same time. In 2010/11 Information about the demand for cassava from the starch factory in Dong Ha City, Vietnam, and for bananas from the food processing factories in the Lao Bao (Vietnam) industrial zone reached villagers. Villagers started growing hybrid cassava and bananas to sell to these factories.

Table 3 shows the year to year changes in the upland agriculture fields and Figure 4 shows the spatial distribution of these fields. Analysis shows a large increase in land cleared for agriculture after road improvement consistent with what is seen in Vietnam. However, there is no clear signal of preference for growing crops near roads as there is in the Vietnamese cases. The 2014 data show a large decrease in land cleared for agriculture, which is consistent with large areas of bananas being planted in 2009. [Once planted, new banana plants sprout to replace old ones that have been harvested; the field does not need to be slashed and burned again. Thus, 2014 having the lowest area of cleared land for agriculture since 1994 is consistent with the integration of bananas as a large scale crop.]

Table 3

Year	Cleared land for upland agriculture (in square meters)	Cleared land for upland agriculture within 600m of National Highway 9 (in square meters)	Percent of agriculture land near roads
1994	2,145,600	588600	27%
1998	4,759,200	1050300	22%
2003	4,112,100	1106100	27%
2008	5,572,800	942300	17%
2009	5,380,200	1508400	28%
2014	3,242,700	668700	21%

Note: roads upgraded in 2007

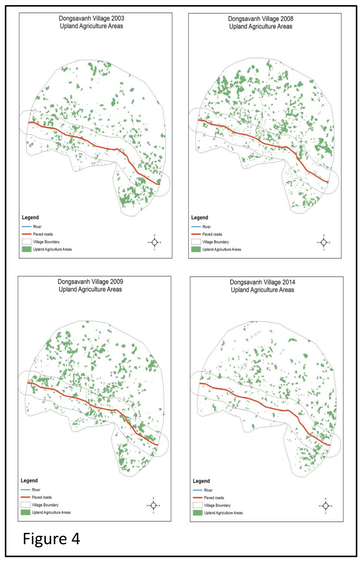


Figure 4

Drivers of change:
1) Introduction of bananas for sale to the factories in Lao Bao
2) Introduction of cassava for sale to the starch processing factory in Dong Ha City
3) Improved market and cross-border connections via Highway 9

Phonhai village's livelihood system is similar to Dongsavanh's system. A secondary road runs through the village in a northwest-southeast direction, connecting the village with Highway 9. As part of the EWEC project this road was upgraded in 2010 and a bridge was built across the major river in the village connecting the village to a previously little used road running east to Vietnam. With improved road access, Vietnamese cattle traders visit the village and purchase local cattle to sell in Vietnam and villagers have expanded cattle raising. New agricultural land clearing in the eastern part of the village is used to grow hybrid cassava. Figure 5 shows the spatial distribution of the upland agricultural fields. Table 4 shows the amount of area cleared yearly for upland fields. Similar to the other villages, upland agriculture fields expanded after road and bridge improvements.

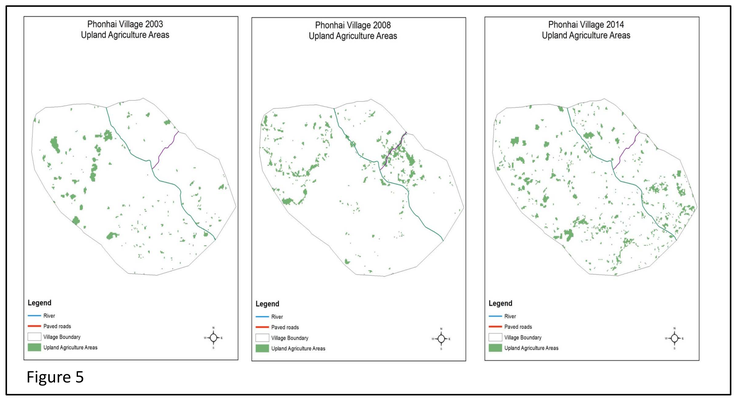


Figure 5

Table 4

Year	Cleared land for upland agriculture (in square meters)	Cleared land for upland agriculture within 600m of National Highway 9 (in square meters)	Percent of agriculture land near roads
1994	2,135,700	244800	11%
1998	3,516,300	600300	17%
2003	1,143,000	216900	19%
2008	1,512,000	496800	33%
2009	2,427,300	642600	26%
2014	2,183,400	504000	23%

Note: road and bridges upgraded and built in 2010

Drivers of change:
1) Cattle buyers / demand for cattle from Vietnam
2) Introduction of cassava for the starch processing factory in Dong Ha City
3) Improved market and cross-border connections via secondary roads

Conclusions

1) Agricultural land use/cover patterns have changd in Klu, Ta Rec, and Dongsavanh;
2) In Ta Rec and Klu there is evidence that upland agriculture fields are being concentrated in close proximity to roads, with possible expansion of tree cover in areas distant from roads;
3) Livelihood systems have changed towards a market orientation in all villages;
4) Drivers in all cases are ultimately demand from urban areas in Vietnam and industrial demand from Vietnam, China, and Malaysia
5) There is evidence of urban-rural and cross-border teleconnections, facilitated by the East-West Economic Corridor road improvements and simplified border protocols.