Urbanization and Development Effects on the Use of Natural Resources

Proceedings of a Regional Workshop

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**July 1993**
Urbanization and Development Effects
On the Use of Natural Resources

Proceedings of a Regional Workshop

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COMMON MISPERCEPTIONS OF FARM LAND PRESERVATION PROGRAMS

AND AGRICULTURAL LAND CONVERSION PROBLEMS

By

Rodney L. Clouser and Lawrence W. Libby

The issue and importance of agricultural land loss in Florida has been debated persistently for over a decade (Clouser). Public decision makers have not reached a definitive resolution on the significance of this issue. This may reflect the true nature of the problem; it may be serious in some areas of Florida and completely insignificant in other areas of the state. Or it may be that the issue is just poorly understood. Agriculture is, after all, much more than land. However, this has not stopped the public debate! So land use planning addresses just a part of the issue—an important part, but not the whole issue by any means.

This document is devoted to discussing some of the perceptions that are common among the public, farmers, and public decision makers related to the issue of agricultural land preservation. As with most such issues these perceptions are part myth, part reality, part wishful thinking. These perceptions are extracted from the experience of the authors who have been involved in the public policy debate on agricultural land preservation as policy educators, and teachers in a land grant university setting.

A top ten list of common concerns, raised by the public, not necessarily ranked by importance related to the issue of agricultural lands would include the following:

---

1 Professor and Extension Coordinator, and Professor and Chair, Food and Resource Economics Department, Institute of Food and Agricultural Sciences University of Florida Gainesville, Florida
1. Most farmland sold in the United States is sold for residential, commercial or industrial development. These developments are the result of urban growth and are forcing farmers out of production.

2. The United States and individual states within the U.S. need to be self-sufficient in food production and farmland protection helps meet that goal.

3. The U.S. is losing cropland rapidly.

4. Farmland protection programs are exceptionally successful/unsuccessful in the U.S.

5. Farmland protection programs are easy to finance.

6. Private property rights indicate that when I hold a deed, my rights to that land are absolute and I can do with the land whatever I want.

7. Foreign competition is forcing farm producers out of business.

8. Large lot sizes preserve farmland, right?

9. Farmland preservation is the same as open space preservation.

10. Since farmland preservation programs are helping farmers the programs are strongly supported by farmland owners.

Obviously other questions are asked but these ten are among the most frequent. Each question will be addressed briefly in some detail.

Is most farmland sold for development? The public perception is that virtually all farmland is sold for development -- that the pull of urban development pressure deprives society of fertile farmland. The farmland owner perspective is "so what if it is, I've paid taxes on the land, I've purchased the land through my hard work and if I can generate economic gain by selling the land for a substantial price that's okay." The value of that land is my only retirement program. It's only fair that I have a chance to cash it in when the time comes. The truth is that information on who farmland is sold to and for what purpose is very spotty. Nationally, a Rural
FOREWORD

Expansion of the urban fringe into rural areas has prompted concerns among economists and policy analysts over the effects of urbanization on natural resource use. The potential effects of urbanization on agricultural land and wetlands has been of particular concern. In coastal areas, urbanization has had a profound affect on shoreline land use. The effects of population growth in the coastal zone has changed historic patterns of shoreline and waterfront land use and has accelerated the rate of conversion of coastal land. The problems of coastal resource and agricultural land use have similar bases in externalities and market failures. Consequently, the policy responses to these problems have similar foundations and outcomes.

In October, 1992 the Southern Natural Resource Economics Committee (SRIEG-10) held a workshop in Clearwater Beach, Florida on urbanization and development effects on the use of natural resources. The program was developed to address general issues of natural resource use as well as issues relating specifically to urbanization effects on coastal land use and on agricultural land. This publication is a compilation of papers presented at that workshop.

Drawing upon their experience in working with policy makers and concerned citizens alike, the first paper by Clouser and Libby addressed the top ten most misunderstood aspects of farmland preservation programs. In the second paper, Jepson discusses the problems faced by residents of Cortez, Florida in dealing with urban growth pressures being exerted by the nearby Tampa Bay metropolitan area. Lipton and Greer present their findings of a study of a maritime business retention strategy that was adopted by the city of Annapolis, Maryland.

Four papers dealt with various aspects of farmland retention strategies and wetlands policy. In the first of these four, Dillman, Reynolds, Tomerlin, and Linn present their findings
Land Transfer Survey (Bernat) was conducted in 1988 that indicates most farmland was not sold for development purposes. Prior to transfer (sale) agricultural land use was: 17.7 percent cropland, 41.9 percent pasture/range, 10.2 percent forest, 10.7 percent rural residences, one-tenth percent subdivision and two-tenths percent in industrial uses. The expected land use in the next five years was 16.3 percent cropland, 40.6 percent pasture/range, 8.2 percent forest, 11.2 percent rural residences, 1.3 percent subdivision and five-tenths percent in industrial use. Only one conclusion can be reached if these numbers are accurate. Most farmland sold is not sold for commercial, residential and industrial development. Often there are intermediate owners who take the farmer off the "hook", hold the land and rent it to other farmers while land use patterns evolve, and then sell for development. They are called land speculators.

An associated issue is why land transfer sales are occurring. Many individuals think farm producers are selling their property because they are "forced" out of business by growth and development. The general scenario is that non-farm development raises the value and therefore taxes on adjacent farmland. Complaints by nearby neighbors force the farmer to work different hours, or pay for additional waste management or improve the general appearance of the place. National data in 1988 indicate that this is a false assumption (Wunderlich). About 69 percent of all farmland sales are voluntary transactions with outside buyers. Another 14 percent are sales to family members. In 1988 about six percent of sales were due to foreclosure and this number could vary significantly over time. About seven percent of parcel transfers were related to gifts and inheritance. The percentages are slightly different if calculated on a per acre basis. The biggest shift is that 56 percent of total acreage transferred was voluntary and about 16 percent was due to foreclosure. About three percent of parcels and two percent
of acres were recorded as "other" reasons in terms of transfers. Urban growth doesn't appear
to be a major influence in land transfers (Reynolds). Still, it must be recognized that farm
producers are an opportunistic group and some sales could be listed as voluntary when in reality
the landowner recognized the best long-term options for the farm were outside of agriculture.

The notion that the U.S. and even individual counties in the U.S. can or should be self-
sufficient in food production is prevalent among lay people concerned with farmland
preservation. Policy specialists, economists and others have failed to educate the public about
advantages (disadvantages) of specialization and trade. Very few adults have heard of the
concepts of absolute and comparative advantage let alone understand these concepts. The
concept of opportunity costs is poorly understood among the public. There is little economic
or even intuitive rationale for a policy of food self-sufficiency either from the producer or
consumer side of the issue. Yet policy educators are frequently asked by consumer groups to
justify self-sufficiency, and by producers who seek someone saying they need to be "protected".
Trade and specialization has both benefits and costs and we must do our best to identify both.
No country, state or nation should try to do everything for itself. It is at best wasteful, at worst
impossible!

The National Agricultural Lands Study completed in the early 1980s caused great concern
over the issue of how rapidly the U.S. was "losing" farmland. No land is really lost, of course,
it just changes use. The initial conclusion of the study was that cropland was being converted
rapidly to non-farm use although later the estimated rate of conversion was decreased
substantially. This study did highlight other issues that are important in discussing agricultural
land loss. For example, individuals must clearly identify how they define agricultural land.
Does the definition include woodlands, wetlands, pastures, forests and cropland? Most of the general public is concerned with land as basis for food production and their interests are primarily in cropland. In many states acres in cropland have increased over time even though broader definitions of agricultural land indicate substantial land conversion. Most people also forget to account for technological gains that have increased farm production per acre. Florida with its large population growth has exhibited both an increase in cropland acres and in production per acre. If you read the popular press you would think just the opposite. However, more work is needed to verify what type and quality of land is no longer in production.

The pessimists and optimists are plentiful on the issue of agricultural land preservation. Those with pessimistic views claim there is little support for preservation programs across the U.S. and the programs are dismal failures. Optimists, on the other hand, pick "one" program performing well and claim it as a standard of the success of preservation programs. Neither conviction is correct. There are some well devised preservation programs that work adequately and there are some ill-devised programs that fail miserably. At least two observations about successful programs need to be made. First, many of the more successful preservation programs (Pennsylvania, Maryland, New York, New Jersey) are located in the northeastern section of the U.S. in states that have areas with very high population densities. Some states also have relatively high tax rates, with mature economies and infrastructure. Second, the most successful programs rely on incentives and the initiative of farmers themselves to participate in farmland retention efforts. Generalizations about the success or failure of programs, however, are tenuous. More specific information about what made programs successful or disappointing is
required. We have an impressive natural laboratory for studying policy performance in this area, but have not really done so (Clouser et al.).

Some farmland preservation programs are expensive to administer and are almost cost prohibitive if easement or land purchases are required. Advocacy groups for preservation programs often lead people to believe that raising funds for farmland preservation programs is easy. It’s not! Such programs requiring substantial state or local funding may even become more difficult to sustain. Why? Most units of state and local government don’t have deep fiscal pockets. In many instances use of funds for preservation programs compete with other debt service needs such as roads, bridges and schools. If funding for farmland preservation programs is structured in a system where funds are competitive with roads, bridges and schools the preservation programs are often at the bottom of the fiscal totem pole. A general observation here is that the appeal of farmland preservation programs among the public doesn’t seem to be related to their willingness to pay for those programs.

Another concern of the public is that foreign investors are buying all the U.S. farmland. This concern can be put to rest easily since foreign ownership of land is followed closely by the federal government. In 1989, only about one percent of U.S. farmland was foreign owned. We are in no danger of being "taken over" by foreign investors (DeBraal).

Many land use planners, as well as the general public, believe that large lot size restrictions in rural zoning preserve farmland (Evans). There are several obstacles associated with this technique of farmland preservation. Some crops may be produced on 40 acre parcels but there are very few locations in the U.S. where commercial farming activities can take place on such small acreage. In order to generate adequate economic activity to support a farm
business the production of very "intensive" high valued commodities (nurseries, citrus, vegetables, etc.) is required. To get adequate acreage for less intensive crops requires multiple leases. Farm producers in some instances are not interested in these multiple leases. Thus, the large lot approach to retaining farmland may actually exacerbate fragmentation of usable farms. Many times the intensive management and farm input activities required to produce high valued commodities lead to an increase in nuisance complaints or ordinances. Some people don't like to hear the sound of a tractor in the field at dawn or worry about spray drift. Finally the concept of large lot sizes causes some concerns in communities with inadequate affordable housing. Large lot sizes increase the cost of home ownership in many instances and most homeowners can't afford the extra land expense. In reality it is doubtful that large lot size restrictions actually preserve agricultural land.

Communities and individuals often confuse the issues of farmland preservation and open space preservation. The two issues, although similar in the perspective of "saving" land, have major differences. Open space land protection is often undertaken with long-term goals of improving environmental quality, preserving habitat and species of wildlife endangered and relieving congestion in general to make urban living more pleasing. The long-term goal of farmland preservation, on the other hand, is to keep land in productive agricultural use. It's easy to see where goals of the two different programs might conflict. For example, agricultural production may or may not be consistent with habitat protection. A pleasing aesthetic urban environment with large greenspaces, wildlife and reduced congestion may not be consistent with farm machinery and chemical use. Farming is far more than land. It is a business requiring investment, requiring activity, requiring a positive perspective on the future. Farmland
protection programs are most effective as open space programs when farming is a part-time operation or not particularly profitable.

A final misperception among the general public is that farmers overwhelmingly support farmland preservation programs. After all, it's farming we want to save! There are many places in the country where this statement is true but there are also many areas where this attitude is erroneous. Florida serves as a useful example. Outside of the policy tool of use value assessment in Florida there appears to be little support within the agricultural community for farmland protection programs. Of course, this inference needs to be qualified with the statement "at this point in time." A county survey in 1979-80 produced the following results.' The support for farmland preservation programs among farmers is influenced by age, ownership of land, equity in the land, geographic location and long-term economic gains that might be foregone if programs are adopted (Krupensky). In general, the younger the farmer, the smaller the amount of capital to invest in land, the less equity in land already owned, the closer the proximity to urban areas, the larger the support from farmers for preservation programs. These factors must be considered before a successful farmland preservation program can be developed.

Summary

It is impossible to discuss in detail the myriad of issues and misperceptions related to agricultural land preservation. The programs themselves are complex and diverse. However, this overview should serve as a useful sample of the misunderstandings that often exist when communities, citizens, farmers and public policy makers discuss this issue. Successful programs are more likely to be developed if these misunderstandings are identified and deliberated before programs are considered or adopted.
References


to which the marine retail industries have declined can not be explained by the recession alone. In 1991, real (adjusted for inflation) retail expenditures on recreational boating were at their lowest point in twenty years (Figure 3).

The graph of retail expenditures on recreational boating bears a remarkable similarity to the classic product life cycle pattern, where an industry moves in terms of its sales volume from an introductory, through a growth phase to a mature phase. The growth phase of an industry is usually spurred by some technological breakthrough or major new market penetration. It is a well known fact that this is what happened in the boating industry in the 1970's and 1980's with the widespread use of fiberglass in boats, and the marketing efforts of several major companies to help penetrate new boating markets. What the product or industry life cycle predicts, however, is that growth does not continue at the same rate. As markets become saturated sales growth begins to slow to the point where it may even decline.

The current economic recession, along with some other factors such as the luxury tax, has accelerated and exaggerated the slowing in sales growth in the marine recreational boating industry that would have occurred due solely to the product life cycle phenomenon.\(^2\) What we would expect is that when the gross domestic product begins growing, disposable incomes increase, and unemployment decreases, boating expenditures will begin increasing. However, short of a major technological breakthrough in boat building or design, or some major structural

\(^2\)The luxury tax which only applies to vessels costing over $100,000 has been blamed by the industry for much of the decline in sales. However, segments of the industry which produce boats well below the $100,000 price have been hit equally as hard. For example, Brunswick Corporation which is the worlds largest manufacturer of pleasure boats, and whose sales are mainly for boats less than $100,000, has had a decline in sales of 44% since 1988 (Brunswick Corporation).
change in the demand for boating, it would be naive and counter to product life cycle theory to expect industry growth to return to the levels of the 1970's and 1980's. The renewed growth in the industry will be driven by the underlying demographic changes in the population that tend to favor growth in boating, in particular, the aging of the baby boom population (Boating Industry).

Measures of Boating Activity

One indication of the health of the marine sector in Annapolis would be a measure of the boating activity there. To our knowledge, no such direct measure exists, but there are indicators of activity such as the number of boats homeported in Annapolis. Clearly, the number of boats homeported ignores the important component of transient boats, particularly to a marine center such as Annapolis.

In the April, 1991, report to the Maritime Advisory Board, Table 5 lists the number of boats homeported in Annapolis for 1990. We were unable within the timeframe of this report to obtain a time series from 1987-1991 of this data. We did, however, obtain homeporting information for Anne Arundel County as a whole. This information was presented in Table 3 in the aforementioned report, and we updated it with 1991 data as well as obtained data on changes in other counties that are competing with Annapolis and Anne Arundel Counties for boating business.

Overall in Maryland, from 1985-1991, there has been a 23% increase in the number of registered and documented boats. This breaks down to a 22% increase in registered boats and a 46% increase in documented vessels. Most of the increase in registered boats has been in the trailerable boat category. Boats not stored on trailers increased only 12% during the period.
Over this same period, registered boats homeported in Anne Arundel County increased only 5%, and documented vessels increased 8%, both below the State average.

<table>
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<tr>
<th>COUNTY</th>
<th>REGISTRATION (% Change)</th>
<th>DOCUMENTED (% Change)</th>
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<tbody>
<tr>
<td>Anne Arundel</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Baltimore</td>
<td>9</td>
<td>88</td>
</tr>
<tr>
<td>Calvert</td>
<td>-4</td>
<td>48</td>
</tr>
<tr>
<td>Cecil</td>
<td>42</td>
<td>60</td>
</tr>
<tr>
<td>Kent</td>
<td>33</td>
<td>39</td>
</tr>
<tr>
<td>Queen Anne</td>
<td>1</td>
<td>82</td>
</tr>
<tr>
<td>St. Marys</td>
<td>-14</td>
<td>77</td>
</tr>
<tr>
<td>Talbot</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Worcester</td>
<td>46</td>
<td>184</td>
</tr>
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</table>

Table 1. Percentage change in registered and documented boats homeported in Maryland’s major boating counties, 1985-1991.

Table 1 lists the Counties and their percentage change in registrations and documentations for comparison to Ocean City. Only counties with significant boat populations (over 1,000) are included.

The good news from the above data is that the boat population in and around Annapolis continues to grow. The main reason growth in Annapolis is slower than the rest of the State and competing areas is that there are few areas in Annapolis where berthing can be profitably added to accommodate the increasing boat population. This is not true in some of the lesser developed areas where ample land exists for profitable marina development. If Annapolis is to continue
to thrive and grow as a boating center then it must rely on maintaining or increasing the transient boat traffic rather than on a growing indigent boat population.

In addition to the effect of limited additional berthing facilities in Annapolis proper, there are indications that some boaters are selectively choosing to take their boat business out of Annapolis due to congestion on both land and sea. In a recently completed Ph.D. dissertation at the University of Maryland, Swartz found that recreational fishing participation rates may be negatively affected by boat congestion, lack of dock space and boat ramps in the Northern Bay Region (Swartz). No such problems with congestion were found in the Southern Bay Region where there is less boat congestion.

While many other counties in the State are growing faster than Anne Arundel County in boat populations, Anne Arundel is still the dominant boating county in the State. These other areas are growing because there are limited alternatives in and around Annapolis, and they offer a different type of boating experience --more rural on land, less congested on the water-- than Annapolis homeported boating does. There is no evidence, however, that these areas are growing at the expense of Annapolis as the boating center for the region.

The "Shopping-Center" Concept

One of the major premises in the previous planning study is that Annapolis has evolved into a major shopping center for marine items and services. This shopping center atmosphere, it was thought, is essential in retaining maritime industries in Annapolis. If the critical mass of businesses falls below that necessary to maintain this shopping center atmosphere, then the viability of all the maritime businesses will suffer.
Regardless of the absolute change in the number of maritime businesses locate Annapolis, it would be important to assess if there has been a change in the shopping status of the City. To test this, we calculated a diversity index for the periods of 1987 and 1991 and compared them to see if there was any significant change. The diversity of the firms represents the degree to which Annapolis fills its role as a maritime shopping center. To calculate the diversity, we used data supplied by the Marine Trades Association of Maryland (MTAM) on the number and types of firms in Annapolis for the two periods. MTAM has categories by which they classify firms. Firms may choose more than one category to be listed under. The Shannon diversity index\(^3\) (Wilson and Bossert) for 1991 was 3.15, and for 1987 was 3.12 (Figure 4). This indicates that diversity has actually increased slightly (all insignificantly) in the maritime industries in Annapolis since 1987. Even with the decline in sales at many businesses, and the loss of some businesses, the shopping center character of Annapolis in the marine area remains intact.

**Changes in Annapolis Maritime Businesses Since 1987**

One indicator to determine whether the maritime retention strategy is effective is to measure the net entry of maritime businesses since implementation of the zoning strategy in 1987. Net entry is the difference between new businesses and businesses departing. If net entry is negative then more businesses departed Annapolis than arrived. Although net entry can serve as an indicator of success of the zoning strategy, it does not definitively tell us whether the

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\(^3\)This is an index commonly used by ecologists to compare species diversity in different areas or in the same area at different times. It's formula is: \(H^* = -\sum p_i \ln p_i\). Where \(p_i\) is the number of observations in industry category \(i\) divided by the total number of observations across all industry categories, and \(\ln\) is the natural logarithm.
Figure 4. The diversity of Annapolis' maritime businesses that helps provide a maritime "shopping center" has not changed since 1987.
strategy is working. To do this, we would need a predictor of net entry without the zoning strategy, which would require a much more extensive analysis than is included in this study.

To measure net entry we followed the strategy taken in the 1987 Maritime Strategy study and the followup 1991 report to the Maritime Advisory Board. These studies used firm listings in the Portbook as a measure of the number of maritime firms doing business in Annapolis. The Portbook charges for firm listings, and therefore, represents an imperfect self-selected sample. However, we do not foresee any bias in one direction or the other for firms being listed in the Portbook, and therefore feel it is a reasonable approximation to a random sample.

Portbooks were obtained for the years 1987-1991 and the firm listings were entered in a database. If a firm appeared in the Portbook in 1987 and did not appear in later years, it was assumed that that firm had exited Annapolis. Firms that appeared in subsequent years were assumed to be new to Annapolis. Using these criterion we measured the net entry of firms for each year. The results are shown in Table 2.

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<tr>
<td>Entering Firms</td>
<td>31 (22%)</td>
<td>19 (13%)</td>
<td>18 (13%)</td>
<td>20 (16%)</td>
</tr>
<tr>
<td>Exiting Firms</td>
<td>25 (18%)</td>
<td>25 (17%)</td>
<td>28 (20%)</td>
<td>25 (20%)</td>
</tr>
<tr>
<td>Net Entry</td>
<td>6 (4%)</td>
<td>-6 (-4%)</td>
<td>-10 (-7%)</td>
<td>-5 (-4%)</td>
</tr>
<tr>
<td>Number of Firms</td>
<td>144</td>
<td>138</td>
<td>128</td>
<td>123</td>
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Table 2. Net entry of marine-related firms in the City of Annapolis since 1987.
If Portbook entries are true measures of business presence or absence, then since 1987, 103 marine-related firms have either exited Annapolis or gone out of business altogether. This loss has been partially offset by the entry of 88 new firms into the Annapolis market. The net effect, since the maritime zones have been enacted is that there has been a net loss of 15 firms since 1987, or 21 firms were lost since the peak year of 1988. Since this is only a random sample, one should look at the rates of entry and exit rather than the absolute amounts as indicators of net entry into the Annapolis market. The rates are given as percentages of the previous years number of businesses. For example, in 1988, the number of new businesses represented a 22% increase over 1987, whereas, 18% of the businesses exited, for a net increase of 4%. Over the 1987-1991 study period, we estimate that there has been an 11% decline in marine-related businesses in Annapolis. The annual rate of business loss peaked in 1990 at 7% and has since declined to 4%.

From the Portbook data, we were unable to determine which businesses were in the various maritime zones to see if these areas were affected differentially. It would be reasonable to assume that with developments along the Edgewood Road, outside the maritime zone, that the businesses in the maritime zones probably accounted for a smaller share of the business entries, and thus, have a greater rate of business loss than in the City as a whole.

Survey of Maritime Businesses

The 1991 Portbook listing of businesses in Annapolis was also used as the basis for a survey of business/property owners regarding the effect of the maritime zoning on their business operations. This survey, like the previous analysis, is intended to be a random sample, not a complete census of all marine businesses in Annapolis. A survey form (available from the
authors upon request) was mailed to each of the businesses listed in the Portbook. In total, 1: surveys were mailed to marine businesses in Annapolis. Four of the surveys were returned to the Post Office, undeliverable as addressed. Of the remaining 131 surveys, responses we received from 47 businesses. This is an excellent response rate (36%) for a one time mailing of a survey, and indicates the importance of this issue to the Annapolis marine business community.

Sample Description

Survey respondents represented a broad range of activities and location within Annapoli. Of the 47 respondents, 27 rented their business space, 17 owned and 3 left the answer blank. Of the 17 property owners, 11 rented space to other tenants. There were 30 respondents located in the maritime zoned districts (MI=13, MM=10, ME=2, MC=1, and unspecified maritime zone=4). Sixteen respondents indicated they were located outside of the maritime zones, and 1 did not know or chose not to respond to the question.

Tenancy

As one might expect, the property owners indicated they have been present in the Annapolis area for a longer period of time than tenants. The average property owner has been in business for 12.4 years compared to 7.2 for tenants. Property owners time in business range
from 2 to 33 years with a median of 10 years.\textsuperscript{4} Tenants also had a wide range of time in business from 1 to 26 years with a median of 6 years.

**Space Occupied**

The median amount of space occupied by both property owners and tenants was similar, 1100 square feet for owners and 1200 square feet for tenants. The smallest space rented by any business was 144 square feet, and the greatest was 10,000 square feet. The minimum space for property owners was also 144 square feet, but the maximum was almost 73,000 square feet of space.

**Rents**

Rental fees ranged from $1.50 to $48 per square foot per year, and the mean was $11.16. The median may be a better indicator of what rents are in the Annapolis area, and this was measured to be $9.75. The rents reported in our sample include both high quality office space and industrial space. Except for the two extremes of $1.50 and $48 per square foot rents were in line with office and industrial rents in Anne Arundel County as reported by the Office of Economic Development.\textsuperscript{4} Industrial space rents in Anne Arundel County can be had for as low as $2.95, but the median rent is $6.75. About 32\% of our sample which did not distinguish between industrial and office space were paying rents below the industrial space median rent for

\textsuperscript{4}The median indicates that 50\% had a number smaller than that indicated and 50\% had a number greater. Medians may be a superior measure of central tendency when there are a few very large or very small responses in the sample, but most are grouped somewhere in the middle of the range.

\textsuperscript{5}See Anne Arundel County Office & Industrial Space Survey, 1991, Anne Arundel County Office of Economic Development.
the County. Office space in the Annapolis/Parole area ranges from a low of $10.00 net to $21.00 for full service space, with median rents of $13.00 and $18.50, respectively. Only 14% of the firms sampled were paying rents greater than the median net rent, and only 3% were paying rents greater than the median full service rent. This indicates that the maritime zone has been effective in keeping rents competitive with those in the non-maritime zones and other parts of Anne Arundel County.

Twelve renters indicated they had compared rents in other areas. Areas mentioned included Kent Island, Deale, Baltimore, Edgewater, Eastern Shore, Solomon, and Anne Arundel County. The vast majority (75%) of the renters indicated that comparable rents were lower in these other areas. The remaining 25% indicated that rents were the same or greater elsewhere. The median response was that rents were 25% lower in these alternative regions. Thus, while it appears that the maritime zone has kept waterfront rents in line with non-waterfront Anne Arundel County rents, there is comparable space in areas outside the County where rents are significantly lower than in Annapolis.

Value of the Annapolis Location

The next two survey questions are an economic contingent valuation experiment. In contingent valuation, respondents are asked to place a dollar value on some hypothetical change in their status. In this case, the renters were asked what the effect would be on their businesses if they were located outside of the Annapolis area. We approached this question in two ways. The first was to ask how much lower rents would have to be for them to consider moving the business out of Annapolis. The second question was more direct and asked how much lower (or higher) their business profits would be if they moved away from Annapolis. Rents and
profits are related. With no other changes lower rents mean greater profits for the marine businesses. The trade-off is that in order to pay lower rents the businesses might have to relocate to an area that would result in decreased sales, and thus, lower profits. The sales volume may be lowered because the firms would no longer benefit from their Annapolis address, whether it is due to the prestige, location in a marine shopping center environment, or referrals from complementary businesses. This explains why rents can be lower in other parts of the State, yet businesses remain in Annapolis.\(^6\)

For the 11 respondents to the contingent valuation questions, they indicated that on average, rents would have to be 41\% lower (the median response was 42\%) than they are currently paying, to induce them to leave the Annapolis area. This represents, an average payment to these firms of $13,400 per year to compensate them for lost profits (or other benefits) as a result of moving from Annapolis. It should be noted that several firms chose to not answer this question, simply stating that they were not interested in moving from Annapolis. It is significant to note that the amount of compensation required by firms to locate outside of Annapolis (a 42\% reduction in rent) is greater than the rent difference that these firms found when looking outside the area. From a business point of view, for firms that currently are in Annapolis, the benefits of locating in Annapolis exceed the additional costs of doing business there.

Nineteen respondents answered the question as to how moving from Annapolis would affect their companies profits. The average response was this would result in a 29\% decrease

\(^6\)We recognize that firm location, particularly small firms, may not be driven solely by profit. The business owner may have a desire to work in Annapolis even though profits might be higher if they located elsewhere. Still, profitability must play a major role in firm location.
in profits (median = -25%). Only 24% stated that moving would have no effect on profits, and none said that it would increase profits. These findings corroborate the basic premise that Annapolis is a unique environment for maritime businesses.

**Vacancy Rates**

Property owners were asked what their vacancy rates were in 1987 compared to the current vacancy rates. According the owners, they had virtually no vacancies in 1987, the mean rate was only 1% and the median was 0%. The current situation is markedly different with a mean vacancy rate of 28% and a median rate of 31%. According to the Anne Arundel County Office of Economic Development, the vacancy rate in the County is 16.3% for both office and industrial space. The vacancy rates of maritime property owners appears to be significantly higher than rates in the County as a whole. This is contrary to the general finding of the City of Annapolis’ Department of Planning and Zoning’s survey of marine businesses and realtor: Marine businesses and realtors from that survey suggested that maritime property vacancies were probably about the same as non-maritime vacancies in the region.

**The Context of the Controversy**

Citizens, business owners and others interviewed for this study -- as well as the survey conducted by Alderman Ellen Moyer in February, 1992 -- expressed a range of opinions about maritime zoning in Annapolis, but the sharpest point of contention has been the issue of preservation versus change. On the other hand some argue that current maritime zoni

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7Technical Memorandum from Mary Burkholder to Eileen Fogarty re: Maritime Business Owners’ Survey Results, January 13, 1992.
regulations are unfair, especially at a time (they argue) that marine business is down and marine tenants are scarce or nonexistent. On the other hand, others argue that Annapolis’s maritime zoning is accomplishing its task of maintaining a marine-oriented area and should not be changed.

To understand the full extent of this controversy, one should perhaps step back and consider the nature of the change which has come to the Annapolis area -- as it has to many other cities and waterfront areas in recent years.

The Character of Change in Annapolis

In addition to a changeable economy, Annapolis and the surrounding area are facing other major shifts. An influx of population has led both to prosperity and to congestion, to opportunity on the other hand and to the loss of continuity with the past on the other. This change has occurred elsewhere in the Baltimore-Washington region, as it has all along the Boston-to-Richmond corridor, but perhaps nowhere with such a sense of loss as in the "Bay Country." Anne Arundel County, like other counties in the region, has seen the addition of new or expanded highways, large areas developed for housing, and an increase in the number of malls and shopping centers, at the expense of forested and agricultural lands. The demise of other natural resource-based industries such as the oyster industry, has also had a negative effect on traditional lifestyles and a "sense of place."

Regardless of whether one views the current development of land with gratitude or horror, it is clear that there has been an expansion in the suburban business sector. A decade ago, for example, the Parole shopping area stood almost alone as a suburban retail center in the Annapolis vicinity; now shopping centers from Marley Station to the north and Annapolis
Harbor Center to the south, including Annapolis Mall and the shopping areas on the Annapolis Neck and Forest Drive, are drawing business from downtown Annapolis. This trend includes marine businesses, such as Boaters World and, more recently, West Marine, both of which have located in the suburban area. Of course other marine businesses, such as Coast Navigation and Glen Housley Sails, have, in the past, moved to the suburbs as well.

In this regard, Annapolis is facing many of the same difficulties confronted by cities throughout the country. Large retail outlets are more easily placed in suburbs. Parking and heavy traffic are more easily accommodated in the outlying areas, and taxes are generally lower. Ironically, stores such as West Marine, while competing with downtown stores, such as Fawcetts and Viking, will almost certainly benefit from the reputation won by Annapolis as a maritime center. On the positive side, they may also add to the general availability of marine items in the area. Since such marine retail outlets do not specialize in repair, maintenance or construction, they will not, in general, take away customers from boatyards or other service businesses.

In the midst of suburban development and other changes, the City of Annapolis faces a difficult balancing act. While the city, like the county, seeks a viable base for taxes and infrastructure, gathering concerns for a vanishing way of life and a degraded environment have led to laws (including State and Federal laws) which protect the Bay’s shoreline, restrict the cutting of trees and attempt to control runoff. And while evaluating its evolving economic relationship with the county and outlying suburbs, the city’s major asset arguably continues to be the historic and cultural setting that makes Annapolis unique -- a uniqueness that almost certainly has economic benefits as well as social ones.
The Maritime Debate

What some see as a confrontation between preservation and prosperity has come to a head in the maritime zoning debate. Some citizens interviewed made a plea to retain the maritime character of the city, especially in Eastport. Some even called for a museum-like setting, where one could watch the building or restoration of wooden boats, as in Mystic, Connecticut, for example. Other said that they like the area "just the way it is," adding that the community had a "love affair" with the marine trades, and enjoyed the presence of boat builders, carpenters, riggers and others connected with the boating industry.

A number of property owners, on the other hand, complained bitterly about obstacles placed in their path. These obstacles were not always related to the maritime zoning issue, or to the City of Annapolis' zoning policy. The property owners in question pointed to such laws and regulations as the critical area law, the tree bill, and occupational safety (OSHA) regulations for the workplace. Their perception was that each year brings more regulation and more expense, making business not only difficult but in some cases impossible.

As an illustration, one property owner planned the building of a marine facility in a designated "marine industrial" (MI) zone. He felt that the City of Annapolis was in fact supportive of his initiative, and according to owners, Alderman and others appeared at meetings to testify in his behalf. Still, because of numerous requirements, the project will probably not, according to his most recent projections, get underway.

Specifically, for instance, he was required to design and build a separate structure for spray painting. The air handling system, because of OSHA requirements, cost a significant amount of money. Even so, the paint operation could not be run during the winter, because the
air handling system would, according to the owner, draw all of the heat out of the building in short order.

**Economic Analysis of the Zoning Strategy**

The economic arguments for the preservation of working maritime waterfront in the City of Annapolis are implicit in the 1986 Planning Study. Having working maritime waterfront makes Annapolis a unique City, and this uniqueness is a "public good". A public good exists when individuals benefit from something, but it is difficult to make them pay (usually, because those who do not pay cannot be excluded from enjoyment of the benefit). In this case there are two groups who benefit from Annapolis' unique character, residents and the maritime-related businesses themselves. Left to the free market transaction of waterfront property, this public good nature is not considered in the transaction and the highest and best use from a purely financial standpoint is conversion of the property to its highest income producing uses (e.g., condominiums, hotels, etc.). From the public welfare point of view, the highest and best use would consider the value of the public good, and would require public sector intervention (e.g., zoning, taxes or subsidies) to maintain these uses.

The value of the unique maritime community in Annapolis is potentially measurable with in-depth economic studies, but such an analysis is beyond the scope of this report. It is our impression that it is widely accepted among citizens, business and property owners that the value of preserving the maritime character of Annapolis' waterfront businesses exceeds the foregone financial benefits from allowing a fundamental change in the makeup of the waterfront community towards non-maritime related businesses. This assumption, for maritime businesses is somewhat substantiated by the contingent valuation experiment conducted in our survey of
marine businesses. Therefore, we accept as a given the correctness of the maritime retention strategy from an economic efficiency argument.  

The economic issue we would like to explore is the effectiveness of zoning in achieving the maritime retention goal. The maritime zones, by dictum, reduce the demand for sale or rental of property in that zone, by eliminating classes of potential renters or buyers from the marketplace. We will use the rental argument to make our point.

The willingness-to-pay a certain level of rent for office or industrial space (rental demand) is a function of how a particular space will effect the profits of the business. The higher the profits at a particular location, the greater the rent the business owner is willing-to-pay. Economists call this kind of demand, a derived demand because it is derived from business profits. We demonstrated in our contingent valuation experiment that business owners are willing-to-pay higher rents if it in turn translates into higher firm profits. This derived demand is depicted in a supply and demand diagram of the Annapolis maritime real estate market (Figure 5).

The quantity of maritime real estate is relatively fixed, and mostly independent of real estate prices. If property owners can at least break-even on property rentals, then the availability of rental space in the short-run will not change. In the long-run, if rental prices are extremely high, new properties will be developed to capture more of the potential market. This is depicted as the nearly vertical real estate supply curve in Figure 5. Without the maritime

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Figure 5. Market diagram showing how the maritime zones and a marine industry recession lowers the demand for rental property in the maritime zone.
zone, the real estate market clears at a higher price than when there is a maritime zone in place. The zoning acts to remove a portion of potential renters out of the market, those that do not meet the requirements of the maritime zone. This removal is represented by a shift downward in the demand curve for rental property. The new market situation with the maritime zone is one where the same quantity of property is leased, but the rental rates are lower. In effect, the zone is a forced subsidy of maritime property owners to maritime businesses. The issue is whether or not the subsidy is sufficient to retain maritime businesses and attract new ones.

When the maritime zones were put into effect, the marine trades were a booming industry. Assumptions were made in the 1987 Maritime Retention Strategy report that the industry was healthy and would continue to grow. With a strong demand by maritime businesses due to the profitability of this industry segment, the viability of the maritime zone was never questioned. Most of the discussion in that report discussed compensation for property owners for the forced benefit transfer to businesses.

Under current conditions where profits have been greatly diminished, the issue of whether the subsidy is sufficient becomes problematic. Without the higher profits, fewer businesses can afford to pay the rents, and the demand curve shifts even lower. The high vacancy rates and the loss of maritime firms in Annapolis indicate that there is currently an excess supply of maritime space in Annapolis. This, in economic terms, is what has created the discussion about reexamining the maritime zones in Annapolis.

Throughout our discussions and analysis with civic leaders, property owners and business owners, no one has suggested that preservation of Annapolis as a maritime center is a flawed concept. We have also suggested that the public and private benefits from this maritime center
may well exceed the costs of not allowing alternative development such as hotels and condominiums. Therefore, any major change in the maritime zone, for example, to allow significantly more non-maritime businesses would not serve the goal of the City of Annapolis. The focus necessarily must fall on how to make the maritime zone viable, even in recessionary times. The answer is that the subsidies to the marine businesses must be increased to retain and attract more of the desired businesses. A rental subsidy created by the maritime zone helps, but for businesses where property rents are only a small portion of their costs, this may not be enough.

We present several recommendations of types of subsidies the City might consider. The first recommendation recognizes that the biggest problem facing small firms and new start-up companies is access to capital. Low interest loans or loan guaranty programs targeted at maritime businesses would create a significant subsidy to attract qualifying businesses to the maritime zones. Business incubators have apparently been raised in passing as a potential aid in attracting maritime businesses.

We have compared the Annapolis maritime zoning restrictions with those recommended in the North Atlantic Water Dependent Use Study and have determined that the flexibility and cross-subsidization of maritime businesses with non-maritime is adequately built in to the Annapolis regulations. The one area that should be considered is how the calculation of second story and higher floor space factors in. Since second-story space does not have direct access to the water, perhaps greater flexibility can be afforded to the use of this space towards uses that are more complimentary to maritime than directly maritime. These uses could potentially cross subsidize ground-level direct maritime uses.
The City of Annapolis, until recently has had a rather painless route in attempting to preserve its maritime identity. The decade of the 1980’s was a boom time for maritime-related industries. The adoption of maritime zones at the peak of this boom was financed by the profits and high waterfront land values that resulted from the boom. In just 3 years, the U.S. marine industries have lost all the sales gains they made over the past 20 years. Although Annapolis has lost some marine businesses during this time, it has managed to hold its own as a major marine center. As marginally profitable businesses closed down, the well-managed ones have managed to stay in business, and a few have actually increased sales despite an overall business decline. Partly because of the existence of Annapolis as a marine shopping center, many of the businesses here have continued on. Although we feel the marine industries are poised for a healthy recovery, we do not anticipate a return to the boom years of the 1980’s. In the absence of a boom in the maritime industries, the City must evaluate how zoning restrictions can be supplemented in order to retain and attract maritime businesses. One of the major tenants of economics is that there are no free lunches. If Annapolis wants to retain its maritime character, it will be costly, but probably worth it.

References


City of Annapolis Department of Planning and Zoning. Report to the Annapolis City Council of the Annapolis Maritime Advisory Board. Annapolis, Maryland. 1991.

URBANIZATION AND THE LOSS OF AGRICULTURAL LANDS AND WETLANDS

by

Buddy L. Dillman, John E. Reynolds, Arthur T. Tomerlin, and Stacey R. Linn

INTRODUCTION

The coastal counties of the Southeast are among those with the most rapidly changing land use patterns. One of the most important impacts of population growth on the natural resource base of the Southeast is the conversion of land which was formerly in extensive uses, such as agriculture, forestry, and wetlands, into urban uses. In our increasingly footloose, service-based economy, the quality and quantity of environmental goods are the principal reasons for the rapid increase in the population of the region. Yet, paradoxically, the resulting increased urbanization is perceived to result in a diminution of aesthetic and ecological values of the natural resource base (Audirac et al. 1990).

In our market economy with its emphasis on private property rights and generally flexible land use controls, the amount of land converted from extensive uses to urban uses generally increases with area population growth. However, there are considerable variations in land consumption between subareas, over time and, to an increasingly important degree, with

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1Dr. Dillman and Dr. Reynolds are Professors, Department of Agricultural and Applied Economics, Clemson University, and Department of Food and Resource Economics, University of Florida, Mr. Tomerlin is Graduate Research Assistant, Department of Agricultural and Applied Economics, Clemson University, and Ms. Linn is Graduate Assistant, Department of Food and Resource Economics, University of Florida. This research was partially supported by a grant from the Resources and Technology Division, Economic Research Service, U. S. Department of Agriculture.
different institutional arrangements. The facts of the matter can be determined only through empirical measurement of the volume and types of land use changes that have occurred. The task is best approached by seeking to determine what changes are taking place and what market imperfections, market failures and institutional forces contribute to the changes. Usually, suggestions consist of suggested tinkering with the markets and institutions to make the system operate more efficiently, rather than with identification of optimal quantities of each land use.

Background and Approach

The research upon which this paper is based employs paired-point sampling to estimate land use changes over time. A number of analyses by researchers of the Economic Research Service (ERS), U.S. Department of Agriculture, have sought to measure land use change through the use of area or point sampling (Zeimet et al. 1976; Frey and Dill 1971; Slogget and Cook 1967). This study is a follow-up to a recently completed national land use change study by the Resources and Technology Division of ERS (Vesterby 1988; Vesterby and Heimlich 1991; Freed and Jones 1988).

The ERS national study analyzed more than 25,000 points on non-federal land changes in use between the early 1970s and the early 1980s. Sample points were drawn from 135 fast-growth counties — those that had experienced population increases of at least 25,000 persons and at least 25 percent — and 57 counties that had large changes in cropland between 1969 and 1982 but were not in the fast-growth category. The number of sample points exceeded

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2While land use consumption for each new resident is difficult to predict for a specific area, marginal urban land use coefficients have been estimated by a number of researchers which vary significantly for different socioeconomic regions and for metro vs. non-metro areas (Reynolds and Dillman 1991; Zeimet et al. 1976; Vesterby and Heimlich 1991; Dill and Otte 1971)
the number required to provide valid estimates of precision at the national level and for four major regions (Vesterby 1988).

Points for evaluation were chosen for the sample counties by overlaying 30' x 60' U.S. Geological Survey quadrangle maps over a transparent mylar grid with randomly selected points, using a light table. Points from the mylar grid were transferred to the quad maps, located on the early 1970s and early 1980s aerial photographs and plotted there. The points were transferred from the quad maps to the aerial photographs visually since the differing resolution of the photography used and the distance distortion from the center to the edge of aerial photographs make measurement or triangulation difficult. The land use at each point was interpreted for the two time periods and entered on a code sheet along with additional point, photo and quad map identification data (Vesterby 1988). Interpretation of land use was limited to 13 predetermined classifications --Table 1, first column-- based on a three level classification system developed by the U. S. Geological Survey (Anderson et al. 1976).

The basic results of the ERS national study are summarized in a from-to matrix of land use change from the early 1970s to the early 1980s, Table 2. A square matrix is produced with the land use categories and acreages listed for the early 1970s on the vertical scale and the same categories for the early 1980s on the horizontal. The acreages in the same land use at the beginning and the end of the period appear on the diagonal. The off-diagonal values show the acreages converted. Row values show the losses from the early 1970s acreages in each use to each of the early 1980s uses at the column heads. Conversely, column values show the gains.

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3 Aerial photography is not available for all areas in all years; thus, photography of usable resolution was obtained for the sample counties as close to 1970 and 1980 as possible, as explained by Vesterby (1988).
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* Numbers refer to standard USGS Classification System codes.
* b Includes farm residence and rural dwellings.
* * Includes all other farm buildings.
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Source: ERS data on land use change, early 1970s to early 1980s (Vesterby and Heimlich 1991). Based on sample data interpreted from aerial photographs.
in the early 1980s from each of the early 1970s uses in the row stubs. The individual vectors of the national matrix and the Southeast regional matrix, along with the various natural resource inventories and results from other research, have provided the basis for a number of interesting analyses (Vesterby and Brooks 1988; Heimlich and Reining 1988; Heimlich 1989; Vesterby and Heimlich 1991).

National Study Results and Indications

Examination of the urban land use vectors and those of other land uses for the U.S. matrix and a similar from-to matrix for the Southeast region prompted some interesting questions about the process of conversion of wetlands, farmlands and forest lands to urban uses. It was observed that more than one million acres were converted to urban uses between the early 1970s and the early 1980s in the 68 Southeastern fast-growth and cropland change counties, only 10 percent was converted directly from wetlands. About 46 percent and 44 percent were converted from agriculture and forestry, respectively. At the same time, large acreages of wetlands were converted to agricultural and forestry uses. These conversions over the decade suggested a possible sequence of land use changes in which wetlands might be converted first to agriculture and forestry, and then to urban uses (Heimlich 1989). Alternatively, as farm and forest lands along the rural-urban fringe were converted to residential and other urban uses, some of these extensive operations may be reestablished at more distant locations, and some wetlands are displaced in the process. Inasmuch as the early 1970s was a period of relatively high commodity prices and large plantings, it is easy to rationalize the replacement of some of the 940,000 acres of farm and forest lands lost to urbanization in the ERS sample counties. Also, since the Agricultural Stabilization and Conservation Service (ASCS) was still providing financial support
for agricultural land clearing and drainage during this period, it is not amazing that 241,000 new acres of farm and forest land were converted from wetlands.

The object of the current research was to follow up on some of these ideas to see if any clear patterns of land use change are occurring in the rapidly urbanizing areas of the Southeast. Specifically, further testing was necessary to see if significant sequential development of wetland involving farm and forest land as an intermediate step has occurred, and to ascertain the economic and institutional reasons for it. To get a better view of the land development processes involved, it was determined that another period needed to be added --the early 1990s-- and that much more intensive samples had to be drawn in areas of concentrated land use change. Thus, small fast growth areas were selected in South Carolina and Florida for intensive sampling. Interpretation of land use at the same sample points at three points in time was expected to allow any sequential changes to be observed and tested for statistical significance.

The concept of sequential development is not inconsistent with the theory of land use succession based on differential economic rents. In addition, institutional arrangements --rules of the game-- promulgated over the two recent decades may well have led to development sequences such as those alluded to here. A brief exploration of the important theory and types of institutional controls is in order before presenting the analytical process.

**THEORY OF LAND USE SUCCESSION**

As population increases, large amounts of land are needed for homes, schools, shopping centers, transportation networks and places of employment. As the demand for high value --usually urban-- uses increases, land is bid away from more extensive uses, such as cropland, pasture, forest land, wetlands and other "undeveloped uses." Those who wish to develop land
for urban uses generally find it relatively easy to bid land away from extensive uses because of higher capitalized net returns --economic rents-- in the more intensive urban uses.

This kind of urban expansion can be illustrated, in a theoretical and highly idealize fashion, in Figure 1. The vertical axis represents the level of economic rent per acre of land and the horizontal axis represents the distance from a given urban center or other optimum location, often referred to as the "100 percent spot." The lines labeled I and II are called "b rent surfaces," as each represents the maximum rent per acre as distance from the 100 perce spot increases. One can visualize a number of bid rent surfaces, one for each different land use each having a different slope, beginning at a different level on the vertical --rent-- axis at reaching a zero rent level at different distances from the urban center. For simplicity, let represent "urban use," which produces \( y_1 \) dollars worth of rent per acre at the 100 percent sp and decreases to zero dollars per acre at distance \( d \).

Rural land use is represented by bid rent surface II. It is flatter because, for many rural land uses, there is little or no particular advantage in being located near the 100 percent spot; hence, \( y_2 \) is only slightly higher than the economic rents produced by lands of equivalent quality at some distance from the urban center. While rural land rents are generally much lower than that of many urban uses on well situated lands, at some distance from the 100 percent spot margin of transference will be reached where the "highest and best" use will change from urban to rural; i.e., the rational land owner, ceteris paribus, will tend to employ the land in some rural use beyond point \( d_1 \), because higher rents can be earned thereby. There will be additional margins of transference as more bid rent surfaces are added to the figure. Rotating the figure around the vertical axis produces the familiar concentric von Thunen rings extensively used
Figure 1
Bid Rent for Two Land Uses
illustrate the theoretical land use pattern around an urban center. Realistically, geographic features, transportation corridors and established activities create irregular, starfish shaped boundaries rather than concentric rings, but the concept is the same.

The effects of population growth are illustrated in Figure 2. As population increases and more urban land is required, the urban bid rent surface increases to $I'$, and the margin of transference shifts outward to $d_2$. The distance from $d_1$ to $d_2$ is the amount of additional encroachment into the rural area that occurs as the highest and best use changes.

What happens to this picture if the area in the zone of transference is wetland? The rural bid rent surface in Figure 3 is modified to show that the rent produced by more extensive use, say agriculture, forestry and commercial recreation, $II_w$, is lower than surrounding urban land. Other things equal, the lower rural rent will extend the area over which urban use is the highest and best use as far as $d_3$. But it is possible that the ability of wetlands to produce economic rent in urban uses is reduced equally because of legal and other transactions costs and poor soil substrate quality for building construction. In this case, the urban bid rent surface becomes $I'w_1$, and the margin of transference remains in the vicinity of $d_2$. On the other hand, wetlands may produce higher rents for residential and other urban uses because of enhanced access to environmental amenities, in which case the urban bid rent surface becomes $I'w_2$, and the margin of transference from urban to rural use of wetland will shift to $d_4$. The likelihood of the latter occurring may depend upon the ability of developers to evade some or all of the institutional restraints on wetland modification or conversion.
Figure 2
Bid Rent Functions with a Population Change

Rent/Acre

$Y_1'$

$Y_1$

$Y_2$

Distance

$O$

$d_1$

$d$

$d_2$

II
Figure 3
Bid Rent Functions with a Low-Valued Wetland
INSTITUTIONAL RESTRICTIONS

Institutional restrictions on land use refer to any application of the powers of government, i.e., police, taxation, spending, proprietary, and eminent domain powers, to guide or direct land use. Such restrictions are designed to enhance the public welfare in those instances in which market failures or market imperfections exist, or can be presumed to exist, and landowner decisions cannot be relied upon to produce acceptable land use. In municipalities, various combinations of planning and zoning, public purchase and ownership, subsidization of private activities, and regulation provide citizens the level of land use control they want, or that they can tolerate. Such institutional restrictions have been employed, to varying degrees, in cities of all sizes in the United States for more than a century. For the most part, municipal restrictions have been directed toward the achievement of greater exclusivity in the location of different urban activities: commercial, industrial, residential, and service areas. Extensive activities generally have been considered as residual land uses inside city boundaries, and the land thought of as undeveloped. In a few instances, these undeveloped areas have been set aside permanently as greenspace or buffers, which arguably are urban concepts of land use.

Rural areas, in addition to being the normal locus of extensive activities --farming, forestry, mining, grazing and wilderness-- are considered to be suitable locations for all kinds of urban activities as well, such as residential, commercial, industrial, transportation and service areas. If any concept of zoning exists in the rural area, it is apt to be of a cumulative type in which "higher order" land uses in the zoning hierarchy are allowed in the "lower order zones." In most rural areas of the United States, land use restrictions are spotty and weak. Notable exceptions are presented by government owned lands in parks, forests, historical monuments and
other such holdings, although excessive grazing and tree cutting are often allowed, and road building and abuse by concessionaires sometimes diminish public values. Other exceptions are the many programs for conservation and protection of natural resources and special areas on individually owned lands by combinations of easements, program payments and regulation. Examples are the protection of wildlife habitat, particularly the habitat of endangered species such as the red cockaded woodpecker and the Florida scrub jay; protection of water quantity and quality; soil conservation measures; regulations concerning the disposal of hazardous wastes; and protection and retention of farmland and wetlands. The latter are of particular importance for this discussion.

Farmland retention regulations and programs vary considerably from state to state, each of which employs some combination of tax relief, "right to farm" laws, purchase or transfer of development rights --PDR/TDR-- agricultural districting and agricultural zoning. The current status of farmland retention programs in the various states is discussed elsewhere in these proceedings (See article by Buist). In spite of the considerable interest in farmland retention nationally during the late 1970s and early 1980s, rural land use regulation does not engender a lot of support and is not thought to contribute more than a minor amount to the transaction costs of developing farm and forest lands in Southeastern metro areas. In South Carolina, for example, the only two farmland protection measures in place are a right to farm law and farm and forest land use value taxation. Both are designed to help farmers and foresters who wish to continue in those activities to do so without regard to the market value and changing uses of surrounding tracts. Neither prevents farmland and forest land conversion to other uses, although
the tax law does contain a tax deferral feature in the form of a five year rollback tax without an interest penalty.

Florida farm and forest land use changes are regulated to a greater extent through growth management laws. The Local Government Comprehensive Planning Act of 1975 requires that local governments adopt comprehensive plans, and development must conform to the plans. The Local Government Comprehensive Planning and Development Regulation Act of 1985 overhauled previous local planning laws and requires consistency between local laws and state and regional plans. The 1985 Act also includes a concurrency clause that requires public services needed to support development be available prior to development so existing levels of service do not deteriorate.

Wetland protection measures, on the other hand, are believed to exact considerable transactions costs on developers, as much because of uncertainty relating to the definition of wetlands as because of the application of the administrative rules promulgated to enforce the legislation of federal, state and local laws governments. The federal government seemed to have settled on a 1991 revision of the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation 1989) which defined wetlands on the basis of hydric soils, hydrophytic vegetation and hydrology. However, the comment period produced consistent and forceful opposition by a host of environmental groups, who argued that the proposed manual changes would result in as much as a fifty percent reduction in the total acreage classified as wetlands. As a result, both the 1991 revision and the 1989 manual were rejected and, at this time, regulators are basing their decisions on a 1987 version of the manual.
There are a number of Federal laws, executive orders and administrative rules that, in one way or another, are ostensibly designed to protect wetlands from being altered. The most important are Section 404 of the Clean Water Act, Executive Order 11990 and the "swampbuster" provisions contained in omnibus farm legislation. Section 404 derives from the U.S. Army Corps of Engineers’ broad powers to control the navigable waters of the United States under Section 10 of the Rivers and Harbors Act of 1899. Originally passed as part of the 1972 Federal Water Pollution Control Act Amendments, and reauthorized in 1977 as the Clean Water Act, Section 404 gives the Corps of Engineers permitting power over the discharge of any dredged or fill materials into the waters of the United States, including wetlands. The U.S. Environmental Protection Agency (EPA) also has oversight over the 404 permitting process.

Executive Order 11990 directs each federal agency to minimize the loss or degradation of wetlands and to preserve and enhance their natural and beneficial values in carrying out agency responsibilities. For example, the order requires the U.S. Department of Agriculture (USDA) to place wetland easements on all wetlands coming into the Farmers Home Administration (FmHA) inventory, a not inconsiderable quantity of land emanating from the "farm crisis" of the 1980s. Over time, such mandatory easements, combined with contributed and purchased easements, can take many acres of development rights out of the private domain and reduce the need for regulatory enforcement.

Probably the most powerful tool for controlling farm conversions of wetlands, but on which apparently has been enforced in a less than vigorous manner, until recently, is the so-called "swampbuster" provision, Title XII (Subtitle C) of the Food Security Act of 1985 — the 1985 Farm Bill. Under "swampbuster," as applied until 1990, a farmer would lose his price
support payments, and other important farm program benefits upon planting a commodity crop on a drained wetland. The program was criticized as being less than enthusiastically enforced, containing important conceptual loopholes, and applying only to farmers who are dependent on farm program benefits for a substantial portion of their farm incomes (Carey, Heimlich and Brazee 1990). Swampbuster was strengthened somewhat in Title XIV (Subtitle B) of the Food, Agriculture, Conservation, and Trade Act of 1990 --the 1990 Farm Bill. The "trigger" for a violation is changed from the time of planting to the time of draining; the role of the Fish and Wildlife Service (FWS) in decision making, along with the Agricultural Stabilization and Conservation Service (ASCS) and the Soil Conservation Service (SCS) will result in considerably more wetland advocacy; and the Secretary of Agriculture is allowed to impose graduated sanctions, depending on the severity of the violation (Meyer 1991; Heimlich 1991).

The many important federal wetland protection initiatives notwithstanding, the state institutional activities that protect wetlands are now, or in the future will become, the first line of defense in wetland protection. They are, in many cases, more stringent than federal regulations. Two outstanding examples are the South Carolina Coastal Zone Management Act - Act 123 of 1977-- and Florida's Henderson Wetlands Protection Act of 1984. The South Carolina Coastal Council is mandated to protect the quality of the coastal environment and to promote the economic and social improvement of the coastal zone and of all of the people of the state through implementation of a coastal management program. The Coastal Council has permitting authority over all proposed activities in wetlands and surrounding areas in the eight coastal counties of the state. The Henderson Wetlands Protection Act was enacted by the State of Florida to provide increased authority for monitoring and regulating development activities
which have the potential of altering fundamentally the remaining wetlands of the state. This legislation authorizes the five water management districts and the Department of Environmental Regulation to regulate agricultural, developmental and other activities that affect wetlands.

In addition to the several federal, state and local governmental programs that impact potential land use change at the rural-urban fringe, there are a host of other institutional factors operating through product and labor markets, values and beliefs, financial markets, educational effects and various other aspects of group, collective, or social actions that influence and/or control individual behavior. As economists, we haven’t any special insight into the workings of these legal and other institutional forces except insofar as they produce economic effects or combine to change economic behavior.

Taken together, the institutional rules of the game are expected to have considerable effect on the conversion of land from rural to urban uses at the rural-urban fringe. It is expected that types of changes and sources of new urban development will differ between the two decades studied whether or not any consistent land use change sequence designed to circumvent wetland conversion regulations is identified or not. The inclusion of a second decade adds an important dimension to the previous studies of land use change since it allows observation of land use change within a period of important institutional control, especially the previously discussed legal and regulatory restrictions.

**DESIGN OF THE CURRENT STUDY**

The study is designed to estimate land use changes over two decades in two growth areas of the Southeast. The land use categories used are found in the right hand column of Table 1, where they are easily compared with those used in the national study. Land use changes are
estimated by analyzing paired sample points over time. The land uses at the selected sample points are interpreted for the early 1970s, 1980s and 1990s. These data are analyzed to identify any land use changes occurring from the 1970s to the 1980s and from the 1980s to the 1990s. For example, the analysis will provide estimates of the amount of land that was urbanized each decade and the acreages of each classification of land converted to urban uses.

The areas chosen for analysis were the Charleston MSA, which is comprised of Charleston, Berkeley and Dorchester Counties, in South Carolina, and the Tampa-St. Petersburg and Bradenton MSAs, which include Hillsborough, Pinellas, Pasco, Hernando and Manatee Counties, in Florida. The study areas were, to some extent, arbitrarily chosen, and no claim is made that they are completely representative of growth areas of the Southeast. At the same time, there is no reason to believe that the two areas are unique in any important way that would bias hypothesis tests or any important conclusions. Both areas combine large population increases with large acreages of wetlands and farmlands. The two areas differ in some important respects. Commercial forestry is much more important in the Charleston MSA, and commercial agriculture including citrus groves and range land are prominent in the two Florida MSAs. The three-county South Carolina study area is slightly smaller in area than the five-county Florida area --2,721 square miles, compared to 3,295 square miles-- and much smaller in 1990 population -- approximately half a million persons compared to over two and a quarter million for the Florida study area.

All of the study area counties except Charleston were included as fast-growth counties in the ERS national study; thus, many of the research materials needed were available, such as the 30’ x 60’ USGS quadrangle maps, early 1970s and early 1980s aerial photographs, some of
the soil surveys, and coded data for the national study sample points. Important additional research materials which had to be purchased included Charleston County maps and early 1970s and early 1980s aerial photographs for areas not covered by overlaps from the other two counties in the MSA as well as early 1990s photography for all three South Carolina counties. Early 1990s aerial photography was not purchased for the Florida study area, since a commitment was obtained early in the study, from the Southwest Florida Water Management District, that land use interpretations for the Florida sample points could be obtained from their geographic information system (GIS). Their GIS database includes 1991 land use interpretations for the study counties based on the Anderson Classification.

By far the greatest task was thickening the sample in the two areas to achieve MSA level validity. A statistically valid area sample size is not determined by total population or geographic area, but by the probability of finding hypothesized changes in land use classifications and the degree of confidence with which one wishes to present the results and conclusions. Thus, there is no cost advantage in using small multi-county areas over whole states or multi-state regions. Also, two study areas require twice as many sample points as one, all other things equal. The advantages of small study areas are related to savings in the purchase of aerial photographs and presumed consistency of application of the institutional rules of the game within a study area.

Another important reason for using small relatively homogeneous areas is the enhanced ability to stratify the area, for sampling purposes, into areas that were a) mostly developed before the first period, b) urbanizing during the study period, and c) largely unchanged within the time period being studied. By concentrating the bulk of the sample points in the "urbanizing
area," it was hoped that large numbers of wetland and farmland change-points could be identified. The "urbanizing area" corresponds to the area d₁-d₂ in Figure 3. The ERS national study produced relatively few change points using randomly selected sample points from whole counties, even though the study counties were chosen using a rigorous "fast-growth" definition. Based upon the research findings of that study and the advice of the ERS researchers involved, the sample in the current study was stratified to concentrate the sample points in the "urbanizing areas" of the study MSAs where land use changes are likely to have taken place between 1970 and 1990. The fact that such urbanizing areas may not correspond to everyone's definition of the rural-urban fringe is recognized.

The urbanizing areas of the three-county Charleston MSA and the five counties of the Tampa Bay MSAs were selected carefully to represent the localities experiencing intense land use change during the 20-year period being studied. First, larger-scale, 7.5′ quadrangle maps were purchased for all areas of the sample counties which could reasonably be expected to have experienced urban growth during the study period. These quad maps were divided into approximately square-mile grids.⁴ Grids representing the urbanizing areas were chosen by visual comparison of the early 1970s and early 1990s aerial photography. The grids are rather large, and all of those selected contained areas in which land use clearly had not changed. Likewise, some grids not included contained minimal evidence of land use change but could not

⁴The Florida counties were divided according to the approximately 640 acre (one mile square) sections of the rectangular survey for which lines appear on the USGS quadrangle maps. In South Carolina, where the rectangular survey system is not used, grids were drawn by the researchers so as to be near one mile square and to fill the 30 x 60 minute USGS quadrangle maps with equal sized grids. These grids turned out to be 4,750 x 5,050 feet, and approximately 551 acres in size.
be characterized as urbanizing areas. Similarly, while not all of the grids included in the urbanizing area were contiguous, some grids in the study counties with considerable land use change were not included because they were remote from the bulk of the urbanizing area. One pre-sample point was plotted randomly on each grid: 383 in the Florida study area and 156 in the South Carolina study area. The points were selected by generating random coordinates by computer.

The total number of sample points to be drawn from the urbanizing area of each of the two study areas was determined by a sample size formula which is based on the desired level of statistical probability, the proportion of pre-sample observations in certain critical classifications, the width of the confidence interval and the number of classifications. The formula for sample size is

\[ n = \chi^2_{1, 1 - \frac{\alpha}{\kappa}} \frac{q_i(1-q_i)}{\delta^2}, \]

where \( n = \) sample size,

\( \chi^2_{1} = \) Chi square with one degree of freedom,

\( \alpha = \) probability of exceeding the confidence interval,

\( \kappa = \) the number of classifications,

\( q_i = \) proportion of observations in the ith class, and

\( \delta = \) percentage half-width of the confidence interval.
The number of classifications ($k$) is 13 (Table 1). The half-width of the confidence interval required depends on the size of the smallest $q_i$, which applies to individual land use change type, i.e., a matrix element, considered to be essential to the hypotheses being tested. The latter depends on the proportion of change points from the pre-sample that fell in that classification. The percentage half-width of the confidence interval was set at one-third $q_i$. The sample size for the Florida urbanizing area was 1,545; in South Carolina it was 1,227. Training of the graduate students involved in the interpretation of land use was facilitated greatly by using the code sheets from the national study. All points from the national study falling in our two study areas were reinterpreted. Doing so provided reinforcement and training for the aerial photography interpreters. Also, reinterpretation alerted us to some needed changes in the classification categories, Table 1, and some of the "decision rules" were changed. For example, soil maps were checked on all forested sample points to determine if a hydric soil existed; if so, the point was classified as a forested wetland (classification 61) instead of forest land (classification 40).

RESULTS

The aggregate results of the land use interpretations for all sample points are presented in square transition matrices much the same as that presented earlier for the national study in Table 2. The results of the study are summarized as land use change from each category in the earlier period into their respective uses in the later period. The 1980s to 1990s transition matrix for the Florida study area that is being developed from a GIS data base has not been fully

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Since the grove and range classifications are irrelevant to South Carolina land use classification, the value of $k$ is reduced accordingly.
compiled. Therefore, only a 1970s to 1980s transition matrix will be presented and discussed for the Florida study area in this report (Table 3). Transition matrices for both the 1970s to 1980s and 1980s to 1990s time periods have been completed for the South Carolina study area (Tables 4 and 5).

Land use in the two study areas differed in several ways in the initial period, the early 1970s; thus, the nature of land use change over time could be expected to differ as well. The Florida study area had 108,480 acres --43.9 percent of the urban fringe study area-- in the four urban uses (Table 3) compared to 16,800 acres in the South Carolina study area --19.6 percent of the area-- (Table 4). There were 49,120 acres in agricultural uses in the Florida area --19.9 percent of the total area-- while the South Carolina area contained 8,400 acres in agricultural uses --9.8 percent. The Florida study area had 8,640 acres of groves and 10,080 acres of rangeland in the 1970s while the South Carolina area had no land classified in these uses.

On the other hand, the South Carolina study area had a larger proportion of the area in forestland than the Florida study area --16,450 acres or 19.2 percent compared to 30,080 acres or 12.2 percent. There was a substantial difference in the amount of land classified as wetlands. In the South Carolina area, there were 36,680 acres of wetlands --30,800 acres of forested wetlands and 5,880 acres of nonforested wetlands-- which amounted to 42.7 percent of the land in the urban fringe study area. In the Florida area, there were 27,840 acres of wetlands in the urban fringe study area --11.3 percent of the total.
Table 3. Transition Matrix of Land Use Change in the Florida Study Area, 1970s to 1980s

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-Thousand acres-

TOTAL USE

1980s LAND USE

1970s

42720

12000

3200

50560

30400

8640

10080

30080

6240

18560

9280

3200

22240

247200
Table 4. Transition Matrix of Land Use Change in the South Carolina Study Area, 1970s to 1980s

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Urban Fringe Land Use

Urban land use --Categories 11, 12, 14 and 16-- accounted for more than two-fifths of the land area in the early 1970s in the Florida study area. Forestland and cropland/pasture were the next largest categories of land use at about 30,000 acres each. Wetlands accounted for 27,840 acres. By the early 1980s, urban land uses were even more dominant, accounting for about two-thirds of the study area. Cropland/pasture declined by 35 percent and accounted for about 20,000 acres, but forestland declined to almost 5,000 acres. Wetlands declined but by relatively smaller amounts. It is interesting to note that acreage in groves increased by about 6 percent indicating that agricultural uses with high income earning capacity seemed to compete more successfully with urban growth (Table 3).

In the South Carolina study area, wetlands accounted for over two-fifths of the land area. Urban land uses and forests each accounted for about one-fifth of the land area. Cropland/pasture accounted for about 10 percent of the land area. By the early 1980s, urban land uses had increased and accounted for more than one-third of the study area. Most of the urban expansion came from wetlands, forests and cropland/pasture. Wetlands declined by 23 percent, forestland declined by 19 percent and cropland/pasture acreage decreased by 24 percent (Table 4).

By the 1990s, urban uses accounted for more than one-half of the land area in the South Carolina study area. Wetlands had declined to only about 24 percent of the land area. Forestland and cropland/pasture had both declined substantially and accounted for about 11 and 5 percent respectively. As urban expansion occurred in the study area, wetlands, forestland and cropland/pasture acreage each declined by 40 to 50 percent (Table 5).
Urban Land Conversion

From the 1970s to the 1980s, there were 58,720 acres of net urban land conversion in the Florida study area. There were 20,800 acres of forestland --35 percent-- 18,720 acres of land in transition --31 percent-- and 12,000 acres of cropland, pasture and groves --20 percent-- converted to urban uses. In addition, 4,000 acres of wetlands and 4,320 acres of rangeland were converted to urban uses --6.7 percent and 7.2 percent, respectively.

From the 1970s to the 1980s, there were 13,860 acres of net urban land conversion in the South Carolina study area. There were 6,510 acres of wetlands --47 percent-- 2,730 acres of land in transition --19.7 percent-- 2,450 acres of forestland --17.7 percent-- and 2,170 acres of cropland/pasture --15.7 percent-- converted to urban uses. From the 1980s to 1990s, there were 14,000 acres of net urban land conversion. The types of land and acres converted were very similar to the previous period --slightly less wetlands and more forestland.

Wetland Conversion

From the 1970s to the 1980s, there were 6,240 acres of wetlands conversion in the Florida study area. There were 4,000 acres of wetlands converted to urban uses; 1,280 acres to water; 800 acres to land in transition; and only 160 acres converted to agriculture.

There were 8,400 acres of wetlands converted to other uses during the 1970s in the South Carolina study area: 6,510 acres converted to urban uses; 1,540 acres to land in transition; 420 acres to agriculture; and 70 acres to forestland. In the 1980s, there were 7,980 acres of wetlands converted to other uses. About 74 percent of that was converted to urban uses, which is about the same percent as in the previous period. There were only 140 acres converted to agriculture and 70 acres converted to forestland.
CONCLUSIONS

This study is concerned with the conversion of agricultural lands and wetlands. The interpretation of land use at sample points provides estimates of the types and quantities of land that are converted to urban uses as population growth occurs in urbanizing areas. By interpreting land use at sample points at three points in time, the quantity changes can be estimated and the sequences of change can be identified. The principal institutional effects contributing to these land use changes are regulatory restrictions and economic incentives.

In general, the primary difference between the two study areas is that in South Carolina a greater proportion of the study area was classified as wetlands in the 1970s and more of the land being converted to urban uses comes from wetlands than in the Florida study area. About 43 percent of the land converted to urban uses in the South Carolina area came from wetlands as compared to 6.7 percent in the Florida area. In the Florida study area about 62 percent of the land converted to urban uses came from forestland, range and agricultural land as compared to 34.7 percent in the South Carolina area. Between 20 and 30 percent of the land converted to urban uses came from the land in transition category for the two study areas.

In the examination of the Southeast region data from the national study, ERS researchers noted that large acreages of wetlands were converted to agriculture and forestry while substantial acreages of agricultural land and forest land were being converted to urban uses. This led to the hypothesis of a possible sequence of land use changes in which wetlands may be converted first to agriculture and forestry and then to urban uses (Heimlich 1989). The results from both the Florida and South Carolina study areas rejects this hypothesis, since very little land was converted from wetlands to agriculture or forestry. In Florida, only 160 acres were converted
from wetland to agriculture or forestry -- 2.6 percent of the total acreage of wetland converted to other uses. In South Carolina, 490 acres of wetlands were converted to agriculture and forestry during the 1970s and only 210 acres during the 1980s. In both study areas, most of the wetland conversion was directly to urban uses. In the South Carolina study area, about 74 percent of the wetland conversion went directly to urban uses in both time periods. In Florida, about 64 percent of the wetland conversion was for urban uses.

It would be interesting to know what happens to agricultural producers as they are displaced by urban expansion. Do they move to other rural areas and reestablish their agricultural operations? If so, are wetlands in these more distant locations converted to agricultural or forestry uses? This study was designed to examine land use changes in the urban fringe areas and cannot answer these types of questions. But future research might focus on identifying the areas and types of situations where wetlands are converted to agricultural and forestry uses.

The principal institutional effects contributing to the land use changes observed in this study are regulatory restrictions and economic incentives. Although resources were not available to examine these effects in this study, additional research should focus on testing the economic and institutional effects on land use changes in the urban fringe.

REFERENCES


EFFECTS OF URBAN LAND CONVERSION ON AGRICULTURE

By

Marlow Vesterby and Kenneth S. Krupa

Introduction

Urbanization directly and indirectly affects agriculture. The most obvious effect is the conversion of farmland into residential lots, streets, schools, and other urban infrastructure. However, more subtle changes occur, both physical and economic. Some are documented, others are not. Effects occur in land values, taxation, prime cropland, idle farmland, the structure of agriculture, and efforts to preserve agricultural land. We discuss some effects of urbanization on agriculture. We organize our discussion under two major headings: conversion of agricultural land and economic effects of urbanization on agricultural production.

Several myths exist about the urban conversion of agricultural land. Perceptions exist that 1) urbanization is converting cropland so rapidly that the nation will soon run out (Simon, 2) land converted is mostly prime cropland best suited for raising crops (Vining et al., 3) urban conversion causes adjacent farmland to become idle and unproductive because of high taxes assessed at urban rates (Conklin and Lesher and 4), various farmland preservation programs are necessary and effective to ensure the nation’s food and fiber producing capacity. We present information that our studies, and others, bring to bear on these perceptions.

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1 Economists, Resources and Technology Division, Economic Research Service, USDA Washington DC. The views presented here are the authors’ and do not necessarily represent policies or views of the U.S. Department of Agriculture.
First, we present a brief description of John Frazer Hart's perimetropolitan bow wave, a theoretical approach supported by empirical data for New York City, explaining changes in agricultural production as urban development pushes out from the city center. Hart's work adds perspective to the Economic Research Service (ERS) studies of urban land conversion. It helps explain analyses of the economic affects on agriculture in 29 counties that were fast-growth four continuous decades from 1950 to 1990.

The percent of people living in urban areas has increased over time. In 1950, the U.S. population was 151 million people, 64 percent of which lived in urban areas. By 1990, U.S. population was 249 million persons (USDC 1992) (Table 1). Of that, 187 million, or 75 percent, lived in urban areas. Population increases result in more housing, employment, schools, shopping areas, and other infrastructure, which translate into demand for land to urbanize.

<table>
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<th>Year</th>
<th>U.S. population million</th>
<th>Urban population million</th>
<th>Portion urban %</th>
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<th>Acres per person</th>
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</table>

Conversion of Agricultural Land

Studies have hypothesized many effects of urbanization on agriculture in the United States. Several have attempted to look at the direct physical effects, generally by estimating the amount of land taken from agriculture for urban uses. Some of these include: work by Zeimet et al. on urbanization in the 1960s of selected parts of the U.S.; the reports of Dill and Otte (1970, 1971) of urban conversion in the Northeast and Western states in the 1950s; a study by Frey and Dill of urbanization in the Southern Mississippi Alluvial Valley; Anderson's analysis of urbanization of rural lands in Colorado (1971, 1984); the National Agricultural Lands Study claiming an urbanization rate of three million acres a year; the 1970s national study by Heimlich et al. and Vesterby and Heimlich reporting land urbanized annually at about three quarters of a million acres; and the 1982 and 1987 National Resources Inventories (1987, 1989) showing about three quarter million acres per year urbanized from 1982 to 1987. We look at some of the effects of urbanization on farmland, and when appropriate, present information from our studies that bear on these topics.

A Theoretical Explanation of Agricultural Land Conversion

Hart outlined a theoretical approach to explain the effect on agriculture of expansion of urban areas around cities. An area encompassing a fifty-mile radius of Times Square, New York City, serves as his case study. He examines population and farmland changes from 1860 to 1987, using census of population and agriculture. Hart describes four general bands of agricultural activity, from the urban center outward; greenhouses, nurseries, vegetables, and dairies. As urban population expanded outward, he found these farming types also shifted outward. The process is similar to the "... bow wave... in front of the bow of a ship
moving through the water” (Figure 1). He calls this the perimetropolitan bow wave. Hart found, for example, that dairying, located in boroughs such as Queens and Bronx in 1925, had disappeared in these areas by 1940 and by 1987 had moved mostly to Orange and Putnam counties, in New York, and several New Jersey counties. Vegetable production had disappeared by 1970 in the most heavily populated zone nearest the urban center, and had moved further out. Urban expansion, and consequently, the bow wave effect on agriculture, varied by time and direction, pushing out more to the west and north. The Atlantic Ocean to the south precluded agricultural expansion in that direction.

Forero, Huntsinger, and Clawson referenced the perimetropolitan bow wave phenomenon in their study of 3 California Counties near San Francisco Bay: Alameda, Contra Costa, and Santa Clara. While the major trust of their study dealt with urban effects on ranching, they documented an intensification of agriculture on croplands at the urban fringe. Typical patterns included shifts to nursery and greenhouse crops and decreases in field and orchard crops in these counties.

Hart’s theory builds on Von Thünen’s (Hall and Sinclair’s work that describe concentric rings of farming around cities, modified by improvements in transportation. Urban expansion can be depicted by bid rent functions where the economic rent for land depends on distance from an urban center and other factors (Reynolds and Dillman; Brooks). Each land use (urban, cropland, or wetland, for example) has a separate bid rent function. With increases in population, urban area expands and outbids land uses that have lower economic rents.
Figure 1

Urbanization Effects on Agriculture

First era  Second era  Third era

Conversion in Fast-Growth Counties

Hart's theory of the effects on agriculture of urban expansion provide insight into the findings of studies of fast-growth counties by the Economic Research Service. Fast-growth county studies were done for both the decades of the 1960s and 1970s. They relied on paired-point, spatial sampling techniques, using aerial photography (Vesterby).

Analyses of land use changes were interpreted from photographs of fast-growth counties in two studies covering 1960-70 and 1970-80 (Zelmetz, Vesterby and Heimlich). A county was defined as fast-growth if, over a decade, it grew by more than 25,000 people and increased in population by at least 25 percent (Vesterby). We assumed that urbanization occurred most intensively in fast-growth counties. While the 135 fast-growth counties of the 1970s represented only 4 percent of nearly 3,100 counties in the United States, they accounted for about half (48 percent) of U.S. population growth. The minimum percentage component of the fast-growth definition excludes counties with large population bases that develop by filling in previously urbanized areas. The minimum absolute component excludes rapidly growing areas with small population bases where development may be widely scattered. To study land use change ERS gathered data on 53 of 129 counties that met the fast-growth definition in the 1960s and 135 of 139 counties that met the definition in the 1970s (Map 1).

Urban area expanded by 37 percent in fast-growth counties in the 1970s. According to Bureau of the Census data, the rate of increase was the same for the United States, a 37 percent urban increase for the 1970s, and 36 percent for the 1960s (Frey, USDC 1988 and 1992). However, for the 1980s the national increase in urban area had slowed to 18 percent (possibly due in part to improved measuring techniques).
Fast-Growth Counties, 1970s

Central Plains
No fast-growth counties

North
28 counties

Pacific
28 counties

Southwest
37 counties

Southeast
42 counties

Increased in population by at least 25,000 and 25 percent
Only about one-third of the 1970s new urban land in fast-growth counties was formerly cropland. The rest came from pasture, range, forest, and other uses. Consequently, the net loss of cropland in fast-growth counties was under 4 percent. Additions to cropland and pasture offset about one-third of the loss to urban uses.

**National Conversion**

Of almost 2.3 billion acres of U.S. land, only 2.5 percent (56 million acres) was in urban uses in 1990. Land used for cropland or pasture was eight times larger than urban land use.

By combining estimates of fast-growth county urbanization with results from studies of non-fast-growth counties (Zeimetz, Dill and Otte 1971), we obtained an estimate of 740,000 acres of rural land urbanized each year in the United States during 1970-80. We extended our photo interpretation results using data for 1982-87 from the 1987 National Resources Inventory (NRI) conducted by the Soil Conservation Service (USDA 1989). Total change in urban uses from 1982-87, estimated in the 1987 NRI, was 726,000 acres per year, far less than the 3 million acre annual conversion rate claimed by NALS.

Urbanization of agricultural land is a dynamic process (Brown et al.. Hart found that agriculture changes as urbanization moves out from the city center. Studies by ERS show that as cropland converts to urban uses, new cropland is developed from other uses such as range and forest (Vesterby and Heimlich, Zeimetz). New cropland in some regions replaces cropland losses in others. Nationally, total acres of cropland have been nearly constant at 450 million acres since 1945 (Daugherty, Heimlich et al., Krupa and Daugherty (figure 2).

Heimlich et al. estimated urban conversion of cropland through the year 2000. Assuming normal population and household increases predicted by the Bureau of the Census (USDC 1988),
Use of land in farms
1945-1987

Source: Daugherty 1991; Krupa and Daugherty 1990
a rate of 0.5 acres per household for fast-growth counties and 1 acre per household in other areas, urban area would expand from 56 to 65 million acres from 1990 to the year 2000. Even if cropland supplied all new urban land, cropland would be reduced less than 2 percent from 1990 levels. However, only a third of land urbanized comes from cropland, so the cropland reduction would likely be even smaller. Barring any unforeseen catastrophe (such as a major war or climatic disaster) there is little reason to be concerned about the nation’s food and fiber producing capacity well into the next century. Taking into account normal productivity increases and the fact that the U.S. frequently exports a third of it’s grain crops, there is even less reason to be concerned about the nation’s ability to feed itself. Urbanization of agricultural land has little effect on the nation’s agricultural productive capacity.

Conversion of Prime Land

Conventional wisdom maintains that developers seek to urbanize level, well-drained land which is often the best cropland; that cities grew in areas with an abundance of "prime" farmland (Dillman and Cousins, Vining et al. (Prime land is "... best suited to producing food and fiber ..." (USDA 1975). Nine factors define prime farmland (Bills et al. 1984). These are moisture supply, soil temperature, soil acidity, water table in relation to the root zone, soil conductivity, frequency of flooding, soil erodibility, soil permeability, and size of rock fragments in the soil.

Urbanization of prime agricultural land received the attention of Dillman and Cousins when they found in their study of the Greenville-Spartanburg-Pickens, South Carolina, SMSA, that 42 percent of the land in the SMSA was prime, whereas 52 percent of the developed land was prime. They concluded that since "... the Standard Metropolitan Statistical Areas
(SMSAs) in the United States contain a disproportionate share of the nation's prime land . . .
development within the SMSA tends to occur on the prime lands." As further evidence,
Dillman and Cousins cite an earlier study by Vining, et al. The Vining study found that 21.3
percent of the land within SMSAs was Land Capability Classes I and II, compared to only 17.6
percent nationally.

The 1970s fast-growth county study showed prime cropland occurred less than
proportionately in fast-growth counties (43 percent) than in the nation (49 percent) (figure 3).
Furthermore, of cropland converted, 40 percent was prime land--less than its occurrence in fast-
growth counties. Prime cropland and pasture converted from other rural uses replaced one-third
of the prime cropland lost to urban uses, resulting in smaller net losses than would otherwise
have occurred. The largest concentrations of fast-growth counties, those in Florida, Arizona,
and southern California, have very little prime land (Map 2). Other areas that have heavy
concentrations of prime land, such as Iowa, Illinois, Indiana, and Kansas, have few fast-growth
counties. Our findings are not necessarily contradictory to those of Dillman and Cousins or
Vining, et al. They studied different areas, at earlier time periods. Examination of prime land
urbanization in fast-growth counties in the 1950s or 1960s may have shown different results.
Also, had we broadened our definition of fast-growth counties to include all those in
metropolitan areas, the result may have been different. Or, perhaps by the decade of the 1970s
a new public awareness resulted in less development of prime land--a weak, unlikely scenario,
since one would have to believe that people moved to Florida, Arizona, and southern California
Figure 3

Quality of Cropland and Pasture

United States
Prime 49%
Not prime 51%

Total - Fast-growth counties
Prime 43%
Not prime 57%

Converted to urban uses - Fast-growth counties
Prime 40%
Not prime 60%

USDA defines Prime farmland as "... best suited to producing food and fiber...."
Prime farmland "... has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed... according to modern farming methods." (USDA)

Prime cropland and fast-growth counties, United States, 1982

County boundaries shown for each of 135 fast-growth counties.

1 dot = 25,000 acres of prime land.

Source: (USDA, 1987).
to avoid urban conversion of prime land. A more likely scenario is that retirement aged people move to these areas to avoid cold, northern winters. The fact that these areas have little prime land likely had no bearing on their decision.

**Effects of Urban Conversion on Adjacent Farmland**

Urban conversion of agricultural land also affects nearby farms. Higher land values, reflecting a potential for more urban development, often means higher farm property taxes. Programs and policies are sometimes initiated to reduce tax burdens and to preserve farms. These efforts can take several different forms, from simple legislative or executive proclamations acclaiming the importance of farming, to right to farm laws, to more comprehensive preferential use value assessment, districting, growth management planning and zoning, and purchase of development rights. These programs have economic costs and often redistribute tax burdens.

**Urbanization and Land values**

Many studies look at the effects of urbanization on increases in adjacent land values. Barkley concluded that "... land values and the market for land still, after a century of investigation, seem to evade explanation." He cites his study of King County, Washington, and several other studies that have shown mixed results. Schultz suggested that a locational matrix works more effectively to explain land values near the center of economic activity than it does at the fringes, where urbanization occurs. Consequently, land values at the rural-urban fringe are often characterized by terms like evasive, muddled, or unpredictable (Barkley). Regardless of the problems of determining land values at the rural-urban fringe, the price of rural land usually rises with increased urbanization (Heimlich and Brooks). While increased land value
may partly reflect rising agricultural value due to shifts to higher value crops, it also reflects a potentially higher urban development value. The effect of urbanization on agriculture is to raise land values, and ultimately, property taxes.

**Agricultural Disinvestment**

Because of higher land values and taxes, urbanization may affect adjacent farmland in another way. Conklin and Lesher argued "... that the usual process for allocating taxes in urban fringes discourages the continuance of agriculture wherever efficient farming requires large real estate improvements that must be maintained and occasionally replaced but lack value for nonfarm purposes." They refer to this phenomenon as agricultural disinvestment. Elsewhere it is called the "impermanence syndrome" (Blueprint Commission, Andrews and Lopez). Both terms refer to premature idling of agricultural land and the degradation of capital stock on farms as a side effect of nearby urbanization. This phenomenon has been studied and supported by Coughlin et al. and Berry. Lopez, et al. concluded that speculative activity reduced the supplies of fruit and livestock products more than other enterprises and that capital intensity was reduced more than land values.

A potential solution to premature disinvestment of farmland was proposed by Conklin and Lesher. Their suggestion was to use preferential or use-value assessment (UVA), that is, assessment of farmland at its farming value instead of a higher urban value for tax purposes. All States have some form of preferential assessment (Aiken). In 1989, twenty-seven states included rollback penalties to recapture a portion of urban market value taxes on farmland later developed for urban uses.
Effects of Urbanization on Land Use Preservation

Because of concerns about the loss of cropland, urban conversion has another effect on adjacent farmland. Urban growth in several parts of the country has resulted in various programs and policies to preserve farmland. These include: purchase of development rights (Hiemstra, Williams and Bills), transfer of development rights (Marcus, Pizor), use-value-assessment, agricultural districts (Bills and Boisvert), zoning, right-to-farm laws, and executive or legislative orders. Costs of preservation programs vary greatly. Use-value-assessment has been proposed as a program to preserve farmland, but Conklin and Lesher concurred with other researchers that even the complete elimination of real estate taxes would not prevent farmers from accepting high urban offers for their land. Mackenzie also concluded that UVA failed to preserve much farmland in a study of Northeast States (Mackenzie). Mackenzie pointed out that UVA is expensive, reducing the "... Northeast's property tax base by something like $20 billion. .."

Indirect Effects

Besides state and local programs, the Federal government has an effect on farmland preservation, both directly and indirectly. The direct effect is through parts of Federal laws (PL 97-98, PL 101-624) that encourage Federal agencies to identify adverse effects of public programs, such as road building, and minimize the extent to which these programs contribute to unnecessary farmland conversion. Indirectly, Federal tax regulations effect farmland preservation, including the capital gains tax and the provisions for deducting interest payments and state and local taxes from Federal income taxes. Federal tax exclusions from donations of
private land to public farmland trusts are another example of how urbanization pressures can affect land use preservation.

**Economic Effects of Urbanization on Agricultural Production**

Urbanization causes adjustments in farms that remain. Heimlich and Brooks (1989) discovered that farms in metropolitan areas were less than half the size of farms in nonmetropolitan areas. But the metro area average value of land and buildings was more than double. They found metro areas contain 16 percent of the U.S. farmland. In addition, crops in metro areas tend to be high value fruits, vegetables, and nursery products because metro area farms have closer access to urban demand for these products. Also, the higher cost of holding land in urbanizing areas leads farmers to operate more intensively to produce maximum revenue per acre. Thirty-eight percent of the dairy products produced in the U.S. are from metro areas. Heimlich and Barnard reinforced earlier findings with the discovery that "Metro farms make up nearly 30 percent of all [U.S.] farms, [and] control nearly 40 percent of farm assets . . . ."

These findings lend support to Hart's perimetropolitan bow wave thesis.

**Counties With Four Decades of Fast Growth**

We examined counties that met the fast-growth definition every decade for the last four decades (Map 3). Only twenty-nine counties qualified. (A previous study by Krupa and Vesterby listed 26 counties that met the definition, but using preliminary census data.) In these counties, each of which experienced four continuous decades of intense urban population pressure since 1950, we wanted to know: 1) what happened to total land in farms, 2) how much the market value of agricultural sales decreased, and 3) the effect on sales of crops.
Map 3

Fast-growth counties, every decade, 1950-1990

Twenty-nine counties that grew by 25,000 persons and 25 percent every decade from 1950 to 1990.
Changes in population, land in farms, and market value of agricultural products, especially higher-valued crops, were the primary factors examined. Data were collected from the 1950 through 1990 U.S. Census of Population and the 1950 and 1987 U.S. Census of Agriculture. The Consumer Price Index (CPI) was used to adjust agricultural sales data to 1982 levels to eliminate the effects of inflation and permit meaningful comparisons between 1950 and 1987.

Population

During the last several decades, increases in U.S. population have been greatest in the South and West. The top 29 counties are located in 14 States (Table 2). Nearly half are in California and Florida. Between 1950 and 1990 they had population increases ranging from nearly 157 thousand to 1.9 million people. The average annual rise ranged between 5.6 and 35.9 percent. As a group, the number of people in the 29 counties more than quadrupled from 3.2 million in 1950 to 18.1 million in 1990 (USDC 1990). The population of the United States increased by two-thirds between 1950 and 1990, from 151 to 249 million people. The top 29 fast-growth counties had 1.9 percent of the U.S. population in 1950 and 11.9 percent by 1990.

Farmland

Twenty-two of the 29 counties, for which data are available, had decreases in farmland (Table 3). The decline ranged from 7,000 acres in Sarasota county, Florida, to 982,000 acres in Maricopa county, Arizona. San Diego county, California, and Maricopa county, Arizona, together gained the most population, 3.7 million people, and had the largest combined farmland
Table 2. Population increase: top 29 fast-growth counties in the United States, ranked by total population, 1950-1990

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| Total           | 18,060               | 3,166                           | 14,894          | 11.8            |
| U.S. Total      | 248,710              | 151,326                         | 97,384          | 1.6             |

Percent of U.S. total: 11.9, 2.1, 11.5

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<td>17</td>
<td>CA Sonoma</td>
<td>774</td>
<td>550</td>
<td>-225</td>
<td>-53</td>
<td>-29</td>
</tr>
<tr>
<td>16</td>
<td>CO Arapahoe</td>
<td>539</td>
<td>295</td>
<td>-243</td>
<td>-56</td>
<td>-50</td>
</tr>
<tr>
<td>15</td>
<td>CO El Paso</td>
<td>1,239</td>
<td>918</td>
<td>-321</td>
<td>-163</td>
<td>-36</td>
</tr>
<tr>
<td>1</td>
<td>CA San Diego</td>
<td>999</td>
<td>530</td>
<td>-469</td>
<td>-68</td>
<td>-117</td>
</tr>
<tr>
<td>2</td>
<td>AZ Maricopa</td>
<td>2,375</td>
<td>1,391</td>
<td>-982</td>
<td>-68</td>
<td>-117</td>
</tr>
</tbody>
</table>

| Total           | 14,878           | 13,221                          | (1,657)                        | (931)                                    | (343)                    |

| U.S. total      | 1,158,966        | 964,471                         | (194,095)                      | (34,520)                                 | (62,175)                |

Percent of U.S. total: 1.01 1.36 1.12 -0.12 -0.04


NA-Not available
* Less than 500

1/ Counties that increased in population by at least 25,000 and 25 percent every decade, 1950-1990.
loss - 1.45 million acres. Five of the ten counties that gained the most population lost the most farmland.

Six counties had no decline in farmland. They are in four states - Arizona, California, Florida, and Nevada. Instead, these counties had increases ranging from 29,000 to over 1 million acres (29 to 162 percent). San Bernadino county, California, gained more farmland between 1950 and 1990 than any other county lost and had two and a half times more farmland in 1987 than in 1950 despite large population increases. The six county farmland increase cannot be attributed to any single agricultural sector. California and Nevada counties had land shifting into the dairy and livestock support sectors. In San Bernadino County, California, more farmland was needed to support a rapidly growing dairy industry that supplied the heavily populated Los Angeles market with fresh milk, butter, and cheese. The magnitude of the expansion was so great that by 1987 San Bernadino county had risen to number one in dairy production among all the counties in the Nation, with over 325 million dollars in sales. Washoe and Clark counties, Nevada, modestly increased their farmland bases via irrigated pasture to grow more hay to support an expanding livestock industry.

Florida counties added more farmland between 1950 and 1987 to expand crop production. In Palm Beach county, Florida, more cropland was required to accommodate growth in the sugarcane industry. In 1950 there were 400 acres in sugarcane. By 1987, this figure had increased to over 375,000 acres planted to sugarcane and sugarcane seed. Manatee county, Florida, added farmland to support a growing vegetable sector. In 1950 Manatee county had about 2,200 acres planted in tomatoes. By 1987, with over 14,600 acres, Manatee County had risen to the rank of sixth largest tomato producing county in the nation. Between 1950 and
1987, the total amount of land in farms (not to be confused with total cropland, which did not change) in the United States decreased by 194 million acres (or 16.8 percent). The top 29 fast-growth counties, which in 1950 had 1.28 percent of total U.S. farmland, increased to 1.37 percent by 1987. During this time, the amount of farmland in the top 29 fast-growth counties together decreased from 14.9 to 13.2 million acres, 11.1 percent. Surprisingly, this was less than the 16.8 percent decline in total U.S. farmland acres.

The six counties with the largest acreage declines - over 200,000 acres each - were all west of the Mississippi River. However, it should be noted that historically the size of both counties and farms in the West have been larger than those in the East.

**Value of Sales of Selected Crops**

Offhand, one might expect decreased sales of agricultural commodities from highly urbanizing counties because of the intense pressure for land to develop. We anticipated the rate of decline would be greater for the top 29 counties than for the U.S. because the rate of farmland loss in these counties was expected to be larger than for the nation.

Eleven of the 29 counties had decreases in market sales (Table 4). However, 17 counties had increases ranging from $2 to $633 million. Sales for all 29 counties together increased $1.9 billion (adjusted to a 1982 base) over the 40 year period. These results are consistent with findings from other studies that found higher values of sales in metropolitan areas (Heimlich and Brooks). (Hart) found agricultural producers in an urbanizing environment would shift to higher value crops. A larger share of market value will come from producing higher-valued commodities such as fruit and nuts; vegetables; and nursery and greenhouse items.

<table>
<thead>
<tr>
<th>Population rank</th>
<th>State and county</th>
<th>Market value difference</th>
<th>Thousand dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>FL Palm Beach</td>
<td>633,176</td>
<td>103,773</td>
</tr>
<tr>
<td>4</td>
<td>CA Riverside</td>
<td>397,006</td>
<td>28,727</td>
</tr>
<tr>
<td>9</td>
<td>CA Ventura</td>
<td>279,084</td>
<td>71,816</td>
</tr>
<tr>
<td>1</td>
<td>CA San Diego</td>
<td>205,849</td>
<td>176,772</td>
</tr>
<tr>
<td>14</td>
<td>CA San Bernardino</td>
<td>202,420</td>
<td>3,655</td>
</tr>
<tr>
<td>28</td>
<td>FL Manatee</td>
<td>98,533</td>
<td>19,196</td>
</tr>
<tr>
<td>2</td>
<td>AZ Maricopa</td>
<td>76,987</td>
<td>31,953</td>
</tr>
<tr>
<td>8</td>
<td>FL Orange</td>
<td>57,265</td>
<td>107,250</td>
</tr>
<tr>
<td>20</td>
<td>FL Lee</td>
<td>40,037</td>
<td>8,968</td>
</tr>
<tr>
<td>12</td>
<td>WA Snohomish</td>
<td>27,090</td>
<td>5,718</td>
</tr>
<tr>
<td>18</td>
<td>FL Volusia</td>
<td>26,096</td>
<td>38,062</td>
</tr>
<tr>
<td>21</td>
<td>OR Washington</td>
<td>17,561</td>
<td>30,858</td>
</tr>
<tr>
<td>10</td>
<td>AZ Pima</td>
<td>8,682</td>
<td>2,141</td>
</tr>
<tr>
<td>7</td>
<td>NV Clark</td>
<td>7,005</td>
<td>NA</td>
</tr>
<tr>
<td>23</td>
<td>OK Dakota</td>
<td>5,830</td>
<td>5,275</td>
</tr>
<tr>
<td>19</td>
<td>CA Solano</td>
<td>3,546</td>
<td>9,998</td>
</tr>
<tr>
<td>24</td>
<td>FL Sarasota</td>
<td>2,201</td>
<td>2,739</td>
</tr>
<tr>
<td>25</td>
<td>NV Washoe</td>
<td>(2,055)</td>
<td>NA</td>
</tr>
<tr>
<td>29</td>
<td>UT Davis</td>
<td>(2,619)</td>
<td>4,767</td>
</tr>
<tr>
<td>13</td>
<td>GA Cobb</td>
<td>(4,842)</td>
<td>NA</td>
</tr>
<tr>
<td>27</td>
<td>VA Prince William</td>
<td>(6,984)</td>
<td>309</td>
</tr>
<tr>
<td>15</td>
<td>CO El Paso</td>
<td>(13,178)</td>
<td>1,467</td>
</tr>
<tr>
<td>16</td>
<td>CO Arapahoe</td>
<td>(20,193)</td>
<td>2,681</td>
</tr>
<tr>
<td>11</td>
<td>TX Travis</td>
<td>(23,576)</td>
<td>434</td>
</tr>
<tr>
<td>22</td>
<td>FL Seminole</td>
<td>(25,027)</td>
<td>5,568</td>
</tr>
<tr>
<td>26</td>
<td>NH Rockingham</td>
<td>(25,764)</td>
<td>661</td>
</tr>
<tr>
<td>17</td>
<td>CA Sonoma</td>
<td>(42,329)</td>
<td>16,322</td>
</tr>
<tr>
<td>14</td>
<td>NJ Ocean</td>
<td>(48,598)</td>
<td>495</td>
</tr>
<tr>
<td>6</td>
<td>VA Fairfax</td>
<td>NA</td>
<td>2,787</td>
</tr>
</tbody>
</table>

Total: 1,975,363 681,611 368,731 121,637 1,154,816

Percent of U.S. total: 8.4 21.1 25.9 4.6 15.8

1/ Adjusted for inflation to a 1982 base.
NA -- Not available.

The real value of higher-valued crops rose in 20 counties, while two counties experienced a decline (Table 4). (Sales in seven counties were unknown due to lack of data.) For the top 29 fast-growth counties, combined, there was an increase of $1.2 billion.

We looked at three categories of high value crops: nursery and greenhouse, vegetables, and fruits and nuts (Table 4). Between 1950 and 1987, nursery and greenhouse products increased more than the other two categories. Twenty-six counties had sales increases ranging from $.3 to $176.8 million. Twenty-two counties doubled nursery and greenhouse sales between 1950 and 1987. Total market value of nursery and greenhouse products sold in the U.S. between 1950 and 1987 increased by over $3.2 billion (or 75 percent).

Population increases provide opportunity for agricultural producers. Perishable items, such as milk and produce for which consumers are willing to pay a premium for higher quality and freshness and for which transportation costs may be high, are often produced close to urban areas (Heimlich and Brooks). More people mean larger markets and more opportunity to sell agricultural products. Such market forces speed the shift into production of higher-value crops on land adjacent to urban areas and conversion of other rural land into cropland.

Farmland and cropland decreased in the most rapidly urbanizing counties during the last four decades. However, the market value of agricultural commodity sales increased. Crop losses from cropland idled or urbanized were more than compensated by increased sales from remaining farms selling higher-valued crops.

Conclusion

Urban conversion of farmland is not occurring at excessively high rates, nor is it taking disproportionate amounts of prime farmland out of production. Urban land is less than three
percent of the total U.S. land area. Even large increases in urban area represent relatively small decreases in rural areas. Farmland decreased less than four percent per decade for the 1960s and 1970s in fast-growth counties. The decline was primarily from farm rangeland and woodland, not cropland. There has been no significant net decrease in cropland in the U.S. since the early 1940s.

Urbanization does not mark the end of agriculture in rapidly growing counties. Even though the amount of farmland may decrease in counties where rapid population growth is sustained over several decades, agriculture still exists, and flourishes in many areas. Changes from hay and grain crops to high value nursery, greenhouse, and vegetable production, and in livestock to dairying, often more than compensate for losses of other crops and livestock in real market value. These changes can be attributed, in part, to the relative comparative advantage gained by agricultural sectors that benefit from proximity to increasingly highly populated market areas.

References


Berry, D. "Effects of urbanization on agricultural activities." Growth and Change. 9(1978):2-8


__________ Prime and Unique Farmlands. Land Inventory and Monitoring Memorandum 3. 1975.


BENEFITS OF AGRICULTURAL LAND PRESERVATION
FOR URBAN POPULATIONS IN PENNSYLVANIA

By

Wesley N. Musser, James S. Shortle, David G. Waddington and Debra K. Israel

In the past two decades, agricultural land preservation has become a persistent policy issue in many parts of the United States. The issue gained a sense of urgency in the 1970s when questions were raised about the adequacy of the diminishing land base for meeting future domestic and export demands for food, fiber, and agricultural fossil fuel substitutes, and when land loss became equated with environmental degradation and loss of cultural heritage (Brenneman and Bates; Crosson; Keene and Coughlin; Steiner and Theilacker). Most states have initiated programs that preserve land, but policy remains unsettled. State and local governments continue to take and deliberate on new actions, and debate continues about the appropriate level and means of farm land preservation (Duncan; Rose).

This paper summarizes two recent empirical studies of agricultural land preservation in Pennsylvania. These studies focus on the economic benefits of land preservation. One is a public choice analysis of a referendum on land preservation and the other is a contingent valuation study. As both studies build on the agricultural economic literature on this topic, the next section reviews the conceptual literature.

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1 Respectively, Professor, Associate Professor, and Former Graduate Assistants, Department of Agricultural Economics, The Pennsylvania State University. State College, Pennsylvania.
Conceptual Background

Many reasons for halting or slowing the conversion of farm land to nonfarm uses can be found in academic and popular literature. The most prevalent reason is maintaining agricultural production capacity to meet current and future demand for food and fiber. Correspondingly, criteria for ranking the relative desirability of alternative land for preservation tend to emphasize agricultural productivity considerations (Brenneman and Bates). Other reasons to preserve include maintenance of the economic base, control of urban sprawl, availability of local produce, preservation of open space/country-side amenities, cultural heritage, and the adverse impacts on community structure. Some reasons relate to widely held concerns while others reflect the specific values of agrarian fundamentalists and other special interests that have become vocal advocates.

Evidence on the demand and supply of land for agricultural production indicates no impending shortage (Crosson). This evidence combined with confidence in competitive markets to allocate appropriate benefits efficiently and technical change that steadily reduces the importance of land in agricultural production has led many economists to dismiss food scarcity as a valid reason for preserving agricultural land (e.g., Castle, Shultz). Economists also tend to be critical of the validity of other reasons given for agricultural land preservation that do not imply allocative inefficiencies related to land market failures (e.g., maintenance of local economic base) or where agricultural land preservation is an approach for addressing problems for which there are more efficient instruments (e.g., urban sprawl) (Gardner; Fischel). Economic arguments used in support of land saving action now primarily emphasize market
failure related to local open space and environmental amenity benefits and stress the local nature of the issue (Castle; Garnder; McConnell; Mulkey and Clouser, Fischel; Wolfram).

This conventional wisdom is somewhat unsatisfying. Its inconsistencies with policy evolution was suggested by Mulky and Clouser (p. 76): "A finding of no market failure and the conclusion that farm land preservation programs are unnecessary is inconsistent with the widespread political support for preservation programs." This framework also ignores some of the reasons for preserving farm land (e.g. cultural heritage). Continuing public support for land saving action despite no apparent food scarcity problems suggest that agricultural land may have broad existence values as well as local amenity values associated with agricultural land. If this is the case, the efficiency loss due to land market failures with respect to the non-rival benefits of farm land will be greater than recent economic literature suggests.

Continued political support for farm land preservation suggests that a public choice perspective may be useful to understand farm land preservation. Wolfram pioneered this approach in arguing that homeowners have an interest in farm land preservation to limit the supply of housing and therefore increase their home values. Fishel has a broader perspective in noting that this is a suburban view but may not be a central city or small city perspective. Agricultural land preservation may limit economic growth and therefore gains in employment and other wealth creating activity from growth. These issues are interesting and warrant more theoretical and empirical research. However, this paper considers a broader more fundamental issue: What benefits can a consumer expect from farm land preservation?

The standard neoclassical consumer model of a consumer maximizing a utility function subject to a budget constraint can be adapted to suggest a taxonomy of benefits. Environmental
amenities and agricultural cultural heritage are goods that could logically be arguments in a utility function; the latter would be a non-rival good with largely existence value. A good closely associated with environmental amenities is outdoor recreation. Shortle and Musser argue that recreation on public and private land is a benefit that is usually not considered in farm land preservation but perhaps deserves more consideration. An important issue here is the substitutability of forestland for farm land in recreation and perhaps other amenity arguments. McConnell also notes tradeoffs between urban and farm pollution as related to farm land preservation as related to environmental amenities.

Some of these benefits may affect the consumers budget constraint rather than utility function. The rival benefits such as recreation may affect cost of recreation in addition to quality. The issue of food availability may largely be a price of food perspective. Prices of food as a general commodity probability are not much affected by quantity of farm land. As argued in the literature reviewed in the previous section, excess production capacity and international trade in agricultural commodities means that limited effects of losses in farm land on food prices in general. However, prices of local food, which may be a separate argument in utility functions, could be greatly affected by loss of farm land near urban areas. The positive and negative economic development effects of farm land preservation also would impact the budget constraint via wealth effects of values of assets and prices of labor and other resources owned by households.

While the effect on food is largely on prices, excess national and local food production capacity may also have existence values. While not relevant in this country at least recently, national and political disasters do still disrupt food production and distribution. The memories
of World War II are still salient for many middle-aged and older people. In addition, food shortages around the world are a continuing problem. While this issue may have more relevance for agricultural trade and commodity price and income policies, it still may have relevance for agricultural land preservation.

The public choice view of these benefits is not completely divorced from the market failure view. Some of these benefits are mirrored in losses elsewhere in the agricultural sector and the broader economy. Therefore, realizing these benefits may not be inefficient. Nevertheless, the benefits discussed here are broader than those in the market failure discussion—e.g., local food, cultural heritage, and excess food capacity were not considered extensively in that argument. Thus, focusing on potential benefits to consumers may be fruitful in understanding farm land preservation.

Survey of Benefits of Agricultural Land Preservation

This study examines attitudes and willingness to pay (WTP) of residents in an urbanizing environment for agricultural land preservation. The study was designed to measure and evaluate perceived benefits of agricultural land preservation. Attitudes, were measured for a wide range of perceived reasons for land preservation and WTP was measured for local, state, and national land preservation programs.

Methodology

The study was conducted in Berks, Leigh, and Northampton Counties in Eastern Pennsylvania in 1989. Like many agricultural areas in the Northeast and Middle Atlantic States, the area was experiencing substantial development pressure and high conversion rates of highly
productive agricultural land. A mail survey of urban and rural residents was used to obtain information on attitudes about the importance of saving farm land, reasons for farm land preservation, and WTP for farm land preservation. Mailing procedures closely followed those of the Total Design Method (Dillman).

Respondents were drawn randomly from area telephone directories. Questionnaires were initially mailed to 2000 individuals. Of these, 108 (5.4 percent) were undeliverable, and 88 (4.4%) were sent to individuals who had moved out of the area or had died. Completed questionnaires were returned by 1080 (59.9%) of those mailed the survey (54% of those who received the sample). This response rate is somewhat lower than the average return rate for mail questionnaires but is not unusually low (Dillman).

Four categories of questions were included in the survey: personal experiences and activities relating to farm land (e.g., recreation on farm land, purchases of local produce, living on farms), attitudes/preferences towards farm land preservation and reasons for preservation, WTP valuations, and socio-economic characteristics. Attitude questions were used to explore the level of support for farm land preservation and reasons for farm land preservation. The attitude questions called for responses on a five point Likert-type scale with one being "Strongly Disagree," two, "Agree," three "Neutral," four "Agree," and five "Strongly Agree." Respondents were asked their WTP to preserve farm land in their county, Pennsylvania, and the United States. An open-ended contingent valuation format was used. WTP for a one-time donation was asked for a generalized farm land preservation program and not for specific parcels of land or number of acres. Unlike earlier studies previously detailed description of characteristics of the land is impossible for state and national programs. The generality of the
question may have introduced hypothetical bias causing a large range of WTP values. However, while the absolute values of WTP may be affected by hypothetical bias, the relative values should be less so.

Results

Attitudes About Farm Land Preservation

Results from the questions about the importance of farm land preservation in the respondents community and county, and in Pennsylvania and the United States are summarized in Table 1. Most respondents indicated it was moderately or extremely important to preserve farm land in each of these areas. In the few cases where respondents indicated that farm land preservation was not at all important, it was generally the case that this sentiment was held for preservation of farm land in their community. More than 88% of the people who said farm land preservation was not at all important in their community lived in urban and suburban areas which have little remaining farm land to preserve. Generally, respondents indicated that they thought it was extremely important to preserve farm land nationally as well as locally. Indeed, these responses suggest that farm land preservation is considered to be as important nationally as it is locally.
Table 1. Responses to Survey Question "How Important Do You Think It Is To Preserve Farm Land?"

<table>
<thead>
<tr>
<th>Area in Question</th>
<th>Extremely Important</th>
<th>Moderately Important</th>
<th>Slightly Important</th>
<th>Not At All Important</th>
<th>NA*</th>
</tr>
</thead>
<tbody>
<tr>
<td>In your community</td>
<td>65</td>
<td>19</td>
<td>6</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>In your county</td>
<td>78</td>
<td>17</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>In Pennsylvania</td>
<td>82</td>
<td>13</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>In the United States</td>
<td>84</td>
<td>11</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

*NA* = No Answer

Analysis of Attitude Responses

Two sets of attitude items were included in the survey for measurement of preferences for land preservation. One was attitudes toward reasons to oppose farm land preservation, and one was attitudes toward reasons to support farm land preservation. Table 2 lists the opposition set, and Table 3 lists the support set. The support attitudes were recorded so that higher scores indicated more support--five is Strongly Agree, four Agree, three Neutral, two Disagree, and on strongly Disagree. On the oppose attitudes, mean responses for both groups were mostly between Neutral and Disagree except on OB which was between Disagree and Strongly Disagree. Respondents therefore gave the highest response on the food-related attitude. On the reasons to support farm land preservation, responses were between Agree and Strongly Agree except for SA and SI but large differences did not exist.
Table 2. Mean Responses for Attitude Question on Reasons to Oppose Farm Land Preservation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>OA</td>
<td>Development of farm land is necessary for economic growth.</td>
</tr>
<tr>
<td>OB</td>
<td>Preserving farm land is unnecessary because there is a surplus of food.</td>
</tr>
<tr>
<td>OC</td>
<td>Farm land preservation would be too expensive.</td>
</tr>
<tr>
<td>OD</td>
<td>Plenty of farm land is still available.</td>
</tr>
<tr>
<td>OE</td>
<td>Money could be better spent on things other than preserving farm land.</td>
</tr>
<tr>
<td>OF</td>
<td>Farm land is a major source of water pollutants.</td>
</tr>
<tr>
<td>OG</td>
<td>Development should be promoted in rural areas.</td>
</tr>
<tr>
<td>OH</td>
<td>Farmers should compete like other businesses.</td>
</tr>
<tr>
<td>OI</td>
<td>We don’t need as much farm land because of new technologies.</td>
</tr>
</tbody>
</table>

The attitude items in Tables 2 and 3 are likely interrelated. This study used factor analysis to identify underlying patterns of responses and to reduce the number of variables for subsequent analysis. The factor analysis used varimax rotation of principal components. A criteria of eigenvalues greater than or equal to one was used to select numbers of factors. Results are reported in Table 4. Factors were given names based on the attitudes on which the factor had high loadings. The first factor had high loadings of SA, SB, SC, SD, SF, and SG. These attitudes are relate to food supply and agrarian culture. The second factor had high loadings of OB, OC, OD, OE, OF, OH, and OI. These attitudes have a relationship to farm land supply. The third factor loaded highly on OA, OG, SH, SI, and SJ. The latter three attitudes related to open space and the former two to controlling growth. SE cross-loaded on both the supply of food and culture and open space factors. This attitude was the only one
concerned with wildlife. The cross-loading may be related to wildlife being considered both a source of food and an integral part of natural environments related to open space.

Table 3. Mean Responses for Attitude Question on Reasons to Support Farm Land Preservation.

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>SA Agriculture provides important local jobs.</td>
<td>3.70</td>
</tr>
<tr>
<td>SB Preserving farm land supports farming as a way of life.</td>
<td>4.12</td>
</tr>
<tr>
<td>SC I prefer locally grown food.</td>
<td>4.10</td>
</tr>
<tr>
<td>SD Farm land should be preserved to ensure adequate food supply for future generations.</td>
<td>4.37</td>
</tr>
<tr>
<td>SE Farm land provides an important wildlife habitat.</td>
<td>4.30</td>
</tr>
<tr>
<td>SF Farms are an important part of our heritage.</td>
<td>4.32</td>
</tr>
<tr>
<td>SG Farm land should be preserved to ensure adequate food supply in case of a national emergency.</td>
<td>4.17</td>
</tr>
<tr>
<td>SH Farm land should be preserved to maintain open space.</td>
<td>4.22</td>
</tr>
<tr>
<td>SI Farm land should be preserved because it provides a scenic countryside.</td>
<td>3.92</td>
</tr>
<tr>
<td>SJ Farm land preservation helps to slow down urban sprawl.</td>
<td>4.03</td>
</tr>
</tbody>
</table>

The factor analysis does support the view that open space is related to support for farm land preservation. The smaller amount of variation explained by this factor does indicate that fewer differences exist in the sample on attitudes related to this issue—individuals are fairly cohesive on this issue. Factors one and two indicate attitude patterns supportive of other benefits of farm land preservation. These factors relate to the broad area of existence value of farm land related to food supply, an agrarian culture, and guaranteeing a supply of farm land. While this study could not find separate influences for these effects, more research with refined attitude
Table 4. Varimax Rotated Factor Scores for Attitudes in Support and Opposition to Farm Land Preservation

<table>
<thead>
<tr>
<th>Attitude Item&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Factor 1: Supply of Food and Culture</th>
<th>Factor 2: Supply of Land</th>
<th>Factor 3: Open Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>OA</td>
<td>-0.34159</td>
<td>0.38569</td>
<td>0.56490</td>
</tr>
<tr>
<td>OB</td>
<td>0.28131</td>
<td>0.65303</td>
<td>0.11611</td>
</tr>
<tr>
<td>OC</td>
<td>0.20047</td>
<td>0.59488</td>
<td>0.28528</td>
</tr>
<tr>
<td>OD</td>
<td>0.15787</td>
<td>0.69077</td>
<td>0.28211</td>
</tr>
<tr>
<td>OE</td>
<td>0.36822</td>
<td>0.65765</td>
<td>-0.11441</td>
</tr>
<tr>
<td>OF</td>
<td>0.17270</td>
<td>0.41704</td>
<td></td>
</tr>
<tr>
<td>OG</td>
<td>-0.20112</td>
<td>0.43338</td>
<td>0.57519</td>
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<tr>
<td>OH</td>
<td>0.10366</td>
<td>0.56360</td>
<td>0.07363</td>
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<tr>
<td>OI</td>
<td>0.10439</td>
<td>0.70620</td>
<td>0.05866</td>
</tr>
<tr>
<td>SA</td>
<td>0.54108</td>
<td>0.16204</td>
<td>0.05499</td>
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<tr>
<td>SB</td>
<td>0.68093</td>
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<td>0.16348</td>
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<tr>
<td>SC</td>
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<td>0.07101</td>
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<td>SD</td>
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<td>0.15794</td>
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<td>SE</td>
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<td>SF</td>
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<td>0.26580</td>
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<td>SG</td>
<td>0.70741</td>
<td>0.22675</td>
<td>0.17076</td>
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<tr>
<td>SH</td>
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<td>0.03555</td>
<td>0.73780</td>
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<tr>
<td>SI</td>
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</tr>
<tr>
<td>SJ</td>
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<td>0.67093</td>
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Eigenvalue

<table>
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<th>Factor 3</th>
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</thead>
<tbody>
<tr>
<td>3.6983</td>
<td>3.4256</td>
<td>2.7349</td>
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</tbody>
</table>

Proportion of Variance Explained

<table>
<thead>
<tr>
<th>Factor 1</th>
<th>Factor 2</th>
<th>Factor 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3512</td>
<td>0.1820</td>
<td>0.1420</td>
</tr>
</tbody>
</table>

<sup>a</sup>Underlined factor scores indicate items loading heavily on this factor.

<sup>b</sup>Codes are identified in Tables 2 and 3.
measures appears warranted. Obviously, support for farm land preservation is broader than just concern for open space.

Willingness to Pay

Willingness to pay for farm land preservation was asked for three areas: county of residence, Pennsylvania, and United States. Zero bids of "nonplayers" were not included in the analysis of WTP (nonplayers were defined as respondents who bid zero for any reason other than "farm land preservation is of no value to me.") Five hundred and sixty-seven respondents were excluded from the WTP analysis as nonplayers or because they did not answer the WTP question. In addition, one other respondent was eliminated because extreme bids for county, Pennsylvania, and United States WTP that indicated responses were significant outliers.

Table 5 shows the means of the WTP responses. The mean WTP values for county, Pennsylvania, and United States were all significantly different from zero at the 0.01 level. The mean bids are higher for county than state and state than United States. A t-test was used in each case to test for a significant difference between WTP for county and state, state and United States, and county and United States using t-scores for paired populations which are not independent. The calculated t-statistics were 5.89, 4.35 and 8.16, respectively, for comparisons between the county and state, state and national and county and national means. The critical values of the test were based on t-values for a one-tailed test since the alternative hypothesis was that the difference between the two means was greater than zero. Mean county and state WTP, mean state and national WTP, and county and national WTP are all significantly different at the 0.01 level.
Table 5. Means for county, Pennsylvania, and United States Willingness to Pay.

<table>
<thead>
<tr>
<th></th>
<th>County</th>
<th>State</th>
<th>United States</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>$105.84</td>
<td>$91.71</td>
<td>$79.45</td>
</tr>
<tr>
<td>(Standard error)</td>
<td>(7.39)</td>
<td>(6.93)</td>
<td>(6.30)</td>
</tr>
</tbody>
</table>

These results clearly show a difference in local vs. nonlocal WTP with local WTP significantly higher than nonlocal WTP. While this result supports the received wisdom concerning the relative values of WTP between local and nonlocal land, it also suggests a significant WTP for agricultural land outside of the county in which one lives. As open space is not likely to be the reason for such support, the broader benefits such as identified in the analysis of attitudes are also important.

Analysis of Referendum on Program to Purchase Conservation Easements

Pennsylvania conducted a referendum in 1987 for a $100 million bond fund to purchase conservation easements for agricultural land. The referendum approved the program by a wide margin with substantial support in both rural and urban areas. This analysis used county vote totals to analyze reasons for the support of theoretical interest.

Methods

In most voting situations, only two choices are available to voters—yes (1) or no (0). Aggregated to a county level and divided by the number of votes cast, the ratio of county voters indicating yes ranges from zero to one. Assuming that the county voting distribution had a logistic distribution a regression model can be estimated with weighted least squares (Kmenta) as follows:
\[
\left( \frac{1}{s_i} \right) \ln \left( \frac{\rho_i}{1 - \rho_i} \right) = \alpha \left( \frac{1}{s_i} \right) + \sum_{j=1}^{m} \beta \left( \frac{X_{ij}}{s_i} \right) + u_i
\]

where the \(X_{ij}\) are independent variables (\(i, j = 1 \ldots, m\)), \(\alpha\) and \(\beta\) are model parameters,

\[\rho_i = \text{proportion of voters voting yes in county } i,\]

\[u_i = \text{regression error term},\]

\[n_i = \text{number of voters in county } i,\]

\[s_i^2 = \frac{1}{(n_i \rho_i (1 - \rho_i))}\]

and

\[\rho_1 = \left( \frac{1}{n_1} \right) \sum_{i=1}^{n_1} y_1\]

The explanatory variables \((X_{yj})\) were variables that could be measured at the county level that were related to theoretical reasoning in the previous section. High levels of development pressure should be accompanied by greater support for farm land preservation because of perceptions of declining open space amenity value and the nostalgia value or desire for local food. Development pressure is measured by the percent change in population density (1980-1986) (PA State Data Center). The open space benefits of farm land preservation was explicitly measured with two variables. The measures of open space used are the proportion of land in farms to total land area (1982 Census of AG) and the proportion of forested land to total land.
area (USDA Forest Service). Forest land is predicted to act as substitute for agricultural land. Both variables were predicted to be negatively related to support for the referendum.

Several household characteristic variables were also included. Under the hypothesis that farm land preservation is a normal good, higher incomes should increase support. Per capita income (1984 by county) was used to measure income level (PA State Data Center). The percent of owner-occupied housing to total housing (including renter occupied) (1980 US Dept. of Census) was also included to test the hypothesis in earlier studies that homeowners support farm land preservation. Another variable included was the percentage of registered Democrats as a measure of political ideology (PA State Data Center). A positive relationship with the vote is predicted because a yes vote implies a desire for government involvement rather than letting the market allocate resources.

Results

The estimated logit regression is reported in Table 6. All the variables except political party affiliation are significant. The farm land and forest land variables had the expected negative signs. The forest land variable indicates that forests are substitutes for farm land. At least in part, farm land preservation is therefore associated with environmental amenities and recreation on rural lands instead of solely the existence benefits of farming and agriculture. The change in population density coefficient had the expected positive sign and indicates that the dynamics of population growth affects demand for farm land preservation in addition to the static effects in the land variables. Income is positive, which supports the view of farm land preservation being a normal good. The homeowner variable was only significant at the 10%
Table 6. Estimated Regression Model for Pennsylvania Farm Land Preservation Referendum.

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Estimated Coefficients and t-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.506*** (2.21)</td>
</tr>
<tr>
<td>Percent Change in Population Density</td>
<td>0.043*** (4.21)</td>
</tr>
<tr>
<td>Per Capita Income</td>
<td>0.00004** (2.23)</td>
</tr>
<tr>
<td>Percent Owner-occupied Housing</td>
<td>-0.015* (-1.82)</td>
</tr>
<tr>
<td>Proportion of Farm Land</td>
<td>-0.009*** (-3.44)</td>
</tr>
<tr>
<td>Proportion of Forestland</td>
<td>-0.447** (-2.02)</td>
</tr>
<tr>
<td>Percent Registered Democrats</td>
<td>0.002 (0.75)</td>
</tr>
</tbody>
</table>

* Significant at 10% level.  
** Significant at 5% level.  
*** Significant at 1% level.

level but had a negative sign. The rent seeking behavior of homeowners associated with land preservation was less important than the perception than preservation could slow economic growth and indirectly reduce possible increases in home values and incomes to other economic factors.

Conclusions

The empirical analysis in this paper provides support for the standard view that open space and other environmental amenities are a benefit of agricultural land preservation.
However, the analysis also supported other reasons for land preservation. For example, the survey data indicated that attitudes related to food supply, agrarian culture, and preserving supply of land were also strongly supported. Two factors related to these broader views were obtained. The contingent valuation survey found a significant WTP for state and national farm land preservation programs that would yield limited environmental amenities. The WTP was higher for county programs than for larger areas. This result could be related to environmental benefits of county programs; however, it also could be related to local food supplies.

These results support the need for more theoretical and empirical analysis of benefits of agricultural land preservation. As suggested in the conceptual part of this paper, existence values for food supplies, especially at the local level, and agrarian culture could be theoretically valid efficiency reasons for such programs in addition to the standard open space and less standard recreational benefits. The dynamics of the relationship between farm land preservation also warrants more investigation. In addition, more empirical research to separate the different components of perceived benefits of land preservation is necessary. Other referenda on farm land preservation could be investigated similarly to this paper. Contingent valuation measures also need refinement to vary characteristics of such programs from the open space focus of former studies. The existence value issues are not easy but may be at the core of benefits of farm land preservation.
References


A PERSPECTIVE ON THE ECONOMICS OF CONSERVATION EASEMENTS

By

Henry Buist¹

Since the 1970's, an increasing number of State and local governments have administrated "purchase of development rights" programs that use easements to protect farmland from conversion to other land uses, such as residential development. Economic and legal issues and problems related to the use of easements as a conservation mechanism are discussed.

A Brief Overview of PDR Programs

The earliest Purchase of Development Rights (PDR) programs originated in the Northeast coastal states in the mid-1970's. In the Washington-Boston corridor states (from Maryland to Massachusetts), income and population growth and continuing metropolitan suburbanization resulted in a rapid increase in the urban value of agricultural land.² Although agricultural districts and use value assessment were already in place, some states perceived that the rate of farmland conversion was too high and commissioned studies of alternative methods to deal with the problem. PDR programs were developed as an additional means to support the preservation of farmland.

¹ Economist, Resources and Technology Division, Economic Research Service, U.S. Department of Agriculture Washington, D. C. The views expressed in the paper are solely the author's and do not represent the views of the USDA. The author thanks Carolyn Fischer and John Michos for assistance.

² The papers in Derr, et. al. describe the various trends.
Statewide programs operate in Connecticut, Maryland, Massachusetts, New Hampshire, New Jersey, Pennsylvania, Rhode Island, and Vermont. Mostly free-standing county or local programs operate in California, Colorado, and New York, as well as in some of the previously mentioned states—such as Pennsylvania and Maryland. Occasionally, some of the programs are suspended or terminated. Delaware authorized its program in 1991 but had not funded it by mid-1992. Some Florida counties have begun purchasing easements and a State committee has recently recommended creating a statewide PDR program.

**The Terms of a Development Rights Purchase**

All PDR programs are voluntary. Farmowners offer or are encouraged to sell the development rights for their land to the appropriate State or local government agency (or, in some cases, to a non-profit land trust). An offer to sell does not guarantee purchase by the PDR agency. The most common easements last thirty years or are permanent. In return for payments, a farmowner must adhere to the use restrictions placed on the land for the duration of the easement contract, even if ownership changes. The use restrictions forbid division or subdivision of the land and prohibit development of the property for residential, commercial, industrial or similar purposes. While active farming is not necessarily required, use of the land must be consistent with the preservation of the land as agricultural land.

**Motivation for Farmland Protection**

Arguments supporting farmland protection appeal to the classical market failure problem in which the private decisions of an economic agent do not reflect full social values or costs. The interpretation of the general principle to the present case is that the farmowner can become
wealthier selling to an urban developer rather than remaining in farming, even though the public goods value of the farm plus the private (market) value of the farm in agriculture might exceed its value in urban use. Farmland protection methods, such as tax relief and easement purchases, quantify the public's valuation of preserved farmland and compensate farmowners for the foregone urbanization value of their land. These public choice mechanisms can resolve, or at least attenuate, the market failure problem (excess conversions of farmland).

Distributive Issues

The market failure aspects of farmland conversion and the public policies intended to correct the market failure raise a number of "distributive" questions related to economic entitlements and burden sharing. A stylized characterization of the political economy surrounding rural-urban conversions can be used to place the questions in context.

Developers read market signals sent by potential future urban residents to extend urban boundaries into agricultural areas. Current residents opposed to specific developments or farmland conversion in general directly or indirectly encourage their political representatives to block farmland conversions.\(^3\) Farmowners (who benefit from the urban-induced capital gains) can either challenge or support the efforts to control development.

\(^3\)It is perfectly acceptable to interpret current residents to include citizens of a local community, a State, or even the Nation as a whole.
Three fundamental questions exemplify the types of conflicts that can arise.

1. Who should pay to preserve farmland?

   Do the private property rights of the farm owner take precedence over the rights of current residents to benefit from the public goods value of preserved farmland? A "yes" answer implies that the current residents must compensate the farm owner if the right to convert and sell to a developer is taken away or curtailed. An obvious method to provide compensation would be a PDR program. A Transfer of Development Rights program would be a way to shift the cost of farmland protection from current residents to developers and future residents. A "no" answer implies that the farm owner must preserve the land without compensation. For example, zoning, the topic of the next section, imposes a no compensation policy.

2. Who should pay for the harm caused by farm conversions?

   When conversions result in congestion or destroy the public goods value of farmland, are current residents entitled to compensation? A "yes" answer implies that the developer or farm owner should pay something like impact fees or conversion taxes--which can be passed on to future residents of the new development in the form of higher prices; alternatively, new residents could be forced to pay compensation in the form of higher property taxes (as is implicit in California's Proposition 13). A "no" answer implies that the current residents bear the burden without compensation, even if future residents share the burden.

3. Are farm owners entitled to urban premiums resulting from government policies?

   When governments invest in public infrastructure (on behalf of current and perhaps future residents) and when the returns from those investments accrue to farm owners in the form of new
urban value, do those gains incontrovertibly belong to the farmowner? A "yes" answer implies that the farmowner can realize these gains without compensating the taxpayers that financed the investments. A "no" answer implies that the farmowner should pay compensation reflecting the public contribution to his land value, say through a special tax upon realizing the gain.

**Zoning and the Taking Clause**

Most states allow their local governments to impose zoning and land use regulations. Depending on the language and extent of legislation, jurisdictions can use zoning to establish agriculture as the preferred land use and to directly control the location and type of developments. While European countries favor this method, since it doesn't require public funds, it can run into legal problems in the United States. The taking clause of the Fifth Amendment requires the government to provide "just compensation" when it takes away private property for public use. Zoning for exclusive agricultural use effectively appropriates-- without compensation-- land value attributable to potential urban use. Alternatively, zoning can be thought of as a special case of an easement program that is involuntary and acquires development rights at zero prices. Agricultural zoning in particular has not been vigorously challenged in the courts, mainly because the agricultural use restriction does not wipe out all inherent value of the land. But zoning law has been one of the most rapidly evolving areas in
legal doctrine and the current trend has been to support private property rights as witnessed by the Supreme Court’s *Lucas v. South Carolina* decision.\(^4\)

So a basic weakness of zoning as a farmland protection technique is that—as soon as development becomes a real and lucrative option—the interested parties can petition to have the zoning modified or they can issue a direct legal challenge to the zoning rulings. PDR programs avoid such problems completely: the programs are voluntary, so it is not a question of eminent domain (involuntary exchange of property rights from private to public hands), and the property owners are compensated, so it is not a taking.

**Easement Programs in Practice**

In general, the details of a PDR program include a statement of objectives, list of eligibility requirements, a description of easement pricing and allocation rules, and an enumeration of monitoring and enforcement conditions.

**The Statutory Price of an Easement**

Every PDR program defines the price of an easement as the difference between the parcel’s full market value and its agricultural value. Appraisers typically assess market value by using comparable sales information or similar methods. Appraisers assess agricultural value by calculating the present value of an estimated income stream or by using formulas based on soil content and productivity. Recently, many programs have also employed comparable

\(^4\text{As pointed out by Terry Moore, a conference participant, the Lucas case was judged to involve a complete not a partial taking of economic land value and, therefore, would not be a decisive precedent in a legal challenge to agricultural zoning.}\)
sales methods for agricultural appraisals. Sales of parcels with existing use restrictions serve as a basis for the comparable sales appraisal.

Generally, the estimated price of an easement establishes the maximum price a PDR agency will pay and marks the point at which negotiations with farmowners begin. The final sale prices depend on the specifics of the negotiation process, the amount of funds that are available, an evaluation of the parcel's agricultural quality, the extent to which applicants agree to sell easements below market value estimates (bargain sales), and other details of the methods that are used to select among easement sale offers.

Allocating Easements: Selection Systems

In choosing among potential easement purchases, the design of the selections systems mostly reflects two common objectives: (A) treating all easement sale applications systematically without bias (i.e., equity), and (B) protecting as much high quality agricultural land as possible given the available amount of money (i.e., efficiency). Several PDR programs use explicit point-ranking systems to prioritize purchases. Generally, parcel scores increase with increases in agricultural quality, the degree of development pressure, and the discount off estimated market price. Agricultural quality is measured by weighing such factors as size, soil quality, agricultural viability, environmental benefits, and location with respect to other protected lands. Inclusion of development pressure measures the urgency of protection. Under the various bidding schemes, parcels receive higher priority the lower the value of the ratio of asking price to assessed market value. Such schemes attempt to impel farmowners to bid against each other and offer discounts so that the program can obtain more easements given the available funds.
After ranking the parcels, the programs offer to buy an easement on those parcels which have the highest scores and which meet other more qualitative criteria, such as satisfying a geographic distribution requirement. Buy offers continue until the number of eligible purchases runs out or until the accepted offers would deplete the available funds. Residual funds usually carry over to new rounds of purchases.

Funding

Common methods of funding easement purchases include issuing bonds, imposing real estate transfer taxes, and earmarking general appropriations for the programs. Some states, such as New Jersey, require matching grants from local governments. Bond financing distributes the burden of paying for farmland protection to those who benefit most: current and future residents whose taxes purchase the benefits derived from protected farmland (once the question of whether a farmowner is entitled to compensation is answered affirmatively). Easement donations and bargain sales which generate tax deductions partly shift the costs of easements from the local or State government to the Federal government.⁵

Easement Valuation Issues

Current appraisal methods—based primarily on comparable sales—and the other rules of PDR programs establish easement prices that can be far different from the economic value of easements as might be viewed by farmowners. Demonstrating the claim that these prices can

⁵For example, if a PDR agency acquired $11,000 worth of easements for $10,000 under a bargain sale, the transaction would save the State government $1000 but would cost the Federal government $280 in lost taxes, assuming the donor faced a 28% marginal tax rate on the sale.
systematically differ from the value of development rights requires an economic model which defines and determines this value. Since farmland can be thought of as just another asset, methods of valuation can be borrowed from the theory of finance.

The Farmowner’s Conversion Decision as an Option

In any given time period, the farmowner has the following "investment opportunity": he or she can give up the agricultural value of the farm and realize its urban value by selling to a developer (who eventually converts the farm). As explicated in Pindyck, these types of investment opportunities resemble financial options. Exercising the option to invest by selling and converting can be delayed but is irreversible once made. The underlying value of the option depends on future urban and agricultural rents which are uncertain today. These features imply that selling today entails not only forfeiting the agricultural use of the farm but also giving up the possibility of waiting for new information—such as changes in government policies or food or housing prices— that might influence the timing and profitability of converting. In short, there is an opportunity cost of converting today instead of waiting and keeping the conversion option alive for future periods.

Existing methods of easement valuation ignore these opportunity costs and possibly misprice the easement. From the point of view of economic theory, the correct way to price easements is to interpret the conversion investment decision as a financial option and to utilize options pricing theory to value this option; the price of an easement should equal the option value of waiting to convert the farm to urban use at the optimal date (which maximizes the farmowner’s expected wealth).
Implication of Option-Like Nature of Conversions

Setting easement prices equal to today's urban value minus today's agricultural value, as PDR programs do using comparable sales estimates, might poorly approximate the option value of converting to urban, properly interpreted. A simple example, borrowed from Pindyck and adapted to the current situation, can illustrate the point.

Consider a two-period model. The agricultural value (per acre) of the farm is known to be the same for both periods and equals $300. The urban value of the farm today is known and equals $500. The urban value next period, however, is uncertain and can take the values $900 and $200 with equal probability. Based on today's values, the price of an easement would be $500-$300 = $200. This measure of value ignores the owner's opportunity of farming one period and then deciding on whether to convert depending on whether urban values have gone up or down. If the revealed urban value next period is $900, the easement would be worth $600, and if the revealed value is $200 the easement would be worthless since the farm is more valuable remaining in agricultural use (300 > 200). Today, ignoring discounting, the value of the waiting option is .5 x 900 + .5 x 300 = $600. Hence, the true value of the conversion option equals max(500,600) = $600; pricing the easement at $200 (instead of $300) assumes that the value of the conversion option is worth only $500 (today's urban conversion value).

Generally, if easements are correctly priced, the farmowner should be indifferent between the following two choices based on today's valuations: (A) never converting, receiving an easement payment, and remaining in farming and (B) farming until the optimal date of conversion and then converting, as determined by expectations concerning future urban and agricultural rents. By design in the example, the farmowner's optimal decision is to wait and
convert next period if urban prices increase. However, a PDR program easement would be priced to compensate him for the lesser value of converting today. In summary, PDR easements are correctly priced only if converting today happens to be the farmowner’s optimal decision; generally it is not.

**Difficulties With Comparable Sales**

A well-known practical problem of using comparable sales as a method to estimate urban value is that, in a geographic area tracing out a distinguishable spatial market, farm parcels convert to urban infrequently and that appraisers cannot control for all financially important differences between parcels, diluting the degree of comparability. The option interpretation of conversion further questions this technique of valuation. On the urban fringe, each farm has some optimal conversion date, say five or ten years later. However, comparable sales are based on actual market transactions for parcels that have reached (what is revealed to be) their optimal date of conversion. Projecting today’s urban value of a converted land onto an unconverted farm can overstate the farm’s urban value and can lead to overpricing of easements, depending on the differences in optimal conversion dates and market conditions. The core problem is the assumption that a farmowner can convert his or her farm as if the optimal conversion date had necessarily been reached. Additionally, a conversion of just one large farm might accommodate all urban demand for land for decades to come, implying that the urban value of all surrounding farmland is, with sufficient discounting, effectively zero (instead of the per acre value of the converted farm).
Direction of Mispriced Easements

The previous two subsections present conflicting results. On a theoretical basis, PDR easements can be systematically underpriced since the true (option) value of converting at the optimal date is undervalued at today's suboptimal conversion value. On a practical basis, PDR easements can be systematically overpriced since optimal conversion dates are assumed to be today, exaggerating the urban value that could be realized had an actual conversion occurred.

If the PDR agency knew or could rationally forecast future urban and agricultural rents, the overpricing problem would not exist by assumption; but failing to value the waiting option would still lead to underpricing. On the other hand, if easement pricing exaggerates urban values, selling the easement today could be worth more than any present or future opportunity to sell in the real estate market, which would make the waiting-to-convert option irrelevant. Generally, farmowners will "self-select" -- those who can do better in the development rights market than in the ordinary real estate market will be the ones who aggressively seek easement deals. These observations suggest that actual PDR transactions result in overpricing (on average), though which influence dominates is an empirical question.

Selling Easements Versus Converting

More support for the overpricing hypothesis follows from a comparison of the tax and related implications of selling easements versus selling full rights to the property in the real estate market. Aiken's survey of Use Value Assessment laws up to 1989 revealed that all fifty states have enabling legislation which permits the portion of a farm's market or urban value which exceeds its agricultural use value to be exempt from local property taxation. Thirty-one states authorize the taxing jurisdiction to recover deferred taxes (a "rollback"), and many of
these states allow interest to be charged on the deferred taxes. These property tax laws endow
selling easements with a tax advantage over selling the property for conversion, since rollback
penalties apply only to a land use change. The easement price should decrease as the tax
advantage increases, but no PDR program references this principle. Furthermore, the basis for
Federal taxation of capital gains is lower under an easement sale than under an ordinary property
sale (by the amount of use value), imparting a second tax advantage. Similarly, Federal farm
programs, such as price and income supports, increase the use value of farms and the
opportunity costs of conversions. The price of easements should decrease as the level of support
increases. Again, however, there is no evidence PDR agencies attempt to account for
differences among parcels in Federal assistance.

Implications of Mispriced Easements

If the PDR agency underprices easements, few farmowners will offer to sell since they
would effectively be forfeiting wealth. Conversely, if the PDR agency overprices easements,
many farmowners would do better under the program than selling in the real estate market,
creating an excess supply of easements given the available funds and perhaps complicating the
selection decisions. Correctly pricing easements, therefore, is essential to the performance of
buying easements as a conservation mechanism.

In fact, if easements are substantially mispriced, the PDR program itself can become
indeterminate. The economic value of easements was determined by the farmowner’s
indifference between two choices: (A) never converting and receiving the (correct or
equilibrium) easement payment and (B) converting at the optimal date. When the easement price
differs from its value, delaying the sale of an easement becomes a third choice and complicates
the option valuation. For example, if the easements are overpriced today, the farmowner might forecast that they will be even more overpriced in the future, causing a delay in the decision whether or not to convert or sell easements until the next period. Such distortions would undermine the conservation objectives and confuse policy planning.

Other Problems and Issues

Administration

Administrative problems hamper PDR programs. The process of purchasing an easement, from application to settlement, typically requires one to two years. Uncertain funding can jeopardize the credibility of a PDR program and lengthen the acquisition period. For example, in 1991, Maryland’s budget problems forced the PDR program to delay the purchase of several million dollars worth of easements after commitments to buy were already made.

Easement Externalities

Like squeezing a balloon, placing easements on some parcels merely increases the urbanizing pressure on unprotected parcels and can result in leapfrog development that is even more incoherent than would have resulted without interference. As easement purchases increasingly restrict the supply of land in potential urban use, the value of "waiting to invest"--postponing an urban conversion or sale of an easement--increases concurrently, reinforcing the previously described policy-based distortion of land markets and further undermining the easement program itself. Just as the urban values of nearby farms are temporally interdependent, the values of easements are also interdependent over time. PDR agencies
should, if possible, include the affects of past acquisitions on future easement purchases and prices.

When easements are purchased, the taxpayer effectively finances the protection of local aesthetic and environmental amenities which will be capitalized in land values. Recalling the distributive questions, should the landowners who directly benefit from these public actions compensate the taxpayers? By default, the answer has been "no" in most cases.

Incentives

All programs insist on paying at most and preferably less than the estimated fair market value of the easement. The farmowners with the most valuable agricultural land, however, may not be the ones willing to forfeit some of their wealth for the public interest. Hence, bidding schemes such as the one used by Maryland may actually deter easement sales on the most desirable land.

The effectiveness of a PDR program is not independent of the characteristics of a particular parcel nor even the socioeconomic characteristics of the farmowner. The path of development can depend on such things as the location of existing infrastructure, and the timing of development can depend on such things as the farmowner's age and income. For example, a farmer who is simply ready to retire and take a pension in the form of a capital gain will not volunteer for an easement sale. Most PDR programs cannot readily accommodate such special situations.
The Role of Private Land Trusts

Land trusts are private, non-profit organizations which acquire land or easements (development rights) by purchase or donation. Their primary goal is to protect lands--such as farmland, wetlands, or open space--that are historically or culturally significant, environmentally valuable, or generally beneficial to the public. In addition to acquiring land or easements, the trusts lobby for the establishment and expansion of land conservation programs, advise policymakers about program design, provide stewardship over protected lands, inform landowners about available programs and the alternatives to selling land, explain the tax implications of donating land or easements, and assist and encourage estate planning. Some trusts directly administrate conservation programs and receive partial funding from State or local taxpayers.

At the federal level, private trusts such as The Nature Conservancy or The Trust for Public Land act something like brokers--purchasing land at or below market value and then receiving payment for the full market value from a Federal agency, such as the Fish and Wildlife Service or the National Park Service. The difference between market value and acquisition cost is, effectively, the trust's fee for conservation services, such as enforcing the terms of the easement. Their main "brokerage" service is enabling Federal agencies to quickly acquire land threatened by development, whereas the normal amount of time it would take a Federal agency to directly acquire a parcel might exceed the amount of time a seller will wait.

Donors of land or easements to a trust may receive partial reimbursement of the value of the donation from taxpayers. Since most land trusts are nonprofit, charitable organizations, Federal tax laws allow donations to be deducted up to 30% of adjusted gross income; any value
that was not deducted due to the yearly limit can be successively carried forward until the residual value is exhausted or until six years of deductions have been taken, whichever comes first. By making a donation instead of selling and realizing a capital gain, the donor avoids Federal and State capital gains taxes, also avoids rollback taxes under Use Value Assessment local property tax laws, and reduces future inheritance and estate taxes (since the value of the estate declines). Hence, the donor can deduct a nominal value of the donation which far exceeds the real, after-tax value.

A New Federal Role

In addition to the substantial but indirect tax incentives for land conservation, the Federal government has recently experimented with a new and explicit subsidy role. The "Farms for the Future" initiative in the 1990 Farm Bill authorized the establishment of an Agricultural Resource Conservation Demonstration Program through the Farmers Home Administration (FmHA). Under this program, a State PDR program can borrow up to $10 million from a lender provided it matches the loan by 50%. The Federal government guarantees the loan and pays all interest costs for the first five years and partially subsidizes the interest costs for an additional five years. Loans can be used to purchase development rights or other interests in land, to pay the FmHA loan guarantee fee, and to invest for the purpose of generating earnings for future farmland protection efforts. In early 1992, as a demonstration case, Vermont was given the authority to apply to the program. Congressional appropriations for other states to participate had not been made as of June 1992.
Alternatives and Final Considerations

Clarifying the Goals of PDR Programs

Contradictions emerge in comparing the various PDR programs. Some states include urban pressure as a positive weight in the selection criteria, while other states attempt to avoid urban pressure (to reduce easement acquisition costs). Some states want to cluster protected farmland, while others attempt to scatter purchases. Some states explicitly rank discounts from estimated easement values while others do not. By disentangling the various goals of the programs, the contradictions can be resolved or at least clarified.

If preserving agricultural viability is the preeminent goal, clustering easement purchases on the most productive farmland makes sense in order to exploit agglomeration economies. Under clustering, urban pressure and easement costs should reduce instead of increase the urgency of protection. No agency has ever had the resources to buy easements on every eligible parcel; those parcels that have accumulated substantial urban value would have to be sacrificed if cheaper substitute parcels of similar agricultural quality were available.

The desire of PDR agencies to buy easements at discounts appears misguided from the clustering point of view. Long-term agricultural viability can be achieved by buying easements on parcels with little or no urban values, making discounts irrelevant. Secondly, underpricing the easements relative to its economic (option) value merely drives willing participants out of the market for development rights.

If preserving open space or the environment is the preeminent goal, a considerably different strategy emerges. So that more people can benefit, scattering purchases makes more sense than clustering. If a nearby urban population demands and benefits from open space or
environmental amenities, high urban values will be strongly positively correlated with the amenities value. Such an association would justify ranking easement purchases based on urban pressure, in stark contrast to the clustering strategy of buying cheap easements.

Connecticut has the best example of the clustering strategy: its program’s selection system positively weighs agricultural quality and proximity to other parcels, negatively weighs urban pressure, and mostly ignores bid discounts. New Jersey has the best example of the amenities strategy: its program shares funds among counties to achieve geographic diversity and positively weighs environmental value and urban pressure.

**The Relative Values of Farmland**

Fiscal problems at every level of government have seriously jeopardized continued support for PDR programs. Nevertheless, if the public goods and agricultural values of farmland (jointly) exceed its urban value, urban conversions signify a real loss of wealth to society. Ironically, when the urban value of a farm exceeds its agricultural value, farmland conversions provide a net addition to Gross Domestic Product (GDP) due to associated construction activity. However, the loss in public goods wealth might exceed this net addition suggesting that GDP should go down, not up. From this point of view, tying farmland protection to fiscal and political vicissitudes makes little sense.

The paper has argued that PDR programs would function better if easement prices more accurately reflected the economic value they are supposed to represent. Generally, protecting farmland is a problem of information. PDR agencies must have knowledge concerning the public goods value, the urban value, and the agricultural value of farmland in order to make
cassment purchase decisions. However, these values are difficult to estimate or even to define in the case of public goods (or social) value.

Options pricing theory, which uses rigorous economic models to forecast urban and agricultural values and which imputes the joint effects of tax and related policies, would be a step towards resolving the pricing issue.\(^6\) However, even if options theory provided better estimates of the values of remaining in farming versus converting, political mechanisms may not exist to implement an effective easement program, especially if citizens strongly disagree over the social value of preserved farmland. Economists call situations of this type "public choice problems."

**Voting Over a Public Choice**

Some states, such as California, have used bond referenda to reveal the public's willingness to pay for preservation. The mechanism has several attractive features in solving the public choice problem. Since the benefits of preserved farmland recur every year, ideally the tax burden would be distributed over time in a way that matches the distributed benefits. Bond financing, which generates a comparatively small increase in yearly tax burden, achieves that linkage better than a much larger one-time tax increase, which might prompt foot-voting. In addition, purchased development rights can be interpreted as a community investment and asset that can be sold (perhaps even for a profit) should community sentiment about urban growth change; governments generally finance public investments with bonds. Finally,

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\(^6\)For example, the paper by Amin and Capozza provides an equilibrium model of agricultural land conversion decisions, though the context of their paper significantly differs from the issues here.
submitting easement purchases to a vote renders a specific decision, however imperfectly, over any public debate regarding the social value of preserved farmland. Bond referenda could be more widely and frequently used to improve the reliability and political acceptability of PDR funding.

**Origins of the Urban Value of Farmland**

Population and income growth, which policymakers cannot easily control, primarily determine the urban value of farmland. However, public investments in infrastructure, which policymakers can control, must be made to accommodate the growth. Coordinating infrastructure investments with easement purchases would help internalize potential conflicts in the objectives of different agencies within government as they relate to land use. For example, Federal and State grants-in-aid to cities can retard urban sprawl into agricultural areas to the extent that it compensates for the many reasons population and employment have been suburbanizing for decades. However, similar aid to newer urban enclaves near the urban fringe would worsen sprawl. In short, urban and agricultural policies directly interact.

Federal tax laws significantly contribute to the urban value of farmland. The deductibility value of mortgage interest payments and taxes to a whole community of new urban dwellers can potentially swamp the same deductibility value to the single farmowner-dweller whose land could be used to build the new community. The bias for urban uses over less dense, rural uses of land is worsened in a more subtle way. Federal laws provide capital gains tax exemptions to homeowners who sell their existing homes and "trade-up" to more expensive ones. To the extent that urban dwellers trade-up by giving developers market signals to
increase the urban boundary, the urban-valued bids for farmland capitalize the tax breaks and make the bids more attractive to the farmowner.

One controversial way likely to bring farmland conversion to a screeching halt would be to add a provision in the tax code that denies tax deductions and exemptions for new housing built on prime farmland. In terms of the distributive questions, the Constitution protects a farmowner against a taking without compensation, but it does not entitle anyone to a subsidy.

Conclusion: Reconsidering the Federal Role

Traditionally, land use issues such as farmland protection have been relegated to State and local governments which administer the various policies, such as zoning and Use Value Assessment laws and PDR programs. Ironically, the mostly unrecognized Federal role--resulting from tax laws, subsidy programs, and regulations--has, perhaps, an even larger influence on the incentives to convert. The Farms for the Future Act attempts to expand the Federal role but the likelihood that Congress provides more funding appears low. Nevertheless, Federal influences on the incentives to convert to urban appear strong enough to reject summary dismissals of the Federal role.

References


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