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What Have We Learned from Over 20 Years of Farmland Amenity Valuation Research in North America?

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At least thirty studies have been conducted in North America over the last twenty-plus years that measure amenity values generated by farmland. A review of these studies provides evidence that estimated farmland amenity values are sensitive to increasing acreage, regional scarcity, alternative land use(s), public accessibility, productivity quality, human food plants, active farming, and intensive agriculture. Farmland amenity values are also sensitive to socio-demographic characteristics of beneficiaries. Inconclusive evidence is provided with respect to the effects of distance, agricultural land use, unique landscape features, property rights, and nonfarmland amenity substitutes. Implications of these results for future farmland amenity valuation research are discussed.

Since their inception in the 1970s, public investment in farmland protection programs has been justified in the policy arena on the grounds of protecting both market values and nonmarket amenity values. Market values include agricultural commodity values, jobs, and income in the farm sector. Nonmarket amenity values include direct public access use values such as farm and ranch tours, indirect public access use values such as countryside scenery viewing, cultural and heritage values, and nonuse values such as existence values of wildlife living on farm and ranch land (Irwin, Nickerson, and Libby; Nickerson and Barnard; Nickerson and Hellerstein). To learn more about the magnitude and determinants of farmland amenity benefits, economists embarked on a research program starting in the early 1980s to assess these amenity benefits using nonmarket valuation techniques.

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The purpose of this paper is to review previous farmland amenity valuation studies and assess what these studies have found with respect to the determinants and magnitude of farmland amenity value estimates. The next section provides a general conceptual framework for the assessment of farmland amenity valuation studies, focusing on alternative land uses and net willingness-to-pay (WTP) for farmland protection and amenities. An overview of previous valuation studies including authors, location, farmland valued, and methods employed is then presented.

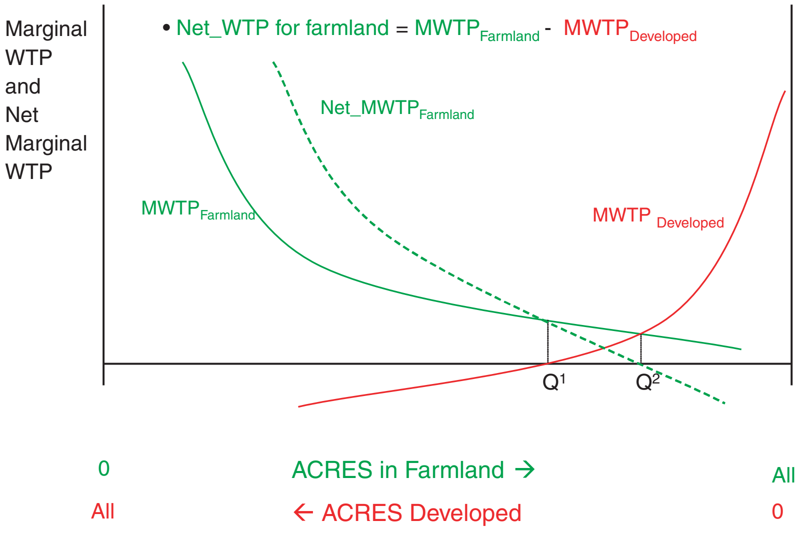
Following the overview of previous studies, major empirical findings with respect to the determinants of farmland amenity values (e.g., willingness-to-pay) are reviewed and synthesized. This review and synthesis provides evidence confirming theoretical expectations with respect to general demand determinants such as quantity of farmland acres protected, relative scarcity of farmland in the region, quality of land for agriculture (e.g., soil quality), availability of substitutes (e.g., nonfarmland that provides similar amenity benefits) and socio-demographic characteristics of beneficiaries. Results also indicate that people care about the type of alternative land use that will occur if farmland is not protected (e.g., intensity of development) and the type of agriculture that is practiced if farmland is protected (e.g., commodity produced and intensity of production practices). Results of previous studies also suggest that preferences for farmland protection are sensitive to location across geographic space including possible negative amenity (or disamenity) values associated with farmland and farming in close proximity to residential households.

After discussing the determinants of values for farmland protection and amenities, per acre value estimates of farmland amenities are presented and discussed. Per-acre estimates are relatively consistent across those studies that employ stated preference methods (e.g., contingent valuation [CV], conjoint analysis [CA]) and across studies that employ revealed preference methods (e.g., hedonic price method [HPM]). Larger differences in per acre value estimates exist between stated and revealed preference studies that can be explained by differences in the nature of the amenity services being valued and by differences in the populations affected by these amenity services. A summary and conclusions are provided in the final section.

Conceptual Background: Competing Land Uses and Net WTP

In order to provide a theoretical basis for understanding and interpreting the valuation methods and results reported in previous empirical studies discussed later in this paper, we conceptually define and illustrate WTP for farmland amenities in this section. Competition for scarce land resources, especially along the urban/rural fringe, results in the conversion of farmland to alternative uses such as residential, industrial, and commercial development. In many places across the United States where urban growth is rapidly increasing, the loss of farmland and the amenities it provides to development has been of high concern to the public and policy-makers. Thus, protecting farmland from development is a major goal and motivation behind farmland protection programs (Irwin, Nickerson, and Libby; Nickerson and Hellerstein).

Figure 1. Allocation between competing land uses

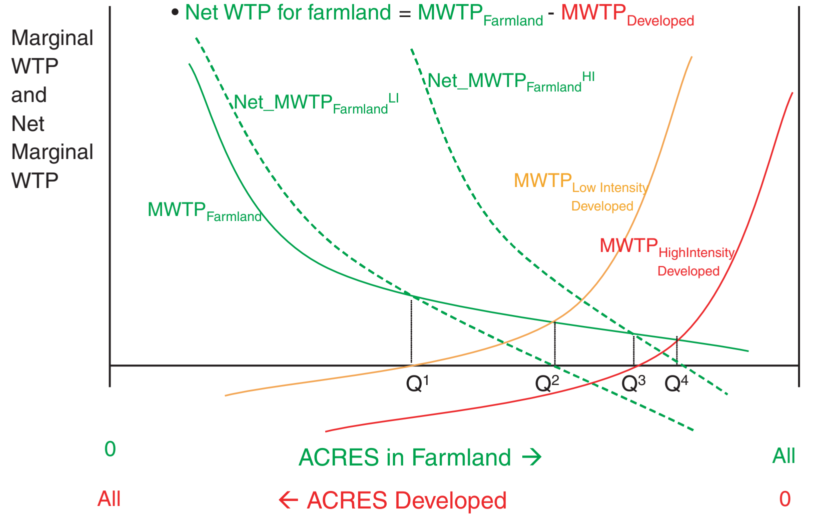


When farmland is protected, opportunities for the public to enjoy farmland amenities are preserved. Thus, demand and WTP for farmland protection and the amenities it provides represent preferences and values for maintaining opportunities to enjoy farmland amenities; for example, paying to protect farmland so that opportunities to visit farms for recreation and tourism related activities (e.g., agritourism, agritainment) or simply viewing countryside scenery are preserved. Once farmland is preserved, a person may end up paying additional money to visit a farm (e.g., parking fees, activity fees) or to view countryside scenery (e.g., travel costs).

Demand and WTP for farmland protection and the amenities it provides, accounting for competing land uses, are illustrated in figure 1. The horizontal axis in figure 1 measures the proportion of land in a community in less-developed uses such as farmland, which is also equal to one minus the proportion in developed uses. The demand or marginal WTP for farmland is illustrated in figure 1 by the curve labeled "$MWTP_{Farmland}$." In areas where farmland is relatively scarce, marginal WTP for farmland is high. As acres of farmland protected increases (left to right on the horizontal axis in figure 1), marginal WTP to protect additional farmland decreases. Higher amounts of farmland imply less developed land. At the same time, developed land also generates urban amenity benefits to residents such as employment opportunities, shopping, and entertainment. Demand or marginal WTP for developed land is illustrated in figure 1 by the curve labeled "$MWTP_{Developed}$."

In areas where developed land is scarce (close to the right-hand vertical axis), marginal WTP for additional developed land could well be positive, reflecting the desire by households for urban amenity benefits. As the amount of developed land increases (moving from right to left on the horizontal axis in figure 1), however, marginal WTP for additional developed land falls. The negative portion

Figure 2. Allocation between competing land uses with alternative development intensity



of the "$\text{MWTP}_{\text{Developed}}$" curve in figure 1 would be associated with perceived disamenities from over-development (e.g., congestion, pollution). The land allocation that yields the highest total amenity benefits is point Q^2 in figure 1, where Q^2 units of farmland are protected in the community and the remaining units are developed. This is not necessarily the socially efficient solution, however. The private (market) values of the competing land uses would also have to be taken into account.

When the amenity value of farmland is measured (e.g. through a stated-preference survey), it is not $\text{MWTP}_{\text{Farmland}}$ that is measured. Rather, the marginal willingness to pay to protect farmland reported by respondents will be a net marginal WTP, equal to the difference between $\text{MWTP}_{\text{Farmland}}$ and $\text{MWTP}_{\text{Developed}}$. This net marginal WTP is shown as the dashed "$\text{Net\_MWTP}_{\text{Farmland}}$" curve in figure 1. At the point where "$\text{MWTP}_{\text{Farmland}}$" equals "$\text{MWTP}_{\text{Developed}}$" ($Q^2$ acres of farmland protected in figure 1), "$\text{Net\_MWTP}_{\text{Farmland}}$" is equal to zero. At the margin where "$\text{MWTP}_{\text{Developed}}$" becomes zero ($Q^1$ acres of farmland protected in figure 1), "Net $\text{MWTP}_{\text{Farmland}}$" equals "$\text{MWTP}_{\text{Farmland}}$."

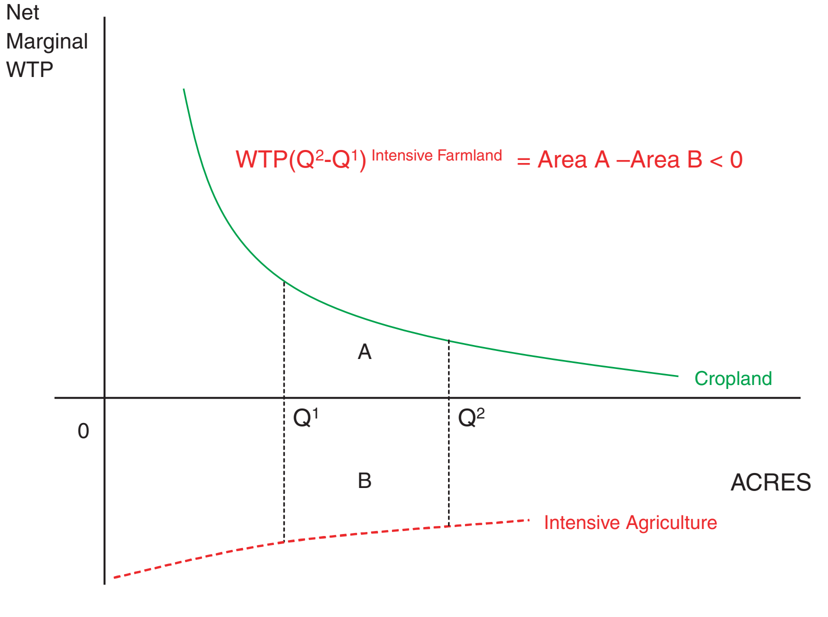
Figure 2 modifies figure 1 to illustrate how alternative development of different intensities may affect the amount of farmland protected in a community and an individual's net marginal WTP for farmland protection. From the perspective of an individual household, conventional high-intensity development (e.g., high-density housing, strip malls, industrial development) is typically considered less attractive as a neighbor than low-intensity development (e.g., large lot residential development, golf courses). In figure 2, the curve labeled "$\text{MWTP}_{\text{High-Intensity Developed}}$" represents an individual's marginal value or WTP for land used for high-intensity development. The curve labeled "$\text{MWTP}_{\text{Low-Intensity Developed}}$" represents an individual's marginal value or WTP for land used for low-intensity development.

As illustrated in figure 2, marginal value or WTP for low-intensity development land lies above marginal value or WTP for high-intensity development land, indicating that individuals prefer more of this type of development. Consequently, in figure 2, the preferred level of farmland protection is lower when the alternative land use is low-intensity development (Q^2) as compared to when the alternative land use is high-intensity development (Q^4). As illustrated in figure 2, it is also expected theoretically that net marginal WTP for farmland protection when the alternative land use is low-intensity development ($Net\_MWTP_{Farmland}^{LI}$) will be lower than net marginal WTP for farmland protection when the alternative land use is high-intensity development ($Net\_MWTP_{Farmland}^{HI}$). In addition, it follows theoretically that WTP for a nonmarginal increment in farmland acres protected is expected to increase as the intensity of alternative development conversion increases. We therefore expect that measured values for farmland protection will be higher or lower depending on the desirability of the alternative land use.

Another general farmland protection and valuation issue relates to possible negative preferences and values generated by farmland. A tract of farmland being used for active agriculture may generate both positive externalities (amenities) and negative externalities (disamenities) such as noise, dust, and odor. If the total value of farmland disamenities is greater than the total value of farmland amenities, net WTP to protect or live nearby the tract of farmland will be negative.

The likelihood of a tract of farmland generating net negative WTP is expected to increase with the intensity of agricultural practices on the land (Ready and Abdalla). For example, suppose a particular tract of land is used to grow crops and raise chickens with a number of highly intensive poultry houses. The solid curve on the top of figure 3 represents the marginal benefits of positive externalities (amenities) associated with cropland including open and green space benefits.

Figure 3. Agricultural use attribute with intensive agriculture



The dashed curve on the bottom of figure 3 represents the marginal damages of negative externalities (disamenities) associated with highly intensive poultry houses including odors and undesirable views.[1] Consider a discrete change in the quantity of farmland from Q^1 to Q^2. In the case illustrated by figure 3, the total value of disamenities (Area B) is greater than the total value of amenities (Area A) resulting in net negative WTP for protecting this tract of farmland. We therefore expect that measured values for farmland protection will be higher or lower depending on the intensity and type of farming practice involved.

Overview of Previous Studies

General background information on previous farmland amenity valuation studies in North America is shown in table 1. The overall purpose of these previous studies was to examine the determinants and magnitude of farmland protection and amenity values. Values measured in these previous studies represent net marginal WTP for farmland protection and amenities (e.g., a point on the $Net\_MWTP_{Farmland}$ curve in figure 1) or net WTP for a nonmarginal change in farmland protection and amenities (e.g., area under the $Net\_MWTP_{Farmland}$ curve in figure 1 between two points).

Four different valuation methods have been employed in these previous studies, CV, CA broadly defined to include choice experiments, the HPM, and a combined travel cost method (TCM)/contingent behavior (CB) approach. CV, CA, and CB are examples of stated preference methods. HPM and TCM are examples of revealed preference methods. All of these valuation methods have been tested and validated through years of research and are widely accepted by federal, state, and local government agencies and the U.S. courts as reliable techniques for estimating nonmarket values such as the amenity benefits of farmland protection (Champ, Boyle, and Brown; Freeman; NOAA). This section provides an overview of these studies, organized by valuation method.

Contingent Valuation Studies

All of the early farmland amenity valuation studies conducted in the 1980s used CV to estimate WTP for the amenity values of farmland protection at the town, county, or state level. CV is a stated preference valuation technique that asks respondents in a survey setting their WTP to protect farmland. The studies that have used this method to describe to the respondent the amount of farmland that will be preserved, how preservation will be accomplished, and usually the type of development that will occur if the farmland is not protected. Within each study, the description of the quantity, attributes, or location of the farmland may be varied across respondents, allowing tests of the influence of these factors on WTP.

As shown in table 1, previous CV studies of farmland amenities include major geographic regions across the U.S. and Canada. Only the U.S. continental west coast is not represented. As indicated in the previous conceptual section, alternative land uses in the absence of farmland protection are expected to influence WTP for farmland protection and amenities. Halstead; Bergstrom, Dillman, and Stoll; Beasley, Workman, and Williams; and Rosenberger and Walsh valued protection

Table 1. Summary of previous farmland protection valuation studies in North America

Study	Farmland Valued	Valuation Method	WTP per Acre[a]	Sample Population
1. Beasley et al.	Old Colony and Homestead farmland in the Matanuska-Susitna Borough, Alaska	CV	\$0. 0327	Random sample of borough households ($N = 119$)
2. Bergstrom et al.	Farmland in Greenville County, South Carolina	CV	\$0.0004	Random sample of county households ($N = 127$)
3. Bittner et al.	Farmland and ranchland in Moffat County, Colorado	CV	\$0.0001	Random sample of county residents and nonresidents ($N = 472$)
4. Bowker and Didychuk	Farmland in the Moncton region of Kent, Albert and Westmorland Counties, New Brunswick, Canada	CV	\$0.0021	Random sample of households in three counties ($N = 93$)
5. Duke and Ilvento	Farms in the State of Delaware	CA	\$0.0468	Intercept sample at all four Delaware Dept. of Motor Vehicles locations ($N = 199$)
6. Duke et al.	Farmland in Sussex County, Delaware	CA	\$0.2599	Random sample of county households ($N = 491$)
7. Geoghegan et al.	Contribution of nearby farmland to residential property values in Calvert, Carroll and Howard Counties, Maryland	HPM	−\$5,026	Residential property sale transactions in three counties ($N = 10{,}135$)
8. Halstead	Farmland near a respondent's home in Towns of East Longmeadow, Greenfield and Deerfield, Massachusetts	CV	\$7.57	Random sample households in three towns ($N = 85$)

Continued

Table 1. Continued

Study	Farmland Valued	Valuation Method	WTP per Acre[a]	Sample Population
9. Irwin	Contribution of pastureland to residential property values in Anne Arundel, Howard, Calvert and Charles Counties, Maryland	HPM	$769.54	Residential property sales transactions in four counties ($N = 55{,}799$)
10. Jauregui et al.	Contribution of nearby farmland to residential property values in Delaware County, Ohio	HPM	Not Available	County residential property sales transactions ($N = 5{,}449$)
11. Johnston et al.	Contribution of adjacent farmland to residential property values in Southhold community, Suffolk County, New York	HPM/CA	−$37,541 (HPM) $0.1945 (CA)	HPM: Residential property sale transactions in Southhold ($N = 374$) CA: Random intercept sample of Southold residents at various public venues ($N = 1{,}123$)
12. Johnston and Duke	Farmland in the Towns of Mansfield and Preston in Connecticut and in Sussex County, Delaware	CA	Reported in rows 6, 13, 14, 15	Random sample of residents in four CT and DE communities ($N = 3{,}309$)
13. Johnston et al. 2007a	Farmland in the Town of Mansfield, Connecticut	CA	$0.6876	Random sample of Mansfield residents ($N = 356$)
14. Johnston et al. 2007b	Farmland in the Town of Preston, Connecticut	CA	$0.1458	Random sample of Preston residents ($N = 289$)
15. Johnston et al. 2007c	Farmland in the State of Connecticut	CA	$0.0171	Random sample of state residents ($N = 288$)
16. Kashian and Skidmore	Farmland in the City of Muskego, Wisconsin	CV	$0.0130	Random sample of Muskego property owners ($N = 630$)

Continued

Table 1. Continued

Study	Farmland Valued	Valuation Method	WTP per Acre[a]	Sample Population
17. Krieger	Farmland in Kane, McHenry and Dekalb Counties, Illinois	CV	$.0036	Random sample of households in three counties ($N = 1{,}800$)
18. Lake and Easter	Contribution of farmland at varying distances to residential property values in Dakota County, Minnesota	HPM	Not available	County residential property sale transactions ($N = 1{,}464$)
19. McLeod et al.	Farmland and ranchland in Sheridan County, Wyoming	CV	$0.0001	Random sample of county residents and nonresidents ($N = 196$)
20. Ozdemir	Farmland in State of Maine	CA	$0.0010	Random sample of state residents ($N = 162$)
21. Ozdemir et al.	Farmland in the United States, Georgia, Maine and Ohio	CA	Reported in rows 20, 29	Random sample of U.S. residents and residents in three states ($N = 802$)
22. Ready et al.	Horse farms in Kentucky counties	HPM	$0.0052 (HPM)	HPM: Residential property owners and renters in state ($N = 3{,}414$)
		CV	$0.0262 (CV)	CV: Random sample of state households ($N = 194$)
23. Ready and Abdalla	Contribution of nearby farmland to residential property values in Berks County, Pennsylvania	HPM	$342.13	County residential property sale transactions ($N = 8{,}090$)
24. Roe et al.	Cropland in Franklin County, Ohio	CA	$1.87	Random sample of county households ($N = 776$)
25. Rosenberger and Loomis	Farmland and ranchland in Routt County, Colorado	Combined TCM and CB	$0.0405	Intercept sample of Steamboat Springs, Routt County visitors at various venues

Continued

Table 1. Continued

Study	Farmland Valued	Valuation Method	WTP per Acre[a]	Sample Population
26. Rosenberger and Walsh	Farmland and ranchland in Routt County, Colorado	CV	\$0.0161	Random sample of county residents ($N = 171$)
27. Sohngen et al.	Contribution of adjacent farmland to residential property values in Delaware County, Ohio	HPM	\$1,930	County residential property sale transactions ($N = 5{,}250$)
28. Swallow	Farmland in Town of Richmond, Rhode Island	CA	\$0.4420	Random sample of town residents ($N = 258$)
29. Volinskiy and Bergstrom	Farmland in the State of Georgia	CA	\$0.0002	Random sample of state households ($N = 195$)
30. Waddington	Farmland in respondent's home county of Berks, Lehigh or Northampton counties, Pennsylvania	CV	\$0.0013	Random sample of residents in three counties ($N = 512$)

[a]WTP per acre values are expressed in mean annual WTP per acre per household except for the Roe et al. and Volinskiy and Bergstrom studies which reported median annual WTP per acre per household. All WTP values are reported in 2007 dollars. It should be noted that most of the WTP values in this column represent aggregations and averages of multiple WTP values reported in a study and were calculated by the authors (see Appendix A for more detail).

of farmland from specified levels of alternative developed land uses (e.g., high, medium, low levels of developed land-use intensity). In contrast, the alternative land uses threatening farmland were not specified in the CV studies conducted by Waddington; Bowker and Didychuck; Ready, Berger, and Blomquist; Krieger; Kashian and Skidmore; McLeod et al.; and Bittner et al.

An important aspect of CV methodology is the manner in which valuation responses are elicited. Halstead as well as Beasley, Workman, and Williams used the iterative bidding technique. Bergstrom, Dillman, and Stoll; Bowker and Didychuck; and Rosenberger and Walsh used the payment card approach. Dichotomous choice (close-ended) questions were used by Ready, Berger, and Blomquist; Krieger; and Kashian and Skidmore. Open-ended questions were used by Waddington; McLeod et al.; and Bittner et al.

Conjoint Analysis Studies

Starting in the early 2000s, economists using stated preference methods to value farmland amenities turned their attention more toward using CA to analyze the relationships between WTP for farmland protection and specific farmland attributes. As used in this paper, the term CA refers to multi-attribute surveys where preferences for farmland protection "packages" are either stated as rating/ranking (traditional conjoint) or stated in referendum style (choice experiments).[2] Individual rankings or ratings combined with data on farmland attributes, contextual factors, and cost are then statistically analyzed to estimate WTP for farmland protection and the effects of farmland attributes and contextual factors on estimation results.

All of the previous CA studies shown in table 1 were conducted in study areas in U.S. east coast states, except for one that was conducted in Ohio. Most of the previous CA studies were conducted in northeastern U.S. states.[3] With respect to the conceptually important alternative land use variable, recent multi-state valuation studies were funded by the USDA National Research Initiative (Ozdemir et al.; Duke, Johnston, and Campson; Johnston and Duke; Johnston, Campson, and Duke 2007a, 2007b, 2007c). Volinskiy and Bergstrom specified alternative levels and risks of development in the absence of farmland protection. Duke and Ilvento also specified alternative development risks in the absence of farmland protection. Alternative land uses in the absence of farmland protection were not specified in the Swallow; and Roe, Irwin, and Morrow-Jones CA studies.

Estimation and calculation of CA valuation results may be sensitive to model parameter estimation techniques. The first and some later CA farmland valuation studies used relatively simple discrete-choice estimation techniques such as conditional logit models (Johnston et al.; Swallow; Ozdemir; Duke and Ilvento; Duke, Johnston, and Campson; Johnston, Campson, and Duke 2007a, 2007b, 2007c). Some recent CA farmland valuation studies have used relatively more complex simulation based approaches such as mixed logit (Johnston and Duke; Volinskiy and Bergstrom).

Hedonic Price Method Studies

In the late 1990s, economists started using the HPM to value farmland amenities. The HPM is a revealed preference valuation technique, which uses property value data to estimate statistical models that relate the price or WTP for land to attributes of the land itself and contextual factors. For example, previous HPM studies have measured the effects of surrounding agricultural land on the price or WTP for residential land.

Previous HPM studies of farmland amenities have been concentrated in the northeastern U.S. (Johnston et al.; Irwin; Geoghegan, Lynch, and Bucholtz; Ready and Abdalla; and the mid-western U.S. (Ready, Berger, and Blomquist; Sohngen et al.; Lake and Easter; Jauregui et al.).[4] Irwin and Ready and Abdalla measured the value of farmland relative to several alternative land uses including forestland, different types and intensities of development, and private and public conservation land. In addition to farmland amenities, Ready and Abdalla also measured the effects of farmland disamenities on residential property values. As discussed in the conceptual section, the presence of farmland disamenities, particularly associated with high-intensity agriculture, is expected to decrease WTP for farmland protection. In contrast to the studies listed previously, which measure the effects of farmland on the price of adjacent or relatively nearby residential property, Ready, Berger, and Blomquist used the HPM to estimate the county-wide amenity value of farmland.

Because parcels of land are distributed over geographic space with some degree of proximity to each other, it may be important to account for spatial interactions when estimating HPM models of farmland values statistically. The first HPM farmland valuation studies (Ready, Berger, and Blomquist; Sohngen et al.; Johnston et al.; Lake and Easter) did not explicitly account for spatial interactions between land parcels. Later studies have used instrumental variable approaches (Irwin; Ready and Abdalla) and spatial HPM models (Geoghegan, Lynch, and Bucholtz; Jauregui et al.) to explicitly model such interactions.

Combined Stated and Revealed Preferences Studies

Rosenberger and Loomis conducted a unique study of the value to tourists of protecting ranch land in Routt County, Colorado. Routt County, home of the Steamboat Springs town and resort, is a popular winter and summer tourist destination. Picturesque western U.S. ranch land is one of the attractions of the area to visitors. The authors combined actual travel cost data (revealed preference data) with contingent travel behavior data (stated preference data) to estimate tourists' WTP to protect ranch land in the county from residential and commercial development.

Determinants of Estimated Farmland Amenity Values

All of the previous studies listed in table 1 provide insights into factors that influence public preferences and values for farmland amenities as reflected by WTP for farmland protection. The effects of characteristics of farmland itself (e.g., acreage, soil quality), alternative land use(s), surrounding landscape, and sociodemographic variables on WTP for farmland protection and amenities are discussed in this section. All of the results discussed in this section are based on intra-study (or within study) comparisons of WTP estimates rather than interstudy (or across study) comparisons.

Farmland Acreage and Scarcity Attributes

Economic theory suggests that the total value (total WTP) for farmland protection should increase with the quantity of acres protected. Several CV studies (Bergstrom, Dillman, and Stoll; Bowker and Didychuck; Ready, Berger, and Blomquist; Rosenberger and Walsh) and CA studies (Johnston et al.; Duke and Ilvento; Ozdemir; Ozdemir et al.; Roe, Irwin, and Morrow-Jones; Johnston and Duke; Volinskiy and Bergstrom) provide strong empirical evidence of this basic relationship. These results suggest that stated preference studies of farmland protection and amenities pass a basic scope test (NOAA; Smith and Osborne).

Economic theory also suggests that as a commodity such as farmland becomes less scarce (e.g., more is provided), marginal value (marginal WTP) should decrease, so that total value (total WTP) increases at a decreasing rate. This generates a downward sloping marginal value (marginal WTP) curve for farmland protected, as illustrated in figure 1. Several CV studies (Bergstrom, Dillman, and Stoll; Bowker and Didychuck; Rosenberger and Walsh) provide strong evidence that marginal WTP for farmland protection in a given location does indeed decrease as acreage protected increases. Also consistent with theoretical expectations, several CV studies (Bergstrom, Dillman, and Stoll; Bowker and Didychuck; Rosenberger and Walsh), CA studies (Johnston et al.; Duke and Ilvento; Roe, Irwin, and Morrow-Jones), and HPM studies (Ready, Berger, and Blomquist; Geoghegan, Lynch, and Bucholtz) provide strong evidence that WTP for small or incremental changes in farmland acres protected is higher in areas where farmland is more scarce.

Alternative Land Use Attribute

According to economic theory, values or WTP for a given policy change is a function of the pre- and postpolicy levels of individual utility determined by the pre- and postpolicy states of the world. Thus, individual values or WTP for a given level of farmland protection are a function of the amount and nature of farmland protected in the postpolicy world compared to expected land use in the pre-policy world. Thus, the expected alternative land use(s) without farmland protection policies should affect WTP for farmland protection. Several CV studies (Halstead; Beasley, Workman, and Williams; Rosenberger and Walsh), HPM studies (Irwin; Ready and Abdalla), and CA studies (Ozdemir; Ozdemir et al.; Volinskiy and Bergstrom) provide strong empirical evidence that the intensity of development in the absence of protection influences WTP for farmland protection in a positive manner, as illustrated in figure 2. Johnston and Duke show that a higher risk of development also increases WTP for farmland protection.

Agricultural Land Use and Quality Attributes

Previous quantitative and qualitative studies of public preferences and attitudes toward farmland protection indicate that along with providing open and green space, a clear and strong public motivation for farmland protection is to protect the agrarian nature of a community including cultural values, heritage values, rural lifestyles and access to fresh, local food supplies. All these factors are dependent on the continued existence of viable farms and farming operations (Bergstrom, Dillman, and Stoll; Furuseth; Bowker and Didychuck; Kline and Wichelns; Duke and Hyde; Hellerstein et al.; Irwin, Nickerson, and Libby; Nickerson and Hellerstein; Paterson et al.). The results of these previous studies suggest that WTP should be greater for farmland that supports active and productive agriculture in addition to open and green space.

A recent multi-state CA study (Ozdemir; Ozdemir et al.; Volinskiy and Bergstrom) provides strong evidence that WTP increases with the presence of prime agricultural soils as defined by the USDA Natural Resources Conservation Service. The specific reasons why respondents in these studies valued protection of prime farmland with prime soils more highly are not clear. The studies cited in the previous paragraph suggest that reasons may include desires to protect cultural and heritage values associated with an agrarian landscape and access to fresh, local food supplies.

The values that people place on protecting the agrarian nature of the landscape and access to fresh, local food supplies suggests that WTP for farmland used to produce human food crops (e.g., cropland, orchards) may be greater than WTP for timberland or pastureland (Nickerson and Hellerstein). Previous HPM (Irwin) and CA studies (Swallow; Ozdemir; Ozdemir et al.; Roe, Irwin, and Morrow-Jones; Volinskiy and Bergstrom) provide some empirical evidence of relatively higher preferences and WTP for preserving cropland as compared to other agricultural uses (e.g., timberland and pastureland). In contrast, in a recent CA study, Johnston and Duke found that differences in five agricultural land use types (nursery, food crops, dairy or livestock, idle farmland, and forest) did not affect WTP for farmland protection in a statistically significant manner.

It is difficult to draw firm generalizations about the effects of agricultural land use types on WTP for farmland protection because of the above mixed results. In addition, the effects of agricultural land use types are likely sensitive to the specific types of cropland, timberland, and pastureland valued. For example, negative preferences for clear-cut timberland and uncared for, apparently abandoned fields were observed in the Paterson et al. qualitative preference study. Other studies in the future may reveal positive preferences for other types of timberland and pastureland or rangeland (e.g., land with unique ecological habitats or scenic beauty).

The desire to preserve the various local benefits from active and viable farms and farming in a community is a strong public motivation for farmland protection. However, evidence from CA studies (Johnston et al.) and HPM (Lake and Easter; Ready and Abdalla; Jauregui et al.) suggest that farmland that is too actively or intensively farmed may result in net negative values to the public. That is, the negative externalities of living near a farm (e.g., noise, dust, odor) may outweigh the positive externalities (e.g., open space, green space), as illustrated in figure 3.

Human Use Attributes

People derive enjoyment from farmland amenities with different levels of access to or use of the land itself. Direct public access gives people the opportunity or right to encroach upon the land for various amenity-related uses such as pick-your-own fruits and vegetables, agritourism activities (e.g., farm tours, hayrides, corn mazes), and nature-based tourism activities (e.g., hunting, fishing, hiking, bird-watching). Indirect public access gives people the opportunity or right to engage in aesthetic uses such as viewing, painting or photographing the land from public property (e.g., public road or nearby public land) without encroaching upon the land. Nonuse amenity values are public benefits supported by farmland that are independent of direct or indirect public access. For example, nonuse amenity values would include an individual's WTP to preserve wildlife habitat and species on farmland that he or she cannot visit or even see, as in the case of an isolated private tract of land with no public road access or nearby public property.

Previous CV (Bowker and Didychuck) and CA (Swallow; Johnston and Duke) studies provide evidence that WTP for farmland protection increases with the provision of public access. These results are consistent with theoretical expectations since increasing public access to farmland increases opportunities for indirect aesthetic use and direct public use benefits. Johnston and Duke examined WTP for different types of public access and found that nonconsumptive uses (e.g., walking and biking) were preferred to consumptive uses (e.g., hunting). The authors state that these results may reflect anti-hunting sentiments in their respondent sample. More generally, these results suggest that there may be conflicts or tradeoffs among different types of public access. For example, hikers are not likely to want to mix with hunters on the same land at the same time, most obviously because of the potential danger. As another example, excessive direct public use of a tract of farmland for agritourism activities (e.g., pick-your-own operations, hayrides, corn mazes) may reduce aesthetic use values of the land (e.g., scenic viewing).

Distance to Farmland

Previous studies provide mixed and inconclusive results with respect to the effects of distance from a household residence to farmland. In a CA study, Johnston et al. found higher watershed-wide amenity values for farmland than for other types of open space, but found in a HPM study that properties adjacent to farmland were worth less than properties adjacent to other types of open space. Lake and Easter found in an HPM study that decreasing distance from a residential property tract to farmland decreased the price of that tract. Ready and Abdalla found in a HPM study that eased farmland located within 400 meters of a house has less of a positive effect on house prices than forested land, but that outside of 400 meters the ordering reversed. In contrast, results of a recent HPM study (Jauregui et al.) show that higher percentage of farmland within 400 and 800 meters has a depressing effect on residential property values. Moreover, the results of this study suggest that the depressing effect of surrounding farmland is higher within 400 meters as compared to within 800 meters. The authors of the previously mentioned three studies speculate that the negative effects of surrounding farmland on residential property values are driven by localized disamenities associated with active farming (e.g., noise, odors, dust). These results are consistent with studies measuring negative effects of CAFOs (confined animal feeding operations) on property values (Palmquist, Roka, and Vukina; Herriges, Secchi, and Babcock).

Results of a HPM study conducted by Sohngen et al. suggest that the amenity and disamenity effects of farmland may be sensitive to the type of community a person lives in (e.g., urban, suburban, rural). Their results showed that homeowners near the central city in a more urbanized setting do not value living near farmland, but they do value living near other types of open and green space (e.g., golf courses). The same study showed that as distance from the central city increases (moving into less urbanized settings), the value of living near farmland rather than developed land uses (e.g., housing subdivision) increases.

In addition to the HPM study results previously mentioned indicating negative effects of living near farmland, some CV studies (Halstead; Bowker and Didychuk) report limited evidence that the total economic value of farmland protection including use and nonuse values is higher for people who live farther away from farmland. It is difficult, however, to compare these results with the HPM distance effect results since previous HPM studies only capture private amenity and disamenity effects associated with farmland located relatively close to households (e.g., adjacent or within 2 miles). CV and CA studies capture more geographically dispersed public amenity and disamenity effects such as public aesthetic use and nonuse values.

Because of the difficulty in controlling for complex and confounding effects (e.g., separating out scarcity, proximity and disamenity, or NIMBY effects), farmland valuation studies do not yet provide a clear picture of how proximity to farmland affects preferences and WTP for farmland protection. One hypothesis suggested by the previously mentioned studies is that homeowners receive high amenity values from farmland in their community, but they prefer not to be located at distances close enough to expose them to possible disamenities associated with farming. In addition, the amenity and disamenity effects of distance to farmland may be sensitive to overall community characteristics such as where a community falls on the spectrum from urban to rural settings.

Other Attributes

Another farmland attribute that may influence values (WTP) for farmland protection is land tenure or ownership. Previous CA (Swallow) and HPM (Ready and Abdalla) studies provide some evidence that open or green space provided by privately owned land with conservation easements is less preferred and valuable than open or green space provided by publicly owned open or green space land. Ready and Abdalla also found evidence suggesting that privately owned eased farmland is less valuable than privately owned, unleased farmland. They speculate that the difference may be related to a difference in how intensively the land is being farmed.

In contrast to the previously mentioned studies, HPM results reported by Irwin suggest that privately owned open or green space with a conservation easement on it generates the highest amenity values, followed by publicly owned open or green space, followed in turn by developable privately owned open or green space land. Similarly, in another HPM study, Geoghegan, Lynch, and Bucholtz found that permanently protected open or green space (including farmland, state and local parks, and golf courses) is more valuable than privately owned farm and forestland that could be developed in the future.

The sensitivity of farmland protection preferences to the permanence of different protection mechanisms was also examined in a recent CA study conducted by Johnston and Duke. Their results show conservation easements and fee-simple purchase are preferred to conservation zoning and explain these results by noting focus group participants indicated that a disadvantage of conservation zoning is there is no guarantee this zoning will not be changed sometime in the future to allow development. Johnston and Duke also showed that state-held conservation easements were preferred over privately held conservation easements (e.g., easements held by private land trusts). One possible explanation for this result is this. Even though the survey instrument stated that conservation easements held by public or private entities would be permanent by contract, respondents in this study may put more trust in the state government to protect farmland permanently, compared to private land trusts. In most U.S. states, land trusts are relatively new and perhaps unfamiliar to citizens.

Economic theory indicates that socio-demographic characteristics of individuals or households may affect their tastes and preferences and in turn influence WTP for goods and services including farmland amenities. The effects of socio-demographic variables on WTP for farmland amenities have been examined primarily in previous CV studies. Individual or household income was found to have a positive effect on WTP for farmland amenities in several studies (Halstead; Bergstrom, Dillman, and Stoll; Rosenberger and Walsh; Krieger; Rosenberger and Loomis). Two previous studies found individual age to have a positive effect on WTP for farmland amenities (Bergstrom, Dillman, and Stoll; Beasley, Workman, and Williams). A positive effect of individual education on WTP for farmland amenities was detected in two previous studies (Bergstrom, Dillman, and Stoll; Waddington). Bowker and Didychuck found a positive effect of household size on WTP for farmland amenities while Rosenberger and Walsh found a negative effect.

Bowker and Didychuck as well as Krieger found that "membership in a conservation or environmental organization" influenced preferences and WTP for farmland amenities in a positive manner. In addition, these two studies found that "visiting open space within the past 6–12 months" increased WTP for farmland amenities. Krieger also found that "visiting a farm within the past 6 months" increased WTP for farmland amenities. Beasley, Workman, and Williams also detected a positive effect of "previous knowledge of farmland conservation programs" on WTP for farmland amenities.

Economic theory suggests that substitutes may influence WTP for goods and services including farmland amenities. The question of interest may be stated as: To what extent do amenities provided by nonfarm open and green space (e.g., public parks and forests) substitute for farmland amenities? We were only able to find one previous study that explicitly tested for substitution effects between farmland and nonfarmland amenities. In a CA study, Roe, Irwin, and Morrow-Jones found a "mild" substitution effect between amenities provided by permanently protected farmland and public parks in a community.

Although largely left out of previous farmland valuation studies to date, broad ecological and environmental attributes may be important determinants of preferences and values for farmland protection. For example, results of a CA study (Swallow) suggest that WTP for farmland protection increases with the ecological uniqueness and ecosystem services provided by the land. His results also suggest that WTP for farmland protection increases with the scenic beauty of the land.

Per Acre Value Comparisons

Estimated household WTP per acre for farmland amenities adjusted to 2007 dollars are shown for all studies reviewed in this paper in table 1. Sample populations for each study are briefly described in table 1. Sample populations vary in scope from the city/town level to the national level. The majority of sample populations are at the county (or township/borough) level. Sample size (*N*) in table 1 represents the number of observations available for estimating WTP for farmland protection and amenities. The range of estimated household WTP per acre and averages across studies using different valuation methods are summarized in table 2.

Most of the values reported in tables 1 and 2 represent aggregations of sometimes many farmland amenity value estimates reported within a particular study, which were not reported in the original study. Rather, the numbers were calculated by the authors using the general procedures summarized in Appendix table A1. Aggregating estimates within studies masks important heterogeneity in determinants of farmland amenity value estimates across studies such as farmland attributes, protection mechanisms, and sample population characteristics. Hence, the values presented in tables 1 and 2 should be interpreted and compared with caution.[5] With this caveat in mind, we present and discuss general differences in WTP for farmland amenities per household per acre observed across studies.

Mean annual household WTP per acre across all previous CV studies ranges from \$0.0001 in Colorado and Wyoming (McLeod et al.; Bittner et al.) to \$21.90 in Massachusetts (Halstead) with an average across all studies of \$1.80. The Halstead study was fundamentally different from the other CV studies reported in table 1; in that he measured WTP to protect a single tract of farmland near a respondent's home while the other studies measured WTP to protect farmland over much wider geographic areas (e.g., all prime farmland in a county). The value estimated in that study is therefore much more like those estimated in HPM studies. If we drop the Halstead study, the range of household WTP per acre estimates shown in table 2 becomes much tighter ranging from \$0.0001 in Colorado and Wyoming (McLeod et al.; Bittner et al.) to \$0.0776 in Kentucky (Ready, Berger, and Blomquist) with a mean across all studies (minus Halstead) of \$0.0114.

Estimated household WTP per acre across all previous CA studies ranges from \$0.0002 in Georgia (Volinskiy and Bergstrom) to \$1.87 in Ohio (Roe, Irwin, and Morrow-Jones) with a mean across all studies of \$0.3463. The lower range of estimated WTP per acre is quite consistent across CV and CA studies and most likely reflects the relative abundance of farmland in the Colorado, Wyoming, Georgia, and South Carolina study areas at the time of these studies. The relatively high (compared to other CA and CV studies) value per acre reported by Roe, Irwin, and Morrow-Jones most likely reflects the high relative scarcity of farmland at the time of this study in the Franklin County, Ohio study area located in the greater Columbus, Ohio metropolitan area.

Estimated household WTP per acre across all previous HPM studies ranges from −\$37,541 in New York (Johnston et al.) to \$5,518 in Maryland (Irwin) with a mean across all studies of −\$3,428. If we drop negative values (representing farmland disamenity values) reported by Johnston et al.; and Irwin, the range of estimated household WTP per acre for positive farmland amenities reported in

Table 2. Estimates of farmland amenity value per acre (WTP Per Household) in North America

	Low	Average	High
All contingent valuation estimates Number of studies = 11	$0.0001 (Bittner et al.; McLeod et al.)	$1.80 (*N* = 38 including multiple values per study)	$21.90 (Halstead)
Contingent valuation estimates minus Halstead Number of studies = 10	$0.0001 (Bittner et al.; McLeod et al.)	$0.0114 (*N* = 29 including multiple value estimates per study)	$0.0776 (Ready et al.)
Conjoint analysis estimates Number of studies = 10	$0.0002 (Volinskiy and Bergstrom)	$0.3463 (*N* = 12 including multiple value estimates per study)	$1.87 (Roe et al.)
Hedonic price method estimates **with** negative values Number of studies = 6	−$37,541 (Johnston et al.)	−$3,428 (*N* = 12 including multiple value estimates per study)	$5,518 (Irwin)
Hedonic price method estimates **without** negative values Number of studies = 4	$0.0052 (Ready et al.)	$1,685 (*N* = 7 including multiple value estimates per study)	$5,518 (Irwin)
Hedonic price method estimates **without** negative values and minus Ready et al. Number of studies = 3	$277 (Ready and Abdalla)	$1,966 (*N* = 6 including multiple value estimates per study)	$5,518 (Irwin)
Combined travel cost and contingent behavior estimates Number of studies = 1	$0.0405 (Rosenberger and Loomis)	$0.0405 (*N* = 1 including multiple value estimates per study)	$0.0405 (Rosenberger and Looms)

previous HPM studies is $0.0052 in Kentucky (Ready, Berger, and Blomquist) to $5,518 in Maryland (Irwin) with a mean across studies of $1,685.

The Ready, Berger, and Blomquist HPM study was fundamentally different from the other HPM studies reported in table 1. They measured the effects on property values of farmland over a wide geographic area (e.g., all horse farms in a county), while the other studies measured the effects of farmland relatively nearby a household (e.g., adjacent to within 0.5 mile). In this way, the Ready, Berger, and Blomquist study is more similar to the CV studies than to the other HPM studies. If we drop the Ready, Berger, and Blomquist study and negative values reported by Johnston et al. and Irwin, the range of estimated household WTP per acre across remaining HPM studies becomes $277 in Pennsylvania (Ready and Abdalla) to $5,518 in Maryland (Irwin) with a mean across studies of $1,966. Farmland is scarcer in the Irwin Maryland study area compared to the Ready and Abdalla Pennsylvania study area, which may account for some of the large difference in per acre values found in these studies.

Conceptually, WTP values reported in tables 1 and 2 generated from CV and CA studies have different interpretations from those generated by HPM studies. CV studies typically ask respondents to value discrete changes in farmland acres protected, and then estimate total WTP for those discrete changes. We can then estimate WTP per acre as reported in tables 1 and 2 by dividing total WTP by the number of farmland acres protected. Previous CA studies ask respondents to rank different discrete "packages" of farmland protection attributes including acreage, and then estimate total WTP for the discrete attribute changes. As in the CV case, we can then estimate WTP per acre as reported in tables 1 and 2 by dividing total WTP by the number of farmland acres protected. Hence, the CV and CA values per acre reported in tables 1 and 2 are average values per acre.[6] In contrast, HPM studies use property value data showing tradeoffs people make over marginal changes in land attributes (assuming data sets with rich land price and attribute observations), and then estimate marginal values or WTP directly. Hence, the HPM values per acre reported in tables 1 and 2 are marginal values per acre.

Another difference between the stated preference (CV and CA) and revealed preference (HPM) value estimates reported in tables 1 and 2 relates to the scope and spread of economic values captured in the value estimates. With the exception of the study by Ready, Berger, and Blomquist, the HPM revealed preference data sets and resulting value estimates only reflect use values accruing to private landowners who live relatively close to farmland. These households would be expected to hold the highest amenity values for farmland protection. With the exception of the Halstead study, previous CV and CA stated preference data sets and resulting value estimates reflect both use and nonuse values to the general public living throughout a local community, region, or state. Thus, the CV and CA values reported in tables 1 and 2 would generally be aggregated over a much larger group of people or population as compared to the HPM values.

Despite the conceptual differences and wide geographical range of previous studies, the per acre value estimates for farmland amenities reported in tables 1 and 2 are quite consistent within valuation methodology. The low, high, and average per acre values estimated in previous CV and CA studies are very close with the exception of the Halstead; and Roe, Irwin, and Morrow-Jones studies. The relatively higher values per acre reported by Halstead and Roe, Irwin, and

Morrow-Jones may be due at least partially to the greater scarcity of farmland in their study areas as compared to the other CV and CA studies. Even though not directly comparable to the CV and CA estimates because it is a marginal rather than an average value, the Ready, Berger, and Blomquist county-wide HPM study generated an estimated farmland amenity value of $.0052 per acre, close to the CV and CA low-value estimates.

The Rosenberger and Loomis study is a unique study combining the TCM with the CB approach to estimate WTP on the part of nonresident recreation and tourism visitors to protect ranch land in Routt County, Colorado. The value of ranchland amenities to visitors of $0.0405 per acre (table 1) is close to the average value across CV studies minus Halstead reported in table 2.

Finally, implications of the units of measurement for the values reported in tables 1 and 2 with respect to estimation of aggregate farmland amenity values or benefits should be noted. Estimation of aggregate benefits of farmland amenities for a particular region (e.g., county, state) would involve multiplying the per household per acre estimates reported in tables 1 and 2 by both the appropriate number of farmland acres protected and the appropriate number of households in the region. The appropriate number of acres is determined by the type of farmland represented by the estimates reported in tables 1 and 2.

For example, Bergstrom, Dillman, and Stoll measured the value of amenities for prime farmland in Greenville County, South Carolina. Hence, it would be appropriate to aggregate their farmland amenity value estimate of $0.0004 per acre (table 1) over the total number of acres of prime farmland in Greenville County, say as defined by the USDA using soil quality. Ready, Berger, and Blomquist measured the value of farmland amenities for a special and unique type of farmland, Kentucky horse farms. Thus, it would appropriate to aggregate their CV estimate of $0.0262 per acre (table 1) only over horse farms in a region.

The appropriate number of households to use in aggregation is determined by the use and nonuse value aspects of the estimates reported in tables 1 and 2. For example, on-site use values of farmland amenities with private access only, such as on-site recreation available only to family and friends of property owners, would apply to a relatively small number of households. For example, the high farmland amenity value of $5,518 per acre reported in the HPM study by Irwin would apply to only a relatively small number of households whose property is adjacent (within 100 meters) of farmland devoted to pasture. Farmland amenity values measured by CV and CA studies capturing spatially diverse values such as scenic viewing and existence values with "public good" characteristics (e.g., nonrivalry and nonexclusiveness) would apply to the largest number of households (e.g., all households in a county or state).[7]

Summary and Conclusions

The results of previous farmland amenity valuation studies in North America provide relatively strong evidence that preferences and values are positively related to farmland acreage, regional farmland scarcity, alternative development intensity, public accessibility, and productivity (e.g., soil quality). There is some evidence that preferences and values are positively related to human food plants, active farming, and negatively related to intensive agriculture. With respect to socio-demographic variables, there is evidence that preferences and values are positively related to income, age, education, visiting open or green space in the past, and experiences with farms and farming.

Previous studies suggest that preferences for farmland protection and amenities are sensitive to spatial or location factors such as distance from a residential household to farmland and where a household is located on the spectrum from urban to rural settings. Particular tracts of farmland are likely to generate both amenities (e.g., open and green space benefits) and disamenities (e.g., noise, dust, odors). The results of previous studies suggest that farmland disamenities are subject to a distance decay function whereby the negative effects of disamenities on preferences and values for farmland protection dissipate as distance from a household to farmland increases. However, the relative magnitudes of amenity and disamenity effects as a function of distance are not well understood from previous studies.

Some evidence from previous studies suggests that people living in highly urbanized areas (e.g., close to the central city) do not value living near farmland. This evidence seems to contradict results from other studies suggesting that farmland amenities located near urban areas is more highly valued by households (consistent with the scarcity principle). There is not enough evidence, however, to draw firm conclusions with respect to how preferences and values for farmland protection and amenities vary across households located on the spectrum from the highly urban, developed central city to highly undeveloped rural areas. Previous studies also provide limited and inconclusive evidence with respect to the relative value of different types of agricultural use (e.g., cropland, pastureland), the effects of alternative property right structures (e.g., land tenure and ownership), the effects of nonfarmland amenity substitutes (e.g., public parks), and the relative value of unique landscape features such as scenic beauty, ecosystem services, buildings, and specialty commodities.

We conclude that although much has been learned about farmland amenity values since the first farmland protection and amenity valuation studies in the 1980s, more qualitative and quantitative research is needed to understand better the effects of specific farmland attributes on preferences and values for farmland protection and amenities. The assessment of previous valuation studies presented in this paper indicates numerous data and knowledge gaps. More research and data are needed, for example, to estimate average and marginal values of farmland amenities accurately. Average and marginal values, for instance, will continually change over time as more farmland is lost to alternative land use(s) and more is protected.

Previous studies clearly show that acreage protected is an important factor influencing WTP for farmland protection. Future studies should therefore include acreage protected as a standard design factor, which frequently was not done in previous valuation studies. Given the results of previous studies showing the strong influence of alternative land use(s) on WTP for farmland protection, this factor should also be included in future studies as a standard design factor, as should probability of conversion. More research and data are needed to better assess the full range of alternative land uses on WTP for farmland amenities (e.g., different types of high-density development including "smart growth" development).

More research and data are also needed to better assess how WTP for farmland amenities is influenced by different agricultural uses of the land to be protected, including commodities produced and the intensity of production. In particular, what types of agricultural commodities and production intensity levels are associated with farmland disamenities and negative WTP values? Although previous studies indicate that WTP for farmland protection tends to increase with land or soil quality, the reasons why are not clear. More research and data are needed to determine if this positive relationship is due to food supply concerns and (or) the amenity values people receive from preserving healthy ecosystems and the associated healthy plant growth and green space.

More research and data are also needed to assess how important public access is to the publics' WTP for farmland protection. From the perspective of private landowners and farmland protection program managers, providing direct, on-site public access to protected land may be viewed as undesirable or unacceptable, even if highly valued by the public who may be paying for protection. Preferences and values on the part of both the public and landowners with respect to public access may vary with the particular type of access and activities (e.g., direct versus indirect access, consumptive versus nonconsumptive on-site activities).

The heterogeneity of preferences and values for farmland protection and amenities across geographic space is not well understood and is another important area of for future research. One area of this spatial research focuses on the relationships between preferences and values for farmland protection and the distance from households to farmland. Carefully designed and controlled studies are needed to accurately model and separate out distance effects from other confounding factors influencing preferences and values for farmland amenities. The effects on preferences and values for farmland amenities of housing location on the urban to rural spectrum is another area of needed future research. Factors such as substitution effects between amenities provided by farmland and nonfarmland (e.g., public parks), land ownership and tenure, ecological services, and scenic beauty also need to be better documented and understood through future studies that explicitly include these items as design factors.

In addition to farmland attributes (including the surrounding landscape) and population characteristics, study design factors including the particular valuation method employed may significantly influence WTP for farmland protection and amenities. For example, do CV and CA studies generate different values for farmland protection and amenities, ceteris paribus? If so, why? As the library of estimated farmland amenity values increases with more valuation studies, carefully designed and controlled meta-analyses may help to answer these and other research questions related to the determinates and magnitude of farmland amenity values. Such meta-analyses would also be useful for facilitating benefit transfer studies involving farmland amenity values.[8]

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Table A1. Summary of procedures for estimating WTP per acre from previous studies

Study	WTP Per Acre Estimation Procedures
Beasley et al.	Mean annual household WTP reported in study averaged across two alternative land use assumptions (medium- and high-intensity development) divided by number of acres protected (7,000 acres) in borough reported in survey questionnaire (obtained from study authors).
Bergstrom et al.	Average of mean annual household WTP divided by total acres protected reported in study across four assumptions of total acres protected (18,000; 36,000; 54,000; and 72,000 acres) in county.
Bittner et al.	Mean annual household WTP reported in study divided by total farmland in county reported in 2002 USDA Census of Agriculture.
Bowker and Didychuk	Average of mean annual household WTP divided by total acres protected reported in study across five assumptions of total acres protected in three counties (23,750; 47,500; 52,280; 71,250; and 95,000 acres) and two public access assumptions (direct, on-site public access and no direct, on-site public access).
Duke and Ilvento	Average of mean annual household WTP per acre reported in study across two alternative land use assumptions (general/mixed agriculture and timberland).
Duke et al.	Average of annual aggregate household WTP per acre for a town across 36 alternative scenarios reported in study divided by number of households in a town (obtained from study authors). Scenarios varied with respect to assumptions about number of acres protected (10; 50; 100; 150; and 200 acres), agricultural land use (poultry, vegetables, forest, grain), likeliness of development (likely to be developed in next 10 years; likely to be developed in next 10–30 years) and means of protection (state preservation contract, fee-simple purchase by land trust, conservation zoning).
Geoghegan et al.	Estimated effect on parcel price of 1% change in farmland within 1,600 meters of parcel multiplied by average parcel price reported in study divided by average farmland acres within 1,600 of parcel (obtained from study authors) multiplied by 1%.
Halstead	Average of annual mean household WTP divided by size of farm protected reported in study across three assumptions of farm size (16; 22 and 24 acres) and three alternative land use assumption (low-, medium-, and high-intensity development).

Continued

Table A1. Continued

Study	WTP Per Acre Estimation Procedures
Irwin	Average of annual mean household WTP per acre reported in study across five alternative land use assumptions (timberland, low-intensity development, high-intensity development, privately-owned conservation land, publicly-owned nonmilitary land).
Johnston et al.	Hedonic: Estimated percentage change in parcel price adjacent to farmland multiplied by average parcel price per acre reported in study.
	CA: Annual mean household WTP per acre reported in study.
Johnston et al. 2007a, 2007b, 2007c	Annual aggregate household WTP per acre for state or town divided by total number of households in state or town reported in study. Note: Reported values are an average for state or town across scenarios that varied with respect to assumptions regarding agricultural land use (food or dairy farm, idle farmland), public access (walking access, hunting access, and no public access), risk of development (low, high), and means of protection (fee-simple purchase by land trust, fee-simple purchase by state, land trust preservation contract, state preservation contract).
Kashian and Skidmore	Annual mean household WTP divided by number of acres protected (6,627 acres) in city reported in study.
Krieger	Annual mean household WTP divided by number of acres protected (20,300 acres) in county reported in study.
McLeod et al.	Annual mean household WTP reported in study divided by number of acres of farmland in county (1,608,206 acres) reported in 1997 USDA Census of Agriculture.
Ozdemir	Annual mean household WTP for prime farmland, located near urban areas, used to grow vegetables/fruits/nuts divided by number of acres protected (240,000 acres) in state reported in study.
Ready and Abdalla	Average of annual mean household WTP per acre reported in study across two alternative land use assumptions (farmland with and without conservation easements).
Ready et al.	Hedonic: Annual mean household WTP per horse farm divided by average size of horse farm (130 acres) in a county reported in study.

Continued

Table A1. Continued

Study	WTP Per Acre Estimation Procedures
	CV: Annual median household WTP reported in study divided by number of horse farm acres protected in a county across four acreage assumptions (216; 4,625; 9,250; and 13,875 acres) calculated from information provided in study.
Roe et al.	Annual median household WTP per acre reported in study.
Rosenberger and Loomis	Annual mean visitor WTP divided by farmland acres in county valley near Steamboat Springs (10,000 acres) reported in study.
Rosenberger and Walsh	Average of annual mean household WTP divided by farmland acres protected reported in study across eight acreage protected scenarios; four scenarios in county valley near Steamboat Springs (2,500; 5,000; 7,500; and 10,000 acres protected) and four scenarios in other county valleys (10,000; 20,000; 30,000; and 40,000 acres protected).
Sohngen et al.	Annual mean household WTP per acre reported in study.
Swallow	Average of annual mean household WTP divided by assumed parcel size (100 acres) reported in study across two public access assumptions (public access and no public access).
Volinskiy and Bergstrom	Annual median household WTP per acre reported in study. Note: Reported value is an average across scenarios which varied with respect to assumptions regarding acres protected in state (100,000; 500,000; 1,000,000; or 2,000,000 acres); agricultural land use (grain crops, hay, pasture, timber, vegetables/fruits/nuts); location (near urban areas or in rural areas); and soil quality (prime agricultural soil, nonprime agricultural soil).
Waddington	Annual mean household WTP reported in study divided by average farmland acres in county calculated from 1987 USDA Census of Agriculture data on farmland by county.

Note: For more detailed information on estimation procedures, please contact the authors.

Endnotes

[1]Note that in contrast to standard pollution externality theory, the marginal damage curve for farmland disamenities as drawn in figure 3 implies that marginal damages of odors, noise, dust, and so on, decrease with increased acres. We have no theoretical expectation as to the shape of the marginal damage curve for farmland disamenities, so it could be drawn to show increasing marginal damages with increasing acres. The shape of the marginal damage curve does not affect the main point of figure 3, which is that farmland disamenities reduce WTP for farmland protection.

[2]As pointed out by one of the reviewers, sometimes choice experiments are not stated as a true referendum, but as a choice (e.g., "select one") from a set of multiple options.

[3]For this paper, the mid-Atlantic states of Delaware, Maryland, and Pennsylvania are grouped with the New England states in the northeastern region of the United States because all of these states face similar farmland protection and land use problems and issues.

[4]Kentucky is classified in different places as a mid-western or a southern region state. For this paper, we include Kentucky in the mid-western region of the United States since the farmland protection and land use issues this state faces seem to be most similar to mid-western states such as Ohio. However, this grouping is rather arbitrary since a good case could be made the farmland protection and land use issues in Kentucky are similar to those faced in nearby southern states such as Tennessee.

[5]For example, for benefit transfer purposes, it would be more appropriate to utilize original study estimates, which retain and show heterogeneity in value estimates with respect to important determinants of farmland amenity values discussed in this paper.

[6]In a CA analysis, it is usually assumed that the marginal utility of each attribute is constant, as is the marginal utility of income, so average and marginal WTP will be the same, and equal to minus the ratio of the coefficient on the attribute over the coefficient on cost.

[7]As pointed out by one of the reviewers, aggregation of WTP values involves additional complexities such as sample representativeness and handling of nonresponse bias.

[8]Meta-analysis attempts to statistically measure systematic relationships between reported valuation estimates for a good or service and attributes of the study that generated the estimates including valuation methods, human population and sample characteristics, and characteristics of the good or service itself. For general discussions of meta-analysis and benefit transfer, see Bergstrom and Taylor and Wilson and Hoehn. These articles appear in a special issue of *Ecological Economics*, which contains other benefit transfer articles of potential specific interest.

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