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Consumer Response to Integrated Pest Management and Organic Agriculture: An Econometric Analysis

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Executive Summary

While several studies have presented aggregate, descriptive illustrations of consumer response to IPM, the willingness-to-purchase and willingness-to-pay for IPM produce as a function of demographic characteristics has not received the exhaustive research attention that has focused on organic produce. The objective of this study was to empirically evaluate which demographic characteristics cause consumers to be more likely to purchase IPM grown produce. A hypothetical willingness-to-purchase model for IPM produce as well as willingness-to-pay models for both IPM and organic produce are presented. A non-hypothetical analysis also predicts consumers who strictly purchase only conventional produce. Income was found to be the most significant determinant of willingness-to-purchase IPM grown produce. Participants with higher annual incomes were more likely to express an interest in purchasing IPM produce and also appeared less likely to strictly purchase conventional produce. Those whose frequently purchase organic produce, those who visit farmers markets and those who live in suburban areas were all found to be more likely to purchase IPM grown produce.

The results also indicate that females, those with higher annual incomes, younger individuals, and those who frequently purchase organic produce are all more likely to pay a premium for both IPM and organically grown produce.

Overall, the results of this survey give insight into the likely consumer response to produce that is labeled as “IPM Grown.” However, before the average consumer exhibits the same level of interest in IPM as the sample in this study, some mechanism must be developed to educate the public about IPM.

Introduction

With escalations in food safety concerns and the rise in direct-to-consumer agricultural marketing, integrated pest management (IPM) and organically grown produce have become increasingly prevalent in recent years. Synthetic chemical pesticide usage by fruit and vegetable growers has become a top concern for consumers relative to other food safety issues (Byrne et al. 1991; Misra, Huang and Ott, 1991) because it poses the problem of human consumption of chemical residues. Many polls indicate that 70-85% of consumers exhibit a medium to high degree of concern toward pesticide residues and pesticide usage. Zellner and Degner (1989) reported this segment at 83%, while Zind (1991) found that 86% of a survey sample expressed concern for pesticide usage, and Burgess et al. (1989) found that 96 percent of consumers were at least somewhat concerned about the use of chemical pesticides in the food that they purchase. Regardless of whether the aversion is justifiable or overstated, public apprehension of the risk posed by pesticides can translate into very real effects in the market for fresh produce (Dunlap and Beus, 1992).

Integrated Pest Management Agriculture

IPM is a system of pest control which evolved amidst concerns of entomologists and other scientists that certain pests were building immunity to synthetic pesticides (Greene, 1991). IPM utilizes a system of highly balanced substitutive and natural approaches to pest control which together minimize the dependence on synthetic chemicals. The implementation of IPM presents a feasible alternative which is more cost effective than organic production and safer than conventional agriculture.

This analysis presents a number of separate logit models which decompose the effects of demographic factors which influence willingness-to-purchase conventional, IPM, and organically grown fresh produce. The attractiveness of this approach is that it reinforces purely hypothetical models predicting consumer response to IPM and organic produce with a non-hypothetical measure of existing real world behavior.

Examining which individuals would be expected to exclusively purchase conventional produce is not a common practice. However, it is simply a reciprocal analysis of which individuals would be willing to purchase IPM or organically grown produce. The conventional model complements the IPM and organic models allowing us to draw stronger conclusions about the consumption habits of the participants. Therefore, any variables which are statistically significant in predicting both strictly conventional consumers and those that are willing to purchase low-input produce, should be estimated with opposing directions for the two models. For instance, if higher levels of education positively contribute to the willingness-to-purchase IPM produce, then it would be expected to negatively contribute to the likelihood of purchasing only conventional produce. The side by side comparison of the hypothetical and non-hypothetical models included in this study also allows us to draw conclusions pertaining to the internal consistency of the responses made by the survey participants.

Whereas consumer response to organic produce has been extensively studied in both real and hypothetical scenarios over the past 15 years, there has been relatively little research on the marketability of IPM produce. Nearly all the existing IPM literature has been supply or production oriented. The majority of studies regarding consumer demand for IPM that have been done present descriptive statistics or aggregate tabulations of willingness-to-purchase and willingness-to-pay measures. If IPM and organic produce are to be successfully marketed side by side conventional produce, it will be necessary to identify and isolate the market segments that would be willing to purchase low-input agriculture. This study attempts to decompose consumer characteristics and demographic variables affecting the willingness-to-purchase and willingness-to-pay for low-input agriculture.

Organically Grown Produce

While organic produce was predominately sold through direct marketing facilities as recently as 1990, it has since become commonplace in grocery chain stores and supermarkets. As with IPM, successful marketing of organically grown produce

presents its own challenges. The market for organic foods is one of the fastest-growing agricultural segments of the economy. A nationwide study shows that sales from the organic food industry are nearing $3 billion a year and are currently growing at an annual rate of over 20 percent (McEnery, 1996). Organically grown produce is typically sold for a premium price over conventionally grown produce. However, returns to growers are dictated by the total supply, consumption demand, and the available organic outlets (Klonsky et al., 1992).

The defining characteristic of organic agriculture is the absence of synthetic chemical pesticides. This attribute addresses the strong risk aversion to the ingestion of pesticide residues which has been shown to be held by the majority of American consumers (Zellner and Degner, 1989; Zind, 1990; Burgess et al., 1989; Govindasamy, Italia and Liptak, 1997[a] and 1997[b]; Byrne et al., 1991, Misra, Huang and Ott, 1991). Furthermore, in an altruistic sense, significant concerns about pesticide damage to wildlife, farm workers, and the environment have also been documented (Weaver et al., 1992) which bolster support for low-input produce. When pest control does become necessary in organic agriculture, natural pesticides and biological controls can help decrease crop damage and short-run economic losses. If used in conjunction with crop diversification, rotation, and cultural practices, organic methods of pest control customarily limit disease and insect damage to acceptable levels (Klonsky et al., 1992). In comparison to conventional agriculture, however, organic production is often quite labor intensive and can result in greater produce losses to disease and insects. Estes and Smith (1996) found only a casual link between willingness-to-pay and the cosmetic appearance of organic produce. This suggests that the most important motivation consumers exhibit when purchasing organic produce is a sensitivity to their health and safety rather than other produce cosmetic characteristics.

Despite rapid growth in production and sales, consumer demand for organic produce is still relatively small when compared to conventional produce. While similar studies have been undertaken in the past, the market for organic produce has quickly evolved

in recent years. Increased awareness of organic produce necessitates that new research is carried out to document the current dynamics of the organic market. In addition to IPM, this study also provides an analysis of consumer willingness-to-pay for organic foods which decomposes the marginal effects of demographic variables, attitudes, and risk perceptions. In dissimilarity to previous research, the study incorporates a higher number of explanatory variables into the logit framework. Higher predictive success and a higher number of significant variables are also uncovered.

Expected Outcome

Before any data analysis was undertaken, a series of hypotheses was made about the effect which major variables were likely to have in the final regression models. It was hypothesized that consumers with different socio-demographic characteristics would exhibit different attitudes toward different types of produce. In view of this and based

Table - 1 Hypothesized Effects of Key Explanatory Variables

	Willingness to Pay for Organic	***Willingness to Buy IPM***	***Willingness to Pay for IPM***	***Prior Knowledge of IPM***
Male	-	-	-	
Age	-	-	-	-
Income	+	+	+	+
Education	+	+	+	+
Children	+	+	+	
Risk	+	+	+	+
Home Garden	+	+	+	+
Buy Organic	+	+	+	+
Visit Farm Markets	+	+	+	+

on a review of past studies of food safety risk perceptions and willingness-to-pay for food borne risk reduction, the following factors were initially expected to significantly

affect consumers' preference and willingness-to-pay for IPM produce. The corresponding expected signs are also listed in Table 1.

Males were expected to be less willing to purchase organically and IPM grown produce than females. Those with higher incomes were expected to be more willing to purchase and more willing to pay a premium for IPM and organic produce. Those with higher levels of education and incomes were expected to be more knowledgeable of IPM before taking the survey than those at lower levels of income and education. Those who had higher risk aversions toward pesticide usage were expected to be more willing to purchase and more willing to pay a premium for IPM produce. Participants with children were expected to be more risk averse and therefore more willing to purchase IPM. Those who had home gardens, those who regularly purchased organic produce, and those who recently visited farmer's markets were all expected to be more risk averse, more willing to purchase IPM produce and more knowledgeable of IPM.

Review of Literature

Many factors have been found to affect the willingness-to-purchase and willingness-to-pay for low-input produce. In most cases, gender and income are among the most significant determinants. In general, while income is usually found to be significant in estimating willingness-to-pay for pesticide risk reduction, conflicting findings have been reported. Most studies have found that willingness-to-pay for food risk reduction increases with income (Elnagheeb and Jordon, 1990; van Ravenswaay and Hoehn, 1991). However, Buzby et al. (1995) detected that income and willingness-to-pay for reduced pesticide grapefruit were inversely related. Paradoxically, many studies have also found food safety concerns decrease as income increases (Buzby et al., 1995; Byrne et al., 1991; Dunlap and Beus, 1992; Jussaume and Judson, 1992). The effect of education has also been found to have conflicting influences on individual pesticide risk concerns (Buzby et al.) and willingness-to-pay for risk reduction.

Hollingsworth et al. (1993) reported that the majority of 549 respondents (63%) agreed or strongly agreed that IPM grown produce is safer than non-IPM produce and 78% agreed that IPM techniques helped to protect the environment. Most respondents (61%) indicated they had not heard of IPM before receiving the survey.

Willingness-to-Purchase IPM Produce

When polled, consumers have responded favorably toward purchasing IPM produce. However, a major shortcoming of previous studies was the failure to document or estimate how specific demographic subgroups responded. Hollingsworth et al. (1993) reported that 75% of respondents said they would purchase IPM-labeled produce over non-labeled produce if there were no price differential and 40% were willing to purchase IPM-labeled produce if it costs slightly more than non-labeled produce. Similarly, Burgess et al. (1989) found that 92% of consumers indicated they would buy IPM grown produce and Anderson et al. (1996) found that 74% would prefer IPM-certified produce.

Willingness-to-Pay for IPM Produce

Burgess et al. (1994) found that few respondents (27%) to a 1989 survey in New York had heard of IPM but when the concept was explained to them, they were receptive to the point of being willing to spend 10% to 25% more for produce grown using IPM techniques. Many respondents indicated that they would even be willing to switch supermarkets to obtain IPM produce. Morris et al. (1993) also reported that the majority of consumers indicated that they would be willing to pay somewhat more for chemical reduced produce, and that 79% would like more signs which labeled low input produce. Ott, Huang and Misra (1991) found that while consumer support for chemical residue testing in fresh produce was strong, and 54 percent of those who indicated that pesticides usage was a food concern were willing to pay more to obtain pesticide free produce, the premium they were willing to pay was very low. Only about one tenth of the sample indicated they would be willing to pay more than an additional 10 percent.

Hollingsworth et al. (1993) found that most respondents (75%) agreed they would buy IPM-labeled produce over non-labeled produce if it cost the same and 40% were willing to buy IPM-labeled produce if it costs slightly more than non-labeled produce. In one relevant study, Underhill and Figueroa (1996) attempted to explain differences in willingness-to-pay for IPM produce by socio-demographic characteristics. However, the explanatory variables in that study were limited to age, income, regional setting (i.e. suburban, urban) and a variable which captured the effect of having previous information of IPM. Underhill and Figueroa reported that younger individuals, higher earning individuals, and those who live in urban settings were the most likely to pay more for certified IPM produce.

Willingness-to-Pay for Organic Produce

Consumers who frequently purchase organic produce have been found to be less concerned about cosmetic surface blemishes, more concerned about pesticide use, and less concerned about the retail price of fresh produce (Goldman and Clancy, 1991). Additionally, Misra, Huang and Ott (1991) and Underhill and Figueroa (1996) both reported that higher earning individuals were the most likely to pay a premium for certified organic produce.

Weaver et al. (1992) reported that 56 percent of consumers indicated a willingness-to-pay of at least a 10% premium to obtain pesticide free tomatoes. Only 19 percent of the sample indicated that they were unwilling to pay any premium at all. Similarly, Huang (1993) reported that the majority of consumers indicated a willingness-to-pay of up to 10% more for organically grown produce. A gender significance was also found which showed females to be more likely than males to pay a premium for organic produce. Huang noted that females and households with children were more likely to have higher risk aversions toward pesticide residues than their counterparts. Groff et al. (1993) also reported that females were more likely than males to place a higher value on organic than conventionally grown produce. Ott and Maligaya (1989) found that females, college graduates, and shoppers over 50 years of age were all more

concerned with pesticide use in agriculture. Byrne et al. (1991) also found that females and lower earning households were more likely to have high concerns over pesticide usage. In contrast to Ott and Maligaya, Byrne et al. found that persons with at least a bachelors degree were less likely to have risk aversions to pesticide residues. Govindasamy and Italia (1998[a]) found that females, households with children, and individuals over 35 years of age were all more likely to have high levels of pesticide risk aversion. However, Govindasamy and Italia (1998[b]) also reported that females were more likely to be sensitive to high produce prices than males.

Misra, Huang, and Ott (1991) documented a negative correlation between education and willingness-to-pay for chemical residue free produce. Analogously, Malone (1990), and Zellner and Degner (1989) reported results showing that higher educated consumers exhibited a lower willingness-to-pay for safer food. Groff et al. (1993) determined that those with lower levels of education were more likely to feel organics are a better produce than conventionally grown produce.

Conflicting marginal income effects have also been reported. Whereas Underhill and Figueroa (1996) and Buzby et al. (1995) found age to be inversely correlated with willingness-to-pay for organic produce, Misra, Huang, and Ott found the opposite to be true. Zellner and Denger also reported findings which suggest that older consumers were more likely to pay higher prices for higher levels of food safety. Ott and Maligaya also found that despite high aversions to pesticide residues willingness-to-purchase alternative agricultural produce decreased when willingness-to-accept cosmetic defects were considered. The inconsistencies of past findings may be the result of changes within the growing market for organically grown produce. New and current data is warranted to provide a clearer picture of the present structure of the market.

Conceptual Framework

Analytically, the empirical model began with the neoclassical demand utility maximization framework in which consumers attempt to maximize utility subject to budgetary constraints imposed by their purchasing power:

$$\text{maximize} \quad U(X_1, X_2, \ldots, X_n) \qquad \text{[Eqn. 1]}$$

$$\text{such that} \quad \text{sum } P_i X_i = Y$$

where U is the level of utility or satisfaction generated by consuming a set of goods and services. X_i represents the quantity of the ith good consumed, Y is the consumer's discretionary income and P_i is the price of the ith good.

The Lancaster Product Attributes Framework and expected utility theory were drawn upon to provide a theoretical basis for utilizing explanatory variables other than prices and income in estimating consumption demand. The Lancaster model proposes that consumers purchase goods for the attributes and characteristics which those products contain. Ladd and Zober (1982), van Ravenswaay and Hoehn (1991), and Baker and Crosbie (1993) have all applied the product attributes framework to define product demand and as function of product attributes. Following those extensions, consider a demand system for product X where X has a vector of product attributes, **a**:

$$X = X(P, \mathbf{a}, Y) \qquad \text{[Eqn.2]}$$

where vector **a** contains dummy variables denoting IPM, or conventional produce. Because consumers have collectively demonstrated a belief that pesticide residues pose a risk to human health, the choice of selecting IPM produce over conventional produce should take into account some measure of risk perceptions. In such a scenario, purchase decisions between conventional and IPM produce are made based upon the expected utility of and the perceived level of risk associated with consuming either type of produce.

An approach followed by Viscusi (1989), and Eom (1994) explicitly incorporated consumers' risk perceptions into an expected utility framework. Eom derived an

expected indirect utility function dependent on income, prices, risk perceptions, and socio-demographic characteristics. Individuals will have separate expected utility functions for each different consumption choice they are presented with. In this case, the selection is between conventional produce (good I) and IPM or organically grown produce (good II) and the consumption decision is dependent on the maximum of the two individual expected indirect utilities:

$$\begin{aligned} & EV(Y, p^{I}, p^{II}, \pi^{I}, \pi^{II}; \mathbf{S}) \\ = \; & \max\,[EV^{I}(Y, p^{I}, \pi^{I}; \mathbf{S}),\ EV^{II}(Y, p^{II}, \pi^{II}; \mathbf{S})] \end{aligned} \qquad \text{[Eqn. 3]}$$

where Y is income, p^{I} and p^{II} are the per unit price of conventional and IPM produce, π^{I} and π^{II} are risk perceptions, and S is a vector of socio demographic characteristics. Among the more important explanatory variables are some measure of income (Y), prices (p) risk perceptions (π), and socio-demographic variables (S: education, marital status etc.).

Components of equations 2 and 3 can be combined to yield a more robust demand relationship than traditional theory provides:

$$X = X(P, \mathbf{a}, Y, \pi, \mathbf{S}) \qquad \text{[Eqn. 4]}$$

where P is a measure of price, **a** is a vector of product attributes (i.e. a dummy variable which denotes IPM produce, etc.), Y is a measure of income, π is some measure of risk aversion, and **S** is a vector of socio-demographic variables. Equation 4 serves as our basic theoretical foundation.

Methodology

The logit model was selected as the regression method in this analysis because its asymptotic characteristic constrains the predicted probabilities to a range of zero to one. The logit technique is a better procedure for capturing the magnitude of the independent variable effects for qualitative variables than are probit models (Amemiya,

1983). The logit model is also favored for its mathematical simplicity and is commonly used in a settings where the dependent variable is binary. Because the data sources provided individual rather than aggregate observations, the common estimation method of choice was the maximum likelihood method (Gujarati, 1992). Among the beneficial characteristics of MLE are that the parameter estimates are consistent and efficient asymptotically (Pindyck and Rubinfeld, 1991). Because the objective was to decompose the effects of explanatory demographic variables, the final model specifications were more dependent on the significance of the parameter estimates than the overall predictive power of the models.

The empirical model assumes that the probability of observing the dependent (for instance, willingness-to-pay a premium for IPM produce), P_i, is reliant on a vector of independent variables (X_{ij}) associated with consumer i and variable j, and a vector of unknown parameters β. The likelihood of observing the dependent variable was tested as a function of variables which included socio-demographic and consumption characteristics.

$$\mathbf{P_i = F(Z_i) = F(\alpha + \beta X_i) = 1 / [1 + \exp(-Z_i)]}$$

Where:

$F(Z_i)$ = represents the value of the standard normal density function associated with each possible value of the underlying index Zi.

P_i = the probability observing a specific outcome of the dependent variable (i.e. the individual would be willing to pay at least a 10 percent premium to obtain organically grown produce or purchase IPM grown produce) given the independent variables X_is

e = the base of natural logarithms approximately equal to 2.7182

Z_i = the underlying index number or βX_i

α = the intercept

And βX_i is a linear combination of independent variables so that:

$$\mathbf{Z_i = \log [P_i /(1- P_i)] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n + \varepsilon}$$

Where:

i	=	1,2,. . . ,n are observations
$\mathbf{Z_i}$	=	the unobserved index level or the log odds of choice for the ith observation
$\mathbf{X_n}$	=	the nth explanatory variable for the ith observation
β	=	the parameters to be estimated
ε	=	the error or disturbance term

The dependent variable Z_i in the above equation is the logarithm of the probability that a particular choice will be made. The parameter estimates do not directly represent the effect of the independent variables. To obtain the estimators for continuous explanatory variables in the logit model, the changes in probability that $Y_i = 1(P_i)$ brought about by a change in the independent variable, X_{ij} is given by

$$\mathbf{(\partial P_i / \partial X_{ij}) = [\beta_j \exp(-\beta X_{ij})] / [1+ \exp(-\beta X_{ij})]^2}$$

For qualitative discrete variables such as the explanatory variables used in this study, $\partial \mathbf{P_i}/\partial \mathbf{X_{ij}}$ does not exist. Probability changes are then determined by:

$$\mathbf{(\partial P_i / \partial X_{ij}) = P_i(Y_i : X_{ij} = 1) - P_i(Y_i : X_{ij} = 0)}$$

Five logit models were developed to predict the likelihood of a number of dependent variables which included purchasing conventional produce, and paying a premium for IPM and organic produce. The models were initially tested under the specification:

$$\begin{aligned}\text{Dep} = {} & \beta_0 + \beta_1 \text{Male} + \beta_2 \text{Age1} + \beta_3 \text{Age2} + \beta_4 \text{Age3} + \beta_5 \text{Income1} + \beta_6 \text{Income2} \\ & + \beta_7 \text{Income3} + \beta_8 \text{Education1} + \beta_9 \text{Education2} + \beta_{10} \text{Shop-Many} \\ & + \beta_{11} \text{Risk} + \beta_{12} \text{Heard-of-IPM} + \beta_{13} \text{Urban} + \beta_{14} \text{Rural} + \beta_{15} \text{Prime} \\ & + \beta_{16} \text{Negative} + \beta_{17} \text{Visit} + \beta_{18} \text{Try-New} + \beta_{19} \text{Garden} + \beta_{20} \text{HSize} \\ & + \beta_{21} \text{Kids} + \beta_{22} \text{Single} + \beta_{23} \text{Div/Sep} + \beta_{24} \text{Media1} + \beta_{25} \text{Media2}\end{aligned}$$

Where:

Dep	=	the dependent variable
Male	=	1 if the individual is male and 0 otherwise
Age1	=	1 if the individual is at least 65 years of age and 0 otherwise
Age2	=	1 if the individual is between 51 to 64 years of age and 0 otherwise
Age3	=	1 if the individual is between 36 and 50 years of ages and 0 otherwise
Income1	=	1 if the household income was $29,999 or less and 0 otherwise
Income2	=	1 if the household income was between $30,000 and $49,999 and 0 otherwise
Income3	=	1 if the household income was between $50,000 and $69,999 and 0 otherwise
Education1	=	1 if highest level of education attained by the participant was a high school degree and 0 otherwise
Education2	=	1 if highest level of education attained by the participant was higher than a high school degree but less than a Masters Degree and 0 otherwise
Shop-Many	=	1 if the individual regularly shops at many food stores to purchase advertised specials and 0 otherwise
Risk	=	1 if the participant believed that the use of synthetic pesticide posed a very serious health risk and 0 otherwise
Heard-of-IPM	=	1 if the individual had knowledge of IPM prior to taking the survey and 0 otherwise.
Urban	=	1 if the individual resides in an urban neighborhood and 0 otherwise
Rural	=	1 if the individual resides in a rural area and 0 otherwise
Prime	=	1 if the individual is the primary food purchaser of the household and 0 otherwise
Negative	=	1 if the individual believed that the use of pesticides had a negative effect on the environment and 0 otherwise
Visit	=	1 if the individual indicated they had visited a farmers' market within the past five years and 0 otherwise
Try-New	=	1 if participant classified him/herself as among the very first to try newly introduced food products and 0 otherwise
Garden	=	1 if fruits and vegetables were grown for consumption at the household
Hsize	=	1 if 4 or more individuals presently reside in the household and 0 otherwise
Kids	=	1 if one or more children under the age of 17 reside in the household and 0 otherwise
Single	=	1 if the marital status of the participant was single and 0 otherwise
Div/Sep	=	1 if the marital status of the participant was either divorced or separated
Media1	=	1 if the participant regularly made use of food advertisements and 0 otherwise
Media2	=	1 if the participant regularly made use of media reports on food safety and 0 otherwise

After an initial test under this specification, explanatory variables were dropped from the models in an attempt to increase performance. Thus $\beta_0 = 0$ for many of the coefficients in each model. The actual specifications are given in the regression results tables.

Data Description

In the Fall of 1996, a short consumer survey was administered at several food retail locations in central New Jersey. To minimize bias, the study was presented to

participants as a “survey of consumers of fresh vegetables” with no mention of pesticides or organics made prior to handing out the questionnaire. In total, 291 completed responses were obtained from grocery shoppers by March of 1997. Topics in the survey questionnaire were based on an amalgamation of several surveys developed for assessing the demand for IPM and organic produce. In addition to attitudes and preferences, the questionnaire included items relating to demographic information such as age, gender, income, education, and household size. Questions related to consumer risk perceptions and the premium price that consumers would be willing to pay for organic produce were a primary focus of the survey. In administering the questionnaire, the major food purchaser for the household was encouraged to be the study participant. Before distribution, the survey was pre-tested by a group of randomly selected individuals. The pre-tested surveys were not included in the final data set. The survey data was input into a flat text file which was subsequently read by SAS running on a UNIX platform for descriptive and econometric analysis.

In addition to data on direct consumer response to IPM and organically grown produce, questions were also included to ascertain perceptions of pesticide use and pesticide concern levels. Of the 291 participants that responded, 60 percent felt that pesticides posed a very serious risk to human health, 37 percent felt pesticides were somewhat hazardous while only 3 percent felt they were not hazardous. Approximately 55 percent believed that conventional produce was generally safe to consume, while 44 percent were unsure or disagreed. Similarly, 58 percent of the respondents believed that there was a difference in the safety of consuming conventional and low input agriculture. Only 10 percent believed that there was no difference in the safety of conventional and low input agriculture while 32 percent were unsure. The majority of respondents (66 percent) indicated that they believed the use of synthetic pesticides had a negative effect on the environment while 26 percent were unsure and only 9 percent disagreed.

As with other studies, less than one third of the respondents (31.4%) had prior knowledge of IPM. When asked if they would be willing to purchase IPM produce given the information they had been presented about it, the majority of participants (71.1%) said they would purchase it, while 24.4% indicated they did not have enough information or were not sure and only 4.5% reported they would not purchase it. Collectively, the survey participants also responded favorably toward organically grown produce. Approximately 36 percent indicated that they would switch supermarkets to be able to purchase organic produce. Only 20 percent of the sample reported that they "never" purchase organic produce. Additionally, 66 percent of the participants reported that they would purchase organic produce if it were more readily available and 67 percent indicated a willingness-to-purchase organic produce if it were cheaper. Of the 283 respondents who replied to the willingness-to-pay questions, 19 percent were not willing to pay any premium for organic produce.

Table 2 provides a descriptive tabulation of the explanatory variables used in this analysis. Approximately 66 percent of respondents were female and 83 percent had completed at least some college. About 58 percent of the participants were 49 years of age or below, while approximately 37 percent of the respondents had annual household incomes of less than $39,999. Approximately 33 percent purchased groceries for children who lived in their household. Roughly 15 percent of the respondents were single, 78 percent were married or widowed, and 7 percent were separated or divorced. About 13 percent lived in rural areas while 8 percent lived in urban areas and 79 percent lived in suburban areas.

Analysis Results

Selection of Models and Explanatory Variables

In total, five logit regression models were selected for inclusion in this study. Each model began with a general specification to which explanatory variables were subsequently dropped or added in an attempt to increase the number of significant

variables and the goodness of fit. In most cases, if a specific variable was not significant but contributed to the predictive power of the model, it remained in the regression. The maximum likelihood results as well as a tabulation of prediction success are presented for each model in Tables 3 through 12.

All the explanatory variables included in the regression models were binary dummy variables generated from categorical questions in the two surveys. Dummy variables were chosen because of the qualitative nature of the responses (Pindyck and Rubinfeld, 1991). In many cases, similar categories were combined (such as divorced and separated) when there were too few responses in a given category. When dropping categories to prevent perfect collinearity, an effort was also made to omit either the highest or lowest category in situations such as age or income to make the interpretation of results easier.

Because R^2 values are not typically high for cross sectional data, (Kennedy, 1992; Nayga and Capps, 1992; Kmenta, 1971), more weight was given to the number of significant variables as a means of selecting the final model specifications. In this study, variables were considered significant at the 0.10 level, however those significant at the 0.05 and 0.01 level are also labeled as such in the regression tables. Another statistic that was used in selecting models was a joint p-value which was calculated to test the null hypothesis that the coefficients of all explanatory variables are zero. The lower the joint p-value, the greater the likelihood of having significant coefficients among the set of explanatory variables. Most of the joint p-values for the accepted models were 0.0001. A descriptive summary of explanatory variables generated from the 1997 survey which includes the mean value and standard deviation are listed in Table 2.

Males were generally less willing to pay a premium for low input produce, they had lower risk aversions, they were less likely to have prior knowledge of IPM, and they were more likely to purchase only conventional produce than females. Gender was

dropped from the willingness-to-purchase IPM model because both males and females were highly supportive of IPM making gender insignificant as an explanatory variable. Age was significant in many models. The older age groups were less likely to pay a premium for low input produce, yet they were more likely to have higher risk aversions to pesticide usage. Older participants were also more likely to purchase only conventional produce and less likely to purchase IPM.

Willingness-to-pay a premium for low input agriculture proved to be directly related to annual household income. Low income households were less likely to pay more for IPM and organic produce than higher income households. Education was significant in determining those who had previous knowledge of IPM. Those with lower levels of education were less likely to have exposure to IPM than those with higher levels.

While dummy variables for regional areas (i.e. suburban, urban and rural) were not generally significant, they were included in every model because they tended to increase the regression fit. One finding which was statistically significant showed that urban households were more likely to purchase IPM produce than suburban households. In contrast, rural households were found to be less likely to purchase IPM produce than suburban households. Marital status was one of the least significant categorical groups. Dummy variables for martial status were dropped from five of the seven models because they adversely affected the predictive power of the regressions. Variables were also included in each model for children. Similarly, a variable was included in many models to capture the effect of changes in household size (HSIZE) which was coded as positive for households with four or more individuals.

Explanatory variables were included for those who regularly purchased organic produce, those who have recently visited a farmers' market and those who had their own home garden. As expected, those who frequently purchased organic produce were found to be significant in many of the models and generally exhibited higher risk aversion toward pesticide usage and higher willingness-to-pay for low input agriculture.

Those who had visited farmers' markets and those with gardens were more knowledgeable of IPM and also more willing to purchase IPM than those who did not. Two dummy variables were created to test for differences in the types of media respondents were exposed to. The variable MEDIA1 was coded as positive if the participant regularly made use of food advertisements and the variable MEDIA2 coded as positive if the participant regularly made use of food safety articles or news stories. MEDIA2 was found to be highly significant in many of the models. Both media variables could prove to be useful when selecting ways to communicate with or educate certain populations about any of the topics of this study. In each case where both media variables were used in the same model, they were estimated with opposite signs indicating a substantial difference between those who make use of food advertisements and those who pay close attention to food safety issues in the media. In general, those who use food advertisements were more frugal, less risk averse, and more likely to purchase only conventional produce than those who did not. Conversely, those who made frequent use of food safety reports were clearly more risk averse, more willing to pay a premium for low input produce and less likely to purchase only conventional produce.

The remaining explanatory variables were meant to measure the effect of different attitudes and shopping practices. These included variables for those who were risk averse (RISK), those who thought there was no distinct safety difference between low-input produce and conventional produce (NO-DIFF), those who believed synthetic pesticide usage has a negative effect on the environment (NEGATIVE), those who shopped at many stores in order to take advantage of advertised specials (SHOP-MANY), those who were the primary grocery purchaser of the household (PRIME), and those classified themselves as among the first to try newly advertised food products (TRY-NEW). While it may be more difficult to assign individuals to these categories than typical socio-demographic categories, they provide a more complete picture of both the survey sample and the psychological aspects involved in making produce purchasing decisions.

Table 2: Descriptive Tabulation of Explanatory Variables

Variable		*Freq*	*Mean*	*Std Dev*
Gender				
(Male)	Male	100	0.344	0.4757
	Female*	191	0.656	0.4757
Age				
(Age4)	Less than 36 years of age*	68	0.234	0.4239
(Age3)	36 - 50 years of age	103	0.354	0.4790
(Age2)	51 - 65 years of age	69	0.237	0.4260
(Age1)	Over 65 years of age	51	0.175	0.3808
Annual Household Income				
(Income1)	$29,999 or less	48	0.165	0.3718
(Income2)	$30,000 to $49,999	58	0.199	0.4001
(Income3)	$50,000 to $69,999	58	0.199	0.4001
(Income4)	$70,000 or more*	127	0.436	0.4968
Education				
(Education1)	High School Degree	43	0.148	0.3555
(Education2)	Some College - Some Graduate School	169	0.581	0.4942
(Education3)	Masters or Doctoral Degree*	79	0.271	0.4455
Regional Location				
(Suburb)	Suburban	229	0.787	0.4102
(Rural)	Rural	39	0.134	0.3413
(Urban)	Urban	23	0.079	0.2703
Have You Visited a Farmer's Market in the past five years?				
(Visit)	Yes	257	0.883	0.3218
	No*	34	0.117	0.3218
Do you grow fruits or vegetables at home?				
(Garden)	Yes	97	0.333	0.4722
	No*	194	0.667	0.4722
Are there children residing in the household?				
(Kids)	Yes	97	0.333	0.4722
	No*	194	0.667	0.4722
Are there two or more children residing in the household?				
(2Kids)	Yes	53	0.182	0.3866
	No*	238	0.818	0.3866
Marital Status				
(Single)	Single	42	0.144	0.3520
(Mar/Wid)	Married/Widowed*	227	0.780	0.4149
(Div/Sep)	Separated/Divorced	22	0.076	0.2648

Do you regularly shop at more than one food store?				
(Shop-Many)	Yes	113	0.388	0.4882
	No*	178	0.612	0.4882
Do you usually make use of food advertisements?				
(Media1)	Yes	64	0.220	0.4149
	No*	227	0.780	0.4149
Do you usually make use of media reports on food safety?				
(Media2)	Yes	119	0.409	0.4925
	No*	172	0.591	0.4925
Did you have knowledge of IPM prior to taking this survey?				
(Heard-of-IPM)	Yes	94	0.323	0.4684
	No*	197	0.677	0.4684
Do you usually purchase organic produce?				
(Organic)	Yes	99	0.340	0.4746
	No*	192	0.660	0.4746
Are you among the first to try newly introduced food products?				
(Try-New)	Yes	79	0.271	0.4455
	No*	212	0.729	0.4455
Do you think the use of synthetic pesticide has a negative effect on the environment?				
(Negative)	Yes	193	0.663	0.4734
	No*	98	0.337	0.4734
Do you believe residues from pesticide pose a very serious hazard?				
(Risk)	Yes	175	0.601	0.4905
	No*	116	0.399	0.4905
Household Size				
(Hsize)	Four or more individuals	67	0.770	0.4217
	Less than four individuals*	224	0.230	0.4217

* Refers to category that was generally omitted in the logit analysis. Please refer to the actual specification of each model.

Model One - Purchase Only Conventional Produce

The dependent variable in model one was coded according to whether or not the respondent purchased conventional produce exclusively. For those who purchase only convention produce, CONV equaled 1 and for those who purchase at least some low-input produce, CONV equaled 0. Of the 291 responses, 22.7 indicated that they only purchased conventional produce while 77.5 percent purchased at least some other types. The regression results for model one are given in Tables 3 and 4. Model one exhibited a McFadden's R^2 of 0.21 and a joint p-value for all explanatory variables of 0.0005.

All three of the age variables indicated that individuals over the age of 35 were more likely to purchase only conventional produce than those 35 years and younger. Two of the age variables (AGE1 and AGE3) were statistically significant and both groups were approximately 15 percent more likely to purchase only conventional produce than those 35 years and younger (AGE4).

All three of the included income variables indicated that those with lower incomes (INCOME1, INCOME2 and INCOME3) were more likely to purchase only conventional produce than those with incomes of $70,000 and over (INCOME4). The category INCOME2 was significant at the 0.01 level and indicated that those with annual household incomes between $30,000 - $49,999 were 16 percent more likely to purchase conventional produce exclusively than the omitted category (INCOME4).

Of the two education variables, participants with college degrees and those with some graduate school were 9 percent less likely to purchase only conventional produce when compared to those who had attained at least a Masters degree. This finding appears consistent when compared across other models as those with higher levels of education tended to exhibit lower risk aversion toward pesticide usage and lower willingness-to-purchase IPM (model 3). Members of the lowest educational group were

Table 3: Model One, Purchase Only Conventional Produce

Variable	*Estimate*	*Standard Error*	*Change in Probability*
Intercept	-0.6783	0.9591	-0.0890
Male	0.0883	0.3694	0.0116
Age1*	1.1879	0.6413	0.1558
Age2	0.6826	0.6134	0.0895
Age3**	1.1319	0.4930	0.1484
Income1	0.4875	0.5678	0.0639
Income2***	1.2464	0.5019	0.1635
Income3	0.3708	0.4534	0.0486
Education1	0.3529	0.5425	0.0463
Education2*	-0.6822	0.3922	-0.0895
Shop-many**	-0.7591	0.3827	-0.0995
Risk**	-0.7543	0.3640	-0.0989
Heard-of-IPM*	-0.7801	0.4119	-0.1023
Urban*	-1.8418	1.0885	-0.2415
Rural	-0.7089	0.5271	-0.0929
Prime	0.3104	0.4906	0.0407
Negative	-0.3544	0.3517	-0.0464
Visit	-0.3160	0.5106	-0.0414
Try-new	-0.2124	0.4005	-0.0279
Garden	-0.2875	0.3664	-0.0377
Hsize	-0.3268	0.4844	-0.0429
Kids	0.4541	0.5087	0.0595
Single	0.0302	0.5878	0.0039
Div/Sep***	-2.6725	1.1181	-0.3505
Media1***	0.9887	0.4142	0.1296
Media2**	-0.7900	0.3928	-0.1036

Joint p value for all explanatory variables: 0.0005; McFadden's R^2: 0.21
Ratio of nonzero observations to the total number of observations: 0.227
*: significant at the .10 level
**: significant at the .05 level
***: significant at the .01 level

Table 4: Model 1 Prediction Success

		Predicted	
		0	1
Actual	0	204	21
	1	53	13

Number of correct predictions: 217
Percentage of correct predictions: 74.6

more likely to exclusively purchase conventional produce than those with at least Master's degrees.

Those who had prior knowledge of IPM and those who exhibited higher risk aversion toward pesticide usage were both approximately 8 percent less likely to purchase only conventional produce. These findings were both statistically significant and consistent with the hypothesized coefficient signs. Interestingly, those who shopped at many food stores were also 8 percent less likely to purchase only conventional produce. While this is difficult to interpret, it is consistent with other parameter estimates. For instance, those who shop at many stores were also more likely to have heard of IPM and also more likely to have visited a farmer's market, both of which also contribute negatively to purchasing only conventional produce.

Those who were either divorced or separated were 35.1 percent less likely to purchase conventional produce exclusively when compared to those who were married or widowed, the omitted category. A dummy variable for single individuals was not significant.

Media variables were also highly significant in predicting which respondents purchased conventional produce exclusively. Those who made frequent use of food advertisements were 13 percent more likely to purchase only conventional produce. Those who made use of food safety reports were 10 percent less likely to purchase conventional produce exclusively. Other variables which captured the effects of shopping behavior and beliefs about pesticides which were not significant but which all demonstrated the hypothesized negative coefficient estimates included VISIT, TRY-NEW, NEGATIVE, and GARDEN. While also insignificant, household size had a negative effect on purchasing only conventional produce.

Model Two - Prior Knowledge of IPM

Model two examined the factors which contributed to having prior knowledge of IPM. The dependent variable, HEARD-OF-IPM, was coded according to whether or not the respondent indicated they had heard or read about IPM before taking the survey. For those who had heard of IPM, the dependent variable was coded as 1 and for those who had not, the dependent variable equaled 0. Of the 291 responses, 32.3 percent indicated that they had prior knowledge of IPM while 67.7 percent reported that they had not. These percentages are relatively consistent with other surveys of IPM (Burgess et al. for example). The regression results for model two are given in Tables 5 and 6. Model two exhibited a McFadden's R^2 statistic of 0.12 and a joint-p value for all explanatory variables of 0.0026.

As expected, the dummy variable for gender indicated that males were less likely to have prior knowledge of IPM than females. This is a reasonable finding because females on average are more active in selecting food for households than males. The variables for income and education all consistently indicated that the highest education category and the highest income category were the most likely to have prior knowledge of IPM. The two lowest income variables were estimated with the expected negative coefficient. The third income variable which was significant at the 0.05 level, indicated that those with annual household incomes between $50,000 and $69,999 were 16 percent less likely to have heard of IPM than those with income in excess of $70,000. Both of the included education variables were statistically significant at the 0.01 level. The lowest education group was found to be 27 percent less likely and those in the middle education group were 15 percent less likely to have heard of IPM than those with Masters and Doctoral degrees. The income and education findings seem to indicate that IPM is a luxury item which is more likely to be found in areas and food stores which are frequented by higher earning and higher educated individuals.

Table 5: Model 2, Prior Knowledge of IPM

Variable	*Estimate*	*Standard Error*	*Change in Probability*
Intercept	-0.9680	0.8038	-0.1993
Male*	-0.5314	0.3188	-0.1094
Age1	0.2975	0.4876	0.0612
Age2	0.2156	0.3971	0.0444
Age3	0.2427	0.3944	0.0500
Income1	-0.6700	0.4799	-0.1379
Income2	-0.2283	0.3859	-0.0470
Income3**	-0.8007	0.3958	-0.1648
Education1***	-1.3013	0.5307	-0.2679
Education2***	-0.7401	0.3094	-0.1524
Suburb	-0.6225	0.4852	-0.1281
Rural	-0.2983	0.5970	-0.0614
Organic	0.4023	0.2909	0.0828
Visit**	1.1422	0.5522	0.2351
Garden***	0.7032	0.2934	0.1448
Media2*	0.5001	0.2924	0.1029
Try-new	0.4531	0.2986	0.0933
Hsize	0.4314	0.4066	0.0888
Kids*	-0.7339	0.4083	-0.1511

Joint p value for all explanatory variables: 0.0026
McFadden's R^2: 0.12
Ratio of nonzero observations to the total number of observations: 0.323
*: significant at the .10 level
**: significant at the .05 level
***: significant at the .01 level

Table 6: Model 2 Prediction Success

		Predicted	
		0	1
Actual	0	164	68
	1	33	26

Number of correct predictions: 190
Percentage of correct predictions: 65.3

The variables VISIT, GARDEN, ORGANIC, and TRY-NEW were each estimated with the expected positive coefficient. VISIT and GARDEN were significant at the 0.05 and 0.01 levels respectively. Those who recently visited farmer's markets (VISIT) were 8 percent more likely to have heard of IPM than those who did not. Similarly, those who grew fruits and vegetables for consumption at home were also 24 percent more likely to have knowledge of IPM than those who did not. Those who purchased organic produce frequently and those who readily tried new food products were both more likely to have knowledge of IPM than those who did not. It is reasonable that this group of variables generally behaved consistently. Together, these variables characterize a segment of individuals who are often very knowledgeable about agriculture, and concerned about the food they consume. The variable MEDIA2 was also significant at the 0.10 level indicating that those who made frequent use of media reports on food safety were 10 percent more likely to have knowledge of IPM than those who did not.

Model Three - Willingness To Purchase IPM

Model three was a willingness-to-purchase model for IPM produce. The dependent variable (BUY-IPM) was based on a survey question which asked respondents if they would be willing to purchase IPM. For those who indicated they would buy IPM (207 respondents), the dependent variable was coded as one and for those who reported they would not purchase IPM (84 respondents), the dependent variable was coded as zero. The regression results for model three are given in Tables 7 and 8. Model three exhibited a McFadden's R^2 statistic of 0.15 and a joint p-value for all explanatory variables of 0.0001.

The gender variable which was used in most of the other regressions was both insignificant and negatively affected the performance of the model and was therefore omitted. The age estimates were consistent with those of other models and suggested that members of the youngest age group (AGE4) were more willing to purchase IPM produce than any of the three older age groups. The oldest age variable (AGE1) was

significant at the 0.05 level and indicated that those over the age of 65 were 19 percent less likely to purchase IPM produce than those 35 years of age and younger.

All three of the included income variables were significant and indicated that the highest earning respondents (INCOME4) were more likely to purchase IPM produce than any of the lower earning participants. The lowest earning group (INCOME1) was 26 percent less likely to purchase IPM produce than the highest earning group, a finding that was significant at the 0.01 level. Similarly, those in group INCOME2 were 16 percent less likely to purchase IPM produce and those in group INCOME3 were 13 percent less likely to purchase IPM produce than those earning over $70,000 annually. The variables INCOME2 and INCOME3 were significant at the 0.05 and 0.10 levels respectively.

Those who shopped at many supermarkets were less likely to purchase IPM produce than those who did not. Significant at the 0.10 level, the variable SHOP-MANY indicated that those who frequently shopped at many food stores to purchase advertised specials were 10 percent less likely to try IPM produce. A possible reason is that this subgroup is highly budget conscious and may assume that IPM produce will cost more than conventional produce. Those that lived in suburban areas were the most likely to purchase IPM produce when compared to other regional areas. Those who lived in urban and rural areas were both 18 percent less likely to purchase IPM produce than suburban residents. The estimated coefficients for regional area, URBAN and RURAL, were significant at the 0.05 and 0.01 levels respectively.

The variables PRIME, NEGATIVE, VISIT, and ORGANIC were all significant at the 0.10 level. As expected, those who believed that the use of pesticides was damaging to the environment, those who had recently visited farmer's markets, and those who frequently purchased organic produce were all more likely to purchase IPM produce. Those who believed pesticides caused negative environmental effects were 10 percent more likely to purchase IPM produce than those who did not. Those who had visited a

Table 7: Model 3, Willingness-To-Purchase IPM Produce

Variable	***Estimate***	***Standard Error***	***Change in Probability***
Intercept	-0.2182	0.6483	0.0409
Age1**	-1.0077	0.4702	-0.1887
Age2	-0.3446	0.4472	-0.0645
Age3	-0.2005	0.4181	-0.0375
Income1***	-1.3775	0.4735	-0.2580
Income2**	-0.8367	0.4092	-0.1567
Income3*	-0.7069	0.4102	-0.1324
Education1	0.7176	0.5115	0.1344
Education2	0.5241	0.3429	0.0981
Shop-many*	-0.5524	0.3138	-0.1035
Heard-of-IPM	0.3094	0.3331	0.0579
Urban**	-0.9871	0.5083	-0.1849
Rural***	-0.9505	0.4038	-0.1780
Prime*	0.6223	0.3809	0.1165
Negative*	0.5245	0.3065	0.0982
Visit*	0.7600	0.4089	0.1423
Organic*	0.5982	0.3399	0.1120
2Kids	-0.5118	0.4112	-0.0958
Risk	-0.0983	0.3164	-0.0184
Garden	0.1940	0.3234	0.0363

Joint p value for all explanatory variables: 0.0001
McFadden's R^2: 0.15
Ratio of nonzero observations to the total number of observations: 0.711
*: significant at the .10 level
**: significant at the .05 level
***: significant at the .01 level

Table 8: ***Model 3 Prediction Success***

		Predicted	
		0	1
Actual	0	19	26
	1	65	181

Number of correct predictions: 200
Percentage of correct predictions: 68.7

farmer's market were 14 percent more likely to purchase IPM and those who frequently purchased organic produce were 11 percent more likely to purchase IPM produce than those who did not. The variables VISIT and ORGANIC are especially useful findings because they not only indicate a segment of the population that is willing to purchase IPM produce, but also provide a way to market IPM to those individuals through farmer's markets and organic retailers. Those who were the primary grocery shoppers of the households were 12 percent more likely to purchase IPM produce than those who were not.

Model Four - Willing to Pay >10% for IPM

Regressions four and five are willingness-to-pay models for IPM and organic produce. The dependent variables were generated from survey questions in which the respondents chose the additional amount they would be willing to pay to purchase IPM and organic produce from a list of pre-defined premiums. The questions provided six responses to choose from which ranged from no premium to an over 20 percent premium. While other studies have made use of an ordered logit model to predict which of the six premiums certain individuals were likely to choose, a decision was made to forego this approach. Subsequently, binary dependent variables were generated such as those used in the other regressions of this study as the ordered logit predictions would have been difficult to draw a meaningful interpretation from. In both models four and five the dependent variable was coded as one for those willing to pay at least a 10 percent premium and 0 otherwise. The dependent variable in model four (PAY-IPM) had a mean value of 0.38 as compared to the dependent variable in model five (PAY-ORG) which had a mean value of 0.34. Overall, 37.8 percent of the respondents indicated they were willing to pay at least a 10 percent premium for IPM produce while 62.2 percent reported they were willing to pay less than that amount. The regression results for model four are given in Tables 9 and 10. Model four exhibited a McFadden's R^2 statistic of 0.14 and a joint p-value for all explanatory variables of 0.0001.

Table 9: Model 4, Pay >10% Premium for IPM

Variable	*Estimate*	*Standard Error*	*Change in Probability*
Intercept	0.6982	0.7633	0.1706
Male*	-0.5309	0.3090	-0.1297
Age1**	-0.9419	0.4826	-0.2301
Age2***	-1.0896	0.4246	-0.2662
Age3*	-0.6646	0.3722	-0.1624
Income1**	-1.0957	0.4779	-0.2677
Income2***	-1.2476	0.4025	-0.3048
Income3**	-0.7608	0.3638	-0.1859
Education1	-0.4683	0.4881	-0.1144
Education2	-0.4689	0.3110	-0.1146
Suburb	-0.0040	0.4984	-0.0010
Rural	0.1668	0.6045	0.0407
Organic***	1.0625	0.2909	0.2596
Visit	-0.0905	0.4525	-0.0221
Risk*	0.6125	0.3025	0.1497
Kids	0.2148	0.3798	0.0525
Heard-of-IPM	0.1642	0.2959	0.0401
Hsize**	-0.7815	0.4014	-0.1910
Shop-Many	-0.3852	0.3035	-0.0941

Joint p value for all explanatory variables: 0.0001
McFadden's R^2: 0.14
Ratio of nonzero observations to the total number of observations: 0.378
*: significant at the .10 level
**: significant at the .05 level
***: significant at the .01 level

Table 10: Model 4 Prediction Success

		Predicted	
		0	1
Actual	0	148	63
	1	33	47

Number of correct predictions: 195
Percentage of correct predictions: 67.0

As expected, the dummy variable for gender (MALE) was significant and had a negative coefficient. Males were found to be 13 percent less likely to pay the 10 percent premium for IPM produce than females. All three age variables were statistically significant and were estimated with negative coefficients when compared to the youngest age group. Those over the age of 65 were 23 percent less likely to pay the premium for IPM produce than those under the age of 36. Similarly, those between the ages of 51 and 65 were 27 percent less likely and those between the ages of 36 and 50 were 16 percent less likely to pay the premium for IPM than the youngest age group.

Whereas the youngest age group was the most willing to pay the premium for IPM, it was the highest income and the highest education groups that were the most willing to accept the premium in those categories. All three of the included income variables were highly significant. Those with annual household incomes below $29,999 (INCOME1) were 27 percent less likely to pay a premium for IPM produce than the those will annual come over $70,000. Similarly, those with annual incomes between $30,000 and $49,999 (INCOME2) were 30 percent less likely and those with annual incomes between $50,000 and $69,999 (INCOME3) were 19 percent less likely to pay the premium than the highest earning group (INCOME4).

The variable for household size (HSIZE) was significant at the 0.05 level. Households with four or more residents were 19 percent less likely to pay the 10 percent premium for IPM produce than were smaller households. These results may be closely related to the significant income variables. For instance, larger households may generally have less discretionary income per resident than smaller households. If so, the negative household size estimate may be consistent with the estimates for income.

Those who frequently purchased organic produce (ORGANIC) were 26 percent more likely to pay a premium for IPM produce. As expected, those with high risk aversions toward pesticides were 15 percent more likely to pay the premium.

Model Five - Willing to Pay >10% For Organic Produce

As in model four, the dependent variable in model five (PAY-ORG) was coded as one for those willing to pay at least a 10 percent premium for organic produce and 0 otherwise. Overall, 34.4 percent of respondents indicated they were willing to pay at least a 10 percent premium for organic produce while 65.6 percent reported they were willing to pay less than that amount. The maximum likelihood estimates for willingness-to-pay are displayed in Table 11. The model exhibited a McFadden's R^2 statistic of 0.28, however, the focus of this study was not the predictive power of the model but to document the effect which differences in demographic characteristics brought about in the willingness-to-pay for organically grown produce. The dependent variable (PAY-ORG) was coded as one for those willing to pay at least a 10 percent premium for organic produce and 0 otherwise. The joint p-value of 0.0001 clearly rejected the null hypothesis that all the coefficients of the explanatory variables were zero.

The gender variable was significant at the 0.10 level and was estimated at the expected negative value. Consistent with the results of previous studies (Huang; Groff; Ott and Maligaya; and Byrne), males were 13 percent less likely to pay a 10 percent premium for organic produce. Also consistent with the results of Underhill and Figueroa, Buzby et al., and Zellner and Degner, all three of the included age variables were more willing to pay the premium than the oldest age group. The explanatory age variables (AGE2, AGE3, AGE4) were all statistically significant when compared to the oldest category (AGE1). Those over under 36 years of age were approximately 40 percent more likely to pay a premium for organically grown produce than those over 65. Similarly, those between the ages 36 and 50 were 35 percent more likely to pay the premium and those between the ages of 51 and 65 were 22 percent more likely to pay the premium than those over the age of 65.

Although the estimated coefficient signs for the income dummy variables were all consistent with our expectations, only one income variable (INCOME2) was significant. Together the three income variables suggest that willingness-to-pay a premium is

greater for those with annual incomes over $70,000. These findings support those of Misra, Huang, and Ott and Underhill and Figueroa. Those with incomes between $30,000 and $49,000 were found to be 30 percent more likely to pay the premium for organically grown goods than the highest income group.

The two educational categories (EDUCATION2 and EDUCATION3) were both found to be less willing to pay the premium for organic produce when compared to the lowest education group (EDUCATION1). Those who had completed some college or attained bachelors degrees were 17 percent less likely to pay a premium for organically grown produce than those who had not attended college. Those who had completed at least some graduate school were 21 percent less likely to pay the premium when compared to those who had not attended college. These findings are consistent with those of Misra, Huang and Ott; Malone; and Zellner and Degner. Possible implications suggest that lower educated consumers may exaggerate the true risks of pesticide usage or higher educated respondents have a higher degree of confidence in produce safety standards.

As expected, the dummy variable denoting those who regularly purchased organic produce (ORGANIC) was highly significant in predicting those who would pay a premium. While this finding was intuitive, it confirms Goldman and Clancy's (1991) findings that those who often purchase organic produce are less concerned than other shoppers about price when they shop for produce. Overall, organic customers were 41 percent more likely to pay the 10 percent premium than those who did not regularly purchase organic produce. Households with more than four individuals were found to be 14 percent less likely to pay a premium for organic produce.

Table 11: Model 5, Pay >10% Premium for Organic Produce

Variable	*Estimate*	*Standard Error*	*Change in Probability*
Intercept***	-2.3307	0.9745	-0.4634
Male*	-0.6444	0.3680	-0.1281
Age2*	1.1081	0.5983	0.2203
Age3***	1.5345	0.6162	0.3512
Age4***	1.9978	0.6075	0.3973
Income1	-0.5766	0.5336	-0.1147
Income2***	-1.5368	0.4950	-0.3056
Income3	-0.4780	0.4128	-0.0950
Education2*	-0.8966	0.4857	-0.1783
Education3**	-1.0308	0.5454	-0.2050
Shop-many	-0.1009	0.3521	-0.0201
Kids	0.3273	0.4357	0.0651
Visit	-0.0703	0.5448	-0.0140
Organic***	2.1023	0.3369	0.4180
Heard-of-IPM***	0.9708	0.3385	0.1930
Risk	0.1204	0.3528	0.0240
Garden	0.4487	0.3398	0.0892
Media1	-0.2879	0.4105	-0.0572
Media2	0.1740	0.3391	0.0346
Hsize*	-0.7265	0.4500	-0.1446
Prime	0.1181	0.4392	0.0235
Try-New**	0.7710	0.3416	0.1533
Negative	0.2921	0.3559	0.0581

McFadden's R^2: 0.28
Ratio of nonzero observations to the total number of observations: 0.343
*: significant at the .10 level
**: significant at the .05 level
***: significant at the .01 level

Table 12: Model 5 Prediction Success

		Predicted	
		0	1
Actual	0	158	47
	1	33	53

Number of correct predictions: 211
Percentage of correct predictions: 72.5

A significant variable also indicated that those who had knowledge of integrated pest management methods of pest control were 19 percent more likely to pay the 10 percent premium for organic produce. Those who indicated they were among the first to try newly introduced food products were also 15 percent more likely to pay an organic premium. While these two variables are not typical demographic categorizations, they help to illustrate possible avenues to solicit potential organic customers.

Conclusion and Discussion

Contributions and Limitations of the Study

This study is among the very first to apply logit models of consumer choice to predict which segments of the population would most likely purchase produce grown using integrated pest management practices. While IPM is an imminently successful and promising agricultural endeavor, little relevant market research had been previously done to understand public sentiment and response to the program. Conversely, a great deal of applied economic work has been done in recent years to estimate the demand for organic produce which is unlikely to ever constitute a major percentage of the global food supply. This study should be a relevant and useful addition to the existing literature for those who intend to market integrated pest management produce.

Of the studies that have been done, few have involved IPM directly. Most have centered on risk aversion to pesticide residues and willingness-to-pay for low-input agriculture. Yet, when these studies are examined as a group, it is difficult to make decisive aggregate interpretations because many of the previous findings are conflicting. For instance, many studies report positive relationships between certain demographic variables and risk aversion to pesticides while still other studies find negative relationships between these same variables and risk aversions. Differences in the survey instruments, sampling techniques, and the hypothetical nature of the questionnaires may all contribute to differences in the findings. Many attitudinal and consumption factors also vary widely from one region to another necessitating research

that is carried out on a localized level. Because of its centralized regional focus, this study may also be a valuable tool for local agribusiness in New Jersey.

The main limitations of the study have to do with the data collection methods. The hypothetical nature of the contingent valuation method allows for a theoretical inconsistency between real life results and those predicted by the survey. However, CV is widely accepted as one of the most cost effective and generally reliable approaches available. The use of different sampling methods to solicit as many responses as possible may have introduced some form of bias into the data. While individuals were contacted randomly by mail to participate in the survey, the danger of non response bias is always present with this technique. Finally, all the respondents who participated in the survey were residents of New Jersey and may share some common attitudes which are unique to this region. Therefore the results may be less relevant to southern and western areas of the country than they are to the states in the northeastern region.

Summary of Findings and Effects of Demographic Variables

IPM is an imminently successful production method that will inevitably play a major role in the future of agriculture. As IPM grown produce continues to increase in its share of the U.S. food supply, there are a number of ways in which it could be marketed to the public. The results of this study suggest that the majority of consumers appear willing to purchase IPM produce; specifically, higher earning households, younger individuals, and those who frequently purchase organic produce appear to be among the most likely to purchase IPM produce. However, before the level of acceptance and demand evidenced by this study can be realized, some form of educational mechanism must be implemented to inform consumers of the benefits and existence of integrated pest management.

Consumers were also found to be willing to pay a premium to obtain IPM produce; specifically, females, higher earning households, younger individuals, and those who

frequently purchase organic produce appear to be among the most likely to pay a 10 percent premium for IPM produce.

The results of this study suggest that the majority of consumers would be willing to pay a premium to obtain organic produce; specifically, females, individuals under 65 years of age, lower earning individuals and those who frequently purchase organic produce appear to be among the most likely to pay a 10 percent premium for organic produce. The results also suggest that higher earning households would be more likely to exhibit a higher willingness-to-pay for organic produce.

Sharp differences in gender were found in the sample. Males were significantly less likely to have heard of IPM than females. Similarly, they were also less likely to pay a premium to obtain either organic or IPM produce. These findings were consistent with previous studies, most of which have found that women are more likely than men to place pesticide residue as a top concern (Dunlap and Beus). Huang also found that females are more likely to place pesticide residues as a top food concern and also that females were more likely than males to pay a premium for certified residue free produce.

With respect to willingness-to-pay for low input agriculture, older individuals were found to be less willing to pay a premium for either IPM or organic produce than younger individuals. Older individuals were also less likely to purchase IPM produce and more likely to purchase conventional produce exclusively than younger individuals.

Households with higher annual incomes seemed to be more willing to pay a premium to obtain organic and IPM produce than lower income households. The regression models also predicted that households with higher incomes would be more willing to purchase IPM produce than lower earning households and that households with higher incomes were also less likely to purchase only conventional produce. As expected, the

most significant education finding was that those with higher levels of education were more likely to have prior knowledge of IPM.

Significant income findings indicated that those with higher annual household incomes would be more willing to pay a premium for low input produce. This effect may also be reflected in households with children as they generally have less discretionary income per individual.

A dummy variable which denoted that the respondent frequently purchased organic produce was significant in many models. As expected those who frequently purchased organic produce were more likely to be risk averse toward pesticide usage, more likely to purchase IPM, and more likely to pay a premium for both organic and IPM produce. Interestingly, while those who frequently purchased organic produce reacted quite favorably toward IPM, the average participant responded much more favorably toward IPM produce than organic produce.

Dummy variables for regional area (i.e. suburban, urban and rural) were relatively insignificant in many of the models. Urban households were more likely to purchase IPM produce than suburban households and rural households would be less likely to purchase IPM produce than suburban households. Suburban households were more likely to be risk averse than urban or rural households. Virtually no other studies have reported statistically significant findings for regional variables making comparison difficult.

Table 13 below summarizes the directional effect of many of the statistically significant findings. Dummy variables for income, age, education and gender were all highly consistent with their hypothesized coefficient signs. The two media variables were added late in the regression analysis and found to be more significant than they were originally hypothesized. Visitations to farmer's markets and home gardeners were ultimately not as significant as they were hypothesized to be.

Table 13 - Summarized Effects of Key Explanatory Variables

Explanatory Variable	***Pay More for Organic***	***Heard of IPM***	***Only Conven.***	***Buy IPM***	***Pay More for IPM***
Male	-	-			-
Education	+	+			
Income			-	+	+
Age	-		+	-	-
Risk			-		+
Organic	+				+
Media1			+		
Media2	+	+	-		
Kids	+	-			
Heard of IPM	+		-		

Nearly all significant parameter estimates for willingness-to-purchase IPM and willingness-to-pay for IPM and organically grown produce were consistent with one another. Furthermore, significant coefficients for these models were found to have opposing signs as the determinants of strict conventional produce customers.

Both of the media variables which were included in the regression models may be useful when selecting ways to communicate with or educate certain populations about any of the topics of this study. In each case where both media variables were used in the same model, they were estimated with opposite signs indicating a substantial difference between those who make use of food advertisements and those who pay close attention to food safety issues in the media. In general, those who use food advertisements were more frugal, less risk averse, and more likely to purchase only conventional produce than those who did not. Conversely, those who made frequent

use of food safety reports were clearly more risk averse, more willing to pay a premium for low input produce and less likely to only purchase conventional produce.

An increased adoption of integrated pest management should increase the sum of producer and consumer surplus. Yet, few growers have adopted IPM production methods because of regulatory barriers and a lack of faith in the program. Given the low awareness of IPM, educational policy measures may be the greatest method to increase consumer support and grower participation. Because education was the best predictor of having prior knowledge of IPM, the results suggest that Extension agents and food marketers should target lower educated households.

The goal of this research was to provide food marketing agents with a better understanding of consumer purchase behavior, preferences and beliefs that are relevant to integrated pest management. These findings may be especially encouraging to those developing marketing strategies for low input produce such as organic and IPM produce.

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Survey of Consumers of Fresh Vegetables

How would you classify yourself in terms of trying a newly introduced food product in the supermarket?

- ❑ among the first to try
- ❑ among the last to try
- ❑ between the first and last to try
- ❑ never try

How frequently do you check the ingredient label on the food you purchase?

- ❑ never
- ❑ occasionally
- ❑ usually
- ❑ always

How often do food advertisements in the newspapers help you decide which food items to purchase?

- ❑ never
- ❑ occasionally
- ❑ usually
- ❑ always

How often do newspaper articles/television/radio reports on food safety issues help you decide which food items to purchase?

- ❑ never
- ❑ occasionally
- ❑ usually
- ❑ always

Do you regularly shop at more than one food store in order to purchase advertised specials?

❑ yes ❑ no

Do you grow fruits or vegetables for consumption at your home?

❑ yes ❑ no

Have you visited a Farmers' Market in the past five years?

❑ yes ❑ no

How do you feel about the following?	**Serious hazard**	**Somewhat of a hazard**	**Not a hazard at all**
Residues from pesticides or herbicides	1	2	3
Antibiotics found in poultry and livestock	1	2	3
Growth stimulant in poultry and livestock	1	2	3
Artificial fertilizers	1	2	3
Additives and preservatives	1	2	3
Artificial coloring	1	2	3

Have you heard or read any news report about integrated pest management (IPM)?

❑ yes ❑ no

Please read before proceeding

Integrated pest management (IPM) is a crop production program in which a combination of pest control techniques are used. The farmer does not rely completely on the regular scheduled use of chemical pesticides. Other methods are used such as resistant plants, natural enemies and destruction of places where pests breed. Only when those other methods fail to control pests does the farmer use chemical pesticides as a last resort. With IPM, farmers typically reduce their usage of chemical pesticides by one-third or more.

If IPM produce was labeled as such in your supermarket do you think that you . .

❑ would buy
❑ would not buy
❑ do not know/not sure

Suppose your favorite vegetable that you purchase regularly costs $1 per pound. Would you pay slightly more for IPM-certified produce?

❑ no
❑ yes, I would pay between 1 cent and 5 five cents more for IPM produce
❑ yes, I would pay between 6 cents and 10 cents more for IPM produce
❑ yes, I would pay between 10 cents and 15 cents more for IPM produce
❑ yes, I would pay between 15 cents and 20 cents more for IPM produce
❑ yes, I would pay over 20 cents more for IPM produce

Would you switch supermarkets to be able to purchase IPM produce?

❑ yes ❑ no

Organically produced food uses ***no*** pesticides and are normally labeled as such in the supermarket. How frequently do you choose fresh food and vegetables that are organically grown?

- ❑ never
- ❑ seldom
- ❑ usually
- ❑ always

Would you switch supermarkets to be able to purchase organic produce?

❑ yes ❑ no

Suppose your favorite fresh vegetable that you purchase regularly costs $1 per pound. Would you pay slightly more for organic certified produce?

- ❑ no
- ❑ yes, I would pay between 1 cent and 5 five cents more for organic produce
- ❑ yes, I would pay between 6 cents and 10 cents more for organic produce
- ❑ yes, I would pay between 10 cents and 15 cents more for organic produce
- ❑ yes, I would pay between 15 cents and 20 cents more for organic produce
- ❑ yes, I would pay over 20 cents more for organic produce

Please select the amount and types of produce you purchased in 1995:

Conventional Produce	___ all	___ most	___ some	___ none
Organic Produce	___ all	___ most	___ some	___ none

How do you feel about the following statements?

	Agree	Neutral	Disagree
Conventional produce is generally safe to consume	1	2	3
There is basically no difference between the safety of conventional, IPM and organic produce	1	2	3
The use of synthetic chemicals in agriculture has a negative effect on the environment	1	2	3
I would buy organic produce if it were more readily available	1	2	3
I would buy organic produce if it were cheaper	1	2	3
I would buy IPM produce if it were more readily available	1	2	3

Your answers to the following questions are strictly kept confidential and will help us interpret the results of this survey.

How many persons, including yourself live in your household? _____

How many persons in your household are below the age of 17? _____

Are you the primary shopper for food in your household?

❑ yes ❑ no

Do your consider your neighborhood

❑ urban ❑ suburban ❑ rural

Please select your gender

❑ female ❑ male

In what range does your age (in years) fall? (Please circle one)

❶	❷	❸	❹	❺
less than 20	**21 - 35**	**36-50**	**51-65**	**over 65**

Please select the highest level of education you have completed. (Please circle one)

❶	❷	❸	❹	❺	❻	❼	❽
Some Grade School	**Some High School**	**High School Graduate**	**Some College**	**College Graduate**	**Some Graduate School**	**Masters Degree**	**Doctoral Degree**

In what range does your annual household income fall? (Please circle one)

❶	❷	❸	❹	❺	❻	❼	❽
Less than $9,999	**$10,000 to $19,999**	**$20,000 to $29,999**	**$30,000 to $39,999**	**$40,000 to $49,999**	**$50,000 to $59,999**	**$60,000 to $69,999**	**More than $70,000**

Which of the following ***best*** describes your current marital status. (Please circle one)

❶	❷	❸	❹	❺	❻
Single	**Married**	**Separated**	**Divorced**	**Widower(d)**	**Other**

If you live in New Jersey, please select the county you reside in.

❶	❷	❸	❹	❺	❻	❼
Mercer	**Somerset**	**Middlesex**	**Morris**	**Monmouth**	**Bergen**	**Other**_____

Thank you for your help in completing this survey and have a good weekend!

THE STATE UNIVERSITY OF NEW JERSEY

RUTGERS

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