Estimation of the Nonmarket Benefits of Agricultural Land Retention in Eastern Canada

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We assess the nonmarket value for retention of farmland in the Moncton area of New Brunswick. We examine a number of factors explaining household external values for farmland preservation and expand on previous work by Beasley et al., Bergstrom et al., and Halstead. Our findings indicate that the marginal external benefit of preserving farmland in general in this region is small compared to the market price and that spatial embedding is not automatic in contingent valuation studies.

The sagacious utilization and management of the land resource is essential to realizing the social, political, and economic goals of a society (Environment Canada). Since the seventies, there has been considerable concern about the conversion of farmland and availability of open space in the United States and Canada (Collins; Conklin and Lesher). Much of the interest centers around the irreversible conversion of agricultural land along suburban or urban fringes to housing subdivisions and commercial developments.

Public concern for retention of land loss is evidenced by established public and private programs in a number of states and provinces, including Ontario, British Columbia, and a number of states which provide for greenways or corridors of unorganized open space. Such programs can be expensive to establish and administer (Beasley et al.).

While estimating the costs of establishing these programs in populated areas is relatively simple, valuing the extra-market benefits is more problematic. Private land markets are usually efficient in allocating land according to marginal values in various productive uses leading to traded commodities such as timber, crops, and grazing rights, along with housing and urban development. However, when public goods aspects of land are concerned, market allocations may deviate substantially from social optima (Crosson, Gardner).

Gardner (p. 1028) lists a number of social benefits provided by retaining agricultural land including food and fiber provision, local economic benefits derived from a viable agricultural sector, open space and other environmental amenities, and more orderly and fiscally sound urban development. He goes on however, to make a strong case that the market is most likely dealing efficiently with all of the above benefits except open space and associated environmental amenities.

The benefits of agricultural land retention in the face of conversion to urban and other uses have been assessed by a number of researchers (Beasley et al.; Bergstrom et al.; and Halstead). However, no empirical studies of the external value of agricultural land retention have been done for regions in Canada. In this paper we examine the nonmarket value for retention of farmland in the Moncton area of New Brunswick. This area, including Kent, Albert and Westmorland counties is one of three major population centers in the Province. Additionally, it is considered to be among the top ten areas in Canada for economic expansion and development. In recent years, this area has experienced rapid urban and industrial development resulting in a loss of approximately 397,000 acres of farmland from a base of 492,300 acres in 1961.

The primary objective of this paper is to measure the external benefits of farmland preservation in a subregion of Eastern Canada. Secondary objectives include examining factors explaining individual household external benefits and expanding on the previous works by Halstead; Bergstrom et

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al.; and Beasley et al. In particular, we (a) provide estimates and corresponding confidence intervals for regional and household average and marginal benefits for preserving agricultural land, (b) provide evidence that contingent valuation studies are not necessarily plagued by embedding, and (c) describe and employ procedures immune to potential dependency problems in the observed dependent variables found in earlier works.

Methods and Data

Nonmarket methodologies have evolved as an alternative approach to obtain money-metric estimates of benefits (costs) to households and individuals of natural resource related programs or policy changes when markets are incomplete. Young and Allen provide a theoretical and conceptual discussion specific to country-side amenity valuation and the use of nonmarket techniques. They conclude that behavior-based valuation approaches such as travel cost and hedonic pricing methods are inferior to contingent valuation which is an intended behavior approach. They argue that travel cost will likely understate amenity values when nonuse or passive use value is significant. Further, they argue that no obvious set of market goods exists which would contain the necessary information to apply the hedonic pricing method in a way in which nonuse value would be captured. They conclude that if benefits are limited to recreation, either travel cost or hedonic pricing would be appropriate. However, for environmental change "outside historical experience" or where there are "considerable indirect benefits," they advocate the use of contingent valuation. Adamowicz, similarly concludes that while appealing, behavioral approaches are generally limited to applications seeking use values.

Theoretically, values elicited via CVM approximate Hicksian welfare measures and may be represented in a number of ways consistent with the utility maximization problem in microeconomics (Mitchell and Carson, p. 26). In an indirect utility framework, *WTP* or equivalent surplus may be represented for the farmland retention case as, $V_0(Y_0\text{-}WTP, AQ_0, P_0) = V_0(Y_0, AQ_1, P_0)$, where Y is income, AQ_0 is a state where a given amount of farmland is preserved in the region, AQ_1 is a state with a reduced amount of farmland resulting from no guarantee that any farmland would be retained, and P is a price vector for various market goods.

Despite over 1100 studies in published sources (Carson et al.), and considerable evolution since the sixties, debate continues among practitioners as to the best structure within CVM for the data collection method, elicitation approach, hypothetical market, payment vehicle, and questionnaire design. Such debate suggests the difficulty of defining an objective and standard set of CVM operating procedures. Subsequent to our study, the National Oceanographic and Atmospheric Administration (NOAA) convened a panel of distinguished economists to assess CVM as an environmental damage assessment tool, particularly for measuring passive-use values potentially admissible in court (Arrow et al.). In general, they concluded that if conservatively applied, CVM could be used as a starting point for resolving legal disputes. Overall, their recommended procedures follow those discussed in Mitchell and Carson.

Previous studies of agricultural land retention valuation have employed CVM in different ways. Beasley et al. and Halstead used variations of the iterative bidding approach with a short text and pictures to value the avoidance of alternative land development scenarios in south-central Alaska and western Massachusetts, respectively. Bergstrom et al. used a mail-back open-ended approach to measure the environmental amenity benefits of agricultural land in Greenville County, South Carolina, partitioning their sample across payment vehicles and providing a treatment for different information levels.[1] A noteworthy point is that in each of the above studies every respondent bid on all of the considered scenarios.

We employ a version of the payment card contingent valuation method (Mitchell and Carson, Cameron and Huppert) to elicit household willingness-to-pay to preserve given units of the Moncton area farmland base. A number of recent studies have used this approach to value other environmental goods (Cameron and Huppert; Reiling et al.; Roberts et al.; Bowker and MacDonald). Although generally recommended by the NOAA panel, we chose not to use the dichotomous choice approach for various reasons including the necessity of larger samples (Cameron and James) and the problem of yea-saying (Mitchell and Carson).

[1] It is not clear to us exactly what Bergstrom et al. did regarding information. On p. 143 they discuss separate groups receiving different bits of information with a binary variable in each payment vehicle model to capture the effect of those receiving additional information. More information led to significantly lower bids, however there appears to be a dependency problem since respondents first bid on a package containing "all the benefits" and then on a reduced package with only environmental amenities. Under such conditions, it is not surprising that the additional information led to lower bids.

Moreover, recent empirical work by Holmes and Kramer indicates that dichotomous choice may be biased in certain circumstances from lexicographic preferences. Budgetary constraints and the lack of an experienced bid elicitor precluded our use of iterative bidding.

The contingent market mechanism involved annual payment into a tax-exempt trust with each respondent bidding on one of four acreage retention quantities (see Appendix). Halstead felt that his use of a tax mechanism may have caused an excessive number of zero bids. However, Bergstrom et al. found no significant difference between trust and tax payment vehicles. While a trust is somewhat unrealistic, a payment vehicle involving increased tax payments was abandoned because of a strong and pervasive antagonistic atmosphere towards taxes created by the controversial and recently implemented federal goods and services sales tax (GST).

By bidding on only one of four randomly assigned quantities, the study incorporates an internal check for "warm glow" and or embedding effects. If a respondent's bid is simply to generate a good feeling about donating to a worthy cause, then mean bids for each of the different amounts would be indistinguishable or possibly of a counter intuitive magnitude. In a *WTP* regression context, the quantity of land regressor would be insignificant or possibly of the wrong sign. Similarly, if embedding, which occurs when the respondent includes values for other entities in their bid for the relevant good were to be a serious problem (Kahnemann and Knetsch), mean bids or the quantity of land regressor would be plagued by insignificance or the wrong sign. As the NOAA panel points out, if an individual were to bid on all of the quantities, then the embedding issue would be forcibly avoided, which is highly undesirable (Arrow et al., p. 27).

Survey Design

Dillman stresses the importance of giving careful attention to such matters as question order and use of lead-ins and transitions in questionnaire construction. Our questionnaire began with a cover letter detailing the aspects of farmland retention and explaining the loss of external benefits. The respondent was then asked to answer several preference/attitude type questions to give a smooth transition to the CVM question. The survey was developed with the assistance of a number of academics, including economists (pro and anti-CVM) and a rural sociologist. In addition, the survey was pretested on-site as well as on a number of undergraduate students. An open-ended approach was used in the pretest to establish a viable bid range for the payment card.[2]

A systematic sample (Cochran) of 140 households in the affected area was conducted. Four representative residential areas were selected, within which households were randomly sampled. Dillman discusses the merits of mail, telephone, and face-to-face survey techniques and concludes that the question of which is best can only be answered subjectively and on a case-by-case basis. We chose a modified face-to-face interview approach. The literature indicates that personal interviews generally produce higher response rates than mail surveys (Mitchell and Carson) and it is the preferred method according to the NOAA panel. Funding and time constraints were also contributing factors.

We expected respondents to be unfamiliar with CVM surveys in general and with valuing the external benefits of agricultural land in particular. The face-to-face format allowed for clarification and explanation if requested. All households were subject to the same experienced interviewer. However, to avoid interviewer bias and social desirability biases, each interview was structured so that the respondent (adult household member) had the option of privately recording her responses and placing the completed questionnaire among a stack of completed and unlabelled responses, thus contributing to the perception of anonymity.

Empirical Model

Our empirical model builds on the previous work of Beasley et al., Bergstrom et al., and Halstead. Our choice of variables is for the most part consistent with these previous studies with a few exceptions. The specification for the empirical model of the total value (*WTP*) curve is:

$$(1)\quad WTP_i = B_0 + B_1 LAC + B_2 INC + B_3 CSG + B_4 DIS + B_5 BGR + B_6 NUM + B_7 VIS + u_i$$

[2] One reviewer felt strongly that we should have used focus groups to develop our survey instrument. In retrospect, additional information from an accepted focus group technique would likely have improved our questionnaire. However, then as now, we are unaware of an unambiguous focus group standard. In light of our pretesting and interview approach, we feel the study is minimally compromised. Nevertheless, were we to repeat the study, we would include a focus group treatment.

where:

WTP = total annual household willingness to pay for a given amount of farmland land preservation;
LAC = log of the amount of farmland to be preserved, 23,750; 47,500; 71,250; or 95,000 acres;
INC = household income level ($/year);
CSG = affiliation with conservation-type organizations (0 = no, 1 = yes);
DIS = distance to the nearest parcel of farmland (km):
BGR = farm background (0 = no, 1 = yes);
NUM = number of people in household;
VIS = visit farmland (0 = no, 1 = yes);
u_i = i.i.d. mean zero random error.

Halstead and Beasley et al. use a "level of development" variable in lieu of acreage, which precludes derivation of preservation values at the margin. We follow Bergstrom et al. and include a quantity of land variable to establish a total value curve. In addition, we impose structure consistent with diminishing marginal utility by using a logarithmic transform on acres.

A number of shift variables were included based on previous studies including income, distance, and farm background. Halstead and Bergstrom et al. found income to be significant, but Beasley et al. did not. Following Halstead, we also included a distance variable. Bergstrom et al. used an urban/rural indicator variable similarly. Beasley et al. suggested that a cardinal distance measure was not appropriate in their study because all households were interspersed with farmland parcels in the area. Farm background was found to be insignificant by Bergstrom et al., however we chose to retain it in our model under the pretext that people with farm backgrounds might react differently to agricultural land preservation than those without. A priori expectations were that income and farm background would shift the total value curve upward while distance could be argued to shift the curve either way.

We also included a number of variables absent from previous land studies. Because household values were elicited, we included a variable to account for the number of people in the household. A binary variable for affiliation with a wide range of conservation-type organizations was included based on its significance in other environmental valuation studies (Bowker and Stoll). Another binary variable to identify direct users of the land was also included. Such a variable, if significant, would potentially allow for direct use and option-to-use value to be separated from more passive values such as existence, and bequests by subtracting mean *WTP* for those who claimed not to directly use the resource from who did. A priori, we expected household number and both of the binary variables to positively influence willingness to pay.

Results

A total of 140 households were sampled; 38 refused interviews, 1 response was incomplete and 9 were determined to be protest bids based on a follow-up question to zero bidders. The protest bids were discarded from the sample. As discussed by Halstead et al., this procedure is not unambiguously preferred. However, because protests were less than ten percent of the sample and response rates were reasonably high, we feel discarding the protests is more justifiable than either treating them as zeroes or worse, assigning sample mean *WTP* values to them. This left 92 usable surveys. Selected sample statistics are reported in Table 1.

For payment card data, Cameron and Huppert suggest a maximum likelihood alternative to ordinary least squares if intervals are 'coarse'. We felt this procedure to be unnecessary given the number of intervals and option for respondents to fill in values between intervals. Regression model ordi-

Table 1. Selected Sample Statistics, N = 93

Variable	Mean	St. Dev.	Min.	Max.
LAC	3.9566	.5298	3.1676	4.5539
BGR	.35484	.48106	0	1
EDU	14.043	2.1054	10	21
INC	42742	20490	15000	95000
NUM	2.7957	1.2646	1	8
DIS	12.527	12.315	0	100
VIS	.7634	.42727	0	1
CSG	.16129	.36979	0	1

Table 2. OLS Regression Parameter Estimates for the Dependent Variable *WTP* (N = 93)

Variable	Coefficient	T-ratio DF = 85	White's T-ratio
Constant	−116.65	−2.8335	−2.7081
LAC	26.781	2.792	2.8007
INC	.000043	.14679	.16402
BGR	−1.8761	−.17494	−.17697
CSG	87.768	5.9384	5.4069
VIS	29.179	2.2904	2.9589
NUM	11.009	2.462	1.8947
DIS	.9975	2.435	2.3893
Adj R-square	.4781	R-square	.5178
F-value 7,85	13.038	DW	1.80

nary least squares (*OLS*) parameter estimates are presented in Table 2.[3] The model R^2 of .52 indicates a fit which is a considerable improvement on previous studies (e.g., Bergstrom et al. (.14); Halstead (.09–.38); Beasley et al. (.21–.30)).

All of the model variables are highly significant with the exception of income (*INC*) and farm background (*BGR*).[4] The income result appears to contradict theory, however a number of CVM studies have also found income to be insignificant in explaining *WTP* for environmental goods and services. Both of the Beasley et al. models and some of the Halstead models had insignificant income variables. Beasley et al. suggest that since money does not actually change hands, poor people may be as "profligate" as rich people. We feel this variable is best left in the model due to potential theoretical importance and because overspecification presents fewer estimator problems than underspecification.

Consistent with Bergstrom et al. the farm background variable (*BGR*) was insignificant. The result runs contrary to popular beliefs that farmers or people with farm backgrounds value land and open spaces differently than society in general. Alternative explanations such as farmers having an economic interest (positive or negative) in the program may also be dismissed.

Sixteen percent of the sample claimed some household involvement in a conservation-type organization (*CSG*). As seen in Table 2, the coefficient on this binary variable is large and highly significant suggesting previous reported models may have been mispecified by omitting such a variable. Our survey admittedly did not quantify the level or intensity of involvement, so a more detailed look into organizational involvement is suggested for future work. This would be particularly important if a large enough proportion of the sample is involved to allow appropriate stratification.

Seventy-six percent of the respondents claimed to visit open spaces within the area at least once a year. As with the conservation variable, this variable (*VIS*) was omitted in previous work but highly significant in our model. One could argue that this variable is simply an attitude or experience indicator however, we feel it potentially represents more. For example, the twenty-nine dollar difference in mean *WTP* between those who claim to visit the land and those who do not may be considered a crude estimate of the difference between those with on-site use and option-to-use values in addition to nonuse values and those with primarily nonuse values. The alternative is to follow the work by Walsh et al. and differentiate between use and nonuse values by asking respondents to assign percentages of the total bid to use and various nonuse values such as option, existence, and bequest values. At a minimum our results indicate that this variable merits further exploration and refinement in future studies and could perhaps be used as a reliability check on the Walsh et al. method.

The distance (*DIS*) parameter estimate was also significant. Each added kilometer increased annual household *WTP* about one dollar. This corroborates the hypothesis that promity may lead to a take-it-for-granted attitude (Bergstrom et al., p. 144). Halstead found distance to be significant in some of his models, however with near-zero value, he considered the effect trivial.

Also absent from other models but significant in our model is the household number variable (*NUM*). We found additional household members to add around eleven dollars to annual household *WTP*. Previous studies for land retention as well as many other household based valuation studies omit

[3] It should be noted that a Tobit model of the same concomitant variable specification was estimated because of possible censoring problems caused by eight out of ninety-two respondents reporting *WTP*'s of zero dollars. The coefficient estimates and significances are remarkably similar with significant estimates exhibiting less than a 5 percent difference in all cases. The uncensored overall mean *WTP* is $70.20 while the censored mean (Greene, p. 728) is $69.74.

[4] The presence of multicollinearity was not considered to be problematic based on examination of the matrix of simple correlations between independent variables and on a series of auxillary regressions among independent variables. Homoscedasticity was rejected based on the results of the Breusch-Pagan-Godfrey Test (Greene, p. 421), although plots of squared residuals vs. predicted showed no readily identifiable patterns. Normality of the residuals could not be rejected based on Greene's test (p. 329), hence *OLS* coefficient estimates are unbiased but not their variances. White's generalized covariance-matrix estimator (Greene, p. 420) was then employed producing resulting significances quite similar to the *OLS* covariance matrix (Table 2).

this potentially important variable. Possible explanations for the importance of this variable include added on-site use value as well as increased option and family bequest considerations.

Finally, the acreage variable (*LAC*) was positive and significant at better than the one-percent level. The logarithmic transform on this variable is theoretically consistent in that it allows for the bid curve to increase at a decreasing rate with acreage retained. Table 3 contains the marginal household and marginal regional *WTP* per 1000-acre increment. Additionally, while validation of *CVM* measures is subject to intense debate, our findings on this variable bode well for *CVM* in light of spatial embedding criticisms (Kahnamen and Knetsch). An important distinction of our survey is that each household bid on only one quantity of land. Nevertheless, a very strong positive relationship to *WTP* was identified leading us to believe that people were not stating values for land retention in general and likely not just purchasing moral satisfaction.

Bergstrom et al. also found a similar strong positive relationship between *WTP* and acreage. However, their results are somewhat suspect from methodological and statistical standpoints. In their survey, each respondent was given all of the acreage amounts to be valued in increasing order, and hence provided four observations. Such a procedure forcibly avoids embedding and has been outrightly rejected by the NOAA panel (Arrow et al., p. 27). Moreover, because they estimated their bid curve as if each response was a separate observation, the independent error assumption for *OLS* is violated, leading to a downward bias on the estimated regression parameter standard errors and increases the chances of Type I error. Beasley et al. and Halstead did not model incremental quantities of land but elicited bids from each respondent to avoid increasing levels of development on a fixed quantity of land. As such, each respondent's bid is conditioned by her seeing all of the scenarios. Hence, when a bid of $100 is offered to avoid a low level of development, it is virtually guaranteed that a bid of more than $100 will be offered to avoid a higher level of development. Moreover, an independence problem similar to that in Bergstrom et al. arises when the authors regress *WTP* on their variable representing the level of development because they included multiple *WTP* observations from each individual. Under such conditions, two analytical approaches are appropriate: (a) randomly select only one observation from each respondent and proceed with *OLS* estimation, or (b) employ an estimated generalized least squares procedure to account for the correlation among the four observations from each respondent (see Hoehn or Judge et al., pp. 519–551). Using one alternative per respondent or, in some cases, randomly ordering questions are perhaps better ways to mitigate the dependence problem.

Conclusions and Implications

As indicated in Table 3, the household *WTP*'s for the amenities provided by preserving 23,750; 47,000; 71,250; and 95,000 acres of farmland in the greater Moncton area are $49.07, $67.64, $78.49, and $86.20 respectively. Ninety-five percent prediction intervals for regression means (Greene, p. 195) are also reported in Table 3.

At first glance these numbers may seem high but with roughly 95,000 acres left, the marginal amenity value per household is only twenty-eight cents per 1000 acres with an average value of about ninety-one cents per 1000 acres. With half the acreage, the marginal value doubles while the average value increases to $1.42 per 1000 acres.

Based upon an estimate of 34,740 households in the three-county area, regional total amenity values for 23,750; 47,500; 71,250; and 95,000 acres are about $1.7, $2.3, $2.7, and $3.0 million, respectively (Table 4). Under existing conditions, the marginal value is $9727 per 1000 acres or about $9.70 per acre, while the average value is $31.52 per acre.

Our household *WTP* at existing conditions is about five times that of Bergstrom et al., while our regional per acre benefits are quite close. At the margin however, our results are much lower for households, a good part of which may be due to model specification differences. Because of methodological differences, it is more difficult to compare our results in a specific way to Halstead or Beasley et al. A conservative estimate of the cur-

Table 3. Household *WTP* for Retaining Farmland

Acres	House *WTP*	95% PI Lower	95% PI Upper	Ave.[1] *WTP*	Marg.[2] *WTP*
23,750	$49.07	$31.48	66.67	$2.07	$1.14
47,500	67.64	58.00	77.27	1.42	.56
71,250	78.49	67.38	89.60	1.10	.38
95,000	86.20	71.51	100.88	.91	.28

[1]Household average *WTP* per 1000 acres with concomitant variables set at sample means.
[2]Household marginal *WTP* per 1000 acres.

Table 4. Regional *WTP* for Retaining Farmland[1]

Acres	Region *WTP*	95% PI Lower	95% PI Upper	Ave.[2] *WTP*	Marg.[3] *WTP*
23,750	$1704692	$1093615	$2316116	$71777	$39604
47,500	2349814	2014920	2684360	49470	19454
71,250	2726743	2340781	3112704	38270	13201
95,000	2994588	2485300	3504571	31522	9727

[1]Based on 1986 Census estimate of 34,740 households.
[2]Average regional *WTP* per 1000 acres.
[3]Marginal regional *WTP* per 1000 acres.

rent price of typical agricultural land in the Moncton area is approximately $600–$1000 per acre. Land in prime locations and frontal lots is priced in the $1200–$1400 range (LeMarsh). Our findings indicate that at the margin, regional extra-market benefits of retaining farmland are about $97 per acre or about 6 to 16 percent of land price.[5] The estimate of $97 is probably an upper bound given that *CVM* tends to overstate "real" willingness to pay (Arrow et al., p. 8). Our relatively conservative result suggests that the land market is, for now, probably not wrought with externality from the standpoint of providing extramarket benefits to the public.

Interestingly, almost a decade later, our results appear qualitatively similar to Bergstrom et al. and Beasley et al. But, as open land becomes more scarce in the region and surrounding areas and perhaps as public attitudes about the environment evolve, the temporal robustness of our results would become suspect. However, under existing conditions, marginal extra-market benefits of farmland retention appear small compared to land prices and the potential costs of establishing a preservation program in the region. In this light, a general farmland preservation program would seem for now socially unwarranted.

It should be noted, that our conclusions are limited to a general land preservation program and conditioned by a number of caveats. We did not consider specific parcels of land nor did we differentiate qualitatively among farmland types, e.g., pasture, row crop, orchard, mixed and others. Also, other than a continuation of the current trend, we did not explicitly describe the kind or level of development which would supplant the farmland. As Beasley et al. and Halstead have shown, this could be an important factor, particularly if specific types of development are of concern.

[5] Based on an interest rate of 10 percent and a perpetual annuity payment.

APPENDIX

From the cover letter . . .

Each year portions of private agricultural land are converted to alternative uses such as industrialization and urban subdivisions. In the Moncton area (including Kent, Albert, and Westmorland counties) there was a total of 492,300 acres of agricultural land in 1961; in 1976 there was a total of 234,700 acres. There are presently 95,000 acres of agricultural land in this area.

Although we produce more food than ever in Canada, we may be losing certain external benefits this land provides. These external benefits can include open space, scenic vistas, wildlife habitat, and traditional country life.

From the payment card question . . .

Our main interest is examining the value which people place on preserving agricultural land for *external benefits*. The next question presents a situation which asks for your best estimation of how you would react in given circumstances. *This situation does not represent any actual policy proposals under consideration.*

Assume that a tax exempt, independent foundation could be *successfully* established to ensure the continued preservation of approximately _____ or _____ acres of the existing 95,000 acres.

What is the maximum *annual* contribution your household would make to such a foundation?

$0	10	50	200
1	15	75	300
2	20	100	400
5	25	150	other $ _____ .

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