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Forestland development and private forestry with examples from Oregon (USA)

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Abstract

Growing human populations inevitably lead to the conversion of some forestlands to more intensive developed uses. Resulting landscape changes can influence long-term timber production possibilities, and affect the quantity and quality of wildlife habitat, outdoor recreation and open spaces that contribute to people's quality of life. Anticipating the potential effects of forestland development can be important to formulating management and policy strategies that balance the multiple demands of society regarding land for development, resource production, and environmental protection. Previous research conducted in western Oregon has: 1) examined factors related to historical forestland development and projected future development; and 2) examined effects of forestland development on private forest management and investment activities. We briefly review these previous research efforts, and combine their resulting data and models to examine what projected forestland development might mean for private forestry in western Oregon over the next 50 years. The analysis draws together a broad body of recent research focused on western Oregon, to provide a context for discussing forestland development issues and their management and policy implications for the U.S. and abroad.

Keywords: Forestland development; Private forestry; Land use; Wildland/urban interface

1. Introduction

Forest managers and policymakers increasingly are involved with the interdependency of socioeconomic trends and changing forest landscapes. In our market-based economy, increasing human populations and incomes, people's life-style choices (household sizes and second homes, for example), and other socioeconomic factors inevitably lead to greater demands for residential, commercial, and industrial building sites, and the conversion of some forestlands to developed uses. Resulting landscape changes can effect changes in forest goods and services that are valued by society, including long-term timber production, wildlife habitat, recreation, and open spaces that contribute to people's quality of life. Current socioeconomic trends are likely to continue for the foreseeable future. Forest managers and policymakers increasingly will need to identify and evaluate

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relationships between socioeconomic trends and landscape change, to balance the changing demands of society regarding land for development, resource production, and environmental protection. Part of that process will involve anticipating the effects of forestland development on forest management and resulting landscape conditions.

Forestland development has been a persistent issue for managers and policymakers in western Oregon, where forests comprise 80% of the land area (Azuma et al., 2002a) and the population has grown by 73% since 1970 (Office of Economic Analysis, 1997). Although southern states are providing a larger share of U.S. timber harvests–64% in 2001 compared to 47% in 1976 (Smith et al., 2004)–the Pacific Northwest (Oregon and Washington) remains a major timber-producing region, with annual timber production averaging 50 million m^3 for the past decade (Haynes, 2003). Pacific Northwest forests also are home to several threatened and endangered species, including spotted owls (*Strix occidentalis caurina*), marbled Murrelets (*Brachyramphus marmoratus*), and coho salmon (*Oncorhynchus kisutch*), as well as several other species of recreational value to hunters and anglers. Oregon is known for its outdoor amenities and Oregonians often cite natural beauty and recreation opportunities as the attributes they most value about living in the state (Oregon Business Council, 1993). Maintaining these characteristics in western Oregon could be a challenge—its population, concentrated largely in the Willamette Valley extending from Portland to Eugene, is expected to grow by another 43% by 2040 (Office of Economic Analysis, 1997).

Previous research conducted in western Oregon has: 1) examined factors related to historical forestland development and projected future development; and 2) examined forestland development effects on private forest management activities. This existing research provides a unique opportunity to examine what projected trends in population and forestland development imply about the future of private forestry in western Oregon, a region known worldwide for its productive forests. We combine data and models from these previous studies to examine what projected forestland development might mean for private forestry in western Oregon over the next 50 years. We use an existing empirical model to project forestland development through 2054. These projections are combined with existing empirical models describing forest stocking, precommercial thinning, and postharvest replanting, to evaluate the degree to which private forestry might be affected by development in future years. The analysis combines extensive recent research focused on western Oregon, to provide a context for discussing the management and policy implications of forestland development for the U.S. and abroad.

2. A national context for examining forestland development

Regionally for Oregon and Washington, forestland area declined by 1.1 million hectares (ha) (5%) from 1952 to 2002 (Smith et al., 2004), and these changes reflect national trends. For the U.S., three million ha of forestland were converted to other uses from 1952 to 2002. Although some converted forestland is cleared for cropland, pasture, and range, the most common end use is development (United States Department of Agriculture Natural Resources Conservation Service [USDA NRCS], 2000). Most forestland development occurs on land owned by nonindustrial private forest (NIPF) owners. NIPF owners control the most U.S. timberland–58% (118 million ha) of the total–and in the Pacific Northwest often own land that is critical to threatened and endangered species, such as lowlands or riparian areas (Bettinger and Alig, 1996). Forestland development brings more people living in closer proximity to remaining forestlands. Population densities on forestland have not been regularly tracked over time until recent work of Hammer et al. (2004) for the north central U.S. Based on nationwide rural–urban continuum classes defined by Butler and Beale (1993), 13% of U.S. forestland now is located in major metropolitan counties and 17% in intermediate and small metropolitan counties and large towns, together comprising 30% of all U.S. forestland (Smith et al., 2004, p. 47).

The issues that forestland development raise for managers and policymakers can be broadly defined as: 1) supply-side issues—how development affects the supply of market and nonmarket forest goods and services; and 2) demand-side issues—how development changes society's demands for forest goods and services. Supply-side concerns largely focus on how development might reduce commercial timber production (Barlow et al., 1998; Wear et al., 1999). These effects are thought to result from a reduced timberland base and diseconomies imposed by parcelization that breaks up large forest parcels into smaller parcels for development (Mehmood and Zhang, 2001), conflicts with nontimber producing neighbors, and wildfire risks in forest–urban settings (USDA Forest Service, 1995). Other supply-side concerns focus on development's role in landscape change-direct habitat loss, forest fragmentation, and changes in forest structure caused by changing forest management (Munn et al., 2002), which can affect the ecological, aesthetic, and recreation services provided by forests.

Demand-side concerns largely focus on potential changes in society's demands and attitudes regarding forests and their management. Increasing urbanization of the U.S. population, coupled with gradual development and crowding of remaining forest landscapes, conceivably increases people's marginal utility for the ever more scarce opens spaces that provide recreation and environmental amenities and enhance quality of life. These changes can result in shifting demands for nonmarket forest goods and services, and political pressure in favor of greater regulation of forestry practices (Egan and Luloff, 2000). DeCoster (2000, p. 3) suggests that many of the problems development may create for forestry–higher land prices, higher taxes, greater regulation–extend far in advance of actual development, raising the opportunity costs of rural land uses in favor of development.

Contemporary forestland development concerns are similar to those cited in the U.S. since the 1970s about farmland development—that development creates diseconomies for remaining family farms, through parcelization, conflicts with nonfarming neighbors, higher per acre production costs, higher land prices, and higher opportunity costs (Sorensen et al., 1997). Those concerns were bolstered by public desire to protect rural environmental amenities unique to farmlands (Gardner, 1977) and led to numerous public efforts to save farmland where it was declining. Since then, population and urban growth throughout the U.S. has made loss of rural lands a nationwide rather than regional land-use policy issue as exemplified, for example, by the federal farmland preservation program (NRCS, 1996) and the smart-growth movement (Young, 1995). That forest policy concerns now echo the traditional themes of farmland loss suggests the degree to which development has encroached on forest landscapes in recent years, adding to long-standing concerns about farmland development.

3. Building density and forestry data for western Oregon

Forestland development concerns among managers and policymakers in western Oregon center on maintaining timber production and habitat by limiting parcelization and fragmentation of forest landscapes (Azuma et al., 2002b). To examine these issues, the Oregon Department of Forestry and the USDA Forest Service's Forest Inventory and Analysis (FIA) program gathered detailed land-use data depicting building densities on private land in western Oregon in 1974, 1982, and 1994 (Azuma et al., 2002b). The data consist of photo point observations of building counts–number of buildings of any size or type within 32- and 259-ha circles surrounding pin pricks on aerial photographs–on nonfederal land for the 19 counties in Oregon west of the crest of the Cascade Mountain Ranges. A portion of the observations were located to coincide with existing FIA field plots (Azuma et al., 2002a) so that building density data could be merged with historical FIA field plot data describing forest conditions and management. Together, the data can be used to examine the degree to which forestry activities might vary by building densities over the time period spanned by the data.

The spatial distribution of buildings across forest and agricultural lands in western Oregon suggests that development historically has affected forestlands at relatively low-densities of below 25 buildings per square kilometer (km) (Fig. 1). This is likely due, in part, to the steep slopes and poor road access that characterize much of the forestland in the region, as well as the greater distance forestlands are from major cities of the Willamette Valley relative to agricultural lands. From 1974 to 1994, forestland comprising 0 to 6 buildings per square kilometer decreased from 97% to 93% of total forestland, while forestland comprising building densities of 7 to 25 buildings per square kilometer increased from 3% to 6% and forestland

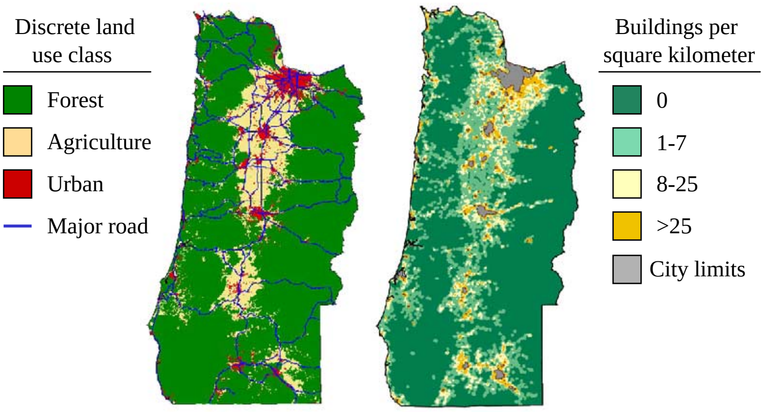

Fig. 1. Western Oregon land uses and building densities, 1994.

comprising building densities greater than 25 buildings per square kilometer increased from <0.5% to 1%. Previous research has used the building density and forestry data to: 1) create negative binomial models describing changes in building densities and project future building densities; and 2) estimate empirical models that test for potential negative correlations between building densities and forest stocking, precommercial thinning, harvesting, and postharvest replanting. We build upon this work by entering projected future building densities into the estimated forest stocking, precommercial thinning, harvesting, and postharvest replanting models, to examine how much these activities might be reduced in the future by continued forestland development.

4. Future forestland development

Building density data (Azuma et al., 2002b) were used to estimate a negative binomial model describing changes in building counts within 32-ha circles from 1974 to 1994, as a function of prevailing development pressures, existing building densities, slope, elevation, and land-use zoning. Development pressures were represented in the model using a gravity index describing the location of land relative to cities of varying sizes, as a proxy for commuting opportunities offered by land in different locations. The models were used to project future building densities based on projected populations (Office of Economic Analysis, 1997) for cities included in the gravity index computation. Technical details regarding the model and projections are reported in Kline (2003). The building density projections show how future development might be distributed across forest landscapes if past development rates and patterns continue.

Projected future development for western Oregon suggests relatively low to moderate growth in urban lands, largely at the expense of agricultural lands (Fig. 2). Major private land uses in 1994 included 2.9 million ha of forestland, 786,000 ha of agricultural land, and 314,000 ha of mixed forest and agricultural land, totaling four million ha of relatively undeveloped rural land (Azuma et al., 2002b). Building density projections suggest that by 2024, 71,000 ha of that rural land (about 2%) will be developed to urban uses comprising greater than 259 buildings per square kilometer (Kline, 2003, Table 4). Most development (46,000 ha) is projected to occur on agricultural lands. By 2054, projections suggest another 142,000 ha of

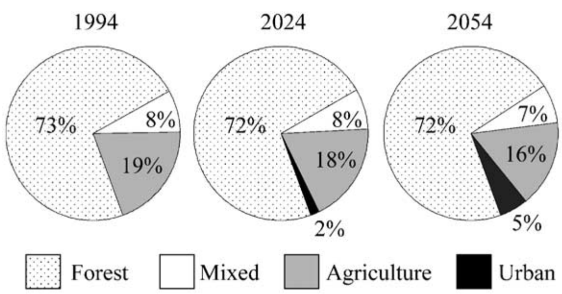

Fig. 2. Projected composition of private forest and farmland in western Oregon, 1994 to 2054 (Kline, 2003).

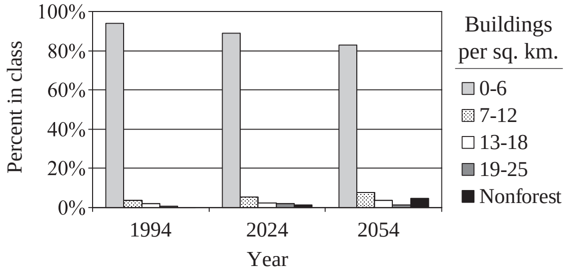

Fig. 3. Timberland by projected building density class, western Oregon, 1994 to 2054.

rural land (3%) will be developed, again comprising mostly (96,000 ha) agricultural lands. Projections suggest that by 2054, just over 1% of the 1994 forestland base will be developed; 18% for agricultural. Although projections suggest that a relatively significant amount of forestland will be developed–15,000 ha by 2024, another 28,000 ha by 2054–these changes are less significant in percentage terms, reducing forestland from 73% to 72% of the private rural land base, relative to the decline in agricultural lands from 19% to 16% (Fig. 2).

Building density projections do indicate additional development of forest and agricultural lands at relatively low densities below urban use thresholds. Of the four million ha of forest and agricultural lands reported for 1994 (Azuma et al., 2002b), over 2% comprised building densities of greater than 25 buildings per square kilometer. Projections suggest this will increase to 4% by 2024 and to 8% by 2054 (Kline, 2003). These numbers do not count low-density development below 25 buildings per square kilometer. Twenty-five buildings per square kilometer roughly is consistent with an average forest parcel size of four ha per building (house), which in Oregon is the minimum parcel size eligible for preferential assessment as forestland for property tax purposes (Oregon Department of Revenue, 1998). Because Oregon no longer views land below the 4-ha parcel size as forest for tax purposes, from a policy perspective we consider it as nonforest.

4.1. Future development by timberland and ownership characteristics

Building density projections computed for FIA field plots suggest that development is likely to affect types of forestlands differently, depending on its timber and ownership characteristics. In percentage terms, forestland development likely will affect the most productive timberlands to a lesser degree than less productive other forestland. About 94% of forestlands in western Oregon are classified as timberland–capable of annually growing at least 1.4 m^3 per ha of industrial wood–while 6% are classified as other forestland (Azuma et al., 2002a). In 1994, nearly all timberland (94%) comprised building densities of 6 buildings per square kilometer or less (Fig. 3). Projections suggest that significant proportions of timberland will still comprise such low building densities in the future—89% in 2024 and 83% in 2054. Building densities on other forestland were relatively higher in 1994–86% comprised 6 buildings per square kilometer or less–and projections suggest that the proportion will decrease rather significantly, to 73% by 2024 and 60% by 2054.

Although land classified as other forestland represents a relatively small proportion of the forestland base, it likely will bear a greater share of future forestland development. One possible reason for this is that other forestlands tend to be characterized by oak savannah, common along the edges of the Willamette Valley, where most development in western Oregon is expected to occur. Timberlands tend to be located more distant from the Valley, on steeper slopes, in less accessible areas of the Coast and Cascade Ranges, which limits their economic potential for most developed uses. Greater earning potential from timber production and limited accessibility to growing cities of the Willamette Valley are two factors that counter development pressures on timberlands in western Oregon now and in the future.

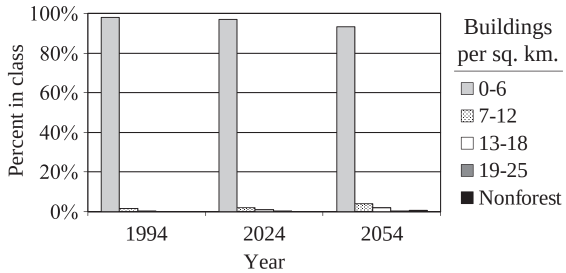

Fig. 4. Industrial private forestland by projected building density class, western Oregon, 1994 to 2054.

Future forestland development also is more likely to affect NIPF-owned lands than industrial forestlands. Industrial forestlands are owned by companies growing timber for industrial uses including those with and without wood processing facilities; NIPF lands are owned by farmers, Native American groups, and other private owners (Azuma et al., 2002a). Building density data for FIA field plots suggest that in 1994 almost all industrial forestlands (98%) comprised building densities of 6 buildings per square kilometer or less (Fig. 4). Building density projections suggest that industrial forestlands will continue to comprise such low building densities in the future—97% in the 2024 and 93% by 2054. NIPF lands, on the other hand, already comprised higher building densities in 1994, with 83% having 6 buildings per square kilometer or less (Fig. 5), and projections suggesting that the proportion will decline to 68% by 2024 and 55% by 2054. Projections suggest that by 2054, 14% of NIPF land reported in 1994 will comprise greater than 25 buildings per square kilometer, while less than 1% of industrial forestland will comprise such densities.

Research in the U.S. and Europe suggests that NIPF owners are motivated by aesthetics, recreation, and other nontimber objectives in addition to timber production (Newman and Wear, 1993; Kuuluvainen et al., 1996). Nontimber objectives have been found among NIPF owners in western Oregon, and are correlated with lower harvest rates and willingness to forego harvesting to improve wildlife habitat (Kline et al., 2000). NIPF owner characteristics imply that future forestland development concentrated mostly on NIPF lands will somewhat limit any adverse effects for timber production in western Oregon, because commercially productive industrial lands will remain relatively unaffected. However, because many NIPF owners' nontimber objectives include ecological protection, future development could affect those forestlands whose owners may be most willing to pursue ecological protection or enhancement efforts.

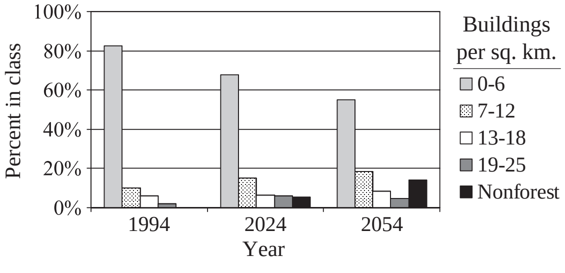

Fig. 5. Non-industrial private forestland by projected building density class, western Oregon, 1994 to 2054.

5. Effects of forestland development on private forestry

Building counts within 259-ha circles (Azuma et al., 2002b) and forestry data for FIA field plots for 1974 to 1994 were used to examine the potential effects of forestland development on the forest management and investment of private forestland owners in western Oregon (Kline et al., 2004). Empirical models were created describing forest stocking, precommercial thinning, harvesting, and tree planting following harvest, as functions of stand and site characteristics, ownership, and building densities. Results suggest that when there is standing merchantable timber, private forest owners in western Oregon have tended to harvest that timber—the likelihood of harvest has not varied with increasing building densities. Results, however, also suggest that investment in forest management, as represented by precommercial thinning, and replanting following harvest, does appear to diminish as building densities increase. The results support the general conclusion that forestland development is correlated with reduced forest management and investment on private forestlands in western Oregon from 1974 to 1994.

To examine what projected forestland development might mean for private forestry in the future, the forest stocking, precommercial thinning, and postharvest replanting models were used to compute future basal areas, and the likelihood of precommercial thinning and postharvest replanting, based on projected building density values estimated for 1994, 2024, and 2054 (Kline, 2003). All independent variable values included in each empirical model were held constant, with the exceptions being those variables that are themselves functions of building density. To the extent that the FIA field plots on which the models were based represent private forestland in western Oregon, the projections suggest the degree to which forest stocking, and precommercial thinning and postharvest replanting rates estimated for 1994, would be reduced by projected forestland development in future years. Results, however, would vary if future forestland development differs substantially from that projected.

5.1. Forest stocking

Generalized least squares regression was used to estimate an empirical model describing average basal area per acre (a proxy for stocking) as a function of stand age, site index, NIPF ownership, and building density (Kline et al., 2004, Table 2). Building densities were found to have a negative effect on basal areas ($P<0.10$), though the magnitude of that effect was relatively small. For example, on average, a NIPF even-aged conifer stand, aged 35 years and having a site index of 100, will have a basal area of 22.9 m^2/ha if located in an area having zero buildings per square kilometer, but 21.3 m^2/ha if located in an area having 25 buildings per square kilometer (Fig. 6). Predicted values of the basal area models show how average basal areas computed for FIA field plots might vary by building density, after accounting for stand and site characteristics.

The basal area model for conifer and hardwood stands (Kline et al., 2004, Table 2, column 2) was used to compute basal areas for FIA field plots, based on projected building densities for 1994, 2024, and 2054 (Kline, 2003). The resulting predicted basal area values show how increasing building densities projected for 2024 and 2054 would reduce basal area values below their estimated 1994 levels, holding other factors constant. Predictions suggest that only a relatively small proportion of field plots would exhibit reduced basal areas owing to increased building densities (Fig. 7). Less than 3% of field plots would exhibit basal area reductions of 2 to 3% by 2024, and only 7% would exhibit such reductions by 2054. By 2054, only 1% of field plots would exhibit basal area reductions of greater than 3%. Meanwhile, by 2024, 2% of field plots would be developed to nonforest uses (attain building densities greater than 25 buildings per square kilometer); 5% by 2054. The relatively small effect that increasing building densities would have on basal areas suggests that by the time forest stocking is reduced by forestland development, that land likely will have already developed to a nonforest use. Thus, outright conversion may warrant greater concern than the relatively modest effects that future forestland development is likely to have in reducing forest stocking in western Oregon.

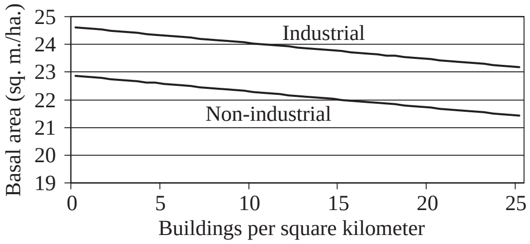

Fig. 6. Building density and basal area on private forestland. Note: For even-aged conifer stand, aged 35 years, site index = 100 (Kline et al., 2004).

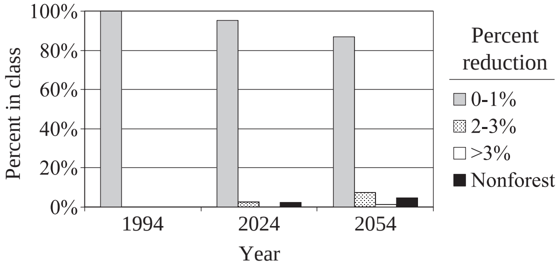

Fig. 7. Estimated reduction in 1994 basal area based on projected forestland development, western Oregon, 1994 to 2054.

5.2. Precommercial thinning

Probit models were estimated describing the likelihood that FIA field plots were precommercially thinned between the 1974 and 1984 inventories and between the 1984 and 1994 inventories, as a function of basal area, site index, slope, road access, NIPF ownership, and building density (Kline et al., 2004, Table 3). As with the forest stocking models, building densities were found to have a negative effect ($P<0.05$) on precommercial thinning likelihood. On average, a NIPF stand with a basal area of 16 m^2/ha, a site index of 100, and 30% slope will have a 7% likelihood of being recently precommercially thinned at any given FIA inventory if located in an area comprising zero buildings per square kilometer (Fig. 8). The same forest stand located in an area comprising 25 buildings per square kilometer will have almost no (0%) likelihood of being recently precommercially thinned. The precommercial thinning model estimated

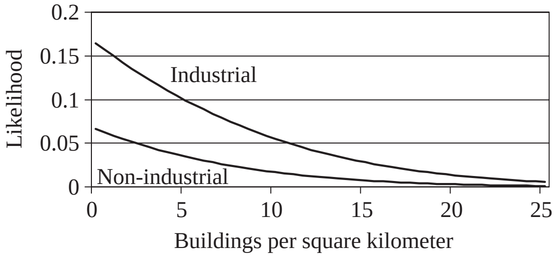

Fig. 8. Building density and precommercial thinning likelihood on private forestland. Note: For stand: basal area=16 m^2/ha, site index=100, slope=30% (Kline et al., 2004).

for even-aged forest stands (Kline et al., 2004, Table 3, column 3) was used to compute the likelihood that FIA field plots included in the model would be precommercially thinned, based on projected building densities for 1994, 2024, and 2054 (Kline, 2003).

Predicted values suggest that in 1994 a third (34%) of FIA field plots had a greater than 10% likelihood of having been recently precommercially thinned, a third (32%) had a likelihood of 3 to 10%, and a third (32%) had a likelihood of less than 3% (Fig. 9). Predictions suggest that by 2024, precommercial thinning likelihood will decline: 31% of plots will have a greater than 10% likelihood of being precommercially thinned, 35% will have a likelihood of 3 to 10%, and 32% will have a likelihood of less than 3%. By 2054, precommercial thinning likelihood will decline further: 28% of plots will have a greater than 10% likelihood, 32% will have a likelihood of 3 to 10%, and 25% will have a likelihood of less than 3%. Meanwhile, by 2024, 2% of FIA field plots will have been developed to nonforest uses; 5% by 2054. The predictions suggest that forestland development could lead to a moderate decline in private owners' investment in precommercial thinning prior to forestland's outright conversion to nonforest uses.

5.3. Planting following harvest

Probit models were estimated describing the likelihood that FIA field plots that had been harvested between successive FIA inventories had been replanted by the later inventory, as a function of postharvest basal area, site index, slope, road access, NIPF ownership, and building density (Kline et al., 2004, Table 5). Building densities were found to have a negative effect ($P<0.10$) on postharvest replanting likelihood for recently harvested field plots. On average, a NIPF stand with a postharvest basal area of 9 m^2/ha, a site index of 100, and 30% slope was found to have a 50% likelihood of having been planted by the FIA inventory following a harvest if located in an area comprising zero buildings per square kilometer (Fig. 10). The same forest stand located in an area comprising 25 buildings per square kilometer was found to have a 28% likelihood of having been replanted. The postharvest replanting model (Kline et al., 2004, Table 5, column 1) was used to compute the likelihood that recently harvested FIA field plots would be replanted, based on projected building densities for 1994, 2024, and 2054 (Kline, 2003).

Predicted values suggest that for the 1994 survey, 40% of recently harvested FIA field plots had a greater than 50% likelihood of being replanted, 26% had a likelihood of 25% to 50%, and 32% had a likelihood of less than 25% (Fig. 11). Predictions suggest relatively little change by 2024: 41% will have a greater than 50% likelihood of being replanted,

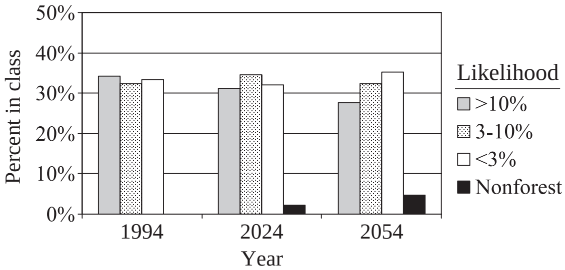

Fig. 9. Estimated precommercial thinning likelihood based on projected forestland development, western Oregon, 1994 to 2054.

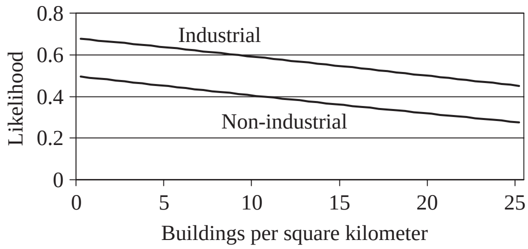

Fig. 10. Building density and planting likelihood following harvest on private forestland. Note: For stand: basal area=9 m^2/ha, site index=100, slope=30% (Kline et al., 2004).

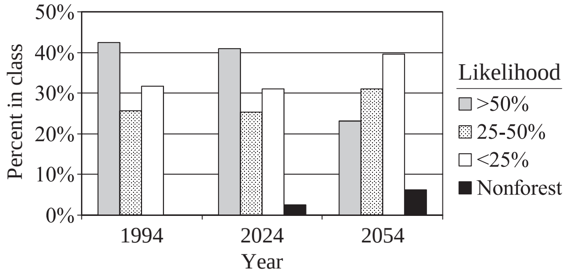

Fig. 11. Estimated planting likelihood following harvest based on projected forestland development, western Oregon, 1994 to 2054.

25% will have a likelihood of 25% to 50%, and 31% will have a likelihood of less than 25%. Predicted replanting likelihood declines more significantly by 2054: 23% of recently harvested plots will have a greater than 50% likelihood of being replanted, 31% will have a likelihood of 25% to 50%, and 40% will have a likelihood of less than 25%. Meanwhile, by 2024, 3% of recently harvested field plots will develop to nonforest uses; 6% by 2054. The predictions suggest that forestland development could result in moderate declines in private owners' investment in replanting following harvest in future years.

6. Discussion

Projected building densities and their potential effects on private forest management in western Oregon suggest that forestland development is likely to result in modest declines in forest stocking and precommercial thinning over the next 50 years, and greater declines in postharvest replanting. Coupled with the finding that harvest rates in western Oregon so far have been unaffected by increasing development (Kline et al., 2004), the results suggest that forestland development alone is unlikely to significantly reduce private timber production over the next 50 years. This is due mainly to the relative geographic isolation of the most productive timber- and industry-owned lands from locations where future development is most likely to occur. Projections suggest that relatively less productive other forest and NIPF-owned lands, and agricultural lands will experience greater development, due largely to their closer proximity to cities and transportation corridors. Factors other than forestland development could play a greater role in future western Oregon timber production, including national and international market forces, continued shift of domestic timber production to the U.S. south, changing public attitudes about forestry, and greater regulation of forestry practices.

Likely ecological effects of forestland development are less certain, largely because they have not been widely evaluated in the Pacific Northwest. Forestland development certainly will have some adverse ecological consequences, as some forest habitat is lost. Accompanying changes in landowners and their forest management objectives could bring both positive and negative changes in habitat conditions, through changes in forest structure, species composition, and succession. These effects are likely to be more prevalent on oak savannah, which tends to edge the Willamette Valley in greater proximity to expanding urban areas than does coniferous forest. Also uncertain are quality of life effects resulting from changes in forest recreation sites and environmental amenities. Although a relatively small proportion of forestland is likely to be developed, greater development of forest landscapes could reduce recreational access and the aesthetic characteristics of remaining forests. Such changes are more likely on forestlands located closest to existing urban areas, where most future development will take place and where those changes are likely to routinely affect the most people.

Our analysis has focused on western Oregon because of the land-use and forestry data available there. Although our results may not apply directly to other forest regions, general conclusions do emerge. First, the effects of forestland development are influenced not just by rates and patterns of population growth and development, but by geography, economics, inherent site productivity, and landowners, among other factors. Much of western Oregon's forestland is buffered from the effects of growth and development by its geographic isolation, steep slopes, and poor accessibility. Second, forestland development effects and the attention they warrant from managers and policymakers depend on the types of forestlands affected. Economic and ecological characteristics vary across the landscape, resulting in a range of implications that depend on the location and density at which development occurs. Timber production effects in western Oregon are minimized because the most productive forestlands and ownerships happen to be the least likely to be developed. Lastly, management and policy can influence only some of the factors involved in forestland development. Reduced property taxes and other financial incentives can help lower the opportunity costs of keeping land in forest. Cost-sharing and technical assistance for habitat enhancement and restoration can mitigate some ecological effects. Persistent, however, are the prevailing economic forces that accompany population growth–increased demand for housing, commercial and industrial sites, and public infrastructure–which exert strong pressures in land markets favoring development.

7. Management, policy, and research implications

Rural land development in the U.S. accelerated in the 1990s compared to earlier decades and projections indicate extensive new development through 2025 (Alig et al., 2004). Many states legislatures have considered smart growth policies and other measures to address urban sprawl. Despite such efforts, a larger population spread across a fixed land base will result in higher population densities on many forest landscapes. How much should forest policymakers and managers worry about forestland development? On the one hand, forestland development does seem to have some effect in reducing commercial timber production on some forestlands. This could be a concern for long-run national timber supplies. On the other hand, forestland development could simply be the workings of efficient land markets, enabling land to move from forestry into other uses in greater demand. There remains, however, the issue of what forestland development means for forest externalities–ecological benefits, environmental amenities, and outdoor recreation–that enhance quality of life.

In the late 1970s and early 1980s, national interest heightened about the loss of farmland to development, and the perceived threat posed for national food security, agricultural viability, environmental amenities, and open space. These concerns culminated with the National Agricultural Lands Study (1981) documenting rates of farmland loss and motivating the implementation of numerous state, and federal farmland preservation programs. Several economists at the time questioned whether farmland loss was a serious problem (Baden, 1984). Some noted that agricultural resources, such as productive soils, arguably are efficiently transacted in land markets, making public programs to protect them unnecessary (Gardner, 1977). As externalities, however, preserving environmental amenities and open space is justified, because land markets typically do not provide sufficient quantities of these. Appropriate policy responses must be carefully crafted to focus on those objectives. Perhaps a similar analysis raised in the context of forestry would help define appropriate policy and management responses to forestland development.

Accompanying our national concerns about forestland development is a need to examine the extent to which development is a real problem for forests and people. Beyond documenting forestland development, we must consider what these changes mean for the full range of market and nonmarket goods and services that forests provide, in light of our changing public attitudes and demands regarding forests. Although most timber and nontimber forest products produced on private forests are priced and transacted in markets, ecological benefits, environmental amenities, and often recreation opportunities are not. They share public goods traits that may warrant greater attention from forest managers, policymakers, and researchers than development effects on timber and other market-priced commodities.

We also must consider the role that public forestlands play in providing many forest benefits and influencing how private forestlands are managed. NIPF lands now are viewed as key complements to public lands in providing habitat for threatened and endangered species, as well as other environmental services. At the same time, reductions in federal timber harvests can increase market incentives for private forestland owners to manage and harvest timber. For public land managers, more people located on forest landscapes bring additional costs in managing additional recreational use. Homes located in forests complicate managing forests in fire-prone landscapes. Debate continues about the role that public forests should play in rural economic development based on traditional natural resource industries versus providing environmental amenities and open spaces that may spur other economic growth through recreation, tourism, and in-migration. The transition among western countries to more urban, postindustrial, and global societies is resulting in the emerging importance of the role of forests in broader socioeconomic and ecological systems (Kennedy et al., 2001). Just as 20 years ago concern about farmland loss called for resolving factors motivating public demand for preserving farmland to define appropriate farmland policy, there now may be a need for similar efforts in forestry. This includes defining the public goods and services that forests provide, evaluating their relative values to society, and identifying appropriate policy and management responses for addressing emerging concerns.

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