Progress Report

Project Title: "Soils, Water, People and Pixels: A Study of Nang Rong"

PI: Ronald R. Rindfuss
University of North Carolina
919-966-7779
e-mail: Ron_Rindfuss@unc.edu

Date: February 2000

Progress is being made on all the major purposes of the grant. A major issue is the extent to which population growth negatively impacts land use. The empirical base on this critical issue is fairly weak because published studies have tended not to control for potential confounding factors. In a paper under review (Entwisle, et al., 1999), using data from social surveys, remotely sensed images, digitized maps, and associated spatial representations, we examine the effects of village size, density, and change on the cultivation of upland crops in Nang Rong, Thailand. The findings show a negligible effect of village size, a positive effect of change, and a negative effect for density of village settlement. Change in number of households is more important than change in size per se. Population effects are felt more at the margins than the center of village settlement.

Central to the study of deforestation and agricultural extensification is the necessity to capture landscape-level information across social, biophysical, and geographical domains, document the nature of LULC and LULCC through remote sensing systems, transform collected data across the thematic domains for cartographic compatibility, frame the research within landscape ecology principles that stress the interplay of scale-pattern-process, and examine landscape form and function through the use of pattern metrics operating within a scale dependent context. We have transformed discrete social survey data to be compatible with continuous environmental variables, assessed the composition and spatial organization of the landscape through pattern metrics, modeled the distribution of population across the landscape, and assessed the relationships between population and environment across a range of spatial scales. The results are reported in a series of papers and briefly summarized in the next two paragraphs.

The plots of canonical correlations for variables representing the social and biophysical domains show a realignment of variables and vectors with scale. The pattern metrics indicate that the landscape of the district has become more homogenous in the lowland, rice-producing sites and more fragmented in the cassava and sugar cane-producing, upland sites. In general, the landscape is being spatially organized through a complex set of population and environmental factors that are dynamic, multi-thematic, and scale dependent.

We find that both social and environmental variables (elevation, cultivated land, cultivated land per person, and total population) are related to plant biomass across spatial scales. However, other variables exhibit spatially dependent tendencies. Slope, for example, is only significant at medium to coarse resolutions. Most importantly, the combined power of population and

environment variables is strongly associated with scale, with the model explaining greater variance as scale increases. The statistical results indicate an "upland effect" associated with the site suitability for cassava. Cassava (and sugar cane to a lesser degree) was the primary crop linked to deforested land within the district. It is generally restricted to the higher elevations and the drier sites.

Weather data from Nang Rong and the surrounding region are being analyzed to determine its validity. An antecedent precipitation index was recently developed to provide a first order approximation of the soil moisture regime. Water budgets will be developed from the weather data in the coming months. In particular, soil and terrain information will be integrated with the weather data to produce a soil moisture surface across the study area. This surface will be developed over monthly increments during a 20-year period that includes the times in which social survey data were collected.

The riskiest component of our project was to see if we could differentiate between rice paddies that were transplanted and those that were planted by broadcasting seed by using remotely sensed data. Transplanting requires significantly more labor, but it also produces a higher yield. Thus being able to remotely detect which planting procedure is used would supply information on both labor needs and yields. This aspect of the project is risky, by our own estimation and the opinion of the reviewers, because rice paddies are small, neighboring paddies may have used different methods of planting, and cloud cover is heavy during the early part of the growing season. Fieldwork has been conducted to collect data on both broadcast and transplanted paddies. Work is now underway to use remotely sensed data to see if we can distinguish the two types of planting procedures and then check against our ground control data.

Finally, a significant strength of our streams of data for Nang Rong district, Thailand, is our ability to integrate them and cross-validate. In this project, the integration for our statistical analyses has been at the village level. Clearly, though, many land use decisions are made at the household level. We have been working, in preparation for the next round of social data collection (funded by NICHD, and not this NASA grant) to develop methods to collect field data for approximately 10,000 households that would permit linkages of that household to the fields it uses, and hence to our collection of remotely sensed images. The sheer size of the household survey presents severe logistical problems. Sufficient progress has been made such that we feel guardedly optimistic about this component of our spring/summer 2000 fieldwork. The ultimate success of this effort, of course, will not be known until after the field work.

PUBLICATIONS AND PAPERS RELATED TO THIS NASA GRANT

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S.J. Walsh, T. P. Evans, W.F. Welsh, R.R. Rindfuss, and B. Entwisle, 1998. Population and Environmental Characteristics Associated with Village Boundaries and Landuse/Landcover Patterns in Nang Rong District, Thailand. Proceedings, Pecora 13 Symposium, Human Interactions with the Environment: Perspectives from Space. American Society for Photogrammetry and Remote Sensing, Bethesda, Maryland {ISBN-1-57083-055-X[CD]}, 395-404.