Environmental degradation can inflict serious damage on poor people, because their livelihoods often depend on natural resource use, and their living conditions may offer little protection from pollution of the air, water and soil. At the same time, poverty-constrained options may induce the poor to deplete resources and degrade the environment at rates that are incompatible with long-term sustainability. In such cases, degraded resources may precipitate a downward spiral, by further reducing the income and livelihoods of the poor. This “poverty-environment nexus” has become a major issue in the recent literature on sustainable development. In regions where the nexus is significant, jointly addressing problems of poverty and environmental degradation may be more cost-effective than addressing them separately (World Bank 2002).

In this note, we use newly-available spatial and survey data to investigate the spatial dimension of the nexus in Lao PDR. Our data enable us to quantify several environmental problems at the provincial level. In a parallel exercise, we map the provincial distribution of poor households. Merging the geographic information on poverty and the environment, we search for the nexus using geo-referenced indicator maps and statistical analysis. While our results are certainly suggestive, we recognize that they represent only the first round of empirical work on this issue.
Future research using higher-resolution data may reveal different, more local dimensions of the nexus in Lao PDR and elsewhere. Nevertheless, the current analysis can suggest a geographic focus for further, more detailed work.

**Mapping Poverty**

We begin the analysis by mapping poverty at the province level. From a welfare perspective, we believe that the size of the poverty population in each area is a better guide for policy than the incidence of poverty.3 Accordingly, we index provinces by the number of inhabitants who fall below the international norm for absolute poverty.4

**Mapping Environmental Problems**

We consider four critical environmental problems, two related to natural resource degradation and two to pollution. The “Green” problems are deforestation and fragile land, while the “Brown” problems are indoor air pollution and contaminated water.

**Deforestation**

The rate of deforestation serves as a proxy for the loss of critical ecosystems and biodiversity, as well as the increased risk of soil erosion in steeply-sloped areas. To see whether deforestation is particularly severe in areas with large poverty populations, we map the rate of deforestation in Lao PDR during the 1990s). Where significant forest areas remain, we assess the spatial correlation of poverty and deforestation using maps, rank correlation coefficients, and regressions. For the country as a whole, our findings suggest that priority areas for poverty alleviation and forest protection are weakly related (Figure 3). At the regional level, however, different patterns emerge. In the north, with a large poverty population, deforestation is high in a relatively small forested area. The south, by contrast, has a large poverty population, relatively extensive forests, and relatively low rates of deforestation. This leads one to believe that there are other driving factors relating to deforestation and the northern poor, and should be the focus of further investigation.

**Fragile Lands**

Steep hillsides under intensive cultivation are particularly vulnerable to erosion and soil degradation and, in any case, the economic return to farming steeply-sloped areas is generally lower than the return to cultivating alluvial soils in river valleys. If rural people are relatively free to migrate to areas with higher expected returns, then we would expect steeply-sloped areas to be more sparsely populated than alluvial plains. A very different picture emerges, however, if the poor are isolated in highland areas. In this case, rapid population growth, coupled with insufficient means or incentives to intensify production, may induce over-exploitation of fragile lands on steep slopes. Degraded resources, in turn, may precipitate a ‘downward spiral’ by further reducing the income of the poor.

Figures 1 and 2 provide useful insights about population clustering on marginal lands in Lao PDR. Figure 2 shows that the northern and southeastern regions have extensive steeply-sloped areas. Comparison with Figure 1 suggests that the concentration of poor people on marginal (steeply-sloped) lands may be a major problem in the north, but not in the south. A recent Poverty Participatory Assessment traces this northern problem to cultural and ethnic issues (ADB, 2001). If marginalized ethnic groups are isolated in highland areas by a historical pattern of separation and discrimination, then population growth and soil degradation may well create a “poverty trap.” Figure 2 suggests the potential for this component of the poverty-environment nexus in northern Lao PDR. Analysis of higher-resolution data could help clarify the links among poverty, ethnicity, topography, land-clearing and soil quality in the northern highlands.

**Indoor Air Pollution**

Recent research has suggested that indoor air pollution from wood fuels is a major cause of respiratory disease in developing countries.6 Many households use wood or charcoal in Lao PDR, so indoor air pollution may be a significant health issue. Gauging the true magnitude of the problem will require household-level pollution monitoring and health assessment. In the absence of indoor air monitoring data, we attempt a preliminary estimate from household survey data on the use of wood fuel and charcoal.

The existence of a true poverty-environment nexus in this context depends on more intensive use of charcoal and wood fuel by poor households. In fact, this is strongly suggested by the high correlation ($\rho = 0.74$) between the province-level poverty population and the population using fuel wood or charcoal (Figure 3). Regression results further confirm that use of wood fuel and charcoal is far more prevalent among poor households than in the general population.7 This, together with the mountainous terrain of Northern Lao, a colder climate, and more indoor cooking, suggests that indoor air pollution may also be part of the poverty/environment nexus in Lao PDR.

**Access to Clean Water and Sanitation**

Safe water and adequate sanitation are critical determinants of health status, particularly for children. Ingestion of coliform bacteria from contaminated drinking water or food is a prime cause of diarrheal disease, which is in turn a major cause of infant mortality in developing countries. Although data remain limited in Southeast Asia, we use the available information to assess the spatial relationships linking poverty, sanitation and diarrheal disease in Lao PDR. At present, many households do not have access to safe
water or sanitation. A poverty/environment linkage may exist if the affected households are disproportionately poor.

Our results indicate a close spatial correlation between poverty and lack of access to clean water ($\bar{A} = 0.85$ in Figure 3). A similarly-positive, but somewhat weaker, relationship exists for lack of access to sanitation ($\bar{A} = 0.43$). Further, a strong relationship exists between poverty and diarrhea ($\bar{A} = 0.75$).

**Conclusions / Key findings**

Figure 4 summarizes the evidence on the poverty-environment nexus in Lao PDR. It suggests that a significant spatial nexus may exist in all four of our environmental dimensions: deforestation, fragile lands, indoor air pollution, and contaminated water. The potential problems appear to be greatest in the northern and northeastern regions of the country. For Lao PDR, our results therefore suggest that the welfare of the poor may be significantly enhanced by close integration of poverty-alleviation and environmental strategies. A geographic focus on the north would appear to be most beneficial.

The above discussion raises an important question of what causal reasons may be behind the coincidence of poverty and environmental degradation in some areas of Lao PDR. If there is a high degree of labor mobility, returns to the use of natural resources must still be high enough for poor people to remain in degraded regions rather than migrate to higher potential areas. In that case, one may presume that the poor contribute to—or even cause—degradation. Structural explanations, in contrast, would imply that it is the limited endowment of a region, and its lack of geographical capital, that has created a concentration of poverty. If labor mobility is limited, then poor people are caught in so-called spatial poverty traps, where the poor resource base contributes to or causes high incidence of poverty (Jalan and Ravallion 2002). To shed more light on these important issues, and to credibly separate cause from effect, would require detailed time series and household data that is currently not available for Lao PDR.

**References**


**Notes**

1. The spatial dimension is critical, because most environmental problems are inherently geographical in nature.

2. One should note that the conclusions from this analysis are applicable only at the provincial level. It is the intention of future research to test whether such claims can be held at other levels of aggregation, such as the district or sub-district level. To be more precise, the provincial unit of analysis here ranges from 3,500 to 21,000 km².

3. An extreme example will help clarify the underlying logic: Ten poor households might constitute the entire population of an isolated district, whose poverty incidence would therefore be 100 percent. On the other hand, one million poor households might represent no more than 40 percent of the population in a large urban area.

4. The poverty line for Lao PDR reflects a cost-of-basic-needs approach: (a) the food poverty line is anchored to an energy thresh-
ence soil vulnerability (for example, vegetative cover, rainfall erosivity, soil erodibility, lengths of uninterrupted slopes, and conservation measures).

6. See, for example, Ezzati and Kammen (2001).
7. For further details see Dasgupta et al. (2002).
8. Similar research has revealed very different patterns in Cambodia and Vietnam. See Dasgupta and others (2002).

Figure 3
Indicator correlation with poverty

Figure 4
Quartile ranking of poverty population and environmental

<table>
<thead>
<tr>
<th>Province</th>
<th>Poverty</th>
<th>Deforestation</th>
<th>Steep slopes</th>
<th>Wood/charcoal use</th>
<th>Unsafe water</th>
<th>No toilet</th>
<th>Diarrhea cases</th>
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5. It should be understood that steeply-sloped land is only one of many factors that influence soil vulnerability (for example, vegetative cover, rainfall erosivity, soil erodibility, lengths of uninterrupted slopes, and conservation measures).

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