Changing Farming Systems in Montane Mainland Southeast Asia, Environmental Impacts, Resiliency, and Climate Change

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Abstract

Historically swidden farming systems have been the dominant land use in Montane Mainland Southeast Asia (MMSEA). These systems, whether nomadic or sedentary, make use of the natural resource base in such a way as to provide resiliency to local livelihood systems that buffer people from periodic shocks, such as extreme climatic events, that the region experiences. These farming systems have sometimes been considered primarily subsistence in nature, but recent research (Leisz 2007, Vien et al. 2007) suggests that MMSEA's swidden systems can be integrated into commercial systems and have the capacity to adapt to changing circumstances. However, since at least the late 1800s governments in the area have promoted policies whose aim is to stop swidden from being practiced (Leisz 2007, Rerkasem et al. submitted). These policies have multiplied in the last three decades and swidden systems are increasingly being replaced with plantation systems (tree and field crop based) and/or sedentary, high input, farming systems that feature decreased fallow periods or permanently cultivated field crops (Fox and Vogler 2005, Xu et al. 2005, Leisz et al. 2005, Padoch et al., 2007, Leisz et al. 2007). This presentation examines how swidden systems are changing in one part of the MMSEA, Vietnam's northern mountain region (NMR), and the projected future changes in this region. It examines issues related to swidden's impact on the environment, projected impacts of the replacement systems and the implications for the regions resiliency in the face of projected climate changes. Findings suggest that replacement systems have more negative impacts on the environment than traditional swidden systems and may limit the resiliency of the regions agricultural production systems.

Environmental Impact of Swidden Systems

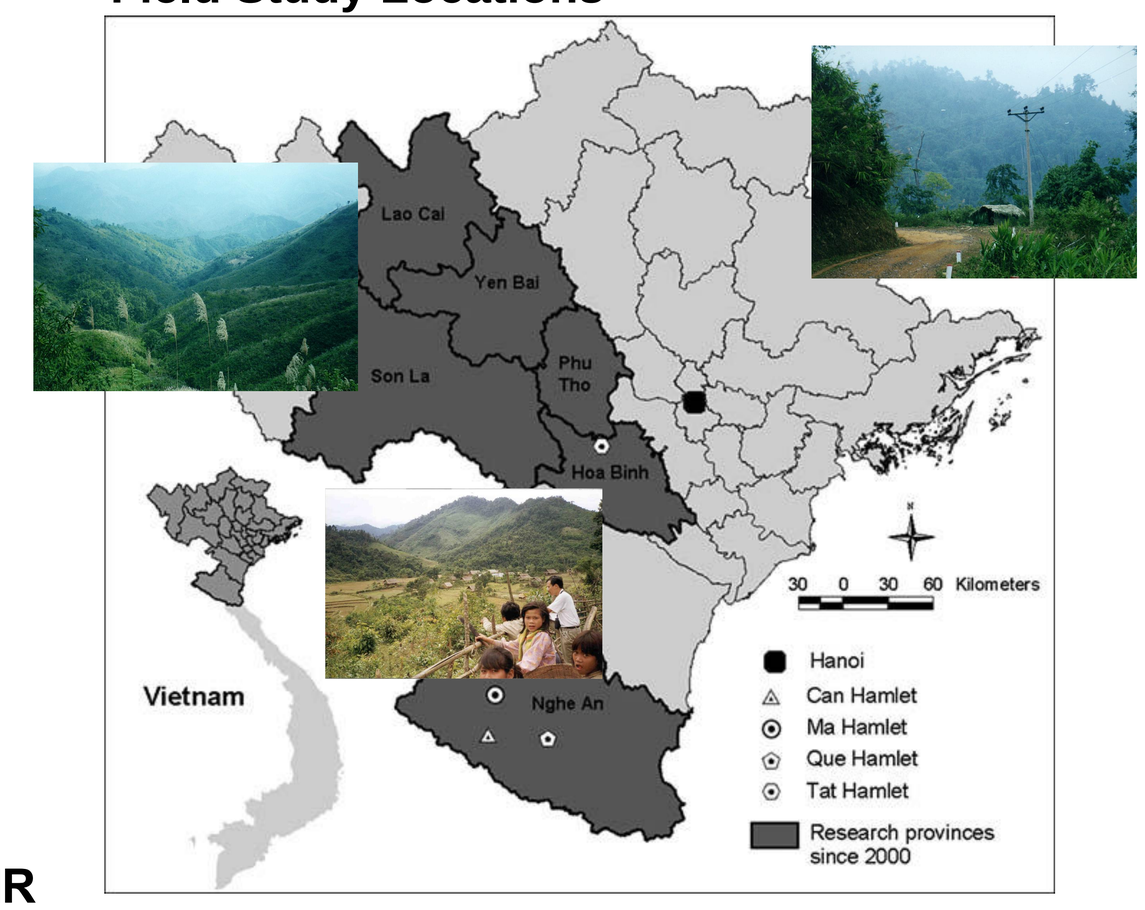
Hydrological impacts (Valentin et al. 2008, Ziegler et al. submitted)
- Constant movement of fields limit impacts to localized area
- Vegetation between fields and streams limit stream sedimentation
- Quick regrowth of secondary vegetation limits impact on infiltration and decreases landslide potential

Agrobiodiversity (Rerkasem et al. submitted)
- High crop diversity
- High wild biodiversity in fallow phase (comparable to primary forest)

Carbon Storage and soil quality (Bruun et al. submitted, Jepsen 2006)
- Time averaged aboveground carbon neutral (15% - 45% of non-logged primary forest)
- Soil Organic Carbon (SOC) levels unaffected by swiddening

System Resiliency (Leisz 2007)
- High. Components of system can be adapted to outside pressures
- Products provided by system are diverse and act as a buffer to outside pressures

Field Study Locations



Projected Farming System Changes in Vietnam's NMR

Change trajectory	Hydrological Impacts (1)	Agrobiodiversity Impacts	Carbon Storage Impacts (2)	Resiliency
Swidden -> permanent hillside agriculture (high input maize systems)	Runoff ↑ Sedimentation ↑ Water quality ↓ Landslide ↑	Crop diversity ↓ Wild biodiversity ↓	97-99% aboveground ↓ 20-40% SOC ↓	To extreme climatic events ↓ Livelihood system ↓
Swidden -> fruit tree plantations	Water quality ↓ Road runoff ↑	Crop diversity ↓ Wild biodiversity ↓	25% SOC ↓ Aboveground not known	Livelihood system ↓ To external shock ↓
Swidden -> rubber plantations	Water quality ↓ Road runoff ↑	Crop diversity ↓ Wild biodiversity ↓	SOC = to swidden or ↓ Aboveground not known	Livelihood system ↓ To external shock ↓
Swidden -> timber plantations (eucalyptus, pine)	Runoff ↑	Crop diversity ↓ Wild biodiversity ↓	SOC 30% ↓ Aboveground not known	Livelihood system ↓ To external shock ↓

(1)Runoff increases due to increased soil compaction; water quality decreases due to increased use of pesticides and chemical fertilizers; road runoff increases due to increased road building associated with these systems. (2) Sources are: Bruun et al. submitted, Sommer et al. 2000, Tanaka 2009, Noguchi 2003, Richards et al. 2007.

Climate Change in the NMR of Vietnam and Farming System Change

IPCC (2007) projects that for SE Asia annual temperatures will increase 2.5^{o} C, but will be higher over the MMSEA; annual rainfall will increase 7% ; and extreme, warm and wet, events will increase on an annual basis by 100% and 44% respectively. These are regional predictions, but predictions for mountainous areas are harder to make and there is less confidence for these areas. The noted changes suggest that farming systems with resiliency built into them will help local populations protect their food and livelihood security. Indications are that the farming system transition going on in the NMR of Vietnam, and the MMSEA, is leading to systems that are less diverse in their makeup and less resilient to environmental changes. Furthermore, they are environmentally more destructive than the traditional systems, while not being overall more productive, further decreasing their resiliency in the face of future climatic variability and changes.

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References

Bruun, T, Neergaard, A, Lawrence, D, Ziegler, A (submitted). Environmental consequences of the demise of swidden agriculture in SE Asia: Carbon storage and soil quality, *Human Ecology*.
Fox, J, Vogler, J (2005). Land-use and land-cover change in Montane Mainland Southeast Asia. *Environmental Management* 36:394-403.
Jepsen, M (2006). Above-ground carbon stocks in tropical fallows, Sarawak, Malaysia. *Forest Ecology and Management* 225: 287-295.
Leisz, S (2007). Reinterpreting the Uplands of Vietnam: Towards Understanding and Correcting a Misreading of its Land Cover, Land Use, and Resource Management Systems. PhD Dissertation. University of Copenhagen.
Leisz, S, Rasmussen, K, Olesen, J, Vien, T, Elberling, B, Jacobsen, J, Christiansen, L (2007). The impacts of local farming system development trajectories on greenhouse gas emissions in the northern mountains of Vietnam. *Regional Environmental Change* 7(4): 187-208.
Leisz, S, Ha, N, Yen, N, Lam, N, Vien, T (2005). Developing a methodology for identifying, mapping and potentially monitoring the distribution of general farming system types in Vietnam's northern mountain region. *Agricultural Systems* 85: 340-363.
Noguchi, S, Kasran, S, Yosup, Z, Tsuboyama, Y, Tani, M (2003). Depth and physical properties of soil in a forest and a rubber plantation in peninsular Malaysia. *Journal of tropical forest science* 15: 513-530.
Padoch, C, Coffey, K, Mertz, O, Leisz, S, Fox, J, Wadley, R (2007). The Demise of Swidden in Southeast Asia? Local Realities and Regional Ambiguities. *Danish Journal of Geography* 107(10): 29-42.
Rerkasem, K, Lawrence D., Padoch, C (submitted). Consequences of swidden transitions for crop and fallow biodiversity. *Human Ecology.*
Richards, A., Dalal, R., Schmidt, S (2007). Soil carbon turnover and sequestration in native subtropical tree plantations. *Soil Biology and Biochemstry* 39: 2078-2090.
Sommer, R, Denich, M, Vlek, P (2000). Carbon storage and root penetration in deep soils under small-farmer land-use in the Eastern Amazon of no-tillage. *Agronomie* 22: 755-775.
Tanaka, S, et al. (2009). Soil characteristics under cash crop farming in upland areas of Sarawak, Malaysia. *Agriculture, Ecosystems and Environment* 129: 293-301.
Valentin, C, et al. (2008). Runoff and sediment losses from 27 upland catchments in SE Asia: Impact of land use changes and conservation practices. *Agriculture, Ecosystems and Environment* 128:225-238.
Vien, T, Leisz, S, Lam, N, Rambo, AT (2006). Using Traditional Swidden Agriculture to Enhance Rural Livelihoods in Vietnam's Uplands. *Mountain Research and Development* 26(3): 192-196.
Xu, JC, Fox, J, Vogler, J, Peifang, Z, Yongshou, F, Lixin, Y, Jie, Q, Leisz, S (2005). Land-use and land-cover and farmer vulnerability in Xishuangbanna Prefecture in southwestern China. *Environmental Management* 36: 404-413.
Ziegler, A, Bruun, T, Lawrence, D, Nguyen, T (submitted). Environmental consequences of the demise of swidden agriculture in Montane Mainland SE Asia: hydrology and geomorphology. *Human Ecology.*