

# Estimating Amenity Values of Urban Fringe Farmland: A Contingent Valuation Approach: Note

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**T**HE CONVERSION OF FARMLAND to residential sites and to other nonagricultural uses is a significant public policy issue in many regions of the United States and other parts of the world. While lost food production potential and the decline of local farming industry are often-cited objections to these shifts in resource use, a more significant issue in land-rich regions, where farming is not seriously constrained by resource availability, may be the site-specific losses of open space amenities associated with agricultural enterprise near population centers. The purpose of this paper is to report on a recent attempt to value these quality-of-environment benefits of farmland in an agricultural region of south central Alaska. We begin with a discussion of a conceptual framework for the valuation of collective goods such as open space and historical values. The next section adapts this framework to the problem under study. This is followed by presentations of the empirical procedures and results. Finally, our discussion relates these results to some earlier work and suggests extensions to the current study.

## Conceptual Background

The food and fiber outputs of agricultural production in the U.S. are exchanged in well organized, largely competitive markets with the potential for providing efficient quantities of these private goods. The open space and other environmental amenities associated with urban fringe agricultural

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lands, however, are unpriced public or collective goods. As such, these benefits are characterized by nonexclusion and nonrivalry in consumption (Mishan 1969). Agricultural landholders cannot appropriate the amenity-associated rents of their property, which accrue instead to third parties. These features inhibit any tendency of unfettered market transactions to systematically result in socially efficient patterns of resource use.

Alaska has an abundance of open space and related environmental amenities to offer its residents and visitors. Since market signals are absent with regard to the production of these collective goods, there is little evidence as to how much these amenities are worth. It seems reasonable, however, that the highest marginal value would be placed on these benefits in situations where they are in short supply (Gardner 1977). In relatively urbanized areas these benefits may take on high value indeed. The importance of the environmental effects of agricultural land preservation is reflected in the criteria by which choices among qualified parcels would be made in a recently proposed Matanuska-Susitna Borough (Alaska) development rights purchase program: (1) agricultural productivity, (2) susceptibility to conversion and (3) contribution to attractiveness of the area (Planning, Inc. 1983). Based on these considerations and the associated historical attraction of the area to tourists, the "Old Colony and Homestead" lands have been singled out as a priority for preservation.<sup>1</sup>

But what is the value of preserving the amenity benefits of these agricultural lands? Certainly if public expenditures are to be made in this effort, some notion of the return on this investment would be helpful to policymakers. A useful theoretical framework for the valuation of collective goods was put forth by Bradford (1970). The essence of this framework is a bid curve which summarizes the trade-off between increments (decrements) of the collective good and decreases (increases) in a numeraire in such a way that welfare remains unchanged. Brookshire, Randall and Stoll (1980) generalized on the Bradford model with a framework that adopts Hicksian (1943) concepts on consumer's surplus in the measurement of benefits associated with all classes of goods including nonexclusive collective goods. The appeal of the Brookshire et al. model for applied work is its allowance for either willingness to pay (WTP) or willingness to accept (WTA) measures of changes in benefits according to the institutional setting of a specific problem.<sup>2</sup>

In our study of potential open space and historical values associated with urban fringe agricultural lands, farmers have the option to develop or not develop these lands for nonagricultural purposes. In this property rights setting, a reasonable measure of benefits of amenity values of agricultural lands would seem to be the public's willingness to pay in order to avoid decreases in these amenities. Thus our adopted measure of benefits is interpreted as Hicksian equivalent surplus.<sup>3</sup>

### **The Empirical Model**

In this study we were interested in both the magnitude and determinants of amenity values. Our efforts focused on the benefits that accrue to in-

dividuals living in communities in close proximity to existing agricultural lands. Following the work of a similar study of farmland preservation in Central Massachusetts (Foster et al. 1982), we hypothesized two different levels of development on these lands and structured a model to account for variations in individuals' willingness to pay to avoid such changes. The general form of this model is

$$WTP_j = f(LOC_i, HEAD_i, KOP_i, LOR_i, LED_i, AGE_i, INC_i, LDEV_i)$$

Where  $WTP_j$  = annual willingness to pay by the  $j^{\text{th}}$  household for the prevention of a given level of residential and commercial housing development on specified agricultural lands;

$LOC$  = 0 – 1 dummy variable identifying the respondent's community of residence (1 = Wasilla area, 0 = Palmer area);<sup>4</sup>

$HEAD$  = 0 – 1 dummy variable to identify head of household respondent (1 = head of household);

$KOP$  = 0 – 1 dummy variable to identify respondents having previous knowledge of proposed governmental programs to purchase development rights on agricultural lands (1 = previous knowledge);

$LOR$  = respondent's years of residence in the study area;

$LED$  = respondent's years of formal education;

$AGE$  = respondent's age in years;

$INC$  = respondent's annual household income in thousands of dollars; and

$LDEV$  = 0 – 1 dummy variable indicating hypothetical level of increased housing development on local farmlands (0 = moderate increase, 1 = large increase).

The model specification is ad hoc in the sense that it was not derived from a rigorously formulated model of consumer choice. Rather, the selection of variables was influenced both by our own intuition and by previous studies attempting to explain individuals' valuations of nonmarket resource services (e.g. see Foster et al. 1982, Desvousges et al. 1983, Daubert and Young 1981).<sup>5</sup> A priori expectations were for the forces captured in variables  $HEAD$ ,  $KOP$ ,  $LOR$ ,  $LED$ ,  $INC$ , and  $LDEV$  to weigh positively on respondents' bids. Conversely, we expected inverse relationships between  $WTP$  and the factors represented in  $LOC$  and  $AGE$ . The exploratory nature of this part of the study was an attempt to evaluate whether bids, which form the basis for our estimate of amenity values associated with agricultural land, are systematic or merely "random noise."

### Survey Procedure

A bidding game contingent valuation technique was employed in collecting data on  $WTP$ .<sup>6, 7</sup> The personal interview questionnaire design followed that of Randall et al. (1974) in its attempt to present a credible

hypothetical situation to respondents. The first part of the instrument consisted of a short text explaining the purpose of the survey and an introduction to the general topic of shifting land uses at the urban fringe.<sup>8</sup> This was followed by some factual information including maps relating to quantity, location, and other characteristics of farmland in the local area. This was considered especially important so that the individual bids or valuations asked for later in the interview would be specific to the local situation and not refer to some general state or national trend in agricultural land conversion.

The next part of the interview process presented the interviewee with a series of color photographs depicting potential levels of housing development for existing agricultural lands in the local area. Photographs associated with Scenario A represented the status quo or no development for the farmland remaining in the Old Colony and Homestead farms in the Palmer and Wasilla areas. Scenario B depicted moderate levels of housing development in photographs showing a landscape with a mixture of housing and farmland. Finally, Scenario C showed a landscape dominated by housing development with no farmland visible in the photographs.

Using Situation A as a reference point in each bidding game, the respondent was asked a series of questions designed to elicit his or her maximum willingness to pay annually to prevent the development scenario first in Situation B (i.e.,  $WTP_{B-A}$ ), and then in Situation C (i.e.,  $WTP_{C-A}$ ) for the entire remaining farmland acreage in the Old Colony and Homestead farming areas. The respondent was given a choice of payment vehicles: an increase in local sales taxes, an increase in property taxes, or a voluntary contribution to a special local farmland preservation fund. The interviewer started the bid at \$25 per year and asked respondents whether their households would be willing to pay that amount to prevent the development scenario under consideration. A "yes" response resulted in the bid being raised by \$25 increments until the interviewee answered "no." At this point the amount was lowered in decrements of \$5 until, again, a "yes" resulted. This final amount was interpreted as the  $WTP$ . Similarly, an initial "no" response was followed by bid decrements of \$5 until a "yes" resulted.<sup>9</sup>

Over a period of approximately four weeks during the summer of 1983, some 153 randomly selected households in the Palmer, Wasilla, and outlying areas of the Matanuska-Susitna Valleys were surveyed. Some of the respondents indicated that they would pay nothing to prevent one or both development scenarios from occurring. Researchers in previous bidding game studies have queried such respondents with follow-up questions to ascertain the motivation for such responses.<sup>10</sup> For those respondents indicating that the amenity actually has no value, the response is typically recorded as a true zero bid. However, for those interviewees objecting to, say, the method of payment or to the idea of having to pay for an amenity that they believe is already rightfully theirs, the typical procedure is to label such responses as "protest" bids and to omit these data from analysis. Similar

procedures adopted for this study resulted in approximately 20 percent of the sample being treated as protest bids.

## Results

The model relating *WTP* to causal factors was estimated by applying ordinary least squares to 119 usable survey responses. Multicollinearity among some of the independent variables led us to pare down the model specification. Regression results for linear and semi-log formulations of the model are presented in Table 1. *F* statistics show both forms to be significant at the one percent level. Further, the statistical significance achieved by most individual regressors suggest that bids offered by survey respondents were systematically linked to causal factors.

Individual regression coefficients in the linear model are particularly useful for direct interpretation of the partial effects of the causal factors on the dependent variable (*WTP*). Considering *LDEV*, for example, it was

TABLE 1. REGRESSION RESULTS FOR A MODEL RELATING *WTP* TO CAUSAL FACTORS<sup>a</sup>

Dependent Variable	Linear Form	Semi-Log Form
	<i>WTP</i>	LN ( <i>WTP</i> )
Constant	78.72 (1.30)	2.686 (3.91)****
LOC	- 40.63 (- 1.49)**	- .4617 (- 1.50)**
HEAD	63.74 (2.40)****	.4161 (1.38)**
KOP	92.94 (3.07)****	.6618 (1.93)***
AGE	- 1.987 (- 1.90)***	- .00036 (- 0.31)
INC	.7328 (1.00)	.0029 (0.35)
LDEV	70.75 (2.74)****	1.7124 (5.86)****
R <sup>2</sup>	.213	.297
F	5.05****	7.90****
n	119	119

<sup>a</sup> T values in parentheses

\*\* Significant at .10

\*\*\* Significant at .05

\*\*\*\* Significant at .01

hypothesized that respondent household's willingness to pay to preserve farmland-associated amenities is directly related to the severity of the amenity loss. Referring to Table 1,  $LDEV$  is statistically significant in both models at the 1 percent level. Additionally, the linear model predicts that a household would be willing to pay \$70.75 more annually to prevent the high development scenario ( $WTP_{C-A}$ ) than it would expend for prevention of the moderate development scenario ( $WTP_{B-A}$ ), *ceteris paribus*. While we expected, a priori, that household income would weigh positively on the size of bid offered, this variable is not significant in either form of the regression equation.<sup>11</sup> Other variables in the model are significant with coefficient signs consistent with our intuition.

Bids to prevent moderate levels of housing development (i.e.,  $WTP_{B-A}$ ) ranged from zero to \$760 with a mean value of \$76 per household annually. Bids to avoid conditions associated with development Scenario C (i.e.,  $WTP_{C-A}$ ) varied from \$5 to \$1,000 with an average of \$144. Estimates of the annual amenity benefits accruing to local residents from the retention to the designated farmlands in agriculture were obtained by aggregating the individual bids in the sample and extrapolating these results over the area population. The results of these calculations were \$626,000 per year and \$1,284,000 per year, respectively, for aggregate  $WTP_{B-A}$  and  $WTP_{C-A}$ .

## Discussion and Conclusion

Previous work by Workman et al. (1979) estimated the potential cost of a state government-sponsored development rights purchase program for Alaska agricultural lands. The estimated cost, indexed to temporally correspond with the bid data, of purchasing these rights on lands located in roughly the same area as that addressed in the current study was \$20,250,000. In addition, the earlier study estimated that such a program would involve annual administrative costs of \$80,000.

Combining the results of these two studies, one can address the efficiency of using this approach to preserving the amenities associated with these urban fringe agricultural lands. The benefit estimates associated with avoiding Scenario C (high development) are the relevant data for this purpose, since any action that would prevent Scenario B would also prevent C. Treating the aggregate bids estimates (less administrative costs) as a measure of annual benefits that would flow in perpetuity, the net present value of the development rights purchase investment was calculated for various discount rates. The results are shown in Table 2. The real internal rate of return was calculated at 5.9 percent. Putting this figure in perspective, real rates of return on the Alaska Permanent Fund portfolio, the state's savings account from oil revenues, ranged from 4.7 to 7.7 percent in recent years (Alaska Permanent Fund Corp. 1984).

Several caveats and suggested directions for further inquiry can be offered. First we recognize that individuals other than local area residents may benefit from the retention of open space and other amenity values

TABLE 2. NET PRESENT VALUE OF OPEN SPACE RETENTION

Interest Rate	Net Present Value (in \$million)	Net Present Value per Acre (in Dollars)
1 %	100.02	14,305
2 %	39.95	5,705
3 %	19.98	2,738
4 %	9.85	1,405
5 %	3.83	545
6 %	-.183	- 29

associated with these farmlands. In addition to the benefits accruing to both in-state and out-of-state tourists who travel through this historic and scenic agricultural area, there may be option and/or existence values associated with its presence.<sup>12</sup> Thus our measures of the value of retaining these amenities may be lower limits.

Our study design limited the levels of non-agricultural development to two scenarios, B and C. In addition, respondents were asked to bid on retaining the entire remaining Old Colony and Homestead area as farmland. Thus our resulting investment analysis treated the "all-or-nothing" case. Future work should recognize the heterogeneous nature of the lands in the area regarding their scenic qualities and should attempt to value various patterns and quantities of open space retention. It is quite possible that the preservation of a small amount of strategically located open space would yield higher net social returns.

#### NOTES

1. A significant portion of these lands was settled during the 1930s under a federally-sponsored program to relocate distressed farmers from the upper midwestern states.
2. The expected relationship between *WTP* and *WTA* for a given change in circumstances has been examined in detail by Willig (1976) and by Randall and Stoll (1980). Except in those situations in which the change has a significant effect on the wealth of the affected parties, the difference between *WTP* and *WTA* measures is expected to be small. Results of recent experiments conducted by Knetsch and Sinden (1984), however, cast some doubt on this conclusion.
3. Alternatively, following Brookshire et al. (1980), if one adopts the status quo as a reference level of welfare, a potential Pareto-improvement criterion would suggest that benefit measures be based on the public's willingness to accept compensation for decreases in these amenity values or Hicksian compensating surpluses in income.
4. A cardinal measure of proximity to agricultural land was considered inappropriate for this study. Since households were interspersed with agricultural parcels in the area, there may be many "sources" of amenity values for each survey respondent. Distance to a particular parcel loses significance under these

conditions. Inclusion of the *LOC* dummy variable merely serves as an indicator of qualitative differences in the farmland preservation sentiments of residents in the two general locations where farms of historical interest remain.

5. Researchers in landscape planning have also found social characteristics to be useful explanatory variables in behavioral models. Socioeconomic factors such as sex, age, education, and length of residence explain as much as 49 percent of the variance in studies measuring scenic valuations (Zube et al. 1974, Sonnenfeld 1966).
6. Contingent valuation procedures are controversial in the natural resource valuation literature. For two recent expressions of opposing views of this technique see Rowe and Chestnut (1983) and Randall, Hoehn, and Brookshire (1983).
7. The hedonic and travel cost methods of non-market valuation were deemed inappropriate for this study. The hedonic technique (Rosen 1974) measures amenity values by isolating price differentials between properties that can be statistically attributed to the environmental attributes. Since these amenities are public or collective goods, they are consumed not only by adjacent property owners but by other local and non-local residents as well. Given their non-exclusive nature, there is no reason to expect amenity values of these agricultural lands to be even approximately capitalized into adjacent land values. The travel cost method (Clawson and Knetsch 1966) is also impracticable. Since the focus of the study was the estimation of value for local residents, little, if any, incremental travel is necessary to enjoy the experience.
8. Further information about the questionnaire is available from the authors.
9. An admitted weakness of this procedure is the inability to test for starting point bias. Since this survey was conducted, checks for starting point bias have become commonplace in bidding games. See Boyle et al. (1985) for a recent assessment.
10. See, for example, Randall et al. (1974) and Daubert and Young (1981).
11. As suggested by one of our reviewers, this result may be attributable in part to the fact that in a contingent market setting respondents do not actually give up anything. Since income does not constrain verbal bids, poor people can be just as profligate as rich people.
12. See, for example, D. S. Brookshire, L. S. Eubanks, and A. Randall (1983).

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