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Overcoming socio-economic barriers to conservation subdivisions: A case-study of four successful communities

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ABSTRACT

Conservation subdivisions have emerged as an option to conserve open space, protect water quality and wildlife habitat, and maintain scenic views without compromising property rights. Despite economic and ecological advantages over traditional subdivisions, conservation subdivisions remain rare. We used a mixed-method study combining a survey of 246 people who attended conservation subdivision workshops with a qualitative case study of four communities that successfully developed conservation subdivisions to identify potential barriers to conservation subdivisions and strategies to overcome those barriers. A principal component analysis based on survey respondent rankings grouped barriers into: resistance to change among stakeholders, concerns about differences between traditional subdivisions and conservation subdivisions, concerns about consumer demand, and misperceptions about construction costs. Survey respondents indicated the top barrier to completion of conservation subdivisions was lack of incentives for developers. The case study communities overcame resistance from developers and landowners through educational efforts including informal meetings, charrettes, and workshops focusing on the environmental and economic benefits of conservation subdivisions. The communities had support from elected officials, and planning staff devoted necessary resources to rewrite ordinances, review sketch plans, and perform site visits. To overcome barriers to conservation subdivisions, communities could provide incentives including density bonuses and expedited approval processes. Encouraging participation in workshops and design charrettes for proposed developments may alleviate concerns of landowners who perceive a loss of property rights from new regulations and aid in the acceptance of conservation subdivisions.

1. Introduction

Human population growth and the ensuing land use changes pose significant challenges to natural resource conservation. In the United States, 22 states experienced population growth rates greater than 10% from 2000 to 2010 (U.S. Census Bureau, 2010). In 2006, privately owned forests were being converted to commercial and residential use at the rate of 1620 ha per day (Stein et al., 2006). Conversion of forest and farmland to residential development alters habitat for plant and animal species, and in rural and suburban areas could be the greatest threat to biodiversity (Milder, 2007).

Conservation subdivisions have emerged as a development strategy that can help communities preserve natural areas in residential developments without altering density levels. Conservation subdivisions use a design strategy that attempts to conserve undivided, otherwise buildable tracts of land as communal open space for residents (Arendt, 1996). 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 (Arendt, 1996). Conservation areas are identified through site visits with developers and planners and an environmental inventory to identify the most ecologically valuable land to conserve. This process uses the natural features of the site to guide how it is developed (Milder, 2007). Conservation subdivisions usually are permitted to have the same number of housing units, or slightly more, as a conventional subdivision would have on the same parcel. The difference is that the housing units in a conservation subdivision are clustered closely together, leaving large areas of open space.

Conservation subdivisions offer potential environmental and economic benefits when compared to conventional subdivisions

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in a similar housing market (Milder, 2007; Mohamed, 2006). Clustering developments on a portion of the land reduces infrastructure costs an average of 34% when compared to conventional subdivisions which require additional grading, more stormwater infrastructure, and a longer road network (Mohamed, 2006; Bowman & Thompson, 2009; Pejchar, Morgan, Caldwell, Palmer, & Daily, 2007; Thomas, 1991). Conservation subdivisions can decrease landscape fragmentation and protect ecosystem services including water quality, wildlife habitat, carbon sequestration, and aesthetic viewsheds (Elmendorf & Luloff, 1999; Lenth, Knight, & Gilbert, 2006). If planned in conjunction with regional conservation efforts, open space in conservation subdivisions can provide connectivity to other protected areas and benefit to wildlife species requiring larger tracts of intact habitat and connectivity between habitat patches (Hostetler & Drake, 2009; Odell, Theobald, & Knight, 2003).

Conservation subdivisions are relatively rare despite their promised environmental and economic benefits, which suggests a need to assess social and logistical barriers impeding their use (Bowman & Thompson, 2009). Preliminary research indicates conservation subdivisions face resistance from realtors reluctant to market environmentally friendly development practices and from developers who perceive risks associated with trying a new development strategy in untested markets (Bowman & Thompson, 2009). Carter (2009) suggested that the most obvious barrier is lack of ordinance language allowing conservation subdivisions as a "use-by-right" in zoning and development regulations. Without this language in place, a developer may have to go through a lengthy rezoning or variance request that costs both time and money. Another challenge associated with conservation subdivisions is long term open space management (Austin & Kaplan, 2003). To address this concern, some ordinances require a conservation easement or a transfer of development rights to guarantee the open space is conserved in perpetuity (Arendt, 1996). Stewardship funds and homeowner association (HOA) fees can be used to cover the costs associated with the maintenance of open space, but lack of knowledge about open space management can lead to disagreements among residents (Austin & Kaplan, 2003).

Previous research has focused on barriers to implementation of conservation subdivisions from the perspective of developers and planning officials (Bowman & Thompson, 2009; Carter, 2009). Gaining perspective from other stakeholder groups (e.g., local politicians, landowners) could explain why conservation subdivisions are an underused option despite their potential benefits. Further, an examination of successful conservation subdivision development may illuminate how the barriers can be overcome. Accordingly, we assessed perceived barriers to construction of conservation subdivisions from the perspective of diverse stakeholder groups (city and county planners, developers, land conservancy staff, foresters, elected officials, landowners, and interested citizens) and used case studies to identify how communities successfully built conservation subdivisions.

2. Methods

Our mixed-method approach combined quantitative data from an online survey of participants from nine workshops on conservation-based development with qualitative data from the four case-study communities. The mixed-method approach was chosen to gain a more comprehensive perspective of the research questions (Greene, Caracelli, & Graham, 1989; Tashakkori & Teddlie, 1998), including a more in-depth look at how successful communities overcame barriers to construction. Our survey population included city and county planners, developers, land conservancy staff, foresters, elected officials, landowners, and interested citizens. We chose this population to survey because we wanted to determine perceived barriers to conservation subdivision development from a variety of stakeholders, expanding the research beyond the focus on planners and developers reflected in most of the literature on conservation subdivisions.

2.1. Study area

North Carolina's population grew by 18.5% to 9,535,483 between 2000 and 2010, and it was the seventh fastest growing state in the United States (U.S. Census Bureau, 2010). Three of the fastest growing regions in North Carolina – the Triangle (Raleigh-Durham-Chapel Hill), the Triad (Greensboro, High Point, Winston-Salem), and the Charlotte metropolitan area – all ranked among the nation's top 20 sprawl centers at the turn of the 21st century (Otto, 2002). Sprawl centers are metropolitan areas where land development occurs at a rate faster than population growth (Otto, 2002). For each new resident that moved to North Carolina, 0.8 ha of land were developed (NC DENR 2007), and 3 million new residents are expected between 2007 and 2030 (North Carolina Wildlife Resources Commission, 2009). In 2011, more than 60 plant and animal species listed as federally endangered or threatened and over 200 state-listed species occurred in North Carolina; eight of the top 21 most endangered ecosystems in the U.S. occurred in the state (N.C. Wildlife Action Plan 2005). Habitat loss and fragmentation from urban development pose the greatest threats to these ecosystems (North Carolina Wildlife Action Plan 2005).

North Carolina has no statewide conservation subdivision ordinance. Instead, subdivision regulations are controlled by counties or municipalities and vary with respect to the amount of open space required and the approval process. Some allow conservation subdivisions "by right" while others may require a rezoning process or a special use permit. Of the 100 counties in North Carolina, 51 had ordinances allowing conservation subdivisions in 2010 (Allen, 2011).

2.2. Survey methods

We surveyed 246 participants from nine workshops on conservation-based development offered by North Carolina State University's Forestry and Environmental Outreach Program between 2004 and 2006. Contact information was obtained from workshop registration records. Key informants [county planner, land conservation specialist, landscape architect, and developer] reviewed the draft questionnaire and modifications were made to improve the clarity and validity of the survey. We followed Dillman's (2007) Tailored Design Method for Internet Surveys and used the online program Survey Monkey (Surveymonkey.com, Portland, Ore). A pre-survey and survey were sent to all participants, and three reminder emails were sent one, three, and four weeks after the survey. A fourth and final reminder was sent to the remaining non-respondents two months after the original request for participation in the survey.

We used Likert scale questions (a 4-point scale with 1 being "not a barrier" and 4 being "a complete barrier" to implementation) to determine how respondents rated potential barriers to successful implementation. Workshop attendees were asked about their interest in sharing information learned at the workshops, about the receptiveness of stakeholder groups to the information, and about their perceptions of home cost in conservation subdivisions.

To assess potential non-response bias, we randomly selected 30 people from the 316 non-respondents, and asked them to complete an abridged version of the survey. We achieved an 83% ($n = 25$) response rate in the non-response survey.

Table 1
2010 U.S. Census data for North Carolina and four case study communities in North Carolina.

Category	North Carolina	Orange county	Town of Davidson	City of Hickory	Randolph county
2000 population	8,046,406	115,536	7,139	37,222	130,472
2010 population estimate	9,535,483	133,801	10,944	40,010	141,752
Persons per square km	76.6	129.8	743.36	540.73	70.74
Percent growth 2000–2010	18.5	13.2	53.3	7.5	8.7
Median income	$43,754	$51,944	$81,111	$38,147	$38,529
College education level	25.8%	53.7%	70.5%	28.8%	12.9%
Median home value	$143,700	$239,500	$419,700	$149,800	$117,100

2.3. Case studies

We used a modified multiple case-study approach (Yin, 2002) to achieve a more in-depth understanding of how four North Carolina communities overcame barriers to implementation of conservation subdivisions. We sought to identify the barriers these communities faced in implementing conservation subdivisions and what steps they took to overcome them. Based on the survey of conservation subdivision workshop attendees, Randolph County, Orange County, the Town of Davidson, and the City of Hickory were identified as representative communities that have successfully adopted ordinances and successfully completed a conservation subdivision. We chose two case study communities that had a higher socio-economic ranking than the state average (Orange County and the Town of Davidson), and two communities that had lower socio-economic rankings (Randolph County and the City of Hickory) to determine the degree to which successful conservation subdivision strategies were dependent on socio-economic status of the community (Table 1). Between June 2009 and August 2009, we conducted in-person, individual, semi-scripted interviews with a member of the planning staff, a planning board member, and a developer from each case study community. Interviews were recorded and transcribed for qualitative analysis.

We asked planning staff and board members about the process their community underwent to incorporate conservation subdivisions into their zoning or development regulations. Questions addressed who or what prompted the zoning regulation change, how much time and money was spent during the process, where resistance was encountered, and how the resistance was overcome. Other questions focused on how conservation subdivisions were defined, the approval process, whether incentives were offered, and the selection and long-term management of open space in the development. All questions were open-ended. Each developer was contacted and asked about their motivation for building a conservation subdivision, barriers they faced during the process, and how they overcame those barriers. Other questions focused on the long-term management of open space, the design process, marketing, and incentives to encourage the use of conservation subdivisions in local development regulations.

2.4. Analysis

We analyzed data from the online survey using SPSS System 17.0 for Windows Vista (SPSS Inc., Chicago Illinois, 60606). We used the overall means of the Likert-scale responses from workshop attendees to rank the barriers to conservation subdivisions. One-way analysis of variance with a Duncan post hoc test was used to determine if ranking of barriers varied by occupation and to determine if occupation was a predictor of success sharing conservation subdivision concepts following the workshops. We performed a principal component analysis to determine groupings of barriers to successful implementation of conservation subdivisions. We used a principal component analysis with varimax rotation to obtain factors that accounted for the greatest proportion of the variance. Factors with eigenvalues greater than one were retained for analysis. To test for non-response bias, we compared the ranking of barriers for respondents and non-respondents using Chi-square tests.

Data from the recordings of case study interviews were transcribed and analyzed to identify common themes and keys to successful implementation of conservation subdivisions. We used the three step (open, axial, and selective) coding process described by Draucker, Martsolf, Ratchneewan, and Rusk (2007). All respondents consented to be identified in quoted text, with the exception of the City of Hickory planning staff who asked to be referred to as "City of Hickory planning staff."

3. Results

The survey response rate was 45%. Respondents were: landscape architects ($n = 73$, 28%); planning staff, planning board members, or board of commissioner members ($n = 71$, 28%); developers and real estate agents ($n = 33$, 12%); conservation and land protection group representatives ($n = 27$, 11%); with private landowners, foresters, land managers, and other occupations making up the remaining 21%. Sixty-nine percent of survey respondents said that conservation subdivisions were an appropriate tool to limit urban sprawl. The distribution of respondents among groups (e.g., developers, planning staff) did not differ between the survey and non-respondent sample ($p > 0.05$). Non-respondents and survey respondents did not differ in how they ranked barriers to implementing conservation subdivisions ($p > 0.05$).

3.1. Barriers to implementation

Respondents rated the lack of incentives for developers as the top barrier to implementing conservation subdivisions (Table 2), and the barrier was rated similarly among occupations (Table 3). The perception that homes in conservation subdivisions are more expensive to build was rated the second highest barrier. When asked about the cost of homes in conservation subdivisions compared to similar homes in conventional subdivisions, 67% of respondents said homes in conservation subdivisions cost more, 29% said they cost the same, and only 3% said that homes in conservation subdivisions cost less.

The third highest rated barrier was lack of interest from elected officials to change zoning regulations with no difference in the ranking detected among occupations (Table 3). The fourth highest rated barrier was smaller lot sizes associated with conservation subdivisions. Restrictive zoning was rated the fifth most important barrier, with conservation groups, developers, landscape architects, and interested citizens rating it higher than planning staff and elected officials (Table 3; $p < 0.001$). The long-term management of open space, the reluctance of planners to review sketch plans, and lack of model ordinance language were less important barriers. Difficulty sharing information among developers, elected officials, and realtors was also a barrier (Fig. 1).

Principal component analysis showed the barriers to implementation grouped on four factors. The Kaiser–Meyer–Olkin measure of sampling adequacy was 0.811 (Table 4). The Barlett's test of

Table 2
Ratings of barriers to implementing conservation subdivisions (CSDs) in North Carolina from a survey of conservation subdivision workshop attendees (2009). Survey respondents were asked to rank barriers on a scale of 1–4 with 1 being "not a barrier" and 4 being a "complete barrier" to implementation.

Possible barrier to conservation subdivisions	*N*	Overall mean	Std. deviation
No incentives for developers	246	3.51	1.21
Perception CSDs are more expensive to build	243	3.43	1.18
Lack of interest from elected officials	246	3.16	1.40
Smaller lot sizes	244	3.07	1.23
Restrictive zoning	219	3.05	1.28
Management of open space	246	2.95	1.23
Lack of consumer demand	221	2.85	1.30
Lack of interest by realtors	220	2.79	1.35
Lack of model ordinance language	220	2.78	1.39
Lack of resources to rewrite ordinances	220	2.76	1.37
Lack of maps of potential conservation lands	220	2.51	1.29
Reluctance of developers to submit sketch plans	220	2.47	1.22
Reluctance of planners to review sketch plans	220	2.20	1.18

Table 3
Ratings by occupation of possible barriers to implementing conservation subdivisions (CSDs) in North Carolina from a survey of conservation subdivision workshop attendees (2009). Survey respondents were asked to rank barriers on a scale of 1–4 with 1 being "not a barrier" and 4 being a "complete barrier" to implementation.

Occupation or interest	*N*	No incentives for developers	Perception CSDs cost more to build	Lack of interest from elected officials	Small lot sizes	Restrictive zoning	Long term management of open space
Planning staff or board of commissioner	61	3.21	3.21	2.75	3.23	2.21 A	3.18
Developer/real estate	26	3.65	3.00	3.38	2.88	3.48 B	2.58
Conservation/land protection group	24	3.13	3.13	3.25	2.96	3.61 B	2.67
Land planner/designer/architect	60	3.73	3.64	3.45	3.03	3.42 B	2.88
Interested citizen/private landowner	20	3.45	3.45	3.50	3.05	3.37 B	3.15

Means within a column followed by different letters differ at the 0.05 probability level according to Duncan's post hoc test.

sphericity was significant (Table 4; $p = 0.000$). The first factor explained 36% of the variance and included barriers related to reluctance among stakeholders to adopt the conservation subdivision approach (Table 4). The second factor included barriers highlighting differences between traditional developments and conservation subdivisions, the third factor included concern about limited consumer demand, and the fourth included the barrier associated with misperceptions about conservation subdivision construction costs (Table 4).

3.2. Case studies

Thematic analysis of qualitative data suggested case study community success stemmed in part from addressing the same types of barriers identified by the factor analysis. Specifically the communities provided incentives to encourage reluctant stakeholders to adopt conservation subdivisions and educated stakeholders regarding potential home buyers' willingness to purchase homes in non-traditional developments.

3.3. Why case study communities supported conservation subdivisions

Informants from all case study communities described conservation subdivisions as a response to perceived threats to their community's rural character posed by rapid development. Conservation subdivisions were implemented to conserve open space while not infringing on landowner property rights. Open space conservation had been a key issue in Orange County for some time, according to Barry Jacobs of the Orange County Board of

Table 4
Principal component analysis factor loadings for ratings of barriers to implementing conservation subdivisions (CSDs) in North Carolina from a survey of conservation subdivision workshop attendees (2009).

	Factors			
	1	2	3	4
Reluctance of developers to submit sketch plans	**0.627**	0.470	−0.096	−0.245
Reluctance of planners to review sketch plans	**0.787**	−0.020	−0.004	−0.432
Lack of interest by realtors	**0.630**	0.143	0.440	−0.122
No incentives for developers	**0.643**	−0.006	−0.028	−0.088
Lack of interest from elected officials	**0.777**	−0.179	0.220	0.135
Lack of maps of potential conservation lands	**0.723**	−0.156	−0.029	−0.131
Management of open space	0.289	**0.683**	0.033	0.011
Smaller lot sizes	0.223	**0.631**	−0.154	0.027
Lack of consumer demand	0.393	−0.035	**0.686**	0.386
Perception CSDs are more expensive to build	0.470	0.148	−0.161	**0.698**
Lack of model ordinance language	0.762	−0.220	−0.257	0.039
Restrictive zoning	0.585	−0.129	−0.514	0.292
Lack of resources to rewrite ordinances	0.573	−0.462	−0.034	−0.127
Eigenvalue	4.709	1.464	1.106	1.045
Percent variance explained	36.221	11.260	8.505	8.035
Kaiser–Meyer–Olkin measure of sampling adequacy				0.811
Bartlett's test of sphericity				0.000

Bold numbers highlight barriers loading on each factor.

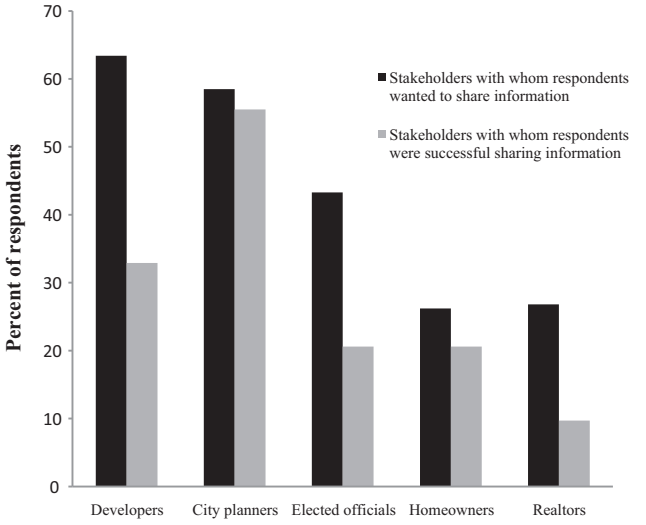

Fig. 1. Stakeholder groups with whom survey respondents were most interested in sharing information on conservation subdivisions and the stakeholder groups with whom they were most successful sharing information. (North Carolina, 2009).

Commissioners. "We've been looking at them [conservation subdivisions] for 20 years."

In the mid-1990s, the Town of Davidson was experiencing unprecedented growth from commuters and immigrants from the Charlotte–Mecklenburg region. Board of Commissioners member Margo Williams said town officials realized they could not stop the growth and formed a land planning committee to shape it in a way that would maintain the town's values and rural character. During this planning period, the town enacted a moratorium on new subdivisions. Davidson planning director Kris Krider said the town's actions were a result of seeing other municipalities in the region struggle with staggering growth rates and suburbanization. Krider said "I think that what promoted [conservation subdivisions] was the tremendous growth that was going on in Huntersville and Cornelius . . .we said timeout, we're not ready to grow, not in a suburban mode."

In the late 1980s, Randolph County also was experiencing a period of rapid growth. Randolph County Planning Director Hal Johnson said the increase in major residential development in the county was diminishing the county's rural character. In response, the county changed the subdivision approval process in 1988 to require that all major subdivisions go through a rezoning process, bringing subdivision approvals into the public arena. The change gave residents a forum to voice their opinions on how they want their community to look. Adjacent property owners concerned about the rural character of the community were less opposed to proposed developments once they saw the types of conservation subdivisions being proposed. The public review helped make conservation subdivisions less controversial and often the preferred type of development because it was more appealing to adjacent landowners. Phil Kemp of the Randolph County Board of Commissioners noted the value of a less controversial review process saying, "It gets approved a little easier because there is less controversy when you have the neighborhood meetings and they see it's going to be a conservation-type subdivision. We have those (informal meetings) as part of the (rezoning) process. . .citizens can come to the county office and meet with the developer and meet with the planning staff before it goes to the public hearing and the planning board and county commissioners. And that's been one of the best things that we've ever done."

The City of Hickory added conservation subdivisions to their development regulations in 2000 after focus groups of residents identified the need for more open space. Planning staff for the City of Hickory said the city took a market approach to conservation subdivisions, adopting the ordinance and letting the demand for open space subdivisions lead to implementation.

3.4. How communities addressed lack of incentives for developers

Each of the case study communities incentivized conservation subdivisions using density bonuses, flexibility in lot size requirements, or an expedited review process to encourage the use of conservation subdivisions. Density bonuses are an incentive-based planning tool that allows developers to build more homes in exchange for retaining the required amount of open space in a development (Center for Land Use Education, 2005). A density bonus can be given for public access to open space or trails, conserving environmentally sensitive areas, or for linking trails to an existing network of greenways.

Randolph County traded density bonuses for several attributes of conservation subdivisions. Developers could add one additional lot for each additional 5% of open space conserved, preserving a designated Natural Heritage site, maintaining forest and natural buffers along parcel lines, developing an approved forestation plan for the open space, and developing and maintaining connector trails to a designated county greenway.

Granting a density bonus for public access is a way some communities increased the amount of publicly available open space without having the financial responsibility of maintaining a public park or greenway. In Davidson, a density bonus was allowed if open space was a part of a greenway system or had trails available for public use. If 60% of open space was publicly accessible, the developer could increase the density by 0.162 units per 1 ha.

The conservation subdivision option in Hickory allowed for a 50% reduction in lot size and a 25% reduction in setback requirements as a density bonus. In Orange County, developer Tom Heffner noted lack of density bonuses and less flexibility in lot size requirements in the rural buffer as a problem. Orange County's requires 33% open space for new developments, with a 0.81 ha minimum lot size in the rural buffer where there is no public water and sewer. Heffner said small density bonuses would encourage developers to build conservation subdivisions. "You're driven to do large-lot subdivisions anyway and you have to do a 1/3 open space by the ordinance. I think even if you had small incentives, maybe even 5% [density], certainly 10% would be a gracious plenty to encourage you to do [conservation subdivisions]."

3.5. How communities addressed perceptions that conservation subdivisions were more expensive to build

The successful communities in our case studies reached out to developers through workshops and informal meetings to overcome misperceptions about the costs associated with building homes in conservation subdivisions. Randolph County and the Town of Davidson held workshops that featured conservation subdivision advocate Randall Arendt and promoted the benefits of conservation subdivisions. The informal meetings in Randolph County and the charrettes in Davidson created an ongoing dialog with developers, planning staff, and property owners. Developers in all four communities stated that construction costs for the conservation subdivisions they built were comparable to conventional subdivisions. Two developers saved money on stormwater management by minimizing the use of curb and gutter and incorporating natural filtration and roadside swales, but some of the savings may have been offset by time spent negotiating with planning staff for special use permits because the ordinance calls for the use of curb and gutter. Davidson developer John Robbins said the conservation subdivisions he built had comparable costs to conventional

subdivisions. Developer Tom Heffner said "it's certainly theoretically possible that a conservation subdivision would be less expensive to build because you'd have less infrastructure."

Blue Sky Acres is an open space development built by Hickory's Habitat for Humanity of Catawba Valley. The extension of water and sewer lines in the area allowed Habitat to cluster homes on smaller lots and conserve over 20% of the property as communal open space. "For us it would definitely be cheaper. Because without the conservation subdivision we would have had fewer lots so your infrastructure costs per lot would have been higher, you know maybe 20–30% higher," Mitzi Gellman, Executive Director for Habitat for Humanity of Catawba Valley, said.

3.6. How communities gained support from stakeholders

Planning staff and the boards of commissioners in each community supported development of conservation subdivisions and pushed for change in the land use policy. In Randolph and Orange counties, focus groups and growth studies were used to determine how residents wanted to see their communities grow. In Orange County, Randolph County, and the Town of Davidson, the planning department staff developed ordinance language allowing conservation subdivisions. The City of Hickory hired a consulting firm to develop their land use plan.

In the Town of Davidson, the proposed changes were met with resistance from developers and property owners who feared conservation subdivision regulations would hurt their property values. Margo Williams, a member of the Town of Davidson Board of Commissioners, said the town worked to address these fears with multiple meetings and workshops featuring Randall Arendt and other land use experts. The workshops focused on the benefits of open space conservation in subdivisions. Williams said "it was the committee's goal to work with the property owners to. . .allay some of the concerns [about property rights]."

Davidson planning director Kris Krider said the process created a negative image of the town in the eyes of some landowners and developers, and it took several workshops to overcome some of these concerns and rebuild the community's trust. He said "Ultimately, the town board adopted the ordinance [promoting open space conservation] and it was known as the land grab. . .It was a hard issue for many people to swallow and it all resulted around takings – 'You're taking my property rights' – so we sought out people like Randall [Arendt]."

3.7. How communities dealt with smaller lot sizes

The successful case study communities used reduced setback requirements and flexibility in lot sizes to overcome the challenges associated with smaller lots in conservation subdivisions. Smaller lot size may be more of an issue in rural areas, because smaller lots can make setbacks for outbuildings and septic systems difficult to achieve. Placing septic fields in the open space, the use of communal septic fields, and on-site treatment plants can allow rural subdivisions to achieve smaller lots. Planning staff from all four case studies said that communal septic fields were an option, but were rarely used and not encouraged because of long-term management concerns. If these communal septic fields or on-site treatment plants are not properly maintained, the city or county may have to take over management of the system.

Flexibility in lots sizes allowed Habitat for Humanity of Catawba Valley to develop more lots while conserving valuable woodlands that provided open space and recreation opportunities to residents. The lots in Blue Sky Acres averaged about 0.07 ha. Mitzi Gellman said the community quickly became the most popular Habitat community in Hickory. Gellman said the neighborhood was unique because it gave residents an alternative to typical lower-income urban settings and offered children in the development a natural playground not available in more traditional Habitat communities. "It's nice that they have a place to do this. Typically our kids are coming out of really low-income neighborhoods or trailer parks, they're coming out of public housing, and so the idea that there are woods across the street that they can play in that feel relatively safe is a new thing as well."

The Town of Davidson required a variety of lot sizes. No more than 50% of the lots in a development can be the same size, which lead to a variety of home sizes, more affordable homes, and more diverse homebuyers. Lots in the Woodlands at Davidson vary from 0.1 ha to nearly 0.4 ha for the estate lots, with the majority being 0.2 ha. In Orange County's rural buffer, there is a 0.8 ha minimum lot size, which requires 1.2 ha of land per home after meeting the 33% open space requirement.

3.8. How communities addressed restrictive zoning

The case study communities used a combination of flexibility in lot sizes, varying open space requirements, approval processes that favored conservation subdivisions, and density bonuses to overcome developers concerns about restrictive zoning. Without ordinance language in place, a developer would have to navigate an often lengthy and costly rezoning or special use permit.

Open space standards, conservation easement requirements, and long-term management requirements differed in each community. The City of Hickory's ordinance allowed less than 30% open space in some zoning districts, but the range of open space required reached 50% in others. Orange County required 33% open space for each new subdivision and required identifying primary and secondary conservation areas during the initial planning phases. When flexible developments were first added to the zoning ordinance, the Orange County planning staff and Board of Commissioners would make a recommendation to the developer, but the final decision on which type of development to build was left up to the developer. Overwhelmingly, developers chose to build conventional subdivisions. To encourage open space subdivisions, Orange County revised their process to require submission of a flexible development plan (but not a conventional plan) and gave final approval to the Board of Commissioners. The flexible development plan required at least 33% open space to be permanently protected through deed restrictions or a conservation easement. Since the approval process was changed, Orange County has seen a number of flexible developments built, but has also seen an increase in the number of minor subdivisions. Under North Carolina law, minor subdivisions (under 4.05 ha) are exempt from zoning regulations.

The Town of Davidson's ordinance included several options for developers and property owners and required the conservation of at least 42% of a proposed development as permanently protected open space. An environmental inventory was required for all development proposals and was meant to be the guiding factor for identifying the conservation areas. The developer paid for the environmental inventory, which identified significant natural areas, sensitive wildlife habitat, wetlands, and existing vegetation on the site.

Flexibility in lot sizes was a key component to the Randolph County ordinance that allowed developers to achieve the same or higher number of units as a conventional subdivision. The ordinance required that 50% of the proposed conservation development be set aside as open space. The county is divided into three growth categories: rural, secondary, and primary. The lot size requirements varied by growth area, but the conservation subdivision option gave developers flexibility in lot sizes. In the rural growth area, the minimum lot size was 1.2 ha, but the conservation subdivision option allowed a minimum of 0.61 ha. In the secondary and primary growth areas, the minimum lot size was 0.37 ha for a

conventional subdivision or ~0.18 ha for a conservation subdivision, which allowed developers to achieve the same number of units they would with a conventional development.

The City of Hickory used varying open space requirements to conserve more open space where more land was available in rural areas, while still conserving some open space in more urban areas. The most rural residential district had a 50% open space requirement for conservation subdivisions; the requirement was 20% in all other residential zoning districts. The ordinance called for the preservation of sensitive areas on the property, including wetlands, mature woodlands, and other significant natural features.

3.9. How communities provided long-term management of open space

To overcome challenges associated with the long-term management of open space, the case study communities used mandatory conservation easements, transfer of development rights, or homeowners' associations with fees dedicated to open space management. Randolph County limited the future development of open space by deed restrictions rather than requiring a conservation easement. Deed restrictions generally do not involve third party oversight for the management of the open space by an organization such as a land trust. Ownership of the open space can be retained by the developer, or by a homeowners' association. If ownership is retained by the developer, they are responsible for paying taxes on the land in perpetuity, which can deter developers from maintaining ownership. Developer Stan Byrd built three conservation subdivisions in Randolph County and retained ownership of the open space in two and transferred ownership to a homeowners' association in the third. Byrd said he would build another conservation subdivision in Randolph County, but he would not build one that did not have a homeowners' association to assume ownership and maintenance of the open space.

A conservation easement is required on the open space in Orange County and the Town of Davidson, but it does not have to be held by a local land trust. The easement also may be held by the developer, the homeowners' association, or the Town of Davidson. Triangle Land Conservancy gained ownership of the 105 ha of open space in the Creek Wood and North Field developments in Orange County and linked the open space to an adjacent property to create a larger nature preserve.

A common concern from a planning department standpoint was the lack of knowledge on the part of homeowners' associations regarding the long-term management of open space. "The big challenge for the town I think is ... they [HOAs] know how to take care of pools and manicure lawns. . .but they don't know anything about protecting woods. So I think that's where land trusts like the Davidson Lands Conservancy can fill an important role," Davidson Planning Director Kris Krider said.

From the City of Hickory's standpoint, the long-term management of the open space was one of the primary concerns regarding conservation subdivisions. "As subdivisions age, homeowners' associations dissolve. They have a tendency to just basically go away over time, unless you have a real established neighborhood."

4. Discussion

We discovered those most critical to implementing conservation subdivisions – developers (Daniels, 1999; Mohamed, 2006), elected officials, and realtors (Carter, 2009) – were more resistant to information about conservation subdivisions than other groups. This may be explained by elected officials, realtors, and developers standing to lose the most if claims about customer preferences and construction cost savings prove false. Although homebuyers value open space in their neighborhood and lots in conservation subdivisions sell faster, are less expensive to build, and sell for a higher price compared to lots in conventional subdivisions, developers believe low-impact design techniques and conservation subdivision designs increase the final costs of homes, and many believe homebuyers are not interested in or willing to pay for homes in conservation subdivisions (Bowman, Thompson, & Colletti, 2009; Mohamed, 2006).

Despite these misperceptions, developers in our case study communities said they saved money when building conservation subdivisions, and successfully sold homes in the subdivisions. Our findings about both perceptions of risk and costs savings associated with conservation subdivisions suggest the need to identify local conservation subdivisions and advertise development savings and sales success. Generic statistics about costs and sales rates in conservation subdivisions outside a local market may not sway developers who may have their entire business on the line each time they start a new development.

Our quantitative and qualitative results suggest communities face four primary types of barriers to implementation of conservation subdivisions: resistance to change among stakeholders, concerns about differences between traditional subdivisions and conservation subdivisions, concerns about consumer demand, and misperceptions about construction costs. Financial incentives proved to be a key to overcoming these barriers among developers. Indeed, such incentives have driven adoption of most recent green innovations including hybrid cars (Diamond, 2009), geothermal heating and cooling (Kagel & Gawell, 2005), and solar and wind power (Lancaster & Berndt, 1984). Density bonuses and an expedited permit process have been promoted to overcome concerns from developers stemming from misperceptions about additional costs associated with conservation developments (Bowman & Thompson, 2009). As with the case study communities in our study, other communities used reduced minimum lot sizes as an incentive to increase open space, and community residents supported the use of these types of financial incentives to promote more environmentally friendly homes (Ellis, 2006). A combination of incentives, such as reduced setback requirements, density bonuses, and state and federal tax credits, may be the best option to promote conservation subdivisions in some communities (Carter, 2009).

Although developers and residents concerned about property rights often resist conservation planning efforts (Peterson & Liu, 2008), community workshops and charrettes were able to address these concerns in three of our case study communities. Highlighting the economic and environmental benefits of conservation subdivisions and dispelling myths about higher construction costs helped address concerns in Randolph County while bitter conflict erupted in the Town of Davidson over the issue of "takings" and the perceived loss of property value associated with smaller lots in conservation subdivisions. Before the workshops and meetings, communication between adjacent landowners and developers of conservation subdivisions was limited to the more formal settings of public hearings or board of commissioners meetings. The workshops and charrettes created an informal setting where adjacent landowners and concerned citizens could see the proposed development plan, raise their concerns directly to the developer, and work with the developer to find a solution that addressed their concerns. Encouraging public participation early on in the process was one key to success. Public participation often comes too late in the process, after decisions have been made, leaving local officials to defend decisions instead of educating the public and seeking input. Conversely, involving relevant stakeholder groups early in the process, reaching decisions by consensus, and adopting a problem-solving approach can facilitate environmental advocacy efforts (Cox, 2006).

Resistance to conservation subdivisions among local politicians may be explained by concerns about potential public backlash against perceived property rights violations or economic damage related to slowing the pace of construction by lengthening approval and permitting processes. The first concern can be addressed with the same type of community workshops used in case study communities to educate developers. Concerns about economic damage can be addressed using workshops and seeking out examples of successful neighboring communities. The City of Hickory was able to encourage conservation subdivisions by changing regulations to remove barriers without adding additional regulations, or increasing permitting or approval time, potentially a politically costly option (Bowman & Thompson, 2009; Carter, 2009). This market approach removed barriers to conservation subdivisions without raising concerns about slowing economic growth through excessive regulation.

However, local communities also must address political pressures from beyond their geographic boundaries as immigrants from urban areas migrate to rural areas (Smith & Krannich, 2000). When residents are concerned about loss of rural character associated with future development, politicians can gamble with new regulations favoring conservation development (Carter, 2009; Ryan, 2002). Once external development pressures reach high levels, however, new regulations must be proposed in a high stakes environment where politicians face potentially unacceptable risk (Peterson & Liu, 2008). Our case study findings suggest successful communities reacted to impending development before development pressures overwhelmed local infrastructure and political capital. Building moratoriums are a way communities can halt residential growth while a land use plan is developed. Moratoriums were used in the Town of Davidson to stop development while the town gauged public sentiment about the direction of the community growth and adopted a land use plan. Davidson was growing at a rate of 74% over 10 years and land prices were at a premium when the town passed the building moratorium. This may explain why new regulations were met with such opposition from developers and landowners who felt the new regulations would lower their property values or increase housing density. Moratoriums are more common in areas of rapid growth as a way to halt the approval of building permits due to a lack of public facilities like sewers, roads, or schools (Janczyk and Constance 1980). Low-density, unplanned development raises the cost of providing public services while higher-density, compact, planned development can reduce the amount of infrastructure required and reduce the public service costs (Carruthers & Ulfarsson, 2003).

Success at implementing conservation subdivisions also required time from the planning department to meet with developers, review sketch plans, perform site visits, and work with developers and residents to come up with a plan that conserves quality open space (Arendt, 1999). Rural counties without the resources necessary to adopt conservation subdivision ordinances could seek out regional partners with land trusts or a council of governments to help defray the costs of rewriting ordinances and sponsoring workshops to promote conservation subdivisions (Carter, 2009). Having an active land trust involved in promoting conservation subdivisions also might alleviate concerns over the long-term management of open space, and could help conserve more ecologically significant open space if the land trust was involved early in the process.

Conservation subdivisions may offer environmental and economic benefits when compared to conventional subdivisions, but there are several potential barriers that must be addressed by communities trying to incorporate conservation subdivisions. Design workshops and charrettes advertising local examples of financially viable conservation subdivisions may be effective means of encouraging conservation subdivisions. Our results suggest charrettes may be more effective when tailored to specific stakeholder audiences. For example information highlighting profitable conservation subdivisions with high resale value would motivate developers and real-estate agents and dispelling myths about property takings would encourage participation among landowners. Providing incentives to developers, requiring funding and long-term management plans for the conserved open space, and reworking the approval process to favor conservation subdivisions can overcome some of the other major barriers to their successful implementation. With these incentives, conservation subdivision development rates may begin to reflect the ecological and social advantages they have over traditional subdivisions.

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