

DEVELOPMENT EFFECTS ON PRIVATE FOREST MANAGEMENT: A CRITICAL LOOK AT THE EVIDENCE

Jeffrey D. Kline*

USDA Forest Service, Pacific Northwest Research Station

*jkline@fs.fed.us

Introduction

The timber production and ecological effects of forest land development are influenced by both the rate and spatial distribution of forest land development, and how remaining undeveloped forest lands are managed. Regarding effects on management, research conducted in the U.S. South and in Oregon suggests that development can reduce the intensity with which landowners manage remaining forest lands, potentially reducing forest commodity production and influencing ecological conditions and processes. Prevailing hypotheses suggest that this process results from: (1) the gradual fragmentation of forest land into smaller and less profitable management units; (2) related changes in the characteristics and management objectives of newer more urban-minded forest owners; (3) potential conflicts arising from conducting forestry in closer proximity to people; and (4) increasing uncertainty among remaining forest landowners regarding prospects for continued forestry in the future (Kline et al. 2004: 34-35).

Empirical evidence of these effects is limited to a few studies that show that population and building densities—proxies for development—tend to be negatively correlated with forest stocking, and the likelihood of pre-commercial thinning, harvesting, post-harvest replanting, and commercial management. However, some of these studies also suggest that in some locations these effects are minimal or absent altogether. Do such anomalies indicate that development does not always reduce forest management? A variety of factors likely influence landowners' forest management decisions in addition to encroaching development. Also, although forest advocates often focus on maintaining "working forests," how management influences the public goods characteristics of private forests,

also must be considered. Whether changes in forest management are of justifiable policy concern depends on their resulting effects on commodity production and ecological change at local, regional, and national scales, and how we as a society view those changes. I review research regarding development effects on private forest management with a focus on judging the policy-relevance of key findings.

The Studies

To my knowledge, empirical studies that have tested for potential correlations between private forest management and proxy variables representing development include Wear et al. (1999), Munn et al. (2002)—both conducted in the southeastern US—Kline et al. (2004) conducted in western Oregon, and Kline and Azuma (2007) conducted in eastern Oregon (Table 1). The four studies differ in the forestry behaviors each examined and the data used to characterize development. However, all four studies were conducted with the objective of examining the degree to which private forest landowners conduct particular forestry activities.

Wear et al. (1999) used expert opinion to test whether population density—their proxy for development—was negatively correlated with the location of commercial timberland in five Virginia counties. Field foresters were provided with county-level forest maps and asked to identify those forest lands they felt were managed as commercial forests. The maps were combined with forest inventory data from the USDA Forest Service's Forest Inventory and Analysis program and population densities reported from the US Census. Regression analysis indicated that the likelihood that forest lands were identified as being managed as commercial forests was found to be nega-

Table 1. Studies That Used Secondary Data to Examine Correlation Between Development and Private Forest Management

Study	Location	Source of forestry data	Evidence of forest management	Development variables examined	Statistically significant
Wear et al. (1999)	Five Virginia counties	Expert opinion	Commercial forestry	Population density	Yes
Munn et al. (2002) ¹	Alabama and Mississippi	Forest Inventory and Analysis ²	Harvest	Population density	Yes
				Proximity to cities	Yes
				Contiguous forest area	Yes
Kline et al. (2004)	Western Oregon	Forest Inventory and Analysis ²	Stocking	Building density	Yes
			Harvest		No
			Pre-commercial thinning		Yes
			Post-harvest planting		Yes
Kline and Azuma (2007)	Eastern Oregon	Forest Inventory and Analysis ²	Stocking	Building density	No
			Harvest		No
			Pre-commercial thinning		No
			Post-harvest planting		No

¹ A fifth study—Barlow et al. (1998)—is cited by Munn et al. (2002) as their pilot study and so is not listed.

² The USDA Forest Service's Forest Inventory and Analysis program conducts periodic inventories of the nation's forest resources.

tively correlated with population density, with predicted likelihood declining from 87% at zero people per square mile to 0% at 170 people per square mile. At 45 people per square mile, results indicated that the likelihood that private lands were managed as commercial forests was 50%. The study is frequently cited by forest advocates as evidence that development and forest fragmentation lead to declines in working forests.

Munn et al. (2002) combined Forest Inventory and Analysis plot-level data describing harvest activities and other forest characteristics in Mississippi and Alabama with US Census population densities. Additional development variables described the distances of forest stands to urbanized areas and the contiguity of stands with surrounding forest lands. Regression analysis indicated that the likelihood that forest owners harvest timber was negatively correlated with population density and positively correlated with forest contiguity. Results regarding urban proximity indicated that harvest likelihood increased with greater distance from urban areas up to 50 to 60 miles, at which point harvest likelihood declined with greater distance. The results support the general conclusion that harvest likelihood generally declines with development.

Building on these studies, Kline et al. (2004) combined Forest Inventory and Analysis plot-level data describing forest stocking (basal area), pre-commercial thinning, harvest, and post-harvest tree planting, with stand and site characteristics, ownership, and building densities—their proxy for development. Building density (or structure count) data were obtained from aerial photographs. Regression analyses indicated no correlation between harvest likelihood and building density, but did indicate negative correlations between building density and forest stocking, pre-commercial thinning likelihood, and post-harvest planting likelihood. Taken together, their results support the general conclusion that forest land development may be reducing the intensity with which private forest landowners in western Oregon manage their forest lands, but that so far only a small proportion of lands had been affected (p. 41).

Most recently, Kline and Azuma (2007) acquired similar data for eastern Oregon and tested for development effects on private forestry there. They found no correlation between building density and forest stocking, and the likelihood with which private forest landowners pre-commercial thinned, harvested, or planted trees following harvest in eastern Oregon. Their results differed from those found by Kline et al. (2004) in western Oregon using virtually identical methods. Kline and Azuma (2007) concluded that their results suggested that either development effects on stocking, thinning, harvest, and post-harvest planting are not prevalent in eastern Oregon or they are not yet observable using available Forest Inventory and Analysis data.

However, in addition to finding no correlation between development and management variables on private lands in eastern Oregon, Kline and Azuma (2007) found generally weak empirical results describing management activities. Typically, in-

dicators of forest management such as stocking, and pre-commercial thinning, harvest, and post-harvest planting activities are assumed to be correlated with stand and site characteristics and landowners' management objectives. Kline et al. (2004) found generally robust correlations between these same indicators and stand age, basal area, site index, and slope in western Oregon, as did Munn et al. (2002) in their harvest analysis in Alabama and Mississippi. Lack of such correlations found by Kline and Azuma (2007) in eastern Oregon could owe to smaller sample sizes available there compared to those available to Kline et al. (2004) and to Munn et al. (2002). They also could indicate that in many places, even places where forest lands are prevalent and population densities are very low as in eastern Oregon, intensive forestry may not be a priority among private forest landowners.

Together, the four studies do provide some empirical evidence that development may reduce the intensity with which private landowners manage their forest lands for commodity production. However, as the results of Kline and Azuma (2007) suggest, these effects are not universal. Eastern Oregon is among the least densely populated places in the continental US, comprises over 3 million acres of private forest land, yet little of that forest land seems to be intensively managed. Private forest management is not influenced by development alone. Rather, a variety of factors likely enter landowners' decision making regarding how they manage their forest lands. Inherent site productivity, location relative to timber markets, and landowner interests and objectives, among other factors, all influence how well the forestry opportunities landowners face compare with other land use opportunities that may not involve eventual harvest. A closer look at individual studies—their empirical results and the characteristics of study areas—provides greater nuance to their general conclusions.

A Closer Look

The forest characteristics prevalent within individual study areas can be important factors in reconciling differing conclusions among studies. For example, the typically dry eastern forest lands examined by Kline and Azuma (2007) differ substantially from the western forest lands examined by Kline et al. (2004). These differences might tend to influence the ways in which private landowners manage their forest lands. Lower average site indices (and lower inherent site productivity) on eastern Oregon forest lands compared to those in western Oregon likely inspire less intensive private management among eastern Oregon forest landowners generally. At a landscape scale, timberland—the most productive forest land—accounts for 70% of the forest land in eastern Oregon versus 90% of forest land in western Oregon. Forest stocking rates (basal areas) found in eastern Oregon also tend to be lower than in western Oregon, likely providing less incentive for pre-commercial thinning. Likewise, post-harvest stocking rates in eastern Oregon tend to be higher than post-harvest stocking rates in western Oregon, providing less incentive for post-harvest tree planting. Lastly, lower average building densities found on eastern Oregon forest lands relative to those found in western Oregon

provide fewer opportunities to observe the potential effects of development on private forestry.

Similarly, the lack of any development effect on harvest found by Kline et al. (2004) in western Oregon could reflect the relatively low building densities found in forested locations there generally, relative to population densities that may exist in forested locations in Alabama and Mississippi examined by Munn et al. (2002). Further analysis could test this. Western Oregon still comprises vast areas of both public and private forest land and relatively little development. Although the forest management decisions of some private forest landowners in Oregon are motivated in part by amenity values, which can dampen some landowners' interests in harvesting (Kline et al. 2000), the sheer quantity of forest land in the region may mean that the marginal utilities of landowners for the amenity characteristics of standing timber may be less than like marginal utilities of landowners in the southeastern US, even in the most densely populated forested locations in Oregon. When private forest landowners in western Oregon have possessed standing merchantable timber, they have tended to harvest. As one of the most productive timber-growing regions in the world, standing timber often possesses significant financial value. Such factors offer potential explanations for the differing empirical results regarding harvest found by Kline et al. (2004) and by Munn et al. (2002):

Another factor to consider when comparing results from different studies is what different results imply for forest policy. The empirical results of Munn et al. (2002), for example, suggest that population density, urban proximity, and forest fragmentation all tend to reduce harvest likelihood among private forest landowners, because the estimated regression coefficients for those explanatory variables were found to be statistically significant. However, the magnitudes of those relationships also are important to assessing whether the adverse effects of development on management should matter to policymakers. Visual examination of the estimated empirical relationship between population density and harvest likelihood, for example, reveals fairly flat lines (Figure 1). Predicted intermediate harvest likelihood declines from 21% at zero people per square mile to 17% at 170 people per square mile, while predicted final harvest likelihood declines from 10% to 8%. Does the magnitude (slope) of this decline mean that policymakers should advocate funding incentive programs to increase, say, intermediate harvest likelihood among forest landowners in the most populated locations from 17% to 21% on par with forest landowners in the least populated locations? It is a question policymakers must consider. Many of the empirical relationships found by Kline et al. (2004) also are fairly flat when viewed in light of projected building density increases (see Kline and Alig 2005).

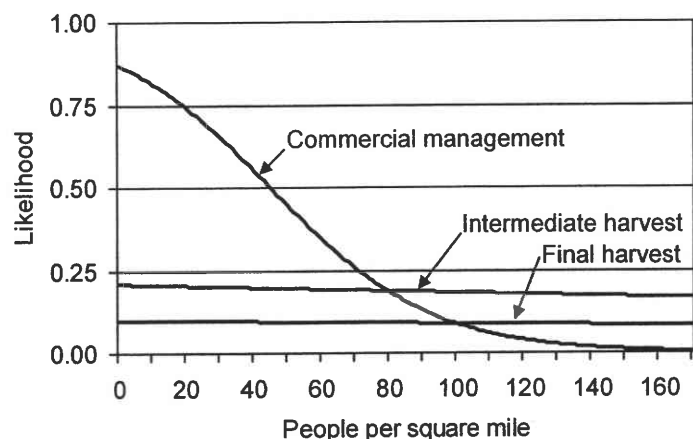
Lastly, it is necessary to consider the temporal context of studies. For example, many forest advocates view the negative correlation between population density and commercial management found by Wear et al. (1999) as evidence that

development is reducing the likelihood that forest landowners maintain "working forests." Indeed, the five-county study area did experience rather significant population growth, from 36 to 58 people per square mile between 1970 and 1990. However, as far back as 1910 area-wide population already was fairly high at 37 people per square mile—the point where an estimated 58% of forest land would be commercially managed (Figure). But agricultural census data indicate that in 1910 most (91%) land in those counties was in agriculture and it remained largely agricultural until about the 1950s when rapid farm abandonment occurred. By 1992—the date of land cover data used by Wear et al. (1999)—agricultural lands comprised just 32% of all land in the study area. However, former agricultural lands would not necessarily have gone immediately into forest. Rather, abandoned farmland simply would not have been reported in the agricultural census; it may have sat for years before growing trees. This land use history suggests that a significant proportion of study area land may have had little long-term legacy of commercial forest management. Although these lands likely were becoming more fragmented by population growth and development, their agricultural legacy suggests that they probably were fairly fragmented by past farming. This, in part, could account for a lack of commercial management observed in more populated locations.

Conclusions and Policy Implications

Studies suggest that population growth, development, and forest fragmentation are correlated with reduced forestry activities. Researchers and policymakers must carefully weigh the policy-relevant implications of such results. Whether such relationships alone justify significant public policy concern depends on the spatial and temporal context of changes affecting forestry in given locations. There is a tendency to advocate open space protection by declaring a need to protect "working lands." By generating revenue for landowners working forests arguably ensure that continued forest cover better competes with other land use opportunities faced by landowners, such as development. From a public goods perspective, however, it may not always pay to have forests working. If working means, say,

Figure 1. Population Density and Predicted Commercial Management (Wear et al. 1999) and Harvest (Munn et al. 2002) Likelihood



intensive plantation forestry, many people may actually prefer forests that are not working. Habitual concern about whether forests are working, and about whether population growth, development, and fragmentation are creating forests that are not working, avoids having to consider broader public preferences regarding forest conservation and management. The influence of socioeconomic change on private forestry and in turn national timber supplies and ecosystem conditions and processes justifiably is of significant public policy concern. However, we must not lose sight of the fact that forests need not always be managed for eventual harvest to generate value for landowners and the public. Too myopic a focus on the working lands concept risks marginalizing the broader implications these studies have regarding the provision of public goods from private forest lands.

References

- Barlow, S.A., I.A. Munn, D.A. Cleaves, and D.L. Evans. 1998. The effect of urban sprawl on timber harvesting. *Journal of Forestry* 96:10-14.
- Kline, J.D. and R.J. Alig. 2005. Forest land development and private forestry with examples from Oregon (USA). *Forest Policy and Economics* 7(5):709-720.
- Kline, J.D., R.J. Alig, and R.L. Johnson. 2000. Fostering the production of nontimber services among forest owners with heterogeneous objectives. *Forest Science* 46(2):302-311.
- Kline, J.D. and D.L. Azuma. 2007. Evaluating forest land development effects on private forestry in eastern Oregon. Res. pap. PNW-RP-572. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 18 p.
- Kline, J.D., D.L. Azuma, and R.J. Alig. 2004. Population growth, urban expansion, and private forestry in western Oregon. *Forest Science* 50(1):33-43.
- Munn, I.A., S.A. Barlow, D.L. Evans, and D. Cleaves. 2002. Urbanization's impact on timber harvesting in the south central United States. *Journal of Environmental Management* 64:65-76.
- Wear, D.N., R. Lui, J.M. Foreman, and R. Sheffield. 1999. The effects of population growth on timber management and inventories in Virginia. *Forest Ecology and Management* 118:107-115.