Economic Valuation of Farm and Ranch Land Amenities: What Economists Have Learned about Public Values and Preferences

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Introduction

Farmland protection became a major public policy issue in the United States during the 1970s because of what was perceived to be an alarming, accelerated loss of farmland to urban and other developed uses. Over the past 30 years, concern about farmland loss has continued, with many state and local governments across the nation implementing farmland protection programs. The Federal government also provides support for state and local farmland protection programs through conservation easement funds authorized by the 2002 Farm Bill. Since the early days, farmland protection programs have been justified in the public policy arena on the grounds of protecting market benefits (e.g., market commodity values) and nonmarket benefits (e.g., amenity values). Amenity benefits of farmland protection include public access use values (e.g., farm and ranch tours, local "pick-your-own" fruits and vegetables), use values that do not involve public access (e.g., countryside scenery viewing, prevention of undesirable development) and nonuse values (existence values of wildlife living on farm and ranch land, cultural heritage values, national food security). 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 economic valuation techniques.

The purpose of this paper is to review previous farmland amenity valuation studies and assess what these studies have found with respect to the magnitude of farmland amenity value estimates and the factors that determine the magnitude of those value estimates. The next section provides an overview of previous valuation studies, including authors, location, farmland valued, and methods employed. Following this overview, major empirical findings on the factors that influence farmland amenity values (e.g., willingness to pay) are reviewed, including attributes of the farmland preserved, distance to the farmland, relative scarcity of farmland in the region, and the type of developed use that will occur if farmland is not preserved. Per acre estimates of farmland amenities are then presented and discussed. A summary and conclusions are provided in the final section.

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Overview of Previous Studies

General background information on previous farmland amenity valuation studies is shown in Table 1. Three different valuation methods have been employed in these studies—contingent valuation (CV), the hedonic price method (HPM), and contingent choice (CC). All of these valuation methods have been thoroughly tested and validated through years of research and are widely accepted by Federal, state, and local government agencies and the US courts as reliable techniques for estimating nonmarket values such as the amenity benefits of farmland protection (Freeman, 1993; NOAA, 1993). This section provides an overview of these studies, organized by valuation method.

Contingent Valuation Studies

All of the early farmland amenity valuation studies used contingent valuation (CV) to estimate willingness-to-pay (WTP) for the amenity benefits of farmland protection at the local town or county level. Contingent valuation is a stated preference valuation technique that asks respondents their WTP in a survey setting to preserve farmland from development. The studies that have used this method 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 preserved. 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.

In some previous farmland amenity CV studies, individuals were asked to indicate their WTP to preserve farmland by "filling in the blank" with a dollar amount (open-ended CV question). In other previous farmland amenity CV studies, individuals were asked to indicate ("Yes" or "No" response) whether they would be willing to pay a given dollar amount to preserve farmland (dichotomous-choice CV question). Other previous studies asked individuals to indicate their WTP to protect farmland by marking an amount shown on a payment card listing a range of dollar amounts (payment card).

States (provinces) represented in these studies conducted in the 1980s and 1990s include Massachusetts (Halstead, 1984), South Carolina (Bergstrom et al., 1985), Alaska (Beasley et al., 1986), New Brunswick, Canada (Bowker and Didychuck, 1994), Colorado (Rosenberger and Walsh, 1997), Kentucky (Ready et al., 1997) and Illinois (Kreiger, 1999). Studies conducted in the early 2000s added Wyoming (McLeod et al., 2002) and Colorado (Bittner et al., 2003) to the list of states in which CV has been used to estimate the total economic value (use and nonuse values) of farmland protection.

Halstead (1984) valued the protection of farmland of generic quality used for general or mixed agriculture located near a respondent's home in several Massachusetts towns. He measured household WTP to protect this farmland from low-, medium-, and high-intensity development using iterative bidding CV questions. Bergstrom et al. (1985) valued the protection of prime quality farmland used for general or mixed agriculture located throughout Greenville County, South Carolina. This study measured household

WTP to protect different levels of farmland acres from high intensity development using payment card CV questions. Beasley et al. (1986) valued the protection of prime quality farmland used for general or mixed agriculture in the Matanuska-Susitna Borough, Alaska from medium and high intensity development. Household WTP was measured in this study using iterative bidding CV questions.

Protection of farmland of generic quality used for general or mixed agriculture in the Moncton regions of Kent, Albert, and Westmorland counties in New Brunswick, Canada was valued by Bowker and Didychuck (1994). They measured household WTP to protect different levels of farmland acres using payment card CV questions. Ready et al. (1997) valued the protection of different numbers and acres of horse farms and associated prime farmland in Kentucky counties. Alternative development of these horse farms in the absence of protection was not specified. Household WTP was measured in this study using single-bounded dichotomous choice CV questions. Rosenberger and Walsh (1997) valued protection of farmland of generic quality used for general or mixed agriculture from medium and high intensity development in Routt County, Colorado. In this study, household WTP to protect various levels of farmland acres was measured using payment card CV questions.

Single-bounded dichotomous choice CV questions were used by Krieger (1999) to estimate household WTP to protect farmland of generic quality used for general or mixed agriculture in a respondent's home county in Illinois. He did not specify expected alternative development in the absence of protection. McLeod et al. (2002) and Bittner et al. (2003) used open-ended CV questions to estimate household WTP to protect farmland of generic quality used for general or mixed agriculture in Sheridan County, Wyoming and Moffat County, Colorado, respectively. Expected alternative development in the absence of protection was not specified in either of these studies.

Hedonic Price Method Studies

In the late 1990s, economists started using the hedonic price method to measure the contribution of farmland amenity benefits to the selling price of residential land. The hedonic price method (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 nearby agricultural land on the price or WTP for residential land. HPM studies have been used to measure the effects of open space and scenic views on price or WTP for agricultural land.

States represented by the HPM studies include Kentucky (Ready et al., 1997), New York (Johnson et al., 2001), Maryland (Irwin, 2002), and Pennsylvania (Ready and Abdalla, 2003). These studies have used local, regional, statewide, and national data sets and the HPM to estimate farmland amenity use values reflected by the contribution of farmland to WTP for residential property. Most HPM studies estimated the impact of farmland on residential properties located in close proximity. An exception was the Bastian et al.

(2002) study, which estimated the impact of aesthetic amenities on agricultural land values in Wyoming.

Johnson et al. (2001) used a local property value data to estimate the contribution of adjacent farmland of generic quality used for generic or mixed agriculture to household WTP for residential property in Suffolk County, New York. Irwin (2002) used a regional property value data set to estimate the effects of nearby (within 400 meters) developable pastureland of generic quality on household WTP for residential property in Anne Arundel, Howard, Calvert, and Charles counties, Maryland. She measured the value of this pastureland relative to several alternative land uses including forestland, low- and high-intensity development, privately owned conservation land and publicly owned nonmilitary land. Ready and Abdalla (2003) used a county-level property value data set to measure the effects of proximity to nearby farmland (within 1,600 meters) used for general or mixed agriculture (positive amenities) and farmland used for larger-scale livestock and mushroom production operations (negative amenities) on household WTP for residential property in Berks County, Pennsylvania. In this study, farmland values were measured relative to alternative land uses including forestland, privately owned conservation land and commercial, residential, or industrial development.

In contrast to the studies listed above, which measure the impact of a specific parcel of farmland on residential property values within several hundred meters of the parcel, Ready et al. (1997) used the HPM to estimate the county-wide amenity value of farmland. They estimated a two-market model that measured differences both in house prices and prevailing wage rates, and used their model results to estimate household WTP to preserve horse farms in Kentucky.

Contingent Choice Studies

In the early 2000s, economists' attention turned more towards using contingent choice (CC) to analyze the relationships between WTP for farmland protection and specific farm and ranch factors that influence WTP including attributes of the land itself and contextual factors such as geographic location. Contingent choice is a stated preference valuation technique that asks individuals in a survey setting to rank different farmland preservation "packages". These different packages vary in the attributes of farmland itself, contextual factors, and price or cost of the package. Individual rankings combined with data on farmland attributes, contextual factors, and price or cost were then statistically analyzed in previous studies to estimate WTP for farmland preservation and the effects of farmland attributes and contextual factors on estimated WTP.

States represented in these studies include New York (Johnson et al., 2001), Delaware (Duke et al., 2002), Rhode Island (Swallow, 2002), and Georgia, Maine, and Ohio (Ozdemir, 2003; Ozdemir et al., 2004). Johnson et al. (2001) measured household WTP to protect adjacent farmland of generic quality use for general or mixed agriculture in Suffolk County, New York. They did not specify alternative development in absence of protection. Duke et al. (2002) valued protection of farmland throughout Delaware of generic quality used for cropland and timberland. Alternative development of farmland

in the absence of protection was not specified. Swallow (2002) measured household WTP to protect farmland of generic quality used for general agriculture and dairy in the local town area of Richmond, Rhode Island. He did not specify alternative development in the absence of protection. A multi-state USDA National Research Initiative-funded contingent choice study examined preferences and value for farmland amenities for the US nationally and in the individual states of Georgia, Ohio and Maine (Ahearn et al., 2001; Boyle et al., 2001; Ozdemir et al., 2004). As part of this study, Ozdemir (2003) measured household WTP to protect prime farmland used to produce human food crops located near urban areas from high-intensity development in Maine.

Determinants of Estimated Farmland Amenity Values

All of the CV, HPM, and CC studies provide insight into factors that influence public preferences and values for farmland amenities as reflected by WTP for farm and ranch land preservation. The effects of farmland attributes, surrounding landscape, and alternative use on WTP for farm and ranch land preservation are discussed in this section and illustrated in Figures 1–9. All of the results discussed in this section are based on intra-study (or within study) comparisons of WTP estimates rather than inter-study (or across study) comparisons.

Farmland Size and Scarcity Attributes

Economic theory suggests that the total value (total WTP) for farmland protection should increase with the size or quantity of acres protected (Figure 1). Several CV studies (Bergstrom et al., 1985; Bowker and Didychuck, 1995; Ready et al., 1997; Rosenberger and Walsh, 1997) and CC studies (Duke et al., 2002; Johnson et al., 2001; Ozdemir, 2003; Ozdemir et al., 2004) provide strong empirical evidence of this basic relationship, i.e., that WTP to preserve more acreage is larger than WTP to preserve less acreage.

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 (Figure 1). This generates a downward sloping marginal value (marginal WTP) curve for farmland acres protected (Figure 2). Several CV studies (Bergstrom et al., 1985; Bowker and Didychuck, 1995; Rosenberger and Walsh, 1997) provide strong evidence that marginal WTP for farmland protection in a given location does indeed decrease as acreage preserved increases. Also consistent with theoretical expectations, several CV studies (Bergstrom et al., 1985; Bowker and Didychuck, 1995; Rosenberger and Walsh, 1997), CC studies (Johnson et al., 2001; Duke et al., 2002), and HPM studies (Ready et al., 1997) provide strong evidence that WTP for small or incremental changes in farmland acres protected is higher in areas where farmland is scarcer, as illustrated in Figure 2.

Alternative Land Use Attribute

According to economic theory, values or WTP for a given policy change is a function of the pre- and post-policy levels of individual utility determined by the pre- and post-policy

states of the world. Thus, individual values or WTP for a given level of farmland protection are a function of an individual's utility before and after the farmland protection policy is implemented, including the amount and nature of farmland protected in the post-policy world compared to expected land use in the pre-policy world, such as the expected alternative land use without the farmland protection policy. We refer to the difference between values or WTP for land in agriculture compared to some alternative use such as commercial development as net values or net WTP for farmland protection.

The derivation of net marginal WTP (net MWTP) for farmland protection is illustrated in Figure 3. The horizontal axis in Figure 3 measures the proportion of land in the community in less-developed uses such as farmland, which is also equal to 1 minus the proportion in developed uses. In areas where farmland is relatively scarce, marginal WTP for farmland (MWTPFarmland) is high. As acres of farmland protected increases (left to right on the horizontal axis in Figure 3) MWTP to protect additional farmland decreases, as was shown in Figure 2.

Higher amounts of farmland imply less developed land. In areas where developed land is scarce (close to the right hand vertical axis), marginal WTP for additional developed land (MWTPDeveloped) could well be positive, reflecting the desire by households for employment and shopping opportunities. As the amount of developed land increases (moving from right to left on the horizontal axis in Figure 3) however, MWTP for additional developed land falls. The negative portion of the MWTPDeveloped curve in Figure 3 would be associated with perceived disamenities from over-development (e.g., congestion, pollution).

In a particular area, the difference between MWTPFarmland and MWTPDeveloped gives an individual's net marginal WTP for farmland protection (Net MWTPFarmland) illustrated by the dashed curve in Figure 3. At the point where MWTPFarmland and MWTPDeveloped (Q^2 acres of farmland protected in Figure 3), Net MWTPFarmland is equal to zero. At the margin where MWTPDeveloped becomes zero (Q^1 acres of farmland protected in Figure 3), Net MWTPFarmland equals MWTPFarmland.

Figure 4 illustrates how alternative development of different intensities may affect an individual's net marginal WTP for farmland protection. From the perspective of an individual household, conventional high-density development (e.g., strip malls, big-box stores) is typically considered less attractive as a neighbor than low-density development (e.g., large lot residential development, cluster-type or conservation subdivisions). In Figure 4, the curve labeled MWTPHigh-Intensity Development represents an individual's marginal value or WTP for land used for high-density development such as shopping centers and quarter-acre or less lot residential development. The curve labeled MWTPLow-Intensity Development represents an individual's marginal value or WTP for land used for low-density development such as cluster-type and large-lot residential development that preserves open and green space.

As illustrated in Figure 4, marginal value or WTP for low-intensity development land lies above marginal value or WTP for high-density development land, indicating that

individuals prefer more of this type of development. Consequently, net marginal WTP for farmland protection when the alternative land use is high-intensity development ($Net_MWTPFarmland^{LD}$) is expected theoretically to be lower than net marginal WTP for farmland protection when the alternative land use is low-intensity development ($Net_MWTPFarmland^{HD}$). Also, 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 as illustrated in Figure 5. Several previous CV studies (Halstead, 1984; Beasley et al., 1986; Rosenberger and Walsh, 1997), HPM studies (Irwin, 2002; Ready and Abdalla, 2003), and CC studies (Ozdemir, 2003; Ozdemir et al., 2004) provide strong empirical evidence that the intensity of alternative development conversion influences WTP for farmland protection in a positive manner.

Agricultural Land Use and Quality Attributes

Previous quantitative and qualitative studies of public preferences and attitudes towards farmland protection indicate that along with providing open and green space, a clear and strong public motivation for farmland protection is to preserve the agrarian nature of a community, including cultural values, heritage values, rural lifestyles, and access to fresh, local food supplies, which are all dependent on the continued existence of viable farms and farming operations (Bergstrom et al., 1985; Furuseth, 1987; Bowker and Didychuck, 1994; Duke and Hyde, 2002; Kline and Wichelns, 1996). 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 contingent choice study (Ozdemir, 2003; Ozdemir et al., 2004) provides strong evidence that WTP increases with the agricultural productive quality of farmland as illustrated in Figure 6. The productivity of farmland, as measured for example by the presence of prime soils, contributes to the economic viability of farms and farming in a community. Previous qualitative studies suggest that people who support farmland protection enjoy seeing the land support flourishing plant growth (Ahearn et al., 2001; Boyle et al., 2001; Paterson et al., 2005). This enjoyment from seeing healthy things grow may also help to explain why so many people like backyard gardening, visiting natural areas and protecting prime agricultural soils and lands.

The value that people receive from seeing healthy things grow combined with the value they place on preserving agrarian culture, heritage, 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 as illustrated by Figure 7. Previous HPM (Irwin, 2002) and contingent choice studies (Ozdemir, 2003; Ozdemir et al., 2004; Swallow, 2002) provide some empirical evidence of relatively higher preferences and WTP for preserving cropland as compared to timberland and pastureland. These results, however, are more preliminary in nature and are likely sensitive to the specific types of cropland, timberland and pastureland valued. For example, negative preferences for clear-cut timberland and unkept, apparently abandoned fields were observed in the Boyle et al. (2001) 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).

Although 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, evidence from recent CC (Johnson et al., 2001) and HPM (Ready and Abdalla, 2003) studies suggest that farmland that is too actively or intensively farmed may result in net negative values to the general public. For example, suppose a particular tract of land is used to grow crops and raise chickens with a number of high-intensive poultry houses. As illustrated in Figure 8, the cropland on this tract of land may generate positive amenity values (area A) while the poultry houses generate negative amenity values (area B) that swamp the positive values resulting in net negative amenity values from this tract of land.

Human Use Attributes

People can derive enjoyment from farmland amenities with different levels of access to or use of the land itself. Direct public use gives people the opportunity or right to encroach upon the land for various amenity-related purposes 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, bird-watching). Aesthetic use gives people the opportunity or right to view, paint or photograph 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 public use or aesthetic use. 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. Another value from farmland protection that does not depend on direct or visual access to the land itself is the growth control function of farmland protection (e.g., less traffic congestion).

Previous CV (Bowker and Didychuck, 1995) and CC (Swallow, 2002) studies provide limited evidence that WTP for farmland protection increases with higher levels of public access. These results are consistent with theoretical expectations since increasing public access to farmland increases opportunities for aesthetic use and direct public use benefits. Previous studies, however, have not addressed potential conflicts between different use and nonuse values of farmland protection. For example, excessive direct public use of a tract of farmland for agritourism activities may reduce some aesthetic use and nonuse values of that land.

Other Attributes

Previous studies provide mixed and inconclusive results with respect to the effects of distance from a household residence to farmland. Johnston et al. (2001), in a CC study, 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. Ready and Abdalla (2003) found in

a HPM study that eased farmland located within 400 meters of a house has a less positive effect on house prices than forested land, but that outside of 400 meters the ordering is reversed. The authors of these two studies speculated that these differences are driven by localized disamenities associated with active farming (e.g., noise, odors, dust). These studies suggest that households receive high amenity values from farmland in their community, but that they may prefer not to be located immediately adjacent to that land.

Similarly, some CV studies (Bowker and Didychuck, 1994; Halstead, 1984) 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 amenity and disamenity effects associated with farmland located relative close to households (e.g., adjacent or within two miles). CV and CC studies capture more geographically dispersed amenity and disamenity effects such as public aesthetic use and nonuse values. Because of the difficulty in controlling for the 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 impacts preferences and WTP for farmland protection.

Another farmland attribute that may influence values (WTP) for farmland protection is land tenure or ownership. Previous CC (Swallow, 2002) and HPM (Ready and Abdalla, 2003) 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 (2003) also found evidence in their study area which suggests that privately owned eased farmland is less valuable than privately owned uneased farmland. In contrast, HPM results reported by Irwin (2002) suggest that in her study area 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.

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 recent CC study (Swallow, 2002) 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 or quality of the land.

Per Acre Value Comparisons

Estimated values or WTP per acre for farmland amenities adjusted to 2003 dollars are summarized in Table 2. Mean annual household WTP estimated in previous CV studies ranges from $.0002 per acre (South Carolina) to $.0697 per acre (Kentucky) with a mean across all studies of $.0142 per acre. To date, total economic values for farmland protection have been estimated in previous CC studies for the states of Maine, New York,

and Rhode Island and range from \$0.0006 per acre (Maine) to \$0.4392 per acre (Rhode Island), with a mean across all studies of \$0.1739.

Two HPM studies have estimated models from which per acre farmland amenity values can be estimated. Using the hedonic regression coefficients from Irwin (2002), and the mean residential price from her study area, a conversion of one acre of uneased cropland to low density development would reduce residential property values within 400 meters by \$1,717.87 on average (in 2003 dollars). A one acre conversion to commercial or industrial use would reduce nearby property values by \$5,018.49. Using the regression coefficients from Ready and Abdalla (2003) and the average house price in their study area, a conversion of one acre of uneased cropland to lower-density housing would decrease nearby house prices by \$35.45 on average, an estimate that is not statistically different from zero. Conversion to industrial land would decrease nearby house prices by \$365.80. Undeveloped land and open space is much more scarce in the Irwin study site than in the Ready and Abdalla study site. This difference in scarcity may explain some of the difference in estimates marginal amenity values.

Conceptually, WTP values reported in Table 2 generated from CV and CC 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 Table 2 by dividing total WTP by the number of farmland acres protected. Previous CC 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 Table 1 by dividing total WTP by the number of farmland acres protected. Hence, the CV and CC values per acre reported in Table 2 are average values per acre. 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 Table 2 are marginal values per acre.

Another difference between the stated preference (CV and CC) and revealed preference (HPM) value estimates reported in Table 2 relates to the scope and spread of economic values captured in the value estimates. With the exception of the study by Ready et al., (1997), the HPM revealed preference data sets and resulting value estimates only reflect use values accruing to private land owners who live relatively close to farmland. These are the households who would be expected to hold the highest amenity values for preservation of the farmland. Previous CC and CV 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 CC values reported in Table 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 Table 2 are quite consistent.

The low, high, and average per acre values estimated in previous CV and CC studies are very close. The Swallow (2002) high value estimate of $0.4392 per acre is most likely due to the fact that this is an average value estimate derived from a relatively small amount of farmland protected. In contrast, the Bergstrom et al. (1985) low value estimate of $.0002 per acre is most likely due to the fact that it is an average value estimate derived from a relatively large amount of farmland protected. Even though not directly comparable to the CV and CC estimates because it is a marginal rather an average value, the Ready et al. (1997) county-wide HPM study generated an estimated amenity value of $.0047 per acre, close to the CC and CV low value estimates.

Do the farmland amenity value estimates reported in Table 2 display systematic variation? This question would perhaps best be answered through a quantitative meta-analysis of farmland amenity value estimates. The authors of this paper plan to attempt such a meta-analysis as a next step in the overall assessment of previous farmland amenity valuation studies. The ultimate success of this type of meta-analysis, however, is questionable because of data constraints. For example, if we graph total WTP reported in previous CV studies against total acres valued (Figure 10) positive relationships are observed within studies. However, a clear trend between studies is more difficult to observe because of between-study variability.

Two HPM studies showed that farmland can generate disamenities. Johnston et al. (2001) found that in Suffolk County, New York, land adjacent to farmland was worth $34,700 less per acre than land not located adjacent to farmland. Ready and Abdalla (2003) found that houses located within one mile of a large-scale animal production facility were worth, on average, $1,857 less than similar houses not located near such farms. These results are consistent with studies measuring negative effects of CAFOs (confined animal feeding operations) on property values (Herriges et al., 2003; Palmquist et al., 1997).

Finally, implications of the units of measurement for the values reported in Table 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 acre per household estimates reported in Table 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 Table 2. For example, Bergstrom et al. (1985) measured the value of amenities for prime farmland in Greenville County, South Carolina. Hence, it would be appropriate to aggregate the farmland amenity value estimate of $.0002 per acre over the total number of acres of prime farmland in Greenville County, say as defined by the U.S.D.A. using soil quality. Ready et al. (1997) measured the value of farmland amenities for a special and unique type of farmland, Kentucky horse farms. Thus, it would appropriate to aggregate their estimate of $.0697 per acre 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 Table 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. On-site use values with public access, such as on-site recreation available to the general public, would apply to a larger number of households. Off-site aesthetic values such as scenic driving and nonuse values such as existence values would apply to the largest number of households since these values are the most spatially dispersed and have "public good" characteristics of nonrivalry and nonexclusiveness.

The Bergstrom et al. (1985) estimates reported in Table 2 represent the total economic value (use and nonuse values) of farmland amenities in Greenville County. Thus, it would be appropriate to aggregate the $.0002 per acre per household estimate over the total number of households in the county. In contrast, the Irwin (2002) estimate of $5,018 per acre per household reported in Table 2 measures use values with private access only and would apply to a relatively small number of households adjacent to or located very close to farmland.

Summary and Conclusions

The results of previous farmland amenity valuation studies provide relatively strong evidence that preferences and values are sensitive to size in acreage (+), regional farmland scarcity (+), alternative development intensity (+), public accessibility (+), and productivity (+). There is some evidence that preferences and values are also sensitive to human food plants (+), active farming (+), and intensive agriculture (-). Previous studies provide limited and inconclusive evidence with respect to the effects of distance from residence to farmland, the relative value of pastureland and timberland, the relative value of unique landscape features such as scenic quality, ecosystem services, buildings, and specialty commodities, the effects of alternative property right structures (e.g., land ownership) and the effects of non-farmland amenity substitutes (e.g., public parks).

We conclude that although much has been learned over the past 20 years about farmland amenity values, much more qualitative and quantitative research is needed to better understand the effects of specific farmland attributes on preferences and values for farmland amenity protection. The assessment of previous valuation studies presented in this paper indicates numerous data and knowledge gaps that need to be filled. More research and data are needed to accurately estimate average and marginal values of farmland amenities. Previous studies clearly show that acreage protected is an important factor influencing WTP for farmland protection. Future studies should therefore include acreage protected as a standard design factor. Given the results of previous studies showing the strong influence of alternative land use on WTP for farmland protection, this factor should also be included in future studies as a standard design factor. More research and data are needed to better assess the full range of alternative land uses on WTP for farmland amenities (e.g., different types of high density development including "Smart Growth" development).

More research and data are also needed to better assess how WTP for farmland amenities is influenced by 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 "flourishing" plant growth and green space.

The relative importance of use vs. nonuse values of farmland amenities is also neither well documented nor well understood from previous studies. More research and data in particular are needed to assess how important public access is to the general public's WTP for farmland preservation. From the perspective of private landowners and farmland preservation program managers, providing direct, on-site public access to preserved land may be viewed as undesirable or unacceptable, even if highly valued by the general public who may be paying for preservation. The effects of different types of nonuse motivations and values (e.g., environmental values, growth control effects) on WTP for farmland protection and amenities are also not well understood.

Distance from an individual's residence to farmland is a potentially important determinant of WTP for farmland amenities. However, results of previous studies examining distance effects are mixed and sometimes contradictory. Carefully designed and controlled studies are needed to accurately model and separate out distance effects from other confounding factors that influence WTP for farmland amenities. Factors such as land ownership and tenure, ecological services, and scenic quality also need to be better documented and understood through future studies that explicitly include these items as design factors.

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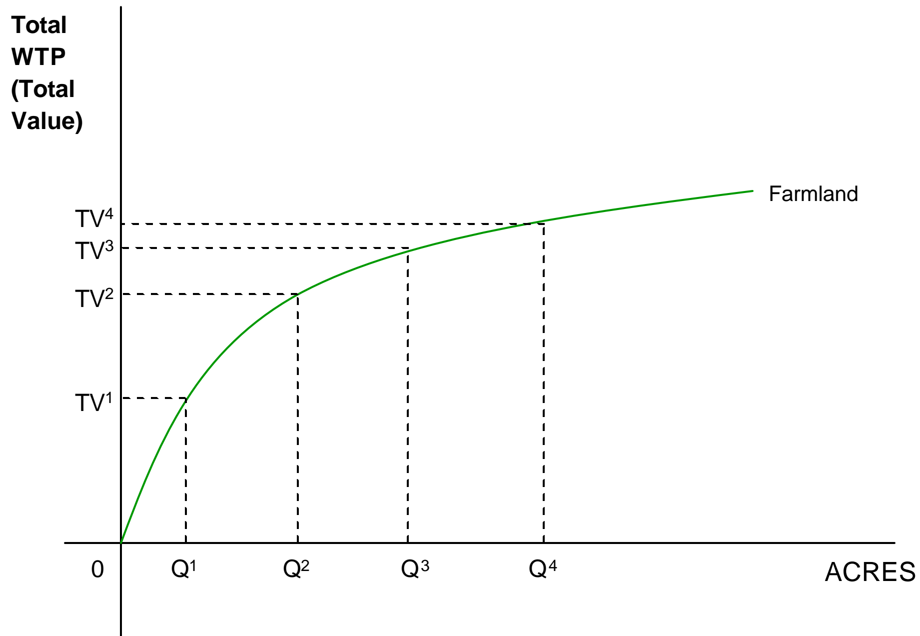
Table 1. Summary of Previous Farmland Amenity Valuation Studies

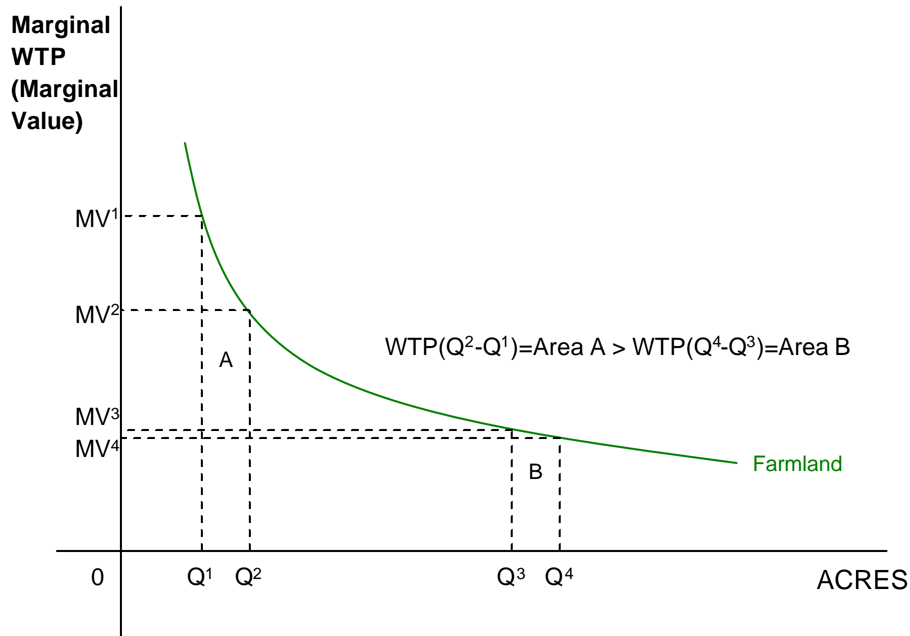
Study	Farmland Valued	Method
Bastian, *et al*, 2002.	Contribution of scenic views to price per acre of remote agricultural land in Wyoming	HPM
Beasley, *et al*, 1986.	Old Colony and Homestead farmland in the Matanuska-Susitna Borough, Alaska	CV
Bergstrom, *et al*, 1985.	Farmland in Greenville County, South Carolina	CV
Bittner, *et al*, 2003.	Farmland and ranchland in Moffat County, Colorado	CV
Bowker and Didychuk, 1994.	Farmland in the Moncton region of Kent, Albert and Westmorland Counties, New Brunswick, Canada	CV
Duke, *et al*, 2002.	Farms in Delaware	CC
Irwin, 2002.	Value of developable pastureland relative to other surrounding land uses on residential property values in multiple Maryland counties	HPM
Johnson, *et al*, 2001.	Contribution of adjacent farmland to per acre sales price in Suffolk County, Long Island, New York	HPM/CC
Halstead, 1984.	Farmland near a respondent's home in Towns of East Longmeadow, Greenfield and Deerfield, Massachussetts	CV
Kreiger, 1999.	Farmland in home county; Kane, McHenry or DeKalb, Illinois	CV
Mcleod, *et al*, 2002.	Farmland and ranchland in Sheridan County, Wyoming	CV
Oxdemir, 2003.	Farmland in Maine	CC
Ready, *et al*, 1997.	Number of horse farms in Kentucky counties	HPM/CV
Rosenberger and Walsh, 1997.	Farmland and ranchland in Routt County, Colorado	CV
Swallow, 2002.	Farms in Town of Richmond, Rhode Island	CC
Ready and Abdalla, 2003	Farmland in Berks County, Pennsylvania	HPM

Figure 1. Size or Scope Attribute



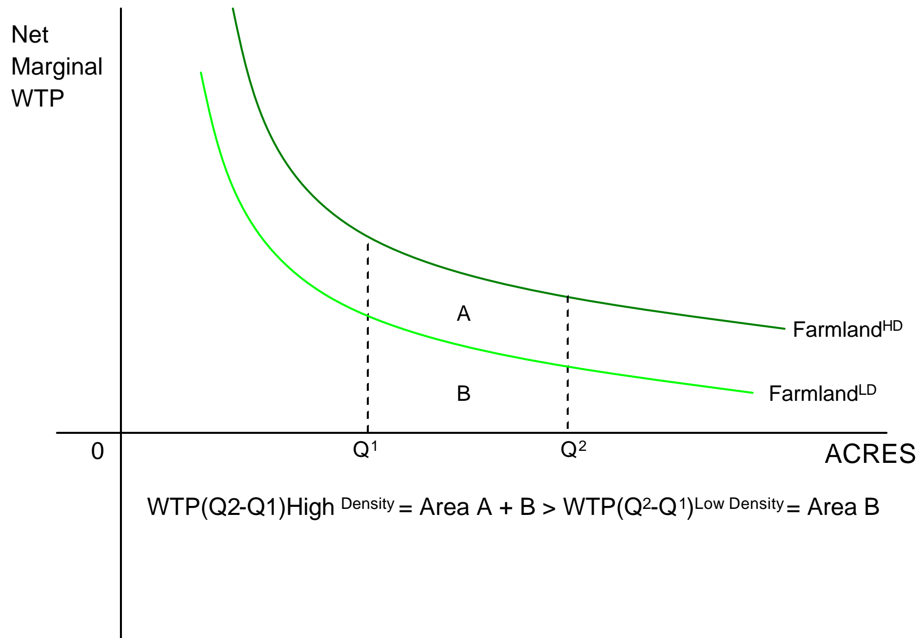
Sources: Bergstrom et al., 1985, *CV*; Bowker and Didychuk, 1995, *CV*; Rosenberger and Walsh, 1997, *CV*; Ready et al., 1997, *CV*; Johnston et al., 2001, *CC*; Duke et al., 2002, *CC*; Ozdemir, 2003, *CC;* Ozdemir et al., 2004, *CC*

Figure 2. Scarcity Attribute



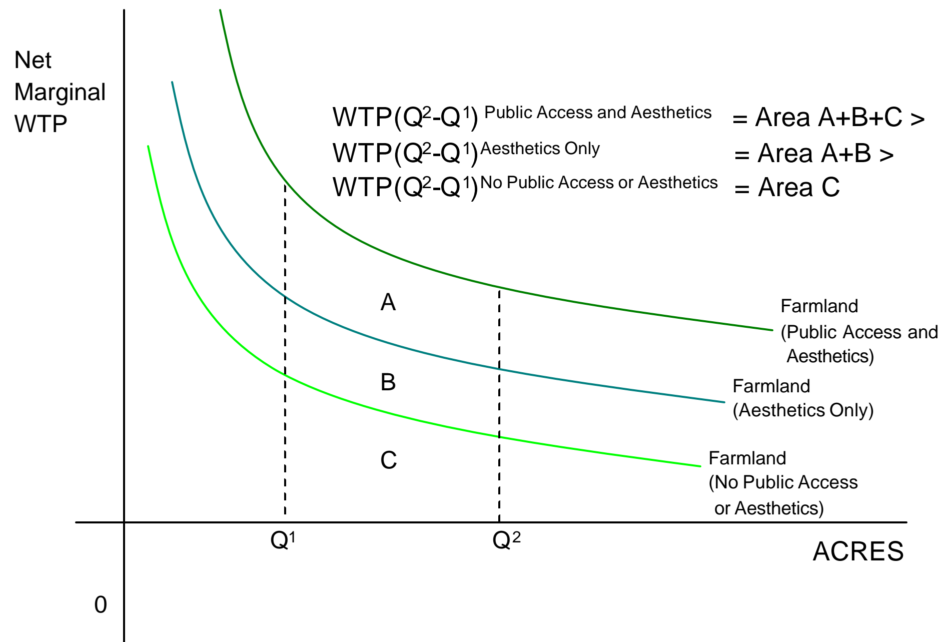
Sources: Bergstrom et al.,1985, *CV*; Bowker and Didychuk, 1995, *CV*; Rosenberger and Walsh, 1997, *CV*; Ready et al., 1997, *HPM;* Johnston et al., 2001, *CC*; Duke et al., 2002, *CC*

Figure 3. Alternative Land Use Attribute



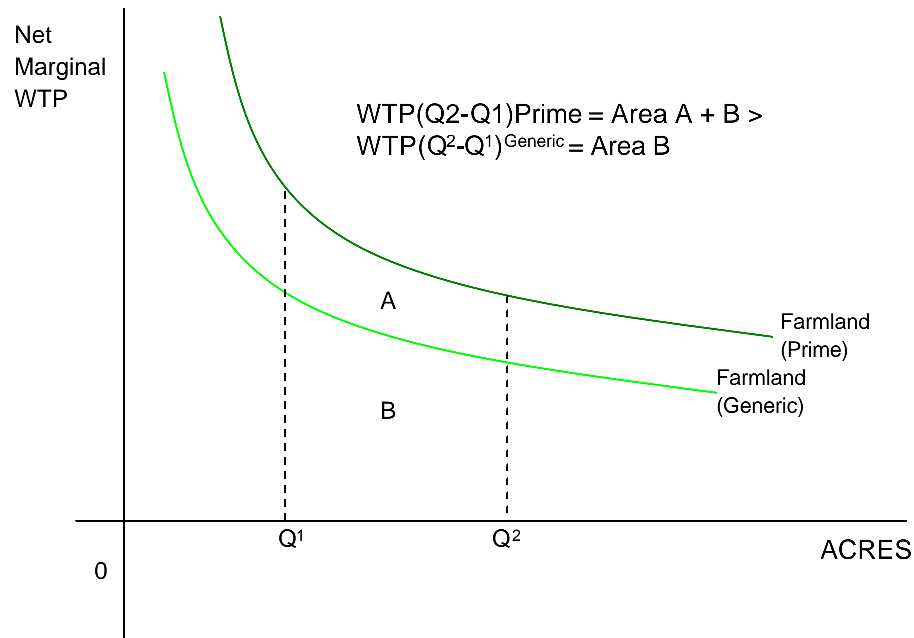
Sources: Halstead, 1984, *CV*; Beasley et al., 1968, *CV*; Rosenberger and Walsh, 1997, *CV*; Irwin, 2002, *HPM*; Ozdemir, 2003, *CC*; Ozdemir et al., 2004, *CC*; Ready and Abdalla, 2003; *HPM*

Figure 4. Human Use Attribute



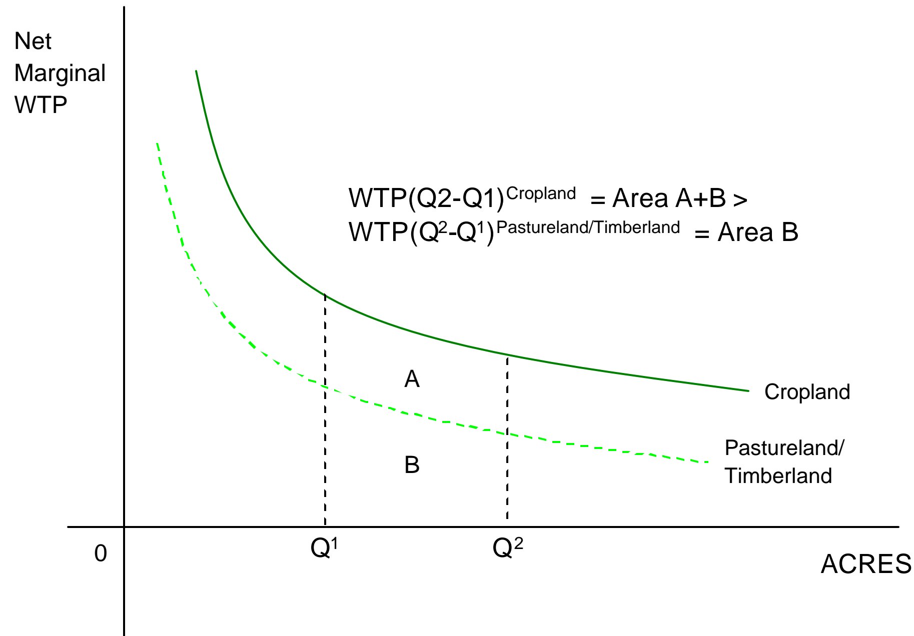
Sources: Bowker and Didychuck, 1995, *CV;* Swallow, 2002, *CC*

Figure 5. Productivity Quality Attribute



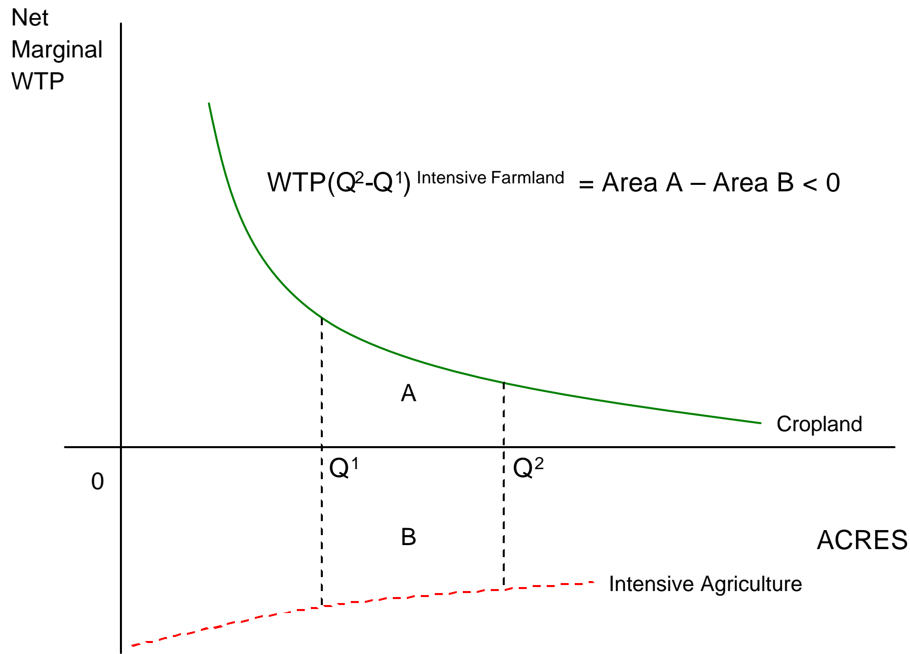
Sources: Ozdemir, 2003, *CC*; Ozdemir et al*.,* 2004, *CC*

Figure 6: Agricultural Use Attribute



Sources: Irwin, 2002, *HPM*; Swallow, 2002, CC; Ozdemir, 2003, *CC*; Ozdemir et al., 2004, *CC*

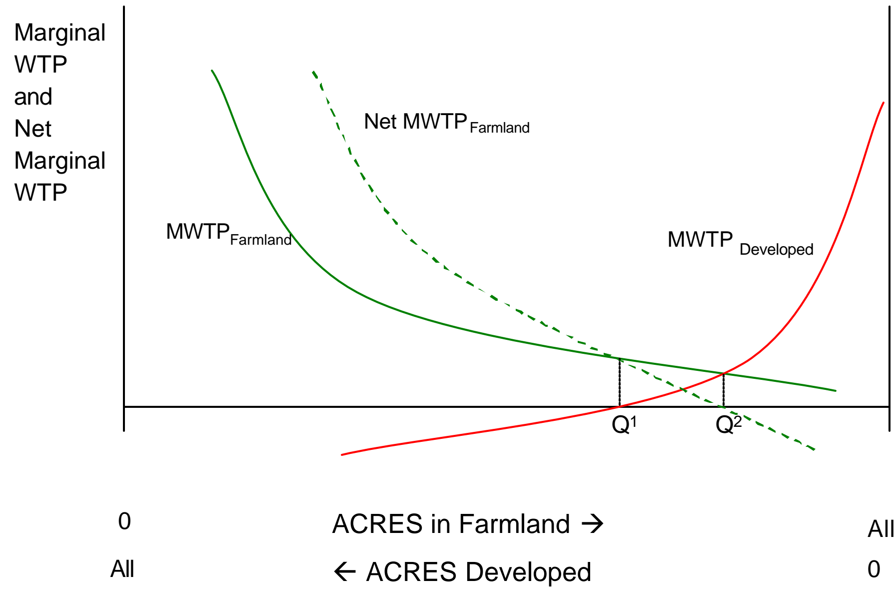
Figure 7: Agricultural Use Attribute: Intensive Agriculture



Source: Ready and Abdalla, 2003, *HPM*; Johnston et al., 2001, *CC*

Figure 8. Allocation Between Competing Uses

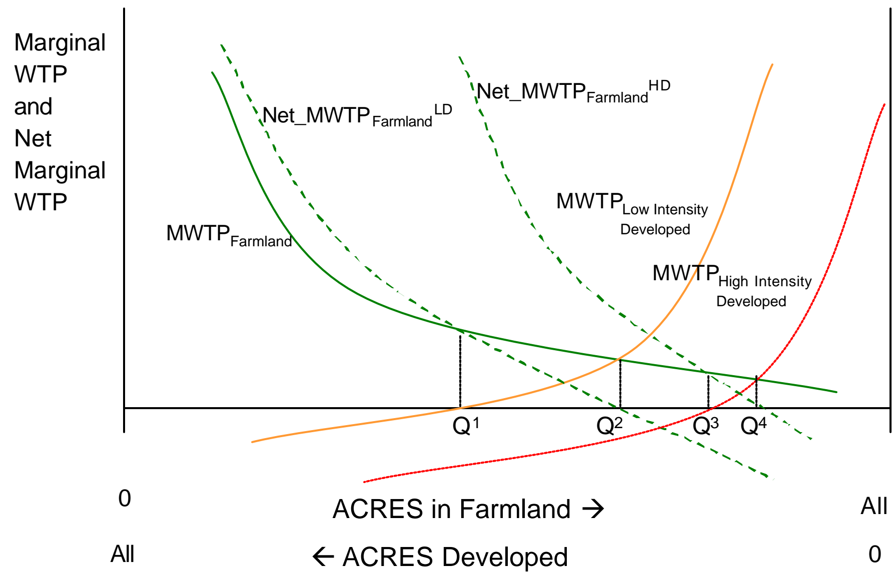
- Net WTP for farmland = MWTP Farmland - MWTP Developed



Source: Compiled by the authors

Figure 9. Allocation Between Competing Uses

- Net WTP for farmland = MWTPFarmland – MWTPDeveloped



Source: Compiled by the authors

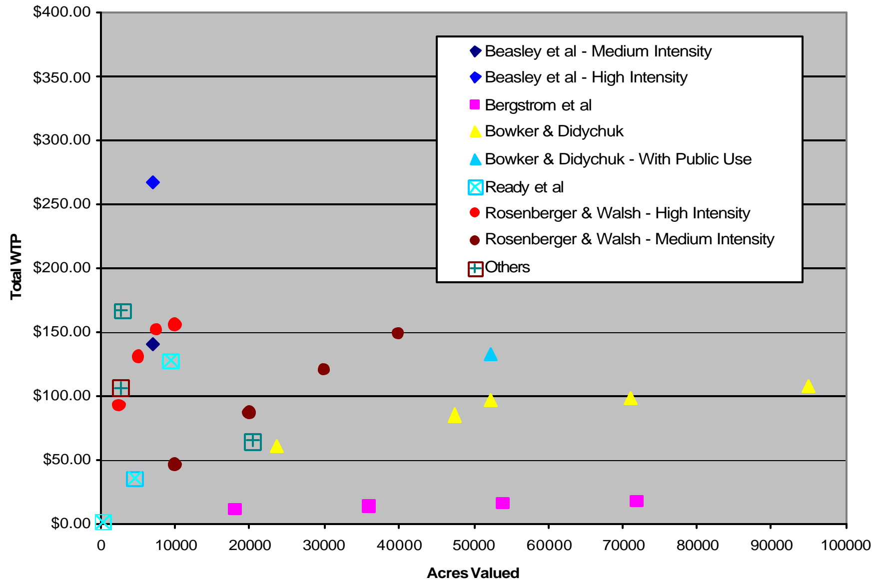
Table 2. Per Acre Value Comparasons*

	Low	Average	High
Contingent Valuation (N=27)	$.0002 (Bergstrom *et al*, 1985)	$.0142	$.0697 (Ready *et al*, 1997)
Contingent Choice (N=6)	$.0006 (Ozdemir,2003)	$.1739	$.4392 (Swallow,2002)
Hedonic Price with Negatives (N=7)	-$3,670.77 (Irwin, 2002)	-$3,905.71	$4,939.50 (Irwin, 2002)
Hedonic Price w/o Negatives (n=5)	$.0047 (Ready *et al*, 1997)	$1.645.04	$4,939.50 (Irwin, 2002)

*2003 Dollars

Source: Compiled by the authors

Figure 10: Total WTP for Farmland Amenities by Acres Protected



Source: Compiled by the authors