

**Perceptions and Preferences of Blount County Residents
Regarding the Conversion of Land
to a Dairy or Residential Development**

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Executive Summary

This research was funded by the University of Tennessee Institute of Agriculture (UTIA) to better understand how Blount County residents would view the conversion of a 500-acre tract of land to a dairy. Between January and March, 2008, 518 Blount County residents were surveyed via telephone by UTIA's Human Dimensions Laboratory regarding their perceptions and preferences with respect to the conversion of a hypothetical tract of land to either a dairy farm or a residential subdivision. Conversion of the tract to a residential subdivision was used as an alternative to a dairy farm, to present respondents with a land use scenario common to many rapidly growing communities at the urban-rural fringe. In the survey, respondents were asked to indicate their level of concern over different possible effects of land use change in their community and whether they thought a dairy farm or residential subdivision was more likely associated with these effects. Respondents were also asked to indicate their level of concern with the conversion of a 500-acre tract of land to either a 300-head dairy or a subdivision. For this question, the proximity of the tract of land to the respondent's home and the density of the residential development were randomly varied over three distances (next door, 2 miles away, and 10 miles away) and three house/lot size densities and average home values (90 \$500,000 homes on five-acre lots, 400 \$350,000 homes on one-acre lots, and 1,400 \$200,000 homes on 0.25 acre lots). The distance to the hypothesized site was varied to determine whether responses to the conversion differed between those who

lived near the site and those farther away. Varying the characteristics of the residential development allowed the subdivision alternative to be specified with some detail while allowing analysis of how differences in these details influenced the perceptions and preferences of the respondents. The survey also included a series of questions about personal and household characteristics. The overall response rate for the survey was 21% and, of the 518 respondents, 387 completed the survey.

Key Findings

- Over 60% of respondents were “not at all concerned” about the conversion of a hypothetical 500-acre tract of land to a 300-head dairy farm.
- About 88% of those surveyed preferred the conversion of the tract of land to a dairy rather than a residential subdivision.
- More than 95% of the respondents believed that conversion of a tract of land to a dairy would be more likely to enhance wildlife habitat and provide more open space than would conversion of the land to a residential subdivision.
- More than 92% of the respondents believed that conversion of land to a subdivision would be more likely to increase traffic congestion, air pollution, and water consumption than would conversion to a dairy farm.
- Respondents were most concerned with the effects of development projects on traffic congestion and water quality, followed closely by the effects on water consumption, wildlife habitat, and air quality.

Key Findings (continued)

- Residents located near the hypothetical site expressed concern over the potential for the dairy to generate offensive odors.
- Persons more concerned about access to open space and the impacts of development on the local economy were also more concerned about the conversion of land to a residential development, and preferred the land to be converted to a dairy.
- Persons living farther away from urban amenities preferred that the land be converted to a dairy rather than a subdivision.
- Respondents whose homes had more extensive vantage points or viewsheds were more likely to prefer the conversion of land to a dairy than a subdivision.
- Households with children and retired residents were more likely to prefer the land converted to a residential subdivision than a dairy.

Discussion

Blount County residents appear to have strong sentiments for retaining agricultural landscapes and moderating the development of residential subdivisions. Slightly more than 60% of respondents to this survey were “not at all concerned” about the conversion of a large tract of land to a 300-head dairy farm. Slightly less than 10% of respondents were “extremely concerned” about conversion of the land to a dairy, while over 56% were extremely concerned about conversion to a subdivision. The percentage of respondents preferring the dairy to the subdivision varied from 72 to 96%, depending on the distance to the hypothetical project and the density of the residential development.

Respondent preference for the dairy was lowest when the hypothetical site was located next door to the respondent and the residential development was low-density with high-valued homes, but respondent preference for the dairy was highest when the hypothetical site was located approximately 2 miles away and the residential development was medium-density with medium-valued homes.

A comparison of the level of respondent concern over the possible effects of land use change on the community, and respondent beliefs as to whether conversion to a dairy or subdivision would be more likely to engender these effects, provides some understanding why most respondents preferred the dairy. Respondents were most concerned about the effects of land use change on air and water quality, traffic congestion, water consumption, and wildlife habitat. And, respondents overwhelmingly believed that conversion of the parcel to a subdivision was more likely aggravate these issues. Though respondents believed that the subdivision development would likely increase the local tax base and nearby property values, create more jobs, and lead to more dining and shopping opportunities, these positive economic effects were not enough to offset respondents' preferences for the potential amenities associated with the dairy.

Regression analyses of survey responses suggest that respondents who were located farther away from the hypothetical site were more likely to prefer the dairy. The decrease in support for the dairy among those nearest the site appears to be due to concerns over localized disamenities, in particular, odor. Respondents who lived farther away from parks, railroads, the Maryville central business district, and certain types of open space (water bodies, golf courses and the Great Smoky Mountains National Park) were more likely to favor the dairy. Respondents whose homes commanded a larger

viewshed were more likely to favor the dairy, suggesting that respondents may prefer the scenery provided by the dairy farm to those provided by subdivisions. Respondents with children, who were retired, or worked in the construction industry, were more likely to favor the subdivision, perhaps reflecting a preference for affordable housing, economic development, and increased employment or income. Respondents more concerned about the effect of land use change on local economic factors (i.e., the local tax base, number of jobs, home value, and retail dining and shopping opportunities) were more likely to favor the hypothetical dairy.

That respondents most concerned about local economic factors preferred a dairy over the greater potential economic growth associated with residential development may seem at first glance somewhat counterintuitive. One explanation for this preference could be that people more concerned about their home value, the number of jobs, dining and shopping opportunities and the local tax base view rapid population growth as the problem and not the solution. Thus, for example, more houses (and people) may not be viewed as a way to increase dining and shopping opportunities but as a way to increase congestion. Or, while population growth may add more to the tax base than a dairy, it could also place a greater demand on the tax base than a dairy in terms of new utilities and roads. A complementary explanation might be that the amenities provided by the dairy are perceived to add value to community quality by providing green space as well as a sense of cultural heritage. In both cases, it seems then that the opportunity costs of forgoing open space and an agricultural heritage for residential development are high for many Blount County residents. This preferential pattern seems consistent with the debate in many rural-urban fringe communities on the relative merits of conserving cultural

traditions tied to the land versus conversion of land for development purposes. In this sense, many residents may be conflicted about enjoying economic growth through residential development on the one hand and preserving the values that make their community special on the other.

Perceptions and Preferences of Blount County Residents

Introduction

After decades of migration off the farm, rapid urbanization and suburbanization are bringing increasing numbers of people back into contact with agriculture. Only now, few of these individuals have a direct link to agriculture, and modern agricultural production may not coincide with the romantic notions of the bucolic rural life. The following excerpt from a *New York Times* article regarding a traditionally rural area in the northeastern-most part of Long Island illustrates this disconnect:

As the North Fork — country cousin to the trendier peninsula to the south — has become an increasingly attractive place for those seeking the un-Hamptons, efforts to preserve farmland and maintain its rural character are bumping up against the constant creep of suburbanization.

Yet some of those city dwellers and suburbanites are not nearly as enamored of the less pleasant aspects of farms, like noisy machinery, animal smells, pesticides, dust from plowing, and zoning that lets homeowners keep barnyard animals.

More and more, those culture clashes are the subject of town hall meetings and political campaigns in Riverhead and Southold, with officials caught in the battle over supporting farmers' livelihoods and other homeowners' quality of life.

“There are so many developments cropping up next to farmland, I was curious if there was any town regulation about it,” said Ms. Kennedy, who said she ultimately decided against complaining to town officials here, and advised her neighbors not to complain to the farmer.

“You don't want to get him mad enough to sell to a developer, so we wind up with a strip mall there,” she said. “A lot of people moved here because it has a rural feel without really being rural.”

Ms. Kennedy wound up staying inside her new house with the windows shut until the booming stopped, less than two weeks later.

Not everyone stifles the urge to complain.

In Southold, the town supervisor, Scott A. Russell, proposed a crackdown on animal noises from farms and from the homes of longtime residents taking advantage of agricultural zoning. (Kilgannon, 2007).

Simply put, while many people like the idea of living in a rural setting, many are unprepared for the realities of living near working farms or livestock operations. However, the choice for these residents is not typically between agriculture and undeveloped land, but between agriculture and some form of urban or suburban development. As Ms. Kennedy realizes, eliminating the smells and noises associated with agricultural production may also lead to the loss of the rural character of her community, or as councilman William Edwards put it: “We’re wrestling with what kind of town we really want to be. We’ll no longer be rural if we can’t preserve our open farmland, and the best way to do that is to let the farmers farm it.” (Kilgannon, 2007).

While East Tennessee and Long Island’s North Fork may have their differences, both are characterized by increasing urbanization and suburbanization of historically rural, agricultural lands. In East Tennessee, this change is fueled by rapid population growth, as the region’s low taxes, abundant recreational opportunities, scenic beauty, and relaxed lifestyle attract migrants from around the country. Blount County is prototypical of this type of growth. Blount County ranks in the top 25% among U.S. counties with respect to Economic Research Service’s (2003) Natural Amenity Index. A gateway to the Great Smoky Mountains National Park, Blount County is rich in natural amenities, including lakes, rivers, and panoramic vistas. But population growth has accelerated since the 1980s, fueled by the development of retirement communities and by Blount County’s role as a bedroom community for commuters working in the Knoxville-Sevierville-La Follette Combined Statistical Area. For example, the population of Blount County grew

by 39% from 1990 to 2007, and the percentage of the population classified as rural declined by 11% from 1990 to 2000. This rapid population growth generates economic benefits, but also threatens the characteristics that attracted newcomers to the area in the first place - natural amenities, scenic beauty, and a rural lifestyle.

Conflict between suburbanization and continued agricultural production is an important topic in many communities, in part, because approximately 40% of the nation's farms are located in metropolitan counties. Conversion of farmland to urban uses represents less than 0.1% of U.S. farmland per year, but local farmland losses continues to rally public support for farmland protection to preserve rural amenities (Nickerson and Hellerstein, 2003). Statistics from the Census of Agriculture provide an overview of Blount County's agricultural industry. From 1987 to 1997, Blount County lost about 8% of its farmland, but the amount of farmland increased by about 2% from 1997 to 2002, reflecting a national trend of increasing numbers of small "hobby" or "lifestyle" farms (Lambert, Wojan, and Sullivan, 2010). In 2002, a little less than 33% of Blount County's land area was in agricultural production. And, like other metropolitan counties across the nation, farmland values have skyrocketed in Blount County. From 1992 to 2002, real farmland value, estimated as the county sales from agricultural marketing divided by the land in farms, increased by 114% to \$5,306 per acre (1992 dollars) (Agricultural Census, 2002). The 1,000 head of dairy cattle in Blount County in 2007 represented a 38% decrease from 2000, also reflecting the nation-wide decrease in the number of small and medium scale dairy farms (NASS, 2008). Beef cattle production in Blount County fared better over the same period, as the total number of cattle in Blount County increased by about 9% to 36,000 head (NASS, 2008).

These trends suggests that some Blount County residents may find themselves facing the same dilemma confronting North Fork residents – accept the disamenities associated with agricultural production, or face the prospect of more rapid urbanization or suburbanization. Indeed, local action groups, such as the Foothills Land Conservancy, are actively engaged in preserving the ecological and cultural heritage of Blount County through the acquisition of interests in real property, focusing on property with attributes such as agricultural productivity, ecological integrity, and historic character. Land use change has also been in the forefront of many Blount County residents’ minds due to the proposed 4.4 mile extension of interstate I-140 in the County. In response to concerns raised by local citizens, the Tennessee Department of Transportation has consented to perform an environmental impact statement before continuing the project.

Gaining a better understanding of how residents view the potential conflict between continued agricultural production and urbanization or suburbanization of farmland open space is important to the University of Tennessee Institute of Agriculture (the “Institute”) as it strives to fulfill its research and outreach missions. However, the views of Blount County residents are of particular importance to the Institute as it is currently in the process of relocating its dairy research facility from Knoxville to Blount County. Relocation of the dairy research facility provides the Institute an opportunity to understand better the perceptions that communities on the rural-urban fringe have of animal agriculture, the extent to which the reality of animal agriculture matches these perceptions, and the value communities place on the preservation of working agricultural landscapes in the face of increasing urban and suburban development. While the site for the facility once supported agricultural production, these operations had ceased until the

Institute began using the site to produce row crops. In the meantime, the area surrounding the site has undergone substantial residential development. As a result, the site is essentially a large parcel of long fallowed grazing land that, but for the transfer of the property to the Institute, would be facing substantial development pressure, with the most likely outcome being the construction of a residential subdivision.

The present research is the first stage of a two-part project. The primary objective of the initial stage project is to explore the perceptions and preferences of local residents regarding the hypothetical conversion of a large tract of undeveloped land to either a dairy facility or a residential subdivision. As a result, a telephone survey of Blount County residents was conducted and the responses analyzed. A second stage of the project, planned for some point after the dairy facility has been operational for a period of time, will attempt to determine how the views of nearby residents change after the construction and operation of the facility. Gaining a better understanding of resident views concerning the presence of a dairy facility will (1) inform the Institute about resident concerns, and (2) enable the Institute to address these concerns while promoting the facility's benefits to the local community. Further, evaluating how the construction and operation of the facility alters resident views about dairies operating in a suburban/urban community will enable the Institute to evaluate, anticipate, and re-focus efforts to avoid or mitigate conflicts or concerns with local residents. Understanding resident perceptions and values regarding the potential physical and environmental impacts of the dairy facility in the community complement ongoing research by the Institute to establish a composite baseline data set before the dairy becomes operational. Finally, a better understanding of how communities value the preservation of land as

working agricultural enterprises will provide the agricultural community and policy makers in Tennessee useful information to guide both agricultural and land use policy and planning.

Literature Review

There is a well-developed literature examining the value of farmland preservation and the amenities associated with having land in agricultural production. Bergstrom and Ready (2009), Kukielka, Johnston, and Duke (2008), Lynch (2007) and McConnell and Walls (2005) provide detailed summaries of this research. Lynch and Duke (2007) use this literature to evaluate the extent to which farmland preservation programs meet their stated goals. Attempts to value the disamenities associated with agricultural production are less numerous, although Bergstrom and Ready (2009) discuss some of these efforts. What follows is an examination of the literature relevant to this research.

The starting point for this examination is a more careful consideration of the nature of the amenities and disamenities associated with a particular land use. Any of the possible uses of a parcel of land has a wide range of implications for nearby landowners and other community members. Thus, each land use has what is essentially a multi-attribute “profile”, or vector of values that encompass a wide variety of factors. Whether an individual element in this vector considering a particular land use generates an amenity or a disamenity depends on the potential alternative uses of the land. Thus, the extent of erosion associated with land in pasture might be a disamenity compared to forested land cover, but an amenity when compared to having the land in tillage.

Gardner (1977) suggested that the amenity values provided by farmland fit in at least one of four categories “(a) ‘sufficient’ food and fiber to meet the nutritional

requirements of a growing national and world population; (b) local economic benefits that derive from a viable agricultural industry; (c) open space and other environmental amenities that accrue chiefly to urban residents; and (d) more efficient, orderly, and fiscally sound urban development” (Gardner, 1977, pp. 1028-1029). More recently, Bergstrom and Ready (2009) categorized the amenities associated with farmland into (i) public access use values, as might be gained from farm and ranch tours, wildlife viewing, or hunting excursions, (ii) use values that do not involve public access, such as scenic vistas or the prevention of undesirable development, and (iii) nonuse values, such as existence values associated with the provision of wildlife habitat or the contribution of the agricultural activity to cultural heritage values or national food security.

As used here, the terms ‘amenity’ and ‘disamenity’ refer to those benefits and costs that accrue to individuals for reasons other than their ownership of the land or involvement in the production, sale or consumption of those commodities produced on the land. These *external* costs and benefits are of interest to economists because their existence suggests the possibility of market failure, or an instance in which the market fails to allocate efficiently land to the most competitive use. This failure lends a possible rationale for government intervention through some type of farmland preservation program or land use regulation. Pollution of public waterways provides a classic example of an external cost. Potential disamenities associated with dairy production would include, for example, odor, stormwater runoff, dust, or increased traffic congestion due to farm equipment sharing public roads. On the other hand, residential development may impose external costs in the form of increased traffic congestion, decreased open space, or increased use of public infrastructure (e.g., water and sewage treatment).

An important consideration when quantifying externalities is between the costs and benefits reflected in an actual market and those that are not. Thus, while these external costs and benefits are not normally transacted in a market, they may influence the prices or availability of goods and services that *are* typically exchanged in a market. For example, while there is no market to purchase “odor-free” air, a land use that emits a strong odor may negatively affect the value of nearby homes. The effect on the housing market provides economists with a way to measure the value people place on reducing this odor. The distinction between the external costs and benefits that affect market prices and those that do not, as well as the distinction between use and non-use values, are important for understanding the different approaches that have been used to value these amenities and disamenities.

These approaches can be divided into (i) those that attempt to determine what characteristics of land use preservation are important to people, and (ii) those that attempt to quantify the utility people receive from such characteristics or from preservation more generally. Two methods have been used to determine what characteristics are important to people. The first typically surveys individuals, directly asking what psychic enjoyment or physical benefits they receive from the amenities provided through farmland preservation. Lynch (2007), in summarizing these studies, concludes that people tend to favor “a mix between agricultural objectives, such as local food production and a rural way of life, and environmental objectives, such as water quality and wildlife habitat” (Lynch, 2007, p. 13). The second method involves examining the expressed goals of farmland preservation programs. These goals generally include the preservation of a productive land base for the agricultural economy, the amenity values of open space and

rural character, moderation of suburban sprawl, and the provision of wildlife habitat and increased groundwater recharge (Lynch, 2007).

Studies attempting to quantify the benefits people receive from farmland preservation rely on one or more of three approaches: (i) hedonic price methods (HPM), (ii) contingent valuation (CV), or (iii) conjoint analysis (CA). The HPM studies use price and other data from real estate markets to estimate the effect proximity to agricultural land or particular types of agricultural operations (e.g., confined animal operations) has on nearby property values. Thus, HPM has the advantage of relying on individual behavior in an actual market, but is only capable of capturing local use values. The CV approach is a hypothetical market exercise where survey respondents are asked, in one way or another, to express their willingness-to-pay (WTP) for farmland preservation. Because expressions of WTP are presumably based on the full range of benefits, that farmland provides to respondents, CV can generate comprehensive valuation of all of the amenities associated with farmland preservation. On the other hand, CV does not rely on the behavior of individuals in actual markets, but is instead the product of a hypothetical market exercise. The CA method is another hypothetical market exercise that asks respondents to make a series of choices between different bundles of goods or services. These choices reveal how a respondent is willing to trade various attributes of these goods or services against each other. For example, if one attribute is farmland preservation (or a particular characteristic of farmland preservation) and another is price, then a monetary value for the attribute or for farmland preservation more generally can be estimated.³

³ More information on these benefit estimation methods can be found in Freeman (1993).

A general finding in the literature is that people tend to support the preservation of farmland in its current use (Bergstrom and Ready, 2009).⁴ More specifically, these studies have generally found that: 1) WTP increases with the amount of acres preserved; 2) WTP is higher in areas where farmland is more scarce but declines as the amount of area already preserved increases; and 3) WTP is positively related to the intensity of the alternative land use (i.e., what happens to the land in the absence of preservation) (Bergstrom and Ready, 2009). These studies provide mixed or inconclusive results regarding the effect of distance to the preserved parcel. This uncertainty appears to result, at least in part, from “localized disamenities associated with active farming (e.g., noise , odors, dust)” (Bergstrom and Ready, 2009). Thus, while a community’s residents may support farmland preservation; this support may not be as strong among residents nearest the preserved farmland. Moreover, what is not clear is whether there are differences between the WTP for certain types of farm operations. For instance, the WTP for preservation of farmland as pasture for horses may be very different from that attributed to large-scale, intensive hog-grain or poultry operations.

The positive correlation between the amount of farmland being preserved and WTP implies that attempts to analyze public preferences for farmland preservation should carefully consider the amount of land to be preserved, and possibly the type of farm operation associated with the parcel. Similarly, the relationship between WTP and alternative land uses suggests that such analyses should clearly specify what happens if the land does not remain in agricultural production (Bergstrom and Ready, 2009). The finding that agricultural practices can have a negative effect on nearby property values

⁴ This result should not be too surprising given the multitude of farmland preservation programs in existence across the country, and the success of ballot referenda to enact such programs or devotion of governmental revenues to fund such programs (AFT, 2005a; AFT, 2005b; LTA and TPL, 2006).

(e.g., Ready and Abdalla, 2005; Herriges et al., 2005; Palmquist et al., 1997) implies that specifying the type of agricultural operation is important, particularly when the operation is a relatively intense livestock operation. For example, Pfeffer and Lapping (1995) found that preservation of some forms of conventional agricultural production, particularly dairy farming, might not be the type of agricultural production non-farm residents wish to conserve.⁵ Similarly, Ready and Abdalla (2005) found that open spaces, including agricultural open spaces, had a positive impact on nearby housing prices, while larger scale animal production facilities had a negative impact on nearby housing prices. Noting that farmers seeking to build large, new dairies have faced substantial resistance from some community members where they were attempting to locate. Eberle, Rendleman, and Peterson (2006) investigated resident WTP to pay to stop a dairy from locating nearby. In general, they found that most residents were unwilling to pay anything to keep a dairy away, although more residents expressed a positive WTP when the proposed dairy was large than when it was small.

Thus, the uncertainty over the effect of distance to farmland preservation sites, the kind of farm operation, and the expectation that this uncertainty may generate localized disamenities suggest the need for further research into the relationship between distance, the nature of the agricultural operations, and alternative non-farm land uses under consideration.⁶

⁵ This point is supported by instances in which nearby residents attempt to prevent more intensive operations from occurring on previously preserved land (e.g., van den Beemt, 2008)

⁶ “Previous studies clearly show that acreage protected is an important factor influencing WTP for farmland protection. Future studies should therefore include acreage protected as a standard design factor. Given the results of previous studies showing the strong influence of alternative land use on WTP for farmland protection, this factor should also be included in future studies as a standard design factor. More research and data are needed to better assess the full range of alternative land uses on WTP for farmland amenities (e.g., different types of high density development including “Smart Growth” development). . . More research and data are also needed to better assess how WTP for farmland amenities is influenced by

Methods and Procedures

Survey Design and Implementation

The survey data was collected by telephoning Blount County residents in the seven census tracts located within a five-mile radius of the Institute's proposed dairy research facility (the "Little River Dairy"). The survey sample was selected randomly from a database of households with known addresses in these census tracts to facilitate geospatial location of the respondents. The design of the survey took place over a four-month period from October, 2007, to February, 2008, and included several iterations of field testing the survey instrument. The final version of the survey included questions about resident level of concern over various effects of land use change, perceptions about the conversion of land to a dairy or a residential subdivision, preferences over the conversion of a 500-acre parcel to either a dairy or a residential subdivision and various personal and household characteristics. (The survey is attached as Appendix I.)

The survey was designed as the first stage of a two-part study. By conducting the survey prior to construction of the facility, it serves as a baseline for the perceptions and preferences of nearby residents regarding the conversion of open space to a dairy facility. The second stage—to be conducted at some point after the facility has operated for a period of time—will analyze whether, how, and why these perceptions change. No attempt was made in the first stage to value respondent WTP to preserve the land in agricultural use due to the prevalence of such studies in the literature, difficulties in designing a sensible instrument whereby respondents could express WTP, and concerns over the

different agricultural uses of the land to be protected including commodities produced and the intensity of production" (Bergstrom and Ready, 2009).

effect such a question might have on public reaction to the facility. It is worth noting that the design of the survey was influenced by the desire to avoid fostering or aggravating any public opposition to the relocation of the dairy facility to Blount County.

Survey Sample

The survey was implemented from February 21, 2008, to March 30, 2008. The response rate was 21%, or 518 completed surveys out of 2,468 eligible numbers called.

Determining how representative the completed responses are of the general population in these seven census tracts is difficult given the time lag since the 2000 Census. However, comparing the demographics of survey respondents to those reported for these census tracts in 2000 indicates that the survey respondents were, in general, older, better educated, earned higher incomes and owned more expensive homes than the general population (Figures 1 - 4). While inflation and real estate appreciation explain some of these differences, it seems clear that the younger, less educated, and less wealthy segments of the population are likely under-represented. Similarly, survey respondents were more likely to be home owners (95% of the survey respondents reported owning their home compared to the Census estimate that only 82% of the occupied housing units in the area were owner occupied). Also, survey respondents may have generally enjoyed a longer tenure in Blount County than the general population; while only 13.9% of the survey respondents claimed to have lived in Blount County for five years or less, the Census reported that 18.7% of the population five and over in 2000 had lived somewhere other than Blount County in 1995. In other ways, the respondents were quite representative of the area's population.

Figure 1. Educational Attainment Distribution: Survey Respondents and 2000 Census

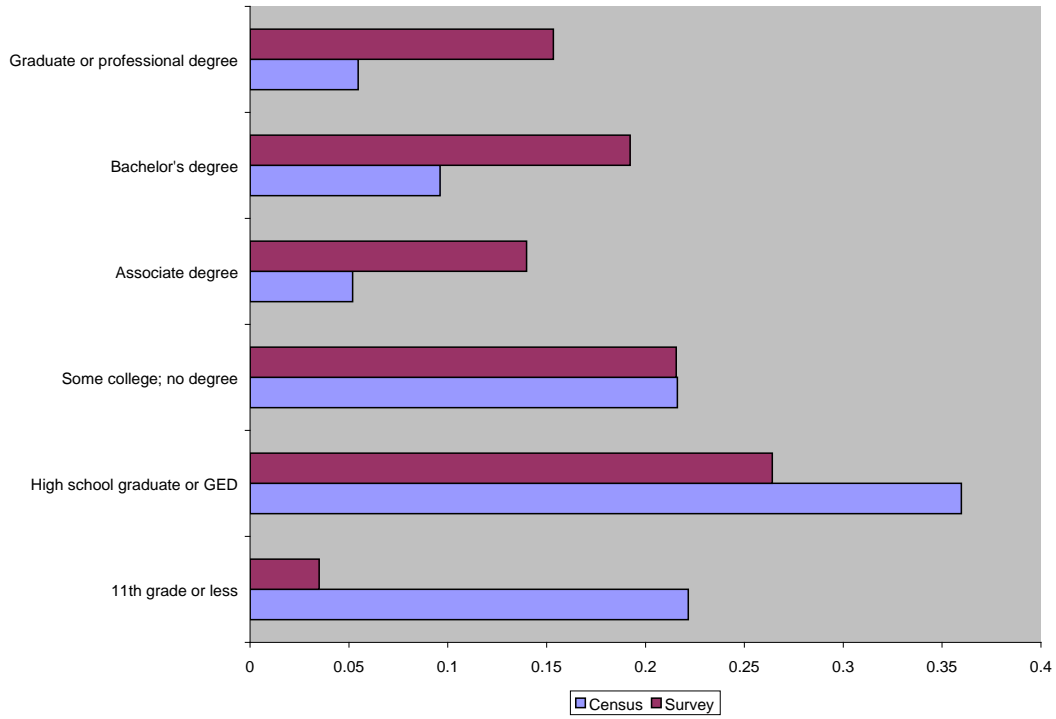


Figure 2. Household Income Distribution: Survey Respondents and 2000 Census

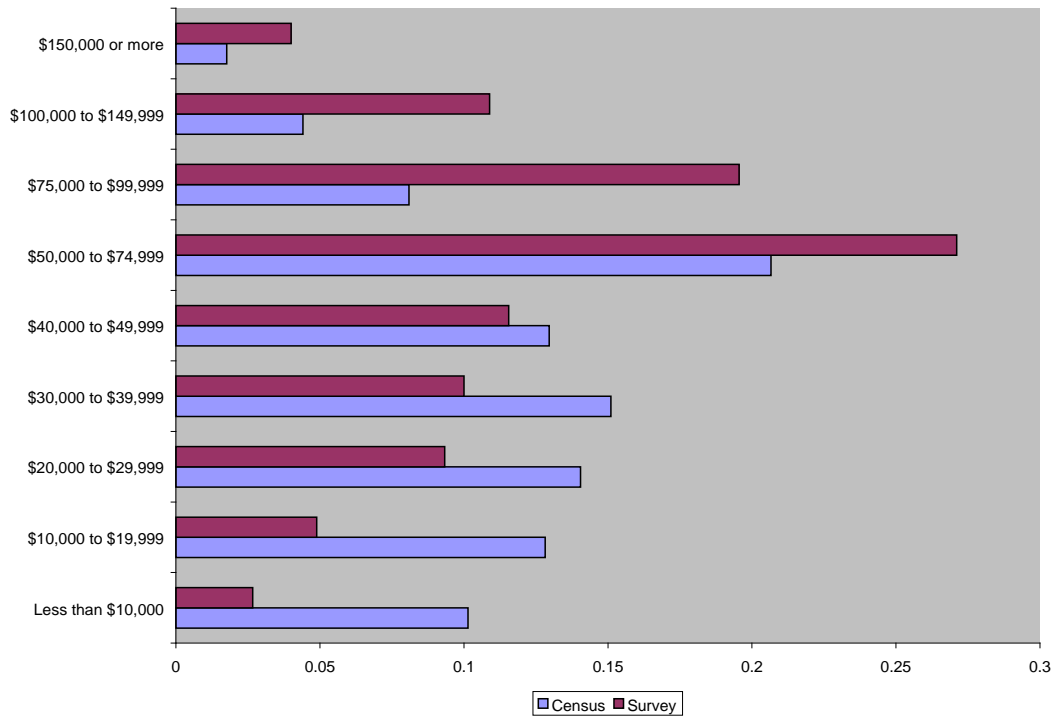


Figure 3. Age Distribution: Survey Respondents and 2000 Census

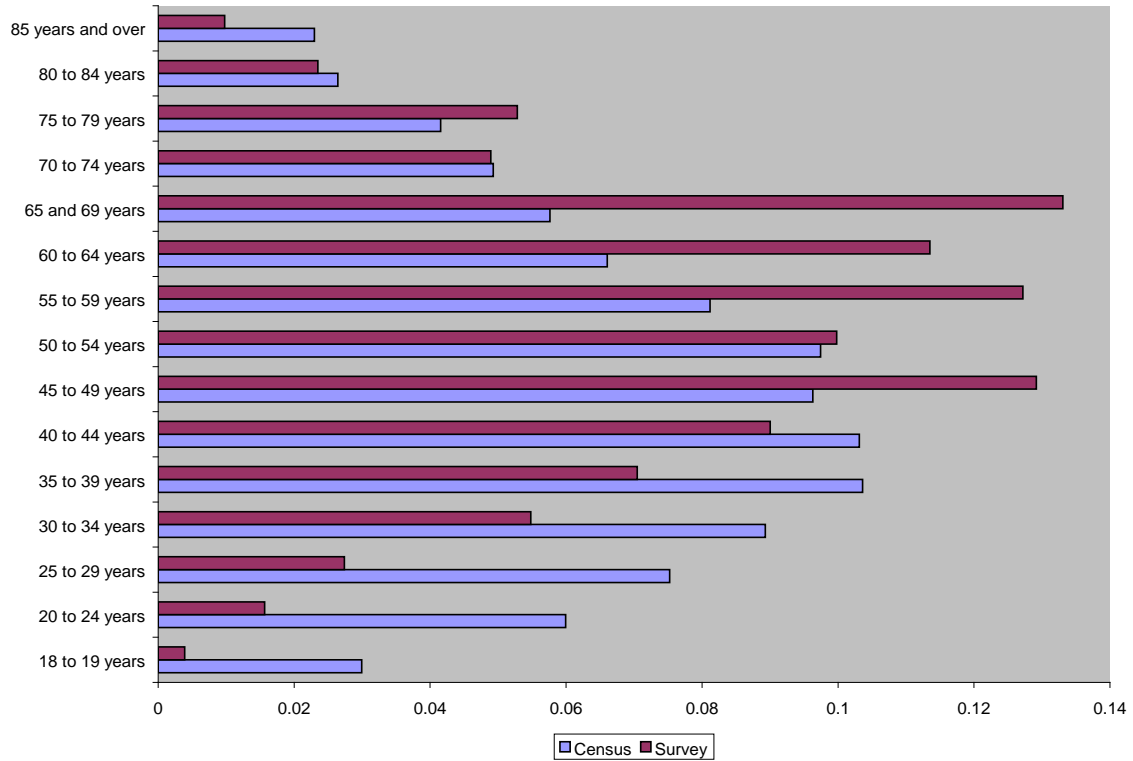
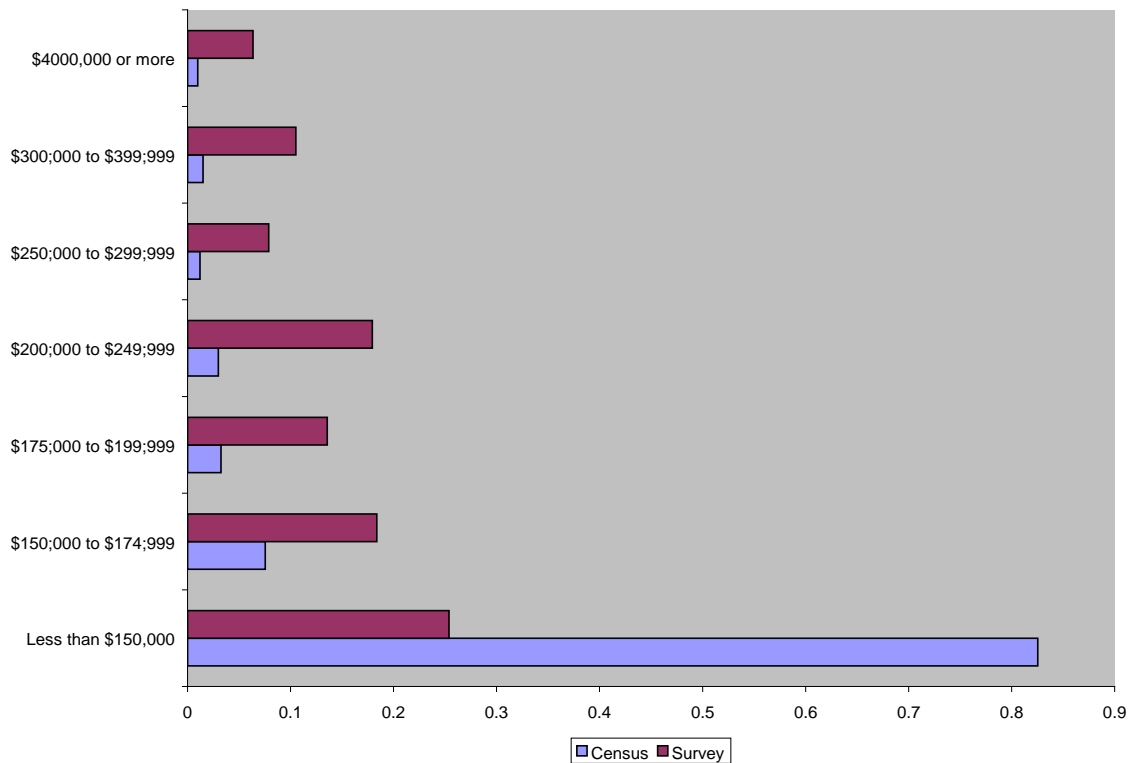


Figure 4. Home Value Distribution: Survey Respondents and 2000 Census



For instance, while 52.4% of the population 18 and over was female in 2000, 52.3% of the survey respondents were female. Similarly, average household size in 2000 was 2.5 people and the average household size for survey respondents was 2.6. Finally, 59.2% of the population 16 and over was employed in 2000, and 61.2% of the survey respondents (all over the age of 18) were employed or self-employed.⁷

Survey Overview

In addition to personal and demographic questions, the survey included questions designed to prompt respondents to consider diverse potential impacts of the conversion of a hypothetical 500 acre tract of land to a dairy farm or a residential subdivision. The first of these series of questions asked respondents to indicate the extent to which they were concerned about twelve possible effects of land use change (Table 1). The survey also included a question that asked respondents to indicate whether they thought conversion of the land to a dairy or residential subdivision was more likely to be associated with a list of twelve effects on local community characteristics (Table 2).

Respondents were then asked to indicate, on a scale of 1 to 5, with 1 meaning “not at all concerned” and 5 meaning “extremely concerned”, how concerned they were about the conversion of a 500-acre land parcel to a 500-acre dairy with 300 cows. Next, using the same ranking system, respondents were asked how concerned they would be if the 500-acre parcel of land was converted to a residential subdivision. Respondents were randomly assigned one of three versions of the dairy question (based on distance to the

⁷ The survey sample statistics reported here are based on the entire sample and may differ from statistics based on the portion of the sample that provided answers to all of the survey questions, as is the case for Table 5.

facility), and one of nine versions of the residential subdivision question (based on distance to subdivision and housing density).

Table 1. Concern over effects of land use change on community characteristics.

<u>Community Characteristic</u>	<u>Mean</u> ¹	<u>Std. Dev</u>	<u>N</u>	<u>Min</u>	<u>Max</u>
Traffic Congestion	4.359 ^a	1.021	516	1	5
Water Quality	4.301 ^{a,b}	1.052	515	1	5
Air Quality	4.248 ^b	1.100	517	1	5
Water Consumption	4.153 ^c	1.146	515	1	5
Wildlife Habitat	4.124 ^c	1.136	516	1	5
School Enrollment	3.854 ^d	1.268	512	1	5
Tax Base	3.826 ^{d,e}	1.257	512	1	5
Open Space	3.801 ^{d,e}	1.220	513	1	5
Public Services	3.731 ^{e,f}	1.204	510	1	5
Own Home Value	3.650 ^f	1.282	500	1	5
Job Creation	3.467	1.269	508	1	5
Dining & Shopping	2.841	1.294	511	1	5

¹ Range is 1 to 5 where 1 is not at all concerned and 5 is extremely concerned about the effect land use change will have on the community characteristic. Like letters indicate that means are not significantly different at a 5% level of significance.

For both questions, distance from the respondent’s home to the parcel being developed varied; (i) next door, (ii) two miles away, and (iii) ten miles away. For the residential subdivision question, the nature of the residential subdivision also varied across three development scenarios; (i) 90 single-family homes on five-acre lots with an average value of \$500,000, (ii) 400 single-family homes on one-acre lots with an average value of \$350,000, and (iii) 1,400 single-family homes on 0.25 acre lots with an average value of \$200,000. Respondent preference for conversion to either the hypothetical dairy or the subdivision was derived from their answers to the level of concern questions, with the less-favored option defined as the option for which the respondent expressed the greatest concern. If respondents expressed the same level of concern with both the dairy

and the subdivision, they were asked to choose between the two. This sequence of questions eliminated ties between the development alternatives. Preferences for the dairy and residential development are summarized over the randomly-assigned distance and residential density scenarios (Table 3). Respondents were also asked two open-ended follow-up questions about what concerned them most about the possible conversion of the parcel to the dairy (Table 4) or to the subdivision.

Table 2. Perceptions of whether conversion to residential subdivision or dairy farm is more likely to have specified effect on community

<u>Effect on Community</u>	<u>Residential Subdivision</u>	<u>Dairy Farm</u>	<u>Neither</u>	<u>N</u>
Cause more traffic congestion	99.2%	0.6%	0.2%	518
Cause more water pollution	83.0%	16.8%	0.2%	494
Cause more air pollution	92.5%	5.9%	1.6%	510
Consume more water	96.1%	3.3%	0.6%	510
Preserve wildlife habitat	3.5%	95.3%	1.2%	513
Lead to increase in public school enrollment	98.2%	1.8%	0.0%	514
Contribute more to local tax base	93.4%	6.4%	0.2%	503
Provide more open space	3.3%	95.7%	1.0%	516
Increase nearby property values	84.7%	13.9%	1.4%	489
Create more jobs	77.8%	17.3%	4.9%	490
Lead to more dining and shopping opportunities	93.0%	4.0%	3.0%	503
Lead to more outdoor recreational opportunities	45.5%	44.0%	10.5%	484

Analysis of Survey Results

Responses to these questions were analyzed with univariate statistics and multivariate regressions. The univariate statistics include simple percentages and mean comparisons reflecting the distribution of the surveyed population, resident concern about development, and preferences for residential development or a dairy.

Table 3. Preference for conversion to dairy by distance and nature of residential subdivision

Residential development type	Distance from 500 ac. tract of open space	Variable	N	Mean	Min	Max	Std. Error	
		Percent preferring dairy	—	72%	0	1	6%	
	Next to your home	Dairy farm level of concern 1/	60	2.47	1	5	0.21	
		Subdivision level of concern 1		4.12	1	5	0.19	
90 homes, 5 ac. Lots, 500 K/home 2/	2 mi. from your home	Percent preferring dairy		89%	0	1	4%	
		Dairy farm level of concern	54	1.57	1	5	0.16	
		Subdivision level of concern		3.98	1	5	0.17	
	10 mi. from your home	Percent preferring dairy			85%	0	1	4%
		Dairy farm level of concern	61	1.49	1	5	0.12	
		Subdivision level of concern		3.93	1	5	0.17	
400 homes, 1 ac. Lots, 350 K/home	Next to your home	Percent preferring dairy		89%	0	1	4%	
		Dairy farm level of concern	71	1.96	1	5	0.15	
		Subdivision level of concern		4.26	1	5	0.14	
	2 mi. from your home	Percent preferring dairy			97%	0	1	3%
		Dairy farm level of concern	47	1.84	1	5	0.17	
		Subdivision level of concern		4.19	1	5	0.17	
10 mi. from your home	Percent preferring dairy			85%	0	1	5%	
	Dairy farm level of concern	51	1.70	1	5	0.16		
	Subdivision level of concern		3.74	1	5	0.20		
1,400 homes, 1/4 ac. Lots, 200 K/home	Next to your home	Percent preferring dairy		88%	0	1	5%	
		Dairy farm level of concern	51	2.39	1	5	0.23	
		Subdivision level of concern		4.44	1	5	0.15	
	2 mi. from your home	Percent preferring dairy			85%	0	1	4%
		Dairy farm level of concern	65	2.20	1	5	0.19	
		Subdivision level of concern		3.91	1	5	0.17	
10 mi. from your home	Percent preferring dairy			95%	0	1	3%	
	Dairy farm level of concern	58	1.44	1	5	0.13		
	Subdivision level of concern		4.09	1	5	0.16		

Notes:

1/ 1 = not concerned at all about tract being converted to this use; 5 = extremely concerned at all about tract being converted to this use.

2/ ac. = acres, K = \$1,000's.

Statistical significances of differences between mean values were analyzed using *t* tests, while statistical significance of correlations between variables were analyzed by analysis of variance (ANOVA).

Table 4. Responses to open-ended question about greatest concern over parcel conversion to dairy by distance to parcel

What concerns you the most about the land being converted to a dairy farm?	If dairy farm is located . . .			
	Next door to respondent (N=68)	2 miles from respondent (N=47)	10 miles from respondent (N=29)	All respondents (N = 144)
Odor	66.2%	40.4%	27.6%	50.0%
Air or water pollution	22.1%	38.3%	41.4%	31.3%
Noise	4.4%	4.3%	0.0%	3.5%
Home value	4.4%	2.1%	6.9%	4.2%
Traffic	1.5%	2.1%	3.4%	2.1%
Water consumption	0.0%	4.3%	3.4%	2.1%
Escaped livestock	2.9%	0.0%	3.4%	2.1%
Other	10.3%	31.9%	31.0%	21.5%

The multivariate regression analyses included ordered probit analyses of respondent level of concern with conversion of the hypothetical parcel to the dairy or the subdivision, and probit analysis of which use respondents preferred (based either on their level of concern for the two uses or, in the event of equivalent levels of concern, on their direct expression of a preference for one use over the other). The extent to which collinearity influenced statistical inference was assessed using variance inflation factors (VIF) (Chatterjee and Price, 1991). Variance inflation factors greater than 10 suggest that standard errors may be inflated by collinearity. Standard errors of the multivariate regressions were estimated with a heteroskedastic robust covariance matrix.

Conceptual model for multivariate regression analysis

The behavioral foundations of the probit and ordered probit regressions are the random utility model (McFadden 1984). Ordered probit regressions are used extensively to analyze ordinal survey response data (e.g., Cooper and Osborn, 1998; Dennis, 2000; Calfee et al., 2001; Greene 2003). Individuals are hypothesized to rank mutually exclusive items (or preferences) in a certain category that maximizes their utility. For the i th respondent there is a choice set (S) with $j = 1, \dots, J$ elements. Each element in the choice set has attributes \mathbf{x}_{ij} . The utility (U) individual i gains by the selection of an item from the choice set is $U_{ij} = V_{ij} + \varepsilon_i$, where V is the deterministic component of utility and ε is an idiosyncratic disturbance term. It is usually assumed that individuals in a population share the same utility function, and that V_{ij} is a linear additive term equal to $\boldsymbol{\beta}'\mathbf{x}_{ij}$, where $\boldsymbol{\beta}$ is an unknown vector of weights attributed to each component of utility. The response individual i provides is an ordinal ranking of their preferences corresponding with his or her underlying utility; $\mathbf{r}_i = \{r_{i1}, r_{i2}, \dots, r_{iJ}\}$ (Calfee et al. 2000). The probability an individual reveals a given preference ordering is therefore $\Pr[\mathbf{r}_i] = \Pr[U(r_{i1}) > \dots > U(r_{iJ})]$. Utility is unobservable, but the researcher observes the revealed preferences (y_i) of respondents (y_j) based on a preference measure, k_j , such that $k_j = 0$ if $y_j \leq 0$, $k_j = 1$ if $0 < y_j \leq \alpha_1$, $k_j = 2$ if $\alpha_1 < y_j \leq \alpha_2, \dots$, $k_j = J$ if $\alpha_{J-1} < y_j$, where the α 's are unknown "utility thresholds" identifying the choice set. The weights attributed to the choice attribute generally indicate the value an individual assigns to moving from one utility level to the next. To untangle this decision structure, the disturbance terms are typically assumed to be normally distributed, the probability ordering is estimated with the normal cumulative density function (Φ) as $\Pr[k_j = j] = \Phi(\alpha_j - \boldsymbol{\beta}'\mathbf{x}_j) - \Phi(\alpha_{j-1} - \boldsymbol{\beta}'\mathbf{x}_j)$. The system of equations is

estimated using maximum likelihood.

Note that the ordered probit model can be restated as $J - 1$ separate regressions. An assumption behind the ordered probit model is that the effects of the regressors on the response outcomes are equal (or parallel) for each equation. Violation of this assumption suggests the model is misspecified. This assumption is tested using a likelihood ratio test. When the assumption is violated, alternative approaches towards analyzing the outcome variable should be considered. Candidate approaches include multinomial probit, multinomial logit, stereotypical logit regressions, or single equation probits.

Variable descriptions and hypothesized relationships for multivariate regressions

The variables included in the multivariate regressions are personal attributes of the respondent, household characteristics, indices representing respondents' sentiments regarding the importance of impacts on local economic and environmental characteristics, and a series of spatial variables including proximity to urban assets, open space, and cattle operations along with the size of these operations (Table 5). To calculate the proximity variables, respondents' locations were geo-referenced with a geocoding tool in ArcGIS 9.2 (Crosier, 2004). Geocoding is the process of finding associated geographic coordinates from geographic data, such as street addresses, or zip codes. With geographic coordinates, the respondents' locations are recorded into Geographic Information Systems. Geocoding respondents' locations allowed us to determine their location relative to physical, natural, and urban amenities in the study area. Discussions of the *a priori* expectations for these variables, along with details on the collection or

creation of additional variables from secondary data sources are provided in the following sections.

Distance to development and density of residential subdivision

The randomly-assigned distance from respondent's home to the hypothetical tract ("Distance to development") is expected to be negatively correlated with the level of concern for both the dairy and the subdivision, but would likely be positively correlated with preference for the dairy to the extent that the disamenities associated with the dairy (e.g., odor, dust, noise, etc.) are more localized than those associated with the subdivision (loss of open space, traffic congestion, etc.) and/or to the extent that the amenities associated with the dairy (provision of open space and wildlife habitat, preservation of rural character, etc.) are less localized than those associated with the subdivision (increase in housing supply, economic development, etc.).

The randomly-assigned types of residential subdivisions ("Subdivision density") would presumably be positively correlated with concern for the subdivision and preference for the dairy as the disamenities associated with the subdivision should be positively related to density, while the effect of an increase in density (and the corresponding lowering of home values) on the amenities associated with the residential development is less clear. Because the Distance to development variable increases with distance and the Residential density variable increases with density, their interaction runs from the closest, least dense subdivision (Distance x Subdivision density = 1) to the most distant and dense (Distance x Subdivision density = 9).

Table 5. Variable Names, Descriptions, and Hypothesized Signs

<u>Variable</u>	<u>Units</u>	<u>Mean</u>	<u>Standard error</u>	-----Expected sign-----		
				Hypothetical development of 500 ac. tract is:		
				<u>Dairy 1/</u>	<u>Residential 1/</u>	<u>Dairy 2/</u>
<i>Respondent/household attributes</i>						
Male	1 = yes	0.514	0.025	(+ / -)	(+ / -)	(+ / -)
Household size	Count	2.664	0.065	(+ / -)	(+ / -)	(+ / -)
Household, with 18 yr. old or younger	1 = yes	0.307	0.020	(+ / -)	(-)	(-)
Years in Blount County/Age	Ratio	0.560	0.018	(-)	(+)	(+)
Job in construction	1 = yes	0.036	0.010	(+)	(-)	(-)
Retired	1 = yes	0.266	0.022	(+ / -)	(+ / -)	(+ / -)
Income	Ordinal, 1 to 11	5.682	0.093	(-)	(+)	(+)
Owns home	1 = yes	0.961	0.010	(-)	(+)	(+)
Lives in multifamily unit	1 = yes	0.023	0.008	(+ / -)	(+ / -)	(+ / -)
Farm experience	1 = yes	0.979	0.007	(-)	(+)	(+)
College degree	1 = yes	0.364	0.024	(-)	(+)	(+)
<i>Local environmental sentiments</i>						
Concern about local economics	Standardized (0,1) 3/	-0.017	0.051	(+ / -)	(-)	(-)
Concern about environment and development	Standardized (0,1) 3/	-0.023	0.050	(+)	(+)	(+)
<i>Distance measures</i>						
Distance to urban assets	Standardized (0,1) 3/	-0.018	0.050	(-)	(+)	(+)
Distance to open space amenities	Standardized (0,1) 3/	-0.023	0.053	(-)	(+)	(+)

Table 5, continued.

<u>Variable</u>	<u>Units</u>	<u>Mean</u>	<u>Standard error</u>	-----Expected sign-----		
				Hypothetical development of 500 ac. tract is:		
				<u>Dairy 1/</u>	<u>Residential 1/</u>	<u>Dairy 2/</u>
<i>Distance measures</i>						
Distance to dairy or cattle operation 4/	Miles	-1.177	0.033	(- / +)	(- / +)	(- / +)
Nearest dairy/cattle operation is small	1 = yes	0.713	0.023	(- / +)	(- / +)	(- / +)
Distance to dairy/cattle operation x small operation	0, miles	-0.833	0.041	(- / +)	(- / +)	(- / +)
View shed 4/	Square miles	10.444	0.079	(+)	(+)	(-)
Dairy in view shed	1 = yes	0.065	0.013	(+)	(+)	(-)

Notes:

1/ Likert (1 = not concerned, 5 = very concerned about project)

2/ 1 = prefers development of land to dairy instead of residential development.

3/ Factor scores.

4/ In natural logs.

Thus, given the hypotheses for the Distance to development and Residential density variables, the effect of the interaction variable on concern for the subdivision is ambiguous, while it should be positively related to preferences for the dairy.

Respondent characteristics and household attributes

A priori expectations of the relationships between the gender of the respondent (“Male”), the number of people in the respondent’s household (“Household size”), whether or not the respondent was retired (“Retired”) or lived in a multifamily unit (“Lives in multifamily unit”), whether the respondent had attended college (“College”), and respondent concern for the conversion of the land to either a dairy farm or a residential subdivision are ambiguous. Similarly, there is no clear *a priori* expectation of the relationship between any of these variables and whether or not the respondent would prefer the land be converted to a dairy than a subdivision.

On the other hand, we hypothesize that households with one or more children less than 18 years old (“Children”), are likely to be less concerned about the conversion of the parcel to a residential subdivision and more likely to favor a subdivision over a dairy, as construction of the subdivision would make it more likely that the respondent’s children can find a job and a residence and thus remain in the local community when they leave the household. In addition, a new subdivision may increase the local tax base, which in turn may increase the funding capacity of local schools. However, households with children may be more concerned about the subdivision if they are concerned about school crowding. The ratio of the number of years the respondent resided in Blount County divided by the respondent’s age (“Years in Blount County/Respondent Age”) is

hypothesized to be negatively correlated with concern for the dairy and positively correlated with concern for the residential subdivision and, thus, more likely to favor the dairy. Respondents who spent a greater portion of their life in Blount County are hypothesized to be more concerned about the changes wrought by the area's rapid population growth. Respondents working in the construction or real estate development industries ("Job in construction") are more likely to prefer the subdivision, given their interest in promoting the construction and development industries. Respondents with higher incomes ("Income") are hypothesized to be concerned about protection of the environment and other public goods such as traffic congestion and, thus, negatively correlated with concern for the dairy, positively correlated with concern for the subdivision, and positively correlated with preference for the dairy. Construction of a subdivision would increase the supply of homes, which is more likely to be perceived as a benefit to respondents who do not own a home. Thus, home owners ("Owns home") are less likely to be concerned about the dairy, more likely to be concerned about the subdivision, and, thus, more likely to favor the dairy. Finally, respondents who had ever visited or worked on a farm ("Farm experience") are likely to be less concerned about the dairy, more concerned about the subdivision and, thus, more likely to favor the dairy.

Data dimension reduction and factor analysis

By construction, the local environmental and economic sentiment variables are highly correlated. The distance proxies are also collinear. With no clear guidance for choosing a particular variable to represent the entire set of variables (and risk potentially losing important information), we used factor analysis to determine the principal

components of the variable sets. Factor analysis summarizes the covariance between individual's responses in terms of a few underlying random factors (Johnson and Wichern, 2002) (Table 6). The procedure essentially partitions variables into sub-sets whose members are highly correlated. Sub-set membership is determined by a common, unobservable factor, which retains information about the variability of the variables assigned to the set. Factors resulting from the decomposition of a data set are uncorrelated. Thus, by collapsing a set of correlated variables into a few factors, information about the data set is retained (including the covariance between variables), but collinearity problems that may arise in multivariate regression that would otherwise occur if the entire set of variables were included is circumvented.

The number of factors was determined by inspecting the eigenvalues of the principal components of the core variables belonging to the local economic and environmental question list. As a rule of thumb, the number of factors retained was determined when the running sum of the principal components equaled 50% of sum total of the eigenvalues (Johnson and Wichern, 2002). Factor membership was determined by inspection of the factor loadings, which may be interpreted as correlation coefficients. The same cut-off point of 50% was used a guideline for membership.

The local environmental and economic sentiments factors were based on responses to 12 survey questions (see Table 1 and Appendix I) regarding the extent to which respondents were concerned about the effects of land use change on various characteristics of the local community.

Table 6. Factor patterns for sociodemographic concerns by respondents, and respondent proximity to community features.

<u>Variables</u>	<u>Eigenvalue</u>	<u>Factor 1</u>	<u>Factor 2</u>	<u>Factor Description</u>
-----Sociodemographic/environmental questions-----				
Increases air pollution	4.72	0.77	0.19	"Environmental & development sentiments"
Increases water pollution	1.51	0.77	0.19	
Decreases wildlife habitat	0.93	0.76	-0.05	
Increases consumption of water	0.76	0.73	0.30	
Decreases open space for recreation	0.67	0.67	0.24	
Increases traffic congestion	0.64	0.61	0.12	
Increases public school enrollment	0.61	0.46	0.38	"Local economic sentiments"
Increases need for public services	0.56	0.46	0.40	
Increases value of home	0.47	0.08	0.79	
Increases number of jobs	0.45	0.09	0.79	
Increasing dining and shopping	0.36	0.16	0.66	
Increases the local tax base	0.31	0.33	0.56	
-----Distance to physical features-----				
ln (Distance to railroad)	2.88	0.95	0.08	"Distance to urban assets"
ln (Distance to local park)	1.43	0.94	-0.07	
ln (Distance to central business district)	0.86	0.91	-0.03	
ln (Distance to pond, river, or lake)	0.68	0.22	0.79	"Distance to open space"
ln (Distance to national park)	0.10	-0.39	0.71	
ln (Distance to golf course)	0.05	0.21	0.55	

The first two principal components of this set of responses explained about 52% of the variability in respondents' perceptions about land use change and community attributes (Table 6). Based on this finding, two factors were assumed to generalize the 12 variables. Factor loadings for the first pattern ranged from 0.61 to 0.77. There were six variables belonging to this group related to environmental concerns and availability of open space. We named this sub-set "Environmental and Development sentiments". The second factor was associated with four variables relating to economic issues, including home value, jobs, taxes, and retail dining and shopping opportunities. We named this sub-set "Local Economic sentiments". In the multivariate regressions, higher factor scores associated with an individual suggest they are more concerned about the effects land use change may have on these sub-sets of community attributes. Thus, respondents with higher scores for the Environmental and Development sentiments factor are hypothesized to be more concerned about any development, but perhaps more likely to favor the dairy given that the respondents generally believe that a subdivision will be more likely to adversely effect local environmental conditions (Table 2). Respondents with higher scores for the Local Economic sentiments factor should be nearly opposite; less concerned about development in general, but more likely to favor the subdivision since respondents believe it more likely to contribute to local economic development (Table 2).

The second factor analysis involved variables measuring the distance between the respondent's home and six physical and natural amenities in Blount County: (1) the Maryville central business district; (2) the Great Smoky Mountains National Park; (3) the nearest railroad; (4) the closest public park; (5) distance to water bodies (pond, lake, or

river); and (6) public or private golf courses. The first two principal components explained 72% of the variation between these variables. As above, two factors were sufficient to generalize distances to the six features. Loadings for the first factor (“Distance to urban assets”), which included distance to the Maryville central business district and to the nearest railroad and public park, ranged from 0.91 to 0.95. Factor loadings for the second factor (“Distance to open space”), which included distance to the Great Smoky Mountains National Park and distance to the nearest water body and golf course, ranged from 0.55 to 0.79. In both instances, the higher the factor score, the greater the distance from the respondent’s home to the features. Thus, in both cases, the higher the factor score the less concerned about the dairy, the more concerned about the subdivision and the more likely the respondent is to favor the dairy, since proximity to these features would constitute a revealed preference for the types of open space and amenities that would be diminished or congested by the construction of the subdivision.

Additional geospatial measures

Additional distance measures were included in the multivariate regressions to gauge the extent to which proximity to current livestock operations affected views on converting the land to a dairy or a subdivision. The location of cattle operations in Blount County were acquired from the Tennessee Valley Authority’s Integrated Pollutant Source Identification (IPSI) data base. The natural logarithm of the distance from the respondent’s home to the nearest cattle operation in Blount County and a dummy variable indicating whether the nearest cattle operation was classified as a small operation. While the meta-data for the IPSI data base indicates that the size categories were based on the

number of head, it does not indicate how many head corresponded to the different categories (small, medium and large). A dummy variable indicating whether the facility was a small cattle operation was included to gauge the potential influence the scale of the nearest cattle operation might have on preferences for conversion of the 500-acre parcel into a dairy. The variable was also interacted with the variable measuring the distance from respondent home to the nearest dairy operation to control for proximity effects. While it seems relevant to include these variables in the regressions, we have no strong *a priori* expectations with respect to their relationships to preferences for residential developments of a dairy.

Digital elevation maps from the U.S. Geological Survey National Elevation Dataset (NED) were used to estimate the breadth of the viewshed associated with the location of respondents' house using the Viewshed tool under ArcGIS Spatial Analyst toolbar (ESRI, 2007). The Viewshed identifies cells of approximately 30 × 30 meters that can be seen from the location of respondents' residence. The cells surrounding each residential location were aggregated to reflect the surrounding viewshed. Note that the viewshed here is a proxy measure of an area that is visible from a fixed point because the estimation of viewshed is purely based on digital elevation. Other factors that may affect a locations' view perspective; for example, slope, aspect, and height of structure, are not considered in the current version of the algorithm available at the time of this study.

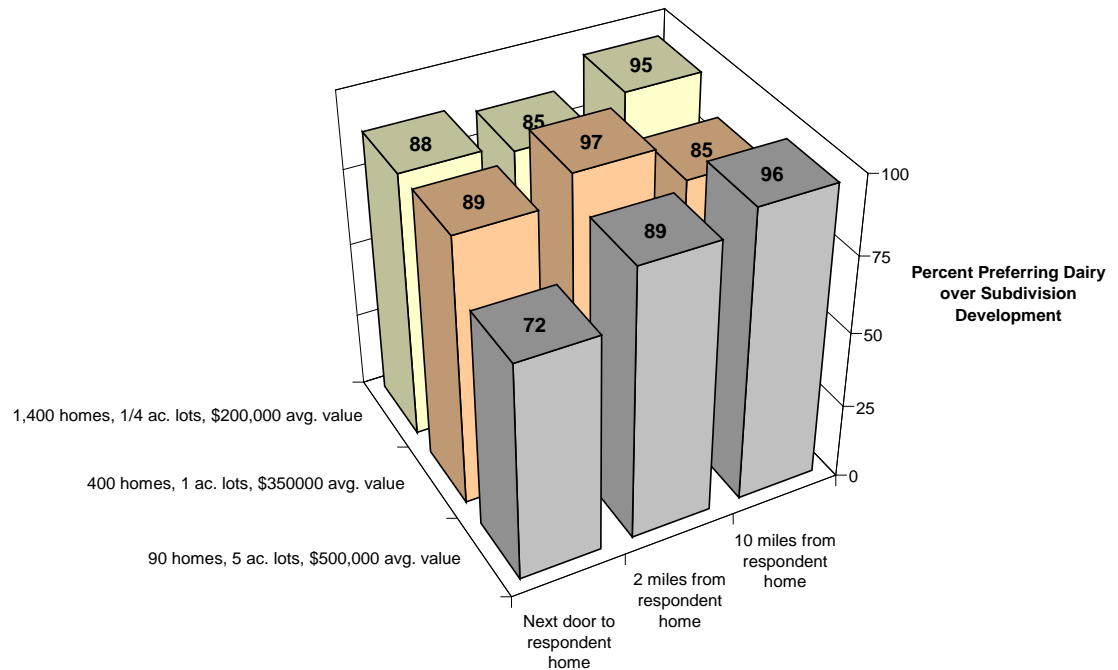
We hypothesize that respondents with larger viewsheds would be more concerned about the conversion of the parcel to a subdivision and more likely to favor the construction of a dairy, provided they believed the dairy would provide more scenic amenities than a subdivision. Finally, a dummy variable indicating whether a dairy was

located in the viewshed was included in the regression models. A positive relationship with preference for the conversion of the parcel to a dairy may suggest that dairies have some scenic value, perhaps contributing to bucolic landscapes.

Results

Responses to the survey suggest that Blount County residents were, in general, not concerned about the conversion of the land to a dairy in this hypothetical exercise. The mean level of concern was 1.90 (N = 514) on a scale of 1 to 5, where 1 represented “not at all concerned” and 5 represented “extremely concerned.” Slightly more than 60% of residents asserted they were “not at all concerned” with conversion to the dairy, while about 10% of respondents stated they were “extremely concerned.” Concern over conversion to the residential subdivision was much higher, with a mean level of concern of 4.07 (N = 513), and 56% of respondents being “extremely concerned.” As a result, 88% of respondents preferred conversion to a dairy over conversion to a subdivision. The percentage of respondents preferring the dairy to the subdivision varied depending on the distance to the project and the density of the residential development, but it was never below 72% (Table 3, Figure 5). Respondent preference for the dairy was lowest when the hypothetical parcel was located next door to the respondent, and the residential development was low density (5 acres) with high-valued homes (\$500,000). In general, the level of concern decreased as distance to the site increased for both the dairy (P-value < 0.0001) and the subdivision (P-value = 0.0233), while preference for the dairy over the subdivision increased as distance increased (P-value = 0.0800).

Figure 5. Relationship between Density and Distance on Respondent Preference for Dairy over Subdivision Development.



A simple statistical analysis of the level of respondent concern over the possible effects of land use change on their community, and their perception of whether conversion to a dairy or subdivision would be more likely to engender these effects, provides some insight into the reasons respondents overwhelmingly preferred the dairy. The mean values of respondent concern about the effects of land use change on community characteristics (Table 1) reveal that respondents were, on average, most concerned about the effects of land use change on traffic congestion, air and water quality, water consumption and wildlife habitat. Since most respondents believed that conversion to a subdivision was more likely to have an adverse effect on these characteristics than conversion to a dairy (Table 2), it is not surprising that respondents

overwhelmingly preferred the dairy. While respondents generally believed that the development of a subdivision was more likely to increase the local tax base and nearby property values, create more jobs, and lead to more dining and shopping opportunities (Table 2), they were not as concerned with these possible effects of land use change (Table 1). The responses to the open-ended question concerning the respondent's greatest concern with the dairy may provide some evidence as to why the preference for the dairy was decreased with increasing proximity to the site. The concern most often identified by respondents was "odor". Further, the frequency of this response decreased as distance to the site increased (Table 4) suggesting respondent recognition of the localized nature of this disamenity.

Multivariate regression analysis

The univariate statistical analysis is supplemented by multivariate regression analysis of respondent level of concern with conversion to the dairy and to the subdivision and over which concern was greatest (or which use respondents appeared to prefer). Variance inflation factors ranged between 1.2 and 13.1, with the largest value associated with the interaction term between the size and distance to a cattle operation. As a sensitivity test, the interaction term was omitted from the regressions to determine the extent to which the significance and signs of the other variables in the model were influenced by the interaction term. Results of the model omitting the interaction term were not qualitatively different from the original model. Therefore, inference of the coefficients does not appear to be compromised with the inclusion of the interaction term in the model.

The results of ordered probit analyses of the level of concern over conversion to the dairy or the subdivision are reported in Table 7, while Table 8 reports the results of a probit analysis of respondent preference for the dairy over the residential subdivision.

Respondent concern for the localized disamenities associated with the dairy farm is reflected in the negative relationship between the distance of the proposed development from the respondent's home and concern about the dairy farm and the positive relationship between distance and preference for the dairy. Thus, while the hypothetical dairy project enjoys overwhelming support relative to the subdivision in the univariate analyses, this support is not as strong among residents situated close to the development site, suggesting "not in my back yard" sentiments for residents located near the project (Table 6). Households with children were less concerned about the subdivision and more likely to favor the subdivision. Respondents who had lived a greater portion of their life in Blount County were more concerned about the residential subdivision and less concerned about the dairy, although these concerns did not translate into a preference for the dairy. Respondents who were retired were less concerned about the subdivision and more likely to favor the subdivision. Lastly, respondents who worked in the construction or real estate industries were more likely to favor the subdivision, while respondents with farm experience were less concerned about the dairy but more concerned about the subdivision.

Respondents who were more concerned about local economic factors were more concerned about the hypothetical subdivision and more likely to favor the dairy. Respondents who were more concerned about local environmental factors were more concerned about both types of development, but did not show a clear preference for one

type over the other. That respondents most concerned about local economic factors preferred a dairy over the greater potential economic growth associated with residential development may seem at first glance somewhat counterintuitive. One explanation for this preference could be that people more concerned about their home value, the number of jobs, dining and shopping opportunities and the local tax base view rapid population growth as the problem and not the solution. Thus, for example, more houses (and people) may not be viewed as a way to increase dining and shopping opportunities but as a way to increase congestion. Or, while population growth may add more to the tax base than a dairy, it could also place a greater demand on the tax base than a dairy in terms of new utilities and roads. A complementary explanation might be that the amenities provided by the dairy are perceived to add value to community quality by providing green space as well as a sense of cultural heritage. In both cases, it seems then that the opportunity costs of forgoing open space and an agricultural heritage for residential development are high for many Blount County residents. This preferential pattern seems consistent with the debate in many rural-urban fringe communities on the relative merits of conserving cultural traditions tied to the land versus conversion of land for development purposes. In this sense, many residents may be conflicted about enjoying economic growth through residential development on the one hand and preserving the values that make their community special on the other.

Respondents who lived farther from urban amenities were more concerned about the subdivision and more likely to favor the dairy, while respondents who lived farther from open space amenities were less concerned about the dairy and more likely to favor the dairy. Respondents with a larger viewshed were more concerned about the

subdivision (although this concern was reduced among those with a dairy in their projected viewshed) and more likely to favor the dairy. Finally, respondents for whom the nearest cattle operation was small were less likely to favor the dairy. It is not immediately clear why living close to a smaller rather than a larger cattle operation would be negatively associated with support for the dairy, although it could be an indication that smaller operations may not, in many instances, be managed as well as larger operations and, thus, impose more external costs on their neighbors than do the larger operations. This remains an empirical question for future research.

Table 7. Ordered probit results for residents' concern over conversion of land to a dairy or residential subdivision

Variable	Units	Model 1				Model 2			
		500 acre development next to home is a:		500 acre development next to home is a:		500 acre development next to home is a:		500 acre development next to home is a:	
		Residential 1/	Dairy 1/	Residential 1/	Dairy 1/	Residential 1/	Dairy 1/	Residential 1/	Dairy 1/
		Estimate	Pr > z	Estimate	Pr > z	Estimate	Pr > z	Estimate	Pr > z
Distance to subdivision	Ordinal, 1, 2, 3	-0.169	0.3900	-0.334	0.0950	-0.167	0.3980	-0.337	0.0920
Development subdivision	Ordinal, 1, 2, 3	0.159	0.4790	0.183	0.3890	-0.135	0.5500	0.172	0.4140
Distance X subdivision density		-0.029	0.7640	-0.008	0.9320	-0.020	0.8400	-0.004	0.9680
Male	(1 = yes)	0.116	0.3760	0.095	0.4660	0.095	0.4670	0.093	0.4750
Household size	Count					-0.068	0.2040	-0.047	0.3840
Household, with 18 yr. old or less	(1 = yes)	-0.461	0.0010	-0.229	0.1020				
Years in Blount County/Age	Ratio	0.567	0.0030	-0.325	0.0690	0.567	0.0030	-0.324	0.0700
Retired	(1 = yes)	-0.284	0.0830	0.252	0.1100	-0.284	0.2460	0.285	0.0650
Job in construction	(1 = yes)	-0.440	0.2340	-0.388	0.3420	-0.440	0.2500	-0.366	0.3790
Income level	Ordinal, 1 to 11	-0.066	0.1030	-0.066	0.1170	-0.066	0.0850	-0.067	0.1200
Owns home	(1 = yes)	0.148	0.6850	-0.186	0.5260	0.148	0.5300	-0.146	0.6190
Lives in multifamily unit	(1 = yes)	-0.492	0.1010	0.229	0.5750	-0.492	0.1920	0.271	0.5100
Farm experience	(1 = yes)	0.428	0.0940	-0.696	0.0170	0.428	0.1370	-0.721	0.0160
College degree	(1 = yes)	-0.177	0.1750	0.009	0.9490	-0.177	0.1650	0.006	0.9680
Concern about local economics	Standardized (0,1)	0.494	0.0000	-0.071	0.2850	0.494	0.0000	-0.073	0.2760
Concern about environment and development	Standardized (0,1)	0.232	0.0010	0.241	0.0010	0.232	0.0020	0.237	0.0010
Distance to urban assets	Standardized (0,1)	0.342	0.0000	-0.111	0.1110	0.342	0.0000	-0.103	0.1320
Distance to open space amenities	Standardized (0,1)	-0.048	0.4780	-0.176	0.0010	-0.048	0.4460	-0.177	0.0010
ln(Distance to dairy/cattle operation)	Miles	0.201	-0.2485	-0.162	0.5080	0.201	0.4450	-0.172	0.4830
Nearest dairy/cattle operation is small	(1 = yes)	-0.131	0.6970	0.393	0.2940	-0.131	0.6940	0.385	0.3070
ln(Distance to dairy/cattle operation) x small operation	(0, miles)	-0.347	-0.8615	0.288	0.2680	-0.347	0.2230	0.294	0.2590
ln(View shed)	Square miles	0.106	0.0050	-0.071	0.1080	0.106	0.0060	-0.070	0.1130
Dairy in view shed	(1 = yes)	-0.481	0.0360	0.011	0.9680	-0.481	0.0510	0.017	0.9480
Cut 1		-0.694		-1.962		-0.705		-1.9893	
Cut 2		-0.261		-1.480		-0.288		-1.5085	
Cut 3		0.477		-0.837		0.435		-0.8674	
Cut 4		1.036		-0.630		0.988		-0.660	
Dependent mean (standard error)		4.02 (0.065)		1.87 (0.065)		4.02 (0.065)		1.87 (0.065)	
Wald test, H ₀ : $\beta = 0$ (227 degrees of freedom)		135		93		127		86	
Log likelihood		-436		-425		-441		-426	
Pseudo R ²		0.13		0.08		0.13		0.08	
N		389		390		389		390	

Notes: Likert, 1 = not concerned, 5 = very concerned.

Table 8. Probit regression results of respondents' preference for conversion of land to a dairy.

Variable		Model 1		Model 2	
		Marginal effect	Pr> z	Marginal effect	Pr> z
Distance to subdivision	Ordinal, 1, 2, 3	-0.068	0.0610	0.069	0.0520
Development subdivision	Ordinal, 1, 2, 3	0.051	0.1980	0.058	0.1320
Distance X subdivision density		-0.022	0.2420	-0.024	0.1890
Male	(1 = yes)	0.027	0.2490 *	0.029	* 0.2110
Household size	Count	-0.004	0.7140		
Household, with 18 yr. old or less	(1 = yes)			-0.059	0.0840
Years in Blount County/Age	Ratio	-0.002	0.9460 *	-0.005	* 0.8590
Retired	(1 = yes)	-0.103	0.0110 *	-0.130	* 0.0040
Job in construction	(1 = yes)	-0.215	0.1150 *	-0.225	* 0.0960
Income level	Ordinal, 1 to 11	-0.006	0.3720	-0.004	0.5000
Owens home	(1 = yes)	0.172	0.1170 *	0.142	* 0.1770
Lives in multifamily unit	(1 = yes)	-0.022	0.7610 *	-0.045	* 0.6050
Farm experience	(1 = yes)	-0.032	0.3500 *	-0.032	* 0.3160
College degree	(1 = yes)	-0.030	0.2870 *	-0.029	* 0.2980
Concern about local economics	Standardized (0,1)	0.061	0.0000	0.059	0.0000
Concern about environment and development	Standardized (0,1)	-0.011	0.4450	-0.008	0.5470
Distance to urban assets	Standardized (0,1)	0.068	0.0000	0.064	0.0000
Distance to open space amenities	Standardized (0,1)	0.022	0.0550	0.022	0.0520
ln(Distance to dairy/cattle operation)	Miles	0.027	0.4340	0.034	0.3270
Nearest dairy/cattle operation is small	(1 = yes)	-0.068	0.0650 *	-0.067	* 0.0530
ln(Distance to dairy/cattle operation) x small operation	(0, miles)	-0.059	0.1510	-0.063	0.1150
ln(View shed)	Square miles	0.014	0.0630	0.014	0.0660
Dairy in view shed	(1 = yes)	-0.008	0.8860 *	-0.011	* 0.8430
Constant		-0.453	0.7250	-0.443	0.7280
Dependent variable mean (standard error)	0.881 (0.016)			0.881 (0.016)	
Wald test, H ₀ : $\beta = 0$ (23 degrees of freedom)	61			76	
Log likelihood	-107			-105	
Pseudo R ²	0.27			0.29	
N	392			392	

(*) for a discrete change in a dummy variable from 0 to 1.

Conclusions and summary

This project was conceived as the first of a two-part initiative designed to identify resident views toward the conversion of an undeveloped tract of land in their community to a dairy and, in a second stage, determine how the presence of the dairy might change their views. The results suggest that while respondents are not, in general, concerned about the hypothetical conversion of land to a dairy, and overwhelmingly prefer a dairy to a residential subdivision (88%), those who would live closest to the dairy are concerned about the possibility of offensive odors, and their preference for the dairy is somewhat tempered by these concerns.

These and other findings provide guidance on addressing resident concerns to UTIA and others interested in establishing dairy operations in or near urban or suburban communities, and provide a basis for understanding how resident perceptions might be changed by the presence of a large dairy facility. The case of the Little River Dairy is special in that the facility will be built and operated by Tennessee's flagship land-grant university. Entrepreneurs, young farmers, or other private ventures seeking to invest in local dairy operations may also find these results encouraging. In many ways, with respect to converting undeveloped land into a dairy facility in urban or suburban communities, the goals and objectives of UTIA, and conceivably, others in the private sector seem consistent with the objectives of local, state, and federal farmland preservation initiatives.

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Appendix I: Copy of Little River Dairy Survey

Introduction

Hello, my name is _____ and I'm calling from The University of Tennessee. We are randomly contacting Blount County residents to find out their views on various changes within the community.

For this survey to be valid, I need to randomly select a person from your household to interview. Could I please speak to the head of household, 18 years of age or older, who had the most recent birthday?

(Repeat Paragraph 1 if new person comes to the phone)

The information you give me on this survey is strictly confidential. This interview is voluntary. If you don't want to answer a question, just tell me. The completion of the survey is considered your consent to participate in the study. The survey is for informational purposes only and will take approximately 10 minutes. We will not ask for a donation or attempt to sell you anything. My supervisor may listen to part of the interview for quality control.

We would like to begin with some questions about the area in which you live.

1. What is your zip code?
 - 1 37701 → GO TO Q2
 - 2 37801 → GO TO Q2
 - 3 37803 → GO TO Q2
 - 4 37804 → GO TO Q2
 - 5 37853 → GO TO Q2
 - 6 37865 → GO TO Q2
 - 7 37878 → GO TO Q2
 - 8 37882 → GO TO Q2
 - 9 37886 → GO TO Q2
 - 10 other → END SURVEY (“Thank you, you do not live in the area we are surveying. That’s all the questions we have.”)

2. How many years have you lived in Blount County? _____

3. Like many counties in Tennessee, Blount County is experiencing population growth and development. One outcome of growth is the conversion of land from one use to another. For example, land may be converted from forest to agricultural or residential use. We would like to find out what concerns you might have about the effects of land use change in your community.

I am going to read you a list of ways in which land use change might affect you or your community. Using a scale of 1 to 5, where 1 means “not at all concerned” and 5 means “extremely concerned,” please tell me how concerned you are about the extent to which land use change:

- a. Increases the local tax base
- b. Increases public school enrollment
- c. Increases traffic congestion or disruption
- d. Increases the number of jobs in the community
- e. Increases air pollution
- f. Increases water pollution
- g. Increases dining and retail shopping opportunities
- h. Increases consumption of local water supplies
- i. Increases the need for investment in public services, such as new sewer lines and treatment capacity
- j. Decreases open space for outdoor recreation
- k. Decreases wildlife habitat
- l. Increases the value of your own home

[Randomize order across survey respondents]

4. I would now like for you to consider two different land uses – first, a 500-acre dairy farm with approximately 300 cows and, secondly, a 500-acre residential subdivision with [90 single-family homes on five-acre lots with an average value of \$500,000, 400 single-family homes on one-acre lots with an average value of \$350,000, 1,400 single-family homes on ¼ acre lots with an average value of \$200,000]. Which of these two land uses do you think will:
 - a. Cause more air pollution.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
 - b. Cause more water pollution.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
 - c. Provide more open space and scenic beauty.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
 - d. Create more jobs.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
 - e. Contribute more to the local tax base.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither

- f. Cause more traffic congestion or disruptions.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
- g. Be more likely to increase nearby property values.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
- h. Preserve more wildlife habitat.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
- i. Lead to more dining and retail shopping opportunities.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
- j. Lead to more outdoor recreational opportunities.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
- k. Lead to a greater increase in public school enrollment.
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither
- l. Consume more water
 - 1 Dairy farm
 - 2 Residential subdivision
 - 3 Neither

[Randomize order across respondents]

I am now going to ask you some questions about how you would view a change in land use if it were to occur [next door to, about 2 miles from, about 10 miles from] your home.

- 5. Using a scale of 1 to 5, where 1 means “not at all concerned” and 5 means “extremely concerned,” how concerned would you be about land [next door to, about 2 miles from, about 10 miles from] your home being converted to a 500-acre dairy farm with 300 cows?
 - If 1 → Go to Question 7
 - If 2 – 5 → Go to Question 6
- 6. What concerns you the most about the land being converted to a dairy farm?
 - _____ → Go to Question 9
- 7. Can you think of any problems that might be associated with the dairy?
 - No → Go to Question 9

Yes, explain _____ → Go to Question 8

8. Is this problem enough to cause you to increase your level of concern about the dairy?

No

Yes, to what? [2-5]

9. Using a scale of 1 to 5, where 1 means “not at all concerned” and 5 means “extremely concerned,” how concerned would you be about land [next door to, about 2 miles from, about 10 miles from] your home being converted to a 500-acre residential subdivision with [90 single-family homes on five-acre lots with an average home value of \$500,000, 400 single-family homes on one-acre lots with an average home value of \$350,000, 1,400 single-family homes on ¼ acre lots with an average home value of \$200,000]

If 1 → Go to Question 11

If 2 – 5 → Go to Question 10

10. What concerns you the most about the land being converted to a residential subdivision? _____ → Go to Question 13

11. Can you think of any problem that might be associated with the residential subdivision?

No → Skip Question 12

Yes, explain _____ → Go to Question 12

12. Is this problem enough to cause you to increase your level of concern about the subdivision?

No

Yes, to what? [2-5]

If, Q5 = Q9, Q8 = Q12, Q5 = Q12, or Q8 = Q9 → Go to Question 13

Otherwise → Go to Question 14

13. If a 500-acre tract of land located [next door to, about 2 miles from, about 10 miles from] your home was going to be converted to either a residential subdivision with [90 single-family homes on five-acre lots with an average home value of \$500,000, 400 single-family homes on one-acre lots with an average home value of \$350,000, 1,400 single-family homes on ¼ acre lots with an average home value of \$200,000 (consistent with previous question)] or a dairy farm with approximately 300 cows, which would you prefer?

1 Residential subdivision

2 Dairy farm

14. Record gender

1 Male

2 Female

To conclude the interview, we have a few questions to help us learn more about Blount County residents.

15. Have you ever worked or lived on a farm?

- 1 Yes → PROCEED TO NEXT QUESTION
- 2 No → SKIP NEXT QUESTION

16. Do you currently work or live on a farm?

- 1 Yes → SKIP NEXT 2 QUESTIONS
- 2 No → SKIP NEXT 2 QUESTIONS

17. Have you ever visited a farm?

- 1 Yes → PROCEED TO NEXT QUESTION
- 2 No → SKIP NEXT QUESTION

18. Have you ever visited a dairy farm?

- 1 Yes
- 2 No

19. Including yourself, how many people currently live in your home? _____

20. How many of these people are under the age of 18? _____

21. Which of the following best describes your home?

- 1 Single-family home on 2 acres or more
- 2 Single-family home on less than 2 acres
- 3 Mobile home
- 4 Duplex/multiple family
- 5 Townhouse/condominium
- 6 Apartment complex → SKIP NEXT QUESTION
- 7 Other _____

22. Do you own or rent your home?

- 1 Own → PROCEED TO NEXT QUESTION
- 2 Rent → SKIP NEXT QUESTION

23. What would you estimate the market value of your home to be?

- 1 Less than \$150,000
- 2 \$150,000 to \$174,999
- 3 \$175,000 to \$199,999
- 4 \$200,000 to \$224,999
- 5 \$225,000 to \$249,999
- 6 \$250,000 to \$299,999
- 7 \$300,000 to \$400,00
- 8 More than \$400,000

24. Which of the following best describes your current employment status?
- 1 Employed full-time outside of the home
 - 2 Employed part-time outside of the home
 - 3 Work from home or self-employed → SKIP NEXT 2 QUESTIONS
 - 4 Retired → SKIP NEXT 2 QUESTIONS
 - 5 Not currently employed → SKIP NEXT 2 QUESTIONS
25. Do you work in the construction or real estate sales industries?
- 1 Yes
 - 2 No
26. Do you work in Blount County?
- 1 Yes
 - 2 No
27. In what year were you born? 19_____
28. What is the highest level of formal education you have completed?
- 1 11th grade or less
 - 2 High school graduate or GED
 - 3 Some college
 - 4 Vocational/Technical degree/certification
 - 5 Associate's degree
 - 6 Bachelor's degree
 - 7 Graduate or professional degree
 - 8 Other (describe)_____
29. I am going to read a list of income categories. Please stop me when I get to your total household income from all sources for the year 2007..
- 1 Less than \$10,000
 - 2 \$10,000 to \$19,999
 - 3 \$20,000 to \$29,999
 - 4 \$30,000 to \$39,999
 - 5 \$40,000 to \$49,999
 - 6 \$50,000 to \$74,999
 - 7 \$75,000 to \$99,999
 - 8 \$100,000 to \$150,000
 - 9 More than \$150,000

Thank you very much for taking the time to complete our survey.