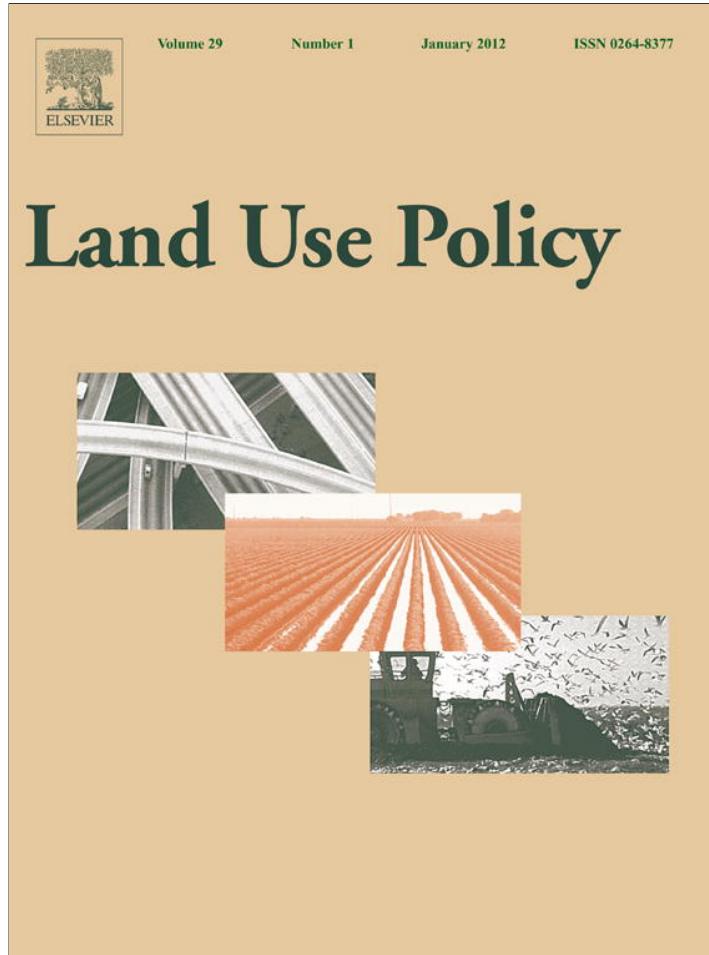


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## Predicting success incorporating conservation subdivisions into land use planning

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### ABSTRACT

Conservation subdivisions have emerged as a development option for communities wishing to conserve important ecological features and maintain rural character without decreasing housing density. Yet, these alternatives to conventional subdivisions rarely are used. We used logistic regression models to identify variables that predict county level success at adopting an ordinance and having a conservation subdivision built. Important predictors for adopting ordinances were median income, percent urban population, and a negative interaction between the two variables; important predictors for successfully completing a conservation subdivision were the adoption of an ordinance allowing conservation subdivisions and percent of residents with at least a four year college degree. Urban counties and the rural counties with higher median income were most successful adopting ordinances. Urban counties with higher education levels and an ordinance in place were most likely to have a conservation subdivision built within them. In poor rural counties, implementation may be more difficult because of limited resources to develop ordinances; these counties could collaborate with land trusts, other planning departments, or a regional council of governments to help lessen the financial burden associated with rewriting ordinances and implementing new land use practices.

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### Introduction

The expansion of metropolitan areas into the urban fringe presents a challenge for elected officials, city and county planners, and developers trying to manage growth in a way that maintains rural character and appeals to residents without limiting property rights of landowners (Beatley and Manning, 1997). Conventional residential development is characterized by low-density development that is automobile dependent, lacks central planning, and has segregated land uses (Kaplan et al., 2008; Brown, 2001). The changing land use patterns associated with substantial population growth and suburban development can negatively affect wildlife habitat and threaten ecosystems (Milder, 2007). Although several alternative neighborhood design strategies are available, developers may be hesitant to embrace novel approaches (SEMCOG, 2003; Bowman and Thompson, 2009).

Conservation subdivisions have emerged as a development option for communities that wish to conserve important ecological features, conserve open space, or maintain rural character and scenic views without compromising property rights (Arendt, 1999; Nelessen, 1994). Conservation subdivisions use a design strategy that attempts to conserve undivided tracts of land with important ecological features as communal open space (Arendt, 1996; Milder, 2007; Pejchar et al., 2007). In a conservation subdivision, ideally 50–70% of the buildable land is set aside as permanent open space by grouping or clustering homes on the portions of the land to be developed.

When compared to conventional homes in a similar housing market, conservation subdivisions offer environmental and economic benefits such as lower construction costs for developers and faster appreciation in market value (Arendt, 1996; Mohamed, 2006; Bowman and Thompson, 2009; Milder, 2007). Conservation subdivisions can decrease landscape fragmentation and help protect ecosystem services, including wildlife habitat, water quality, and aesthetic viewsheds (Elmendorf and Luloff, 1999; Lentz et al., 2006). If conservation developments are designed in conjunction with regional conservation efforts, open space in these developments can provide connectivity to other protected areas and benefit wildlife species that require larger tracts of intact habitat and connectivity between habitat patches (Hostetler and Drake, 2009;

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Odell et al., 2003). However, there are perceived risks for elected officials and developers that may impede integration of conservation subdivisions into land-use planning (Allen et al., 2012).

Despite their potential environmental and economic benefits, conservation subdivisions are an underused option (Vogt and Marans, 2004; Bowman and Thompson, 2009; Carter, 2009). Although natural amenities are important to some homebuyers, cost is a concern and interest in traditional amenities such as large lots and large homes remains prevalent (Vogt and Marans, 2004). In a 2002 national survey, community characteristics such as highway access, park areas, trails, and sidewalks were desired by 20% of homebuyers, whereas larger houses, larger lots, and less developed areas were desired by 40% of the recent homebuyers (National Association of Home Builders, 2002).

Some communities are more successful at implementing environmentally friendly land use practices such as conservation subdivisions than others, but the specific reasons behind that success are largely unknown. Our objectives were to determine: (1) what factors predict success at adopting conservation subdivision ordinances; and (2) what factors predict success at building a conservation subdivision. We used a survey of all 100 county planning departments in North Carolina to assess predictors of success adopting ordinances and success completing conservation subdivisions.

In North Carolina, the population growth rate averaged 16.6% statewide from 2000 to 2009 (U.S. Census Bureau, 2009). In 1997, farmland comprised 30% ( $38,222 \text{ km}^2$ ) of the total land area. By 2007, this number decreased to 27% ( $34,295 \text{ km}^2$ ), a loss of  $3926 \text{ km}^2$  in 10 years (U.S. Department of Agriculture, 2007). North Carolina's population grew by 16.6% to 9,222,414 between 2000 and 2009, and it was the eighth fastest growing state in the United States (U.S. Census Bureau, 2009). The state had a population density of 64 people per square kilometer and a median household income of \$46,574, which is \$5455 lower than the national median (U.S. Census Bureau, 2007). For each new resident that moved to North Carolina, 0.8 ha of land were developed during this period (North Carolina Wildlife Resources Commission, 2009), and 3 million new residents are expected between 2007 and 2030 (North Carolina Wildlife Resources Commission, 2009). By 2030, North Carolina is expected to be the seventh most populous state in the United States, surpassing New Jersey, Michigan, Ohio, and Georgia (U.S. Census Bureau, 2007).

## Methods

### Survey

We surveyed the 100 county planning departments in North Carolina using e-mail and telephone interviews. We focused on county governments because low density development in the United States typically occurs outside existing cities and their annexation zones (Soule, 2006). Planning staff from each county was asked if conservation subdivisions currently were allowed in their zoning ordinance or subdivision regulations, whether there were incentives in place to promote them, and whether a conservation subdivision had been successfully completed in their community. The response rate for planning departments was 100%. We recorded median income, percent urban population, and college education level for each county (U.S. Census Bureau, 2009).

### Analysis

We modeled success adopting conservation subdivision ordinances and success building a conservation subdivision using binary logistic regression. The binary dependent variables were

**Table 1**

Binary logistic regression models predicting success adopting conservation subdivision ordinances and success constructing a conservation subdivision.

Parameter	Estimate	Standard error	P	Nagelkerke $R^2$
<b>Ordinance</b>				
Median income	0.325	0.089	0.000	0.376
Urban population	0.163	0.062	0.008	
College education	-0.009	0.053	0.869	
Median income * urban population	-0.004	0.001	0.015	
<b>Construction</b>				
College education	0.120	0.058	0.039	0.474
Urban population	0.014	0.013	0.297	
Median income	-0.057	0.068	0.402	
Ordinance	-2.902	0.828	0.000	

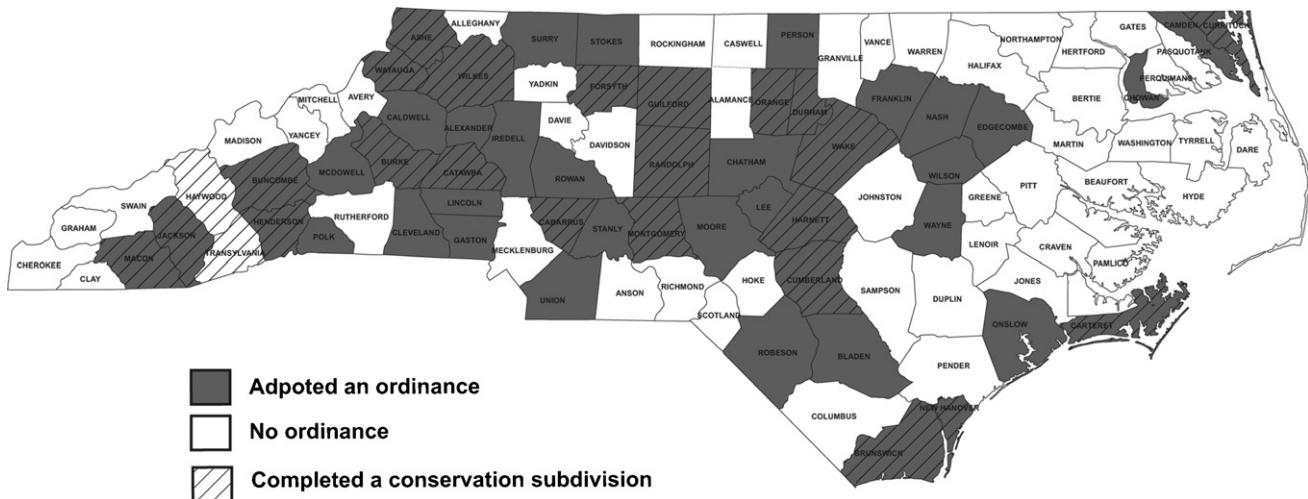
if the county had a conservation subdivision ordinance (No = 0; Yes = 1) and if the county had completed a conservation subdivision (No = 0; Yes = 1). Independent variables included in the models were median income, percent urban population, and college education level (percent with four-year degree or higher). We hypothesized education and income would predict conservation subdivision ordinance adoption and development because previous literature suggested education and income are positively related to more environmentally friendly behavior (Dietz et al., 1998; Straughan and Roberts, 1999). We included the interaction between median income and percent urban population in the model for adopting a conservation subdivision ordinance but removed it from the final model for building a subdivision because it was not significant. We included this interaction to determine what effect income had on success adopting an ordinance as percent urban population increases. In the model predicting success building a conservation subdivision, we included a class variable representing whether or not the county had a conservation subdivision ordinance in place. In both models, we divided median income by 1000 to facilitate comparisons of model coefficients. Analysis was conducted using SPSS System 17.0 for Windows Vista (SPSS Inc., Chicago, IL 60606).

## Results

Fifty-one counties out of 100 in North Carolina had ordinance language allowing conservation subdivisions in their development regulations (Fig. 1). Of the 51 counties with conservation subdivisions in their development regulations, 24 had successfully completed a conservation subdivision; two counties had completed a conservation subdivision without a specific ordinance in place. Counties with conservation subdivision ordinances experienced higher immigration (mean = 0.56%, SE = 0.17%) during the 1990s than counties which did not develop ordinances (mean = -0.17, SE = 0.16; U.S. Census Bureau, 2009).

A negative interaction between median income and percent urban population predicted successful adoption of a conservation subdivision ordinance (Table 1). When percent urban population was >50%, the probability of successfully adopting an ordinance was high regardless of income (Fig. 2). However, counties with <50% urban population had a higher likelihood of successfully adopting a conservation subdivision ordinance as median income increased; rural counties with lower median income were the least successful at adopting a conservation subdivision ordinance.

Probability of successful construction of a conservation subdivision increased with the adoption of an ordinance and as college education level increased (Table 1). Education levels in counties in which a conservation subdivision was built were higher (28% with a four-year degree or higher [range 9–52%]) than in



**Fig. 1.** North Carolina counties that had successfully adopted conservation subdivision ordinances and successfully completed a conservation subdivision (2010).

counties in which no conservation subdivisions were built (18% with a four-year degree or higher [range 8–37%]).

## Discussion

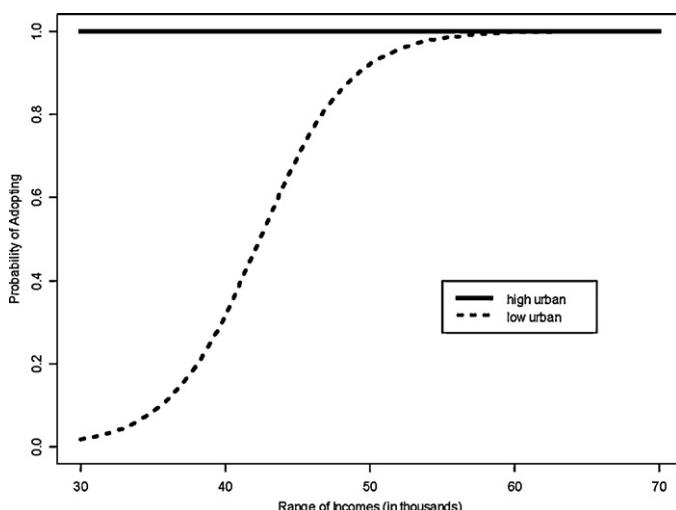
The higher probability of adopting a conservation subdivision ordinance and completing a development in counties with urban centers likely reflects a response to rapid urban sprawl around North Carolina's metropolitan regions. The North Carolina counties that successfully adopted conservation subdivision ordinances were close to the state's major metropolitan areas – the Triangle (Raleigh–Durham–Chapel Hill), the Triad (Greensboro, High Point, Winston–Salem), and Charlotte – all of which rank among the nation's top 20 sprawl centers ([Otto, 2002](#)). Further, urban counties typically have a larger planning staff and more resources than rural counties. Such resources likely facilitate conservation planning efforts, including adoption of conservation subdivision ordinances and incentives to developers to promote conservation subdivisions ([Carter, 2009](#)).

Successful adoption of conservation subdivision ordinances in rural counties with higher median incomes may be explained

by new residents seeking to protect the natural amenities that attracted them to the counties. Rural counties that successfully adopted ordinances were located along major interstate corridors that connect the state's largest metropolitan areas. These counties were experiencing rapid population growth as relatively wealthy residents from the urban center moved to more rural areas. Natural amenities such as open space and developments featuring mature trees, farmland, or forests draw residents to rural areas (Sofranko and Williams, 1980; Crump, 2003; Vogt and Marans, 2004). However, rapid increase in residential development jeopardizes the rural character that attracted the new residents. The "gangplank" hypothesis proposes that new residents are drawn to rural communities because of natural amenities, scenic views, and small-town character, and become concerned about future development threatening these values (Smith and Krannich, 2000; Groothius, 2010). These newcomers typically are more supportive of land use restrictions than long-term residents (Cockerham and Blevins, 1977; Inman and McLeod, 2002; Groothius, 2010). Because counties with ordinances experienced greater immigration rates than counties without ordinances, it is possible that newcomers were driving adoption of conservation subdivision ordinances in rural counties with higher median incomes as a way to maintain the rural amenities that attracted them.

Our results suggest the most important step for successful construction of a conservation subdivision is the adoption of ordinances that explicitly allow conservation developments. In North Carolina, restrictive zoning that does not allow conservation subdivisions or lot size flexibility was rated the fifth most important barrier to successful completion of a subdivision (Allen et al., 2012). Developers and landscape architects, who would be taking a perceived financial risk to build a conservation subdivision, rated this more of a barrier than planning staff and elected officials. Without an explicit conservation subdivision ordinance in place, developers may be deterred by what could be a time-consuming, costly special permitting process to build a conservation subdivision without an ordinance (Carter, 2009; Bowman and Thompson, 2009). Only two North Carolina counties built a conservation subdivision without an ordinance allowing them. These counties were located in the mountains of western North Carolina, where the resort home market and higher-end developments, along with the desire to preserve open space and scenic views, may make conservation subdivisions a viable option even without an ordinance.

Our results highlight a link between education and demand for development practices perceived as environmentally friendly (Straughan and Roberts, 1999). In North Carolina, 22.5% of



**Fig. 2.** Probability of adopting conservation subdivision ordinance across a range of income in counties with high (>50%) and low (<50%) percent urban populations. Urban population percentages were based on the 10th and 90th percentiles from 2000 Census data.

residents have at least a four-year college degree, but communities that had built conservation subdivisions had much higher proportions of college educated residents, (e.g., Durham County [40.1%], Orange County [51.5%], and Wake County [43.9%]). Additionally, communities with conservation subdivisions often had a college or university that may have attracted more environmentally conscious residents. For example, North Carolina State University, the University of North Carolina – Chapel Hill, and Duke University are located in Wake, Orange, and Durham counties, respectively, which all have successfully built conservation subdivisions.

Almost half of the 51 counties with a conservation subdivision ordinance had not completed a development, so barriers in addition to lack of ordinances may impede implementation. Changes in land-use regulations can create conflict over property rights among landowners, developers, and elected officials (Peterson and Liu, 2008; Allen et al., 2012). In most cases, a combination of support from planners, legislators, developers, and consumers would be needed to address this barrier (Vogt and Marans, 2004; Peterson and Liu, 2008). In North Carolina, the lack of incentives for developers, concerns about higher construction costs, and concerns about smaller lot sizes may present additional barriers to construction of conservation subdivisions (Allen et al., 2012).

Wealthy urban counties may plan for conservation subdivisions more frequently because they have resources for in-house specialists to write ordinances and assist with inventories. In the absence of model statewide ordinances, low-income rural counties trying to implement conservation subdivisions must seek partners to help promote conservation subdivisions. Local, regional, or statewide land trusts interested in holding easements in conservation subdivisions may be willing to aid in the promotion or adoption of conservation subdivision ordinances. Land trust staff may have the expertise to assist with the inventory or assessment required for conservation subdivisions when low income counties lack the resources to hire an in-house specialist. In North Carolina, seven of the 25 land trusts maintain easements in conservation subdivisions. In some states, land trusts play an active role in the promotion of conservation subdivisions by providing examples of model ordinance language and actively pursuing easements in conservation subdivisions (Natural Lands Trust, 2011). Although some land trusts in North Carolina have easements in conservation subdivisions, they may not actively pursue them due to long-term management concerns associated with engaging homeowner's associations (Allen, 2011).

To defer costs from rural counties that lack resources, regional councils of governments or other governmental agencies also may assist in the development of ordinances, regional conservation planning, or organization of workshops promoting conservation subdivisions. Without these partnerships, low-income rural counties will be less likely to adopt a county ordinance or have a conservation subdivision successfully built. In North Carolina, this need has been addressed by two initiatives. The North Carolina Wildlife Resources Commission created a guide to provide North Carolina's communities a tool for nature friendly growth (North Carolina Wildlife Resources Commission, 2009). Additionally, the North Carolina Urban and Community Forestry Program developed a handbook to guide North Carolina communities in the use of conservation design for land use planning (Allen et al., 2011).

Although our study suggests that enacting an ordinance allowing conservation subdivisions by right is the most important factor leading to successful construction of a conservation subdivision, counties may need to do more than just adopt such an ordinance. Educating developers about the higher prices homebuyers are willing to pay for homes with access to urban open space may encourage construction of more conservation subdivisions (Bolitzer and Netusil, 2000; Geoghegan, 2002). In North Carolina, some planning departments used workshops and

informal meetings to teach developers about the economic benefits of conservation developments (Allen et al., 2012). These planning departments sponsored workshops featuring conservation subdivision advocate Randall Arendt and promoted the benefits of conservation subdivisions (Allen et al., 2012). Other planning departments used informal meetings and design charrettes to create an ongoing dialog with developers, planning staff, and property owners (Allen et al., 2012). The workshops and charrettes created an informal setting where landowners and concerned citizens could see proposed development plans, raise their concerns to the developer, and work to find a solution that addressed their concerns (Allen et al., 2012). Incentives for developers, expedited permit reviews, and reworking subdivision approval processes to favor conservation subdivisions over conventional subdivisions can make them more appealing to developers (Allen et al., 2012). Future research should consider additional variables for predicting the use of conservation subdivisions in conservation planning. Key variables could include political ideology, historical immigration trends, budget size, ethnicity, and age structure within counties.

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