Heterogeniety of Farmer Choices: Do Perceptions of Risk, Control, Likelihood of Damage and Sociability Affect Outcomes?

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1 Introduction

Economists have studied the impact of the agricultural practices on a variety of environmental outcomes. It has been shown in the literature that farmers make choices which are consistent within a profit maximizing framework. But an important question unanswered was, are there factors other than profit which affect farmer choices? Another related question which has not been studied enough: is whether there is a heterogeneity of farmer preferences? Do certain groups of farmer behave systematically differently from other farmers belonging to a different group? Extant research (Konar, Roe and Irwin, 2012) indicates that there is some evidence of heterogeneity of farmer choices along environmental preferences.

This paper seeks to address whether there are other factors which contribute to the heterogeneity of farmer preferences. One possible answer is that perceptions or preconceived ideas that farmers may have developed over their lifetime through interaction with other people might impel them to behave in certain ways. Often these factors are not observable to the researcher. We use a data set which specifically asks questions to farmers to gauge their awareness about environmental issues, the perceived control they have over nutrient runoffs, the extent to which they are social, their perception of the likelihood of damage from nutrient loss, their perception about efficacy of best management practices, social norm and their risk perception. These variables are used in conjunction with observables to see if there are indeed any effect of perception of farmers on tillage choices. Furthermore, whether heterogeneity of farmer choices exist is empirically tested by using Latent Class Regressions.

2 Literature Review

There is a considerable volume of literature in psychology suggesting that social norm have a powerful impact on individual decisions and actions. The experimental literature in psychology demonstrates that providing information on social norms have a powerful influence on individual action. Cialdini, 2003 talks about injunctive versus descriptive norms. Descriptive norms are what is popular/typical/normal, i.e. descriptive norm can be thought of what is. Injuctive norms are those that are morally approved/disapproved, i.e. injunctive norm are what ought to be. This paper contends that public service announcements (PSA) could have a huge impact on individuals' decisions but could also backfire. A PSA focussing on positive descriptive norm (example some prevalence of environmentally beneficial activity) could be extremely useful and motivate people to follow the norm on the other hand a PSA focussing on a negative descriptive norm would convince people that particular action is commonplace and there is nothing seriously wrong in committing it.

Goldstein, Cialdini and Griskevicius, 2008 contends that appeals employing descriptive norms proved superior to environmental protection compared to injunctive norms. They talk about provincial norm, which is a normative appeal made when describing a group behavior that closely mimics individuals' immediate situational circumstances. For e.g., a sign in a hotel room saying that most people in this particular room typically reuse their towel is an instance of provincial norm as opposed to a sign saying most people staying in this hotel reuse their towel which is an example of a global norm. they contend that individuals tend to respond stronglyl to provincial norm statements compared to global norm. Their conclusion suggests that descriptive norm of same social category or identity did not motivate individuals as much to prosocial as would be expected.

Gerber and Rogers, 2009 shows that publicizing positive descriptive norm would increase the probability of voter turn out. Individuals are more likely to change from not voting to voting when they hear about a descriptive norm of high turn out (HTO) as opposed to a low turn out (LTO).

Influence of norm on individuals mean that a number of people tend to emulate what the norm is. There are a variety of reasons as to why individuals might want to emulate norms. We might want to signal to people that we belong to a high station in society by undertaking conspicuous consumption (Veblen, 1899). Pesendorfer, 1995 situates fahion in the social context. Often trends/styles/fashion are 'in' given a particular social or cultural context and because of social demand. Often what is fashionable has no practical use. So fashion has to be understood by considering consumption as a social activity. The adoption of fashion is driven by differentiation of types, where the upper class might want to differentiate themselves from the lower class. This paper analyzes a 'dating game' where there are two types of players 'low' and 'high' and analyzes the conditions of various fashion cycles extending from 0 (new design renders old design obsolete) to long cycles depending on the size of the investment and fixed cost undertaken for the design in question.

Individuals might want to conform to social norm for fear of incurring social penalty. Akerlof, 1980 contends that individuals might want to break social norm if they derive a positive utility or pecuniary benefit from it. But breaking of the norm leads to erosion of the social norm. It is likely that with a greater percentage of the population within the community breaking the social norm, the norm might be eroded away. But in the presence of a sufficiently high penalty breaking the social norm may not be possible. The paper talks about multiplicity of equilibria and demonstrates conditions under which more than one social norm could be supported.

Individuals might want to emulate social norm because they derive some intrinsic utility from conforming to the social norm. Akerlof and Kranton, 2000 theorizes and includes

identity into the utility function. Individuals receive identity based payoffs derived fromtheir own actions. They also derive identity based payoffs derived from actions of others. Third parties can generate persistent changes in these payoffs. Choice of identity is therefore also an economics decision. Actions chosen, which otherwise may not make sense, can be explained as actions chosen to bolster a sense of self. Identity now underlies a new type of externality where individual actions can have meaning for and evoke responses in others.

Individuals might want to conform to a norm to signal a benevolent underlying preferences. Bernheim, 1994 posits that individuals care about status (popularity, esteem or respect). They define preferences over social status variable in addition to preferences over consumption which is closely related to the concept of altruism. An altruistic person cares about another person but a person motivated by esteem, popularity or status cares about what others think about them. Esteem comes from the expected future behavior. Tastes and proclivities determine future action but they are unobservable. So individuals signal their tastes and proclivities (to gain esteem) by choosing actions (determined by factors other than consumption). Thus a generous individual might be esteemed while a selfish individual might be disdained. Individuals might subscribe to a homogeneous set of behavior (norm) despite having a heterogeneous preferences to gain popularity or acceptance.

Becker, 1974 contends that individuals might conform to a norm to attain social acclaim. This paper incorporates social interaction in a utility framework and uses the concept of 'social income', the sum of a person's own income and monetary value to him of relevant characteristics of others which Becker calls social environment.

In the context of informational uncertainty, individuals might want to follow others' choices because their peer may be privy to information precluded to them. Banerjee, 1992 contends that individuals paying attention to choices made by others could be rational becasue they have information that this individual does not have resulting in 'herd behavior'. But this means individuals are less responsive to their own information than they are to choices made by others and thereby being less informative to others who might follow their choices paying less heed to their information.

There is a considerable amount of literature on 'conditional cooperation' which has shown that people are more likely to contribute to public goods when informed that others are contributing. Alpizar, Carlson and Johansson-Stenman, 2008 contend that individuals conform to norm by reciprocating, i.e. if they observe unselfish behavior they would themselves behave unselfishly. People are motivated by their own view of themselves as well as others' view of them. People have been observed to cooperate far more than what a standard economic theoretical model would predict and one plausible explanation is 'conditional cooperation', contribute more if you see others are contributing as well, Fishbacger, Gachter and Fehr,

2001 (Economic Letters). Frey and Meier, 2004 contend that roughly 50 % of individuals increase their contributions if others do as well. Conditional cooperation exists but the effects vary depending on past contribution amount/behavior. Those who do not contribute do not change their behavior, while those who are indifferent react most strongly to information about others' behavior.

Individuals have been known to conform or follow suit because it facilitates social learning. Conley and Udry, 2010 investigates learning about a new technology by farmers which includes adoption of intensive use of fertilizers and other agricultural chemicals. Farmers adjust input levels as a response to news of profitability of neighbors using same input levels. Foster and Rozenzweig, 1995 incorporates learning by doing and learning from others in a modified targer-input model of ew technology in the context of Green Revolution period in India.

Peer effects have been found to play an important role in retirement savings (Duflo and Saez, 2003, 2002). Mobius, Niehaus and Rosenblat, 2005 investigates the effect of social learning on consumer demand for standard consumer products such as cell phones and mp3 players and find social learning effects are at least as big as advertising effects.

Clark, Kotchen and Moore, 2003 investigates the motivations for pro-environmental behavior (PEB). He contends that economists have tended to examine the influence of external conditions like income, price and socio-economic characteristics often leading to conclusions that effective tools for changing behavior are driven via motivations of reward, punishment or regulations. Psychologists link internal or psychological variables to behavior and thus PEB originates from beliefs, values and attitudes that orient individuals toward particular actions. Therefore awareness, education, guilt and persuasion are effective methods to change individual actions. The internal variables in this paper includes scales for altruism (Schwartz norm activation model) and environmental attitudes (NEP scale). results indicate that the outcome variable, participation in green electricity, is significantly affected by both the altruistic attitudes and environmental attitudes. Amongst external variables, participants tend to have higher income and fewer members in households.

3 Survey Data and Variables

This paper uses data from a survey conducted on corn and soy farmers in the Maumee watershed area in northwest Ohio. The Maumee river drains into Lake Erie and 60 - 80 % of the landuse in the watershed is agricultural, predominantly farming corn and soybean. Topological and soil conditions within the Maumee watershed are relatively homogeneous, allowing analysis of heterogeneity to largely focus on preference heterogeneity rather than

gross physical variation.

We conducted a mail survey of around 2000 farmers with postal addresses in counties within the Maumee watershed following a modified version of Dillman's Tailored Design method (Dillman, 2000). We sent an announcement letter and a survey packet by mail and followed up with non respondents by sending a reminder letter and a replacement survey. Farmers who completed the survey were entered into a raffle to receive one free pair of football tickets to an Ohio State Buckeyes football game. This elicited 674 responses (around 34%) of the approximately 2000 farmers that we reached out to.

The survey was pilot tested several months before distributing the surveys with farmers recruited by local extension educators. Some of the key questions asked in the survey which have been used in this study is described below. To gauge the farmers' preference as environmental stewards in relation to profit motivation is measured by the following question.

> If you had 100 points to assign to these five goals to demonstrate their relative importance when making farm management decisions, how would you do that? For example, someone who places equal weight on making a profit and maintaining a farming lifestyle, but no weight on the remaining goals would assign 50 points to profit and 50 points to lifestyle, and 0 to the rest. Assign the points in the way that best reflects the importance of each goal to you. Be sure that the total points assigned add up to 100.

The five goals were (i) Making a Profit, (ii) Being an Environmental Steward, (iii) Protecting Human Health, (iv) Ensuring Farm Viability for My Children and (v) Maintaining a Farming Lifestyle. Another set of similar questions asked farmers to rate the above listed five goals on a Likert Scale ranging from 0 to 3 (not important to very important).

We created three alternative variables to capture the relative importance of environmental stewardship vis a vis profit. We did a principal component analysis on goal number (ii) and (iii) from the likert scale questions and retained the only factor produced. This is called the Environment and Health 1. This variable is used in conjunction with the variable which records the response to the likert scale question for profit ((i)). Initially all the five goals were included, but due to high uniqueness profit was dropped. Further, a principal component analysis was done on goals (i) and (ii) from the points allocated out of 100 and the only factor from this was also retained. This is denoted as Environment and Health 2 which is used in conjunction with the response to the number of points allocated to profit out of 100. The last variable we constructed was a difference between the points given to environment and the profit (from the question which asks farmers to allocate out of 100). This is denoted as $E - P$ and regressions which use this variable does not have profit points in it because it already makes use of it.

We used the following two questions to measure the environmental awareness of farmers. On a likert scale of 0, 1 and 2 (not aware to very aware) they were asked to rate the following: how aware are you of the algae issues in (a) Grand Lake St. Mary's and (b) Western Lake Erie Basin. Principal component analysis yielded one factor which we call Aware.

To measure the perceived control the farmers have over nutrient loss and water quality we employ principal component analysis on the following three questions, on each of which the farmer was supposed to respond on a likert scale of 7 points:
How much control do you have over nutrient loss on your farm?, reducing nutrient loss would be (very difficult to very easy), and how much control do you have over your farms impact on water quality? The first factor of the result was retained and named Control.

The response to a 5 point likert scale to the question the following question measures the sociability of the farmer: how often do you have conversations with other friends and neighbors who farm about farming and farm management? The response is measured as Social. We created two measures of perceived likelihood of harm of nutrient loss from agriculture. The first variable was constructed by doing a principal component analysis on three 5 point likert scale questions which asked: circle the number that indicates how likely or unlikely it is that nutrient loss from agriculture will negatively impact of (a) farming profit potential (b) row crop farming as a viable occupation and (c) livestock farming as a viable occupation. This variable is called Likelihood Measure from Farming Practices (Llfarmprac). The second variable is constructed from two similar 5 point likert scale questions: circle the number that indicates how likely or unlikely it is that nutrient loss from agriculture will negatively impact of (a) human health and (b) water quality. This variable is called Likelihood Measure of Human Health and Water Quality (LlhumanhealWQ).

The perceived efficacy of various management practices are measured by doing a principal component analysis on the following 5 point likert scale questions: indicates to what extent you agree or disagree with each of the following statements having to do with nutrients and related management practices (a) nutrients lost from agricultural fields contribute to water quality issues in Ohio, (b) nutrients lost from livestock operations contribute to water quality issues in Ohio, (c) variable rate application reduces the amount of fertilizer lost from the farm field and (d) conservation tillage reduces the level of nutrients lost through erosion. The result yielded two factors, the first factor loaded on the first two questions and we call it HarmWQ. The second factor loaded on the other two variables and we call it Efficacy of best management practices (Effibmp).

A variable called Norm is constructed from the principal component analysis of the following two 5 point likert scale responses (strongly disagree to strongly agree): (a) when it comes to my nutrient management practices, I want to do what society thinks I should do

and (b) when it comes to my nutrient management practices, I want to be like other farmers in my community. Risk Perception of farmers about harm from nutrient loss is measured by the 7 point likert scale question: circle the number that most accurately represents how concerned you are about nutrient loss on your farm.

Farmers' attitude towards risk tolerance is measured from the principal component analysis of the following 11 point likert scale questions: (a) are you generally someone who is willing to take risks or do you try to avoid taking risks?, (b) how would you rate your willingness to take risks while driving, (c) how would you rate your willingness to take risks with investments, (d) how would you rate your willingness to take risks in your occupation as a farmer and (d) how would you rate your willingness to take risks with your health. There are two factors, one that loaded on (c) and (d). This is called Riskmonfin and the other factor is called Riskhealsafe.

The observable variables used are gender, age, education, the number of generations the farmer has been farming (1st, 2nd and 3rd) and gross sales from the farm.

The farmer choice of interest for this study are the tillage practices of farmers. The survey asks a 3 point likert scale (never, sometimes and always) question: how often you engage in the practice of (a) Conservation tillage (30-90% post-planting residue) and (b) No-till (90% or more post-planting residue). From these two questions we have calculated a variable for Conventional tillage. We use two kinds of variable, firstly the binary response. This is created by collapsing sometimes and always as 1 and never as 0. The binary responses are used to estimate a logistic regression of conventional, conservation and no till. The multinomial response variable is used to estimate a multinomial logit model. Finally a latent class model is estimated for both the binary response and the multinomial response variables.

A latent class model is a finite mixture logit model and assumes that there are possibly different groups or classes of farmers in the sample where farmers belonging to one group makes choices systematically different from choices made by farmers in other groups. Within each group farmers are supposed to behave identically. The number of groups and membership of farmers into different groups are unobservable to the researcher but can be estimated and predicted. There are two kinds of variables in latent class models: predictors and covariates. The predictors are variables that directly affect the outcome variable of interest, in our case tillage choices made by farmers. The covariate variables do not affect the outcome variable directly but determine the membership into different classes.

4 Empirical Results

Tables 1, 2 and 3 reports the marginal effects for the logistic regression of the binary response for conventional tillage, conservation and no till. For all the regressions we used four cases, firstly when we did not include any environment or profit variables, and then the three variables of environment described above in conjunction with the relevant profit variable. Table 2 indicates that an increase in gross sales makes it more likely for the farmer to do conservation tillage. Farmers with higher risk perception are more likely to do conservation tillage. Table 3 indicates that a rise in monetary and financial risk tolerance increases the likelihood of farmers doing no till. But it is pretty clear from the first three tables that the binary response variables do not really have any strong results. This is also true when we estimate a latent class regression for the binary responses of all three types of tillage practices. The results yield a zero classes indicating that there is no farmer heterogeneity. As we will see the multinomial responses yield different results.

Tables 4, 5 and 6 report estimates of a multinomial logit model. As earlier four sets of regressions are run, one with no environment or profit variables, followed by the three sets of environment and profit variables. The marginal effects are reported, which for each set of regression is constituted of a couple of columns (numbered 1 through 8 for four regressions). In Table 4, which reports the marginal effects of a multinomial logit of conventional till, the base category is always do conventional till (conventional till=2) and the reported results are of those corresponding to never fo conventional till (conventional till=0) and sometimes do conventional till (1). For tables 5 and 6, the base categories are never do conservation/no till (conservation/no till=0) and the marginal effects associated with doing sometimes (1) and always (2) is reported.

Table 4 suggests that older the farmers get they are more likely to switch from doing sometimes conventional till to always conventional till and it is significant at 5% level of significance. 3rd generation of farmers are more likely to switch to never doing conventional till. Environment or profit variable are not very significant.Further as risk tolerance in monetary and financial matters increases farmers are more likely to switch from doing sometimes conventional till to always conventional till.

Table 5 reports that for conservation tillage, as gross sales of farmers go up they are more likely to do sometimes conservation tillage over never doing conservation tillage. As the perceived effectiveness of agricultural practices with regard to nutrient loss harming water quality goes up (Harmwq) farmers are more likely to switch from always doing conservation tillage to never doing conservation tillage. This is a bit counter intuitive. Increase in risk tolerance in monetary matters makes farmers more likely to do sometimes conservation

tillage, but for couple of instances it makes them more likely to switch from always conservation tillage to never conservation (negative coefficients). As risk perception increases farmers tend to do more of always conservation tillage.

From table 6 we can conclude that older farmers tend to switch from sometimes no till to never no till. In couple of the regressions we have statistically significant results to show that as control goes up farmers are more likely to do no till. As the perception of the likelihood of damage done to human health and water quality goes up farmers are more likely to switch from always no till to never no till. An increase in riskmonfin makes farmers more likely to do sometimes no till over never no till.

Tables 7 and 8 reports the result from the latent class regressions of conventional and conservation tillage (multinomial responses of 0, 1 and 2 indicating never, sometimes and always). The latent class regression for the no till for the multinomial response and all the binary responses yielded 0 class models. Again for each outcome we ran four sets of regressions, each consisting of three columns. The first two columns are for the two classes and the third column reports the pvalue. For the first regression in table 7, we have 65% of the farmers belonging to class 1 who on an average have lower points for conventional tillage (0.92 over 1.23) which means they do less conventional tillage on an average. The first group have a higher perception of control (0.19 over -0.17), are more social (2.54 over 1.81) and have more risk perception (4.48 over 3.96). A negative coefficient on age for class 1 indicates that if you are a farmer who does less conventional tillage to begin with (membership of class 1), as you grow older it is more likely that you will do even lesser amount of conventional tillage. The positive coefficient for class 2 on age indicates that farmers who are doing more conventional tillage are likely to do even greater amounts of conventional tillage with age. Farmers who are doing less conventional tillage to begin with are more likely to do more conventional tillage if they are first or second generation farmers. This holds for the first and the last regression (which has $E - P$). But for the other two regressions, it seems that second generation farmers are likely to reduce their conventional tillage. While if you belong to the group of farmers who are doing more conventional tillage, they are more likely to increase it even further for the second, third and fourth regressions.

Table 1: Logistic Regression for Conventional Till

	(1)	(2)	(3)	(4)
Conventional				
Female	0.0813	0.0929		0.0617
	(0.383)	(0.170)		(0.360)
Age	-0.00167	-0.00129	-0.00124	-0.000557
	(0.409)	(0.421)	(0.537)	(0.606)
Edu	-0.00772	-0.00817	-0.0281	-0.00875
	(0.562)	(0.469)	(0.195)	(0.471)
2nd Gen	-0.0693	-0.0443	-0.0938	-0.0413
	(0.369)	(0.398)	(0.113)	(0.416)
3rd Gen	-0.0470	-0.0293	-0.0583*	-0.0392
	(0.352)	(0.376)	(0.0971)	(0.363)
Gross Sales	0.00403	0.00586	-0.00305	0.000375
	(0.720)	(0.523)	(0.862)	(0.962)
Profit Scale	-	-0.0600	-	-
		(0.369)		
Profit Pts	-	-	-0.000172	-
			(0.914)	
Env Health 1	-	0.0146	-	-
		(0.415)		
Env Health 2	-	-	0.0760	-
			(0.148)	
$E - P$	-	-	-	0.00109
				(0.366)
Aware	-0.00603	-0.00516	-0.00703	-0.00925
	(0.740)	(0.674)	(0.798)	(0.551)
Control	-0.0123	-0.0125	-0.00967	-0.00460
	(0.547)	(0.463)	(0.742)	(0.735)
Social	-0.000601	-0.000941	9.72e-05	-0.00500
	(0.964)	(0.917)	(0.996)	(0.650)
Llfarmprac	-0.0141	-0.0109	-0.0222	-0.0109
	(0.548)	(0.522)	(0.465)	(0.553)
LlhumanhealWQ	0.0197	0.0127	0.0170	0.00547
	(0.476)	(0.499)	(0.561)	(0.719)
Harmwq	0.0225	0.0118	0.0219	0.0124
	(0.376)	(0.454)	(0.374)	(0.456)
Effibmp	0.00398	0.00188	0.000477	-0.00275
	(0.799)	(0.854)	(0.984)	(0.801)
Norm	-0.00902	-0.00458	-0.00363	0.000517
	(0.623)	(0.703)	(0.891)	(0.967)
Riskamonfin	0.00572	0.00499	-0.00251	0.00542
	(0.742)	(0.680)	(0.925)	(0.671)
Riskbhealsafe	-0.0114	-0.00483	-0.0118	-0.00242
	(0.584)	(0.708)	(0.647)	(0.844)
Risk Perc	-0.00968	-0.00607	-0.0237	-0.00756
	(0.539)	(0.580)	(0.285)	(0.558)
Observations	286	285	269	272

*** p<0.01, ** p<0.05, * p<0.1

Table 2: Logistic Regression for Conservation Till

	(1)	(2)	(3)	(4)
Conservation				
Female	-0.0266	-0.0340	-0.0225	-0.0201
	(0.819)	(0.777)	(0.846)	(0.851)
Age	-0.00493	-0.00464	-0.00531	-0.00430
	(0.108)	(0.122)	(0.133)	(0.144)
Edu	-0.00865	-0.00131	-0.0168	-0.0163
	(0.673)	(0.952)	(0.419)	(0.418)
2nd Gen	0.0452	0.0192	0.0770	0.0696
	(0.612)	(0.828)	(0.428)	(0.461)
3rd Gen	0.0585	0.0309	0.0919	0.0768
	(0.463)	(0.691)	(0.299)	(0.358)
Gross Sales	0.101**	0.0956**	0.0855*	0.0914**
	(0.0320)	(0.0341)	(0.0621)	(0.0466)
Profit Scale	-	0.0978	-	-
		(0.102)		
Profit Pts	-	-	0.00190	-
			(0.327)	
Env Health 1		0.00174		
		(0.952)		
Env Health 2	-	-	0.0437	-
			(0.323)	
$E - P$	-	-	-	-0.000542
				(0.620)
Aware	-0.0170	-0.0194	-0.0184	-0.0252
	(0.576)	(0.538)	(0.547)	(0.405)
Control	-0.0133	-0.00784	-0.00207	-0.0121
	(0.648)	(0.795)	(0.944)	(0.673)
Social	-0.0154	-0.0194	-0.00816	-0.00727
	(0.545)	(0.470)	(0.743)	(0.762)
Llfarmprac	-0.0387	-0.0454	-0.0310	-0.0366
	(0.309)	(0.263)	(0.403)	(0.330)
LlhumanhealWQ	0.0615	0.0676	0.0581	0.0548
	(0.165)	(0.151)	(0.203)	(0.209)
Harmwq	-0.0100	0.00168	-0.0161	-0.00416
	(0.742)	(0.958)	(0.609)	(0.886)
Effibmp	-0.000494	0.00449	0.00377	0.0129
	(0.987)	(0.885)	(0.899)	(0.660)
Norm	0.00176	0.00262	0.00369	-0.00304
	(0.953)	(0.933)	(0.903)	(0.917)
Riskamonfin	0.0618*	0.0591	0.0414	0.0400
	(0.0978)	(0.112)	(0.211)	(0.209)
Riskbhealsafe	-0.00968	-0.0109	0.00447	-0.00158
	(0.754)	(0.741)	(0.880)	(0.957)
Risk Perc	0.0714**	0.0669*	0.0774*	0.0712*
	(0.0439)	(0.0519)	(0.0749)	(0.0591)
Observations	286	285	268	272

pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Logistic Regression for No Till

	(1)	(2)	(3)	(4)
No Till				
Female	-0.0287	-0.0547	-0.0399	-0.0156
	(0.852)	(0.741)	(0.817)	(0.926)
Age	-0.00115	-0.000414	-0.00221	-0.00235
	(0.670)	(0.884)	(0.472)	(0.422)
Edu	0.00450	0.0147	0.00589	0.00488
	(0.867)	(0.610)	(0.847)	(0.869)
2nd Gen	0.00825	-0.0205	-0.0744	-0.0663
	(0.935)	(0.846)	(0.500)	(0.546)
3rd Gen	0.125	0.0966	0.102	0.118
	(0.166)	(0.295)	(0.266)	(0.204)
Gross Sales	0.0379	0.0279	0.0555*	0.0455
	(0.156)	(0.312)	(0.0640)	(0.109)
Profit Scale	-	0.151**	-	-
		(0.0209)		
Profit Pts	-	-	0.00193	-
			(0.408)	
Env Health 1	-	0.00527	-	-
		(0.886)		
Env Health 2	-	-	-0.0337	-
			(0.518)	
$E - P$	-	-	-	-0.00286*
				(0.0811)
Aware	0.0464	0.0499	0.0526	0.0596
	(0.233)	(0.218)	(0.214)	(0.152)
Control	-0.0187	-0.00813	-0.0189	-0.0252
	(0.615)	(0.836)	(0.657)	(0.543)
Social	0.0401	0.0399	0.0324	0.0372
	(0.214)	(0.235)	(0.359)	(0.280)
Llfarmprac	0.0264	0.0196	0.0155	0.0108
	(0.524)	(0.649)	(0.733)	(0.809)
LlhumanhealWQ	-0.0532	-0.0487	-0.0409	-0.0369
	(0.222)	(0.275)	(0.398)	(0.438)
Harmwq	0.0400	0.0588	0.0518	0.0566
	(0.279)	(0.146)	(0.213)	(0.166)
Effibmp	0.0233	0.0320	0.0300	0.0438
	(0.504)	(0.381)	(0.453)	(0.263)
Norm	-0.00108	-0.000861	0.00594	-0.0126
	(0.976)	(0.982)	(0.885)	(0.751)
Riskamonfin	0.118***	0.113***	0.121***	0.122***
	(0.00556)	(0.00761)	(0.00480)	(0.00400)
Riskbhealsafe	-0.00939	-0.0126	-0.0213	-0.0333
	(0.801)	(0.751)	(0.619)	(0.431)
Risk Perc	0.00196	-0.0135	0.0153	0.00426
	(0.938)	(0.633)	(0.595)	(0.878)
Observations	286	285	268	272

pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Multinomial Logit Regression for Conventional Till

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conventional	0	1	0	1	0	1	0	1
Female	-0.0574	-0.0473	-0.0759	-0.0408	-0.114***	-0.0203	-0.0555	-0.0549
	(0.430)	(0.671)	(0.190)	(0.704)	(3.78e-09)	(0.840)	(0.405)	(0.618)
Age	0.00217	-0.00399**	0.00247	-0.00383**	0.00100	-0.00405**	0.000967	-0.00355*
	(0.186)	(0.0409)	(0.120)	(0.0499)	(0.524)	(0.0439)	(0.547)	(0.0737)
Edu	0.0109	-0.0143	0.0151	-0.0143	0.0254*	-0.0194	0.0153	-0.0153
	(0.488)	(0.459)	(0.337)	(0.457)	(0.0970)	(0.335)	(0.321)	(0.442)
2nd Gen	0.134**	-0.101	0.130**	-0.133*	0.105	-0.115	0.0881	-0.108
	(0.0334)	(0.206)	(0.0370)	(0.0892)	(0.110)	(0.172)	(0.142)	(0.186)
3rd Gen	0.0928**	0.00390	0.0922**	-0.0243	0.0686	0.0214	0.0856**	0.00239
	(0.0176)	(0.948)	(0.0187)	(0.676)	(0.104)	(0.731)	(0.0392)	(0.969)
Gross Sales	-0.00121	0.0548**	-0.00795	0.0535**	0.00360	0.0481**	0.00219	0.0541**
	(0.931)	(0.0188)	(0.583)	(0.0185)	(0.792)	(0.0425)	(0.872)	(0.0224)
Profit Scale			0.110**	-0.0377	-	-	-	-
			(0.0434)	(0.491)				
Profit Pts	-	-	-	-	0.000309	0.000733	-	-
					(0.810)	(0.630)		
Env Health 1	-	-	-0.0280	0.0283	-	-	-	-
			(0.160)	(0.249)				
Env Health 2					-0.0551	0.0456		
					(0.139)	(0.254)		
$E-P$							-0.00192**	0.000623
							(0.0256)	(0.548)
Aware	0.00904	0.00704	0.0108	0.00341	0.00744	0.0133	0.0170	0.00392
	(0.692)	(0.799)	(0.628)	(0.900)	(0.740)	(0.638)	(0.453)	(0.889)
Control	0.0162	-0.0213	0.0228	-0.0247	0.0117	-0.0117	0.00753	-0.0162
	(0.477)	(0.427)	(0.307)	(0.354)	(0.617)	(0.680)	(0.746)	(0.565)
Social	-0.000360	0.0112	0.000847	0.00338	0.000227	0.00346	0.00701	0.00117
	(0.984)	(0.611)	(0.962)	(0.877)	(0.990)	(0.878)	(0.691)	(0.959)
Llfarmprac	0.0151	-0.0111	0.0180	-0.0190	0.0126	-0.0162	0.0163	-0.0245
	(0.533)	(0.709)	(0.454)	(0.519)	(0.584)	(0.584)	(0.505)	(0.422)
LlhumanhealWQ	-0.0232	0.0396	-0.0225	0.0402	-0.00819	0.0418	-0.00710	0.0404
	(0.322)	(0.185)	(0.337)	(0.172)	(0.727)	(0.183)	(0.765)	(0.200)
Harmwq	-0.0308	0.0320	-0.0241	0.0403	-0.0211	0.0213	-0.0232	0.0310
	(0.115)	(0.211)	(0.215)	(0.123)	(0.273)	(0.417)	(0.222)	(0.239)
Effibmp	-0.00428	0.00749	-0.00216	0.0145	0.000240	-0.00328	0.00554	0.00496
	(0.828)	(0.771)	(0.911)	(0.572)	(0.990)	(0.904)	(0.772)	(0.854)
Norm	0.0120	-0.00180	0.00831	0.00286	0.00314	0.00477	-0.00182	-0.000527
	(0.575)	(0.946)	(0.699)	(0.914)	(0.884)	(0.864)	(0.934)	(0.985)
Riskamonfin	-0.0107	0.0593**	-0.0125	0.0552**	-0.00574	0.0557**	-0.0125	0.0590**
	(0.636)	(0.0280)	(0.580)	(0.0441)	(0.795)	(0.0473)	(0.566)	(0.0316)
Riskbhealsafe	0.0171	-0.0303	0.0122	-0.0259	0.00631	-0.0310	0.00545	-0.0386
	(0.429)	(0.259)	(0.579)	(0.342)	(0.762)	(0.278)	(0.797)	(0.172)
Risk Perc	0.0112	0.0241	0.0107	0.0163	0.0160	0.0247	0.0113	0.0247
	(0.471)	(0.182)	(0.499)	(0.383)	(0.344)	(0.210)	(0.499)	(0.201)
Observations	286	286	285	285	268	268	272	272

pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Multinomial Logit Regression for Conservation Till

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Conservation	1	2	1	2	1	2	1	2
Female	-0.0380	-0.0708***	-0.0380	-0.0719	-0.0473	-0.0696***	-0.0242	-0.0729***
	(0.697)	(7.35e-06)	(0.980)		(0.635)	(1.13e-05)	(0.801)	(5.69e-06)
Age	-0.00106	-0.00151	-0.000357	-0.00126	-0.00192	-0.00131	-0.00124	-0.00145
	(0.585)	(0.256)	(0.854)		(0.339)	(0.334)	(0.531)	(0.295)
Edu	-0.00336	0.00814	-0.00386	0.0141	-0.00560	0.0152	-0.00631	0.00998
	(0.860)	(0.519)	(0.838)		(0.781)	(0.261)	(0.752)	(0.453)
2nd Gen	-0.0505	0.0721	-0.0794	0.0797	-0.0485	0.0762	-0.0604	0.0685
	(0.541)	(0.204)	(0.331)		(0.569)	(0.192)	(0.473)	(0.217)
3rd Gen	0.0737	0.0326	0.0462	0.0301	0.101	0.0283	0.0802	0.0347
	(0.250)	(0.390)	(0.457)		(0.130)	(0.476)	(0.222)	(0.379)
Gross Sales	0.0610**	0.00835	0.0537**	0.00490	0.0545**	0.00792	0.0574**	0.0100
	(0.0153)	(0.406)	(0.0210)		(0.0232)	(0.457)	(0.0174)	(0.330)
Profit Scale			-0.684	0.800				
			(0.986)					
Env Health 1	-	-	0.0252	-0.0204	-	-	-	-
			(0.264)					
Aware	0.00626	0.0111	0.00475	0.0110	0.00598	0.00904	0.00466	0.00978
	(0.808)	(0.526)	(0.849)		(0.822)	(0.622)	(0.861)	(0.592)
Control	-0.00939	-0.00457	-0.0147	0.00412	-0.00997	0.00593	-0.0107	-0.00419
	(0.712)	(0.810)	(0.564)		(0.709)	(0.767)	(0.689)	(0.832)
Social	0.0228	-0.0204	0.0151	-0.0202	0.0214	-0.0221	0.0217	-0.0180
	(0.297)	(0.167)	(0.472)		(0.331)	(0.146)	(0.326)	(0.238)
Llfarmprac	0.0122	-0.0157	0.00862	-0.0170	0.0129	-0.0163	0.00597	-0.0143
	(0.647)	(0.401)	(0.742)		(0.627)	(0.369)	(0.828)	(0.451)
LlhumanhealWQ	0.0239	0.0126	0.0195	0.0168	0.0317	0.0176	0.0316	0.0159
	(0.407)	(0.516)	(0.488)		(0.281)	(0.367)	(0.289)	(0.415)
Harmwq	0.0310	-0.0363**	0.0388	-0.0344	0.0256	-0.0305*	0.0352	-0.0311**
	(0.204)	(0.0173)	(0.126)		(0.313)	(0.0542)	(0.163)	(0.0426)
Effibmp	0.00131	-0.000174	0.00624	0.00213	-0.00509	0.00500	0.00791	0.00649
	(0.958)	(0.991)	(0.802)		(0.849)	(0.757)	(0.764)	(0.685)
Norm	0.00267	0.00896	0.00330	0.0110	0.00532	0.00796	-0.00412	0.00632
	(0.916)	(0.597)	(0.895)		(0.841)	(0.653)	(0.877)	(0.725)
Riskamonfin	0.0943***	-0.0318*	0.0895***	-0.0333	0.0892***	-0.0274	0.0922***	-0.0344*
	(0.000198)	(0.0802)	(0.000495)		(0.000804)	(0.138)	(0.000417)	(0.0609)
Riskbhealsafe	-0.0275	0.00671	-0.0242	0.00746	-0.0248	0.00400	-0.0363	0.00718
	(0.319)	(0.712)	(0.386)		(0.385)	(0.827)	(0.206)	(0.704)
Risk Perc	0.00398	0.0349**	-0.00545	0.0343	0.00839	0.0331**	0.000777	0.0356**
	(0.832)	(0.0250)	(0.775)		(0.669)	(0.0394)	(0.968)	(0.0303)
Profit Pts					0.000695	0.000599		
					(0.630)	(0.590)		
Env Health 2	-	-	-	-	0.0278	-0.0308	-	-
					(0.486)	(0.387)		
$E-P$	-	-	-	-	-	-	-4.39e-05	-0.00120
							(0.964)	(0.101)
Observations	254	254	253	253	243	243	246	246

pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Multinomial Logit Regression for No Till

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
No Till	1	2	1	2	1	2	1	2
Female	-0.0224	0.00370	-0.0344	-0.00226	0.0440	-0.0718***	-0.0114	0.00123
	(0.869)	(0.966)	(0.803)	(0.978)	(0.725)	(3.03e-06)	(0.932)	(0.987)
Age	-0.00437**	0.00355**	-0.00385*	0.00356**	-0.00396*	0.00233	-0.00391*	0.00224
	(0.0484)	(0.0183)	(0.0831)	(0.0175)	(0.0878)	(0.100)	(0.0821)	(0.112)
Edu	-0.00684	0.0128	-0.00103	0.0137	-0.0173	0.0237*	-0.0117	0.0178
	(0.754)	(0.322)	(0.963)	(0.306)	(0.444)	(0.0653)	(0.602)	(0.160)
2nd Gen	-0.0387	0.0407	-0.0602	0.0381	-0.0656	0.000104	-0.0537	-0.00656
	(0.671)	(0.429)	(0.505)	(0.466)	(0.491)	(0.998)	(0.574)	(0.892)
3rd Gen	0.0641	0.0390	0.0348	0.0363	0.0667	0.0137	0.0719	0.0242
	(0.392)	(0.292)	(0.640)	(0.338)	(0.386)	(0.743)	(0.351)	(0.550)
Gross Sales	0.0363*	-0.00697	0.0290	-0.00764	0.0382*	0.00131	0.0366*	-0.00409
	(0.0802)	(0.563)	(0.168)	(0.545)	(0.0766)	(0.908)	(0.0803)	(0.718)
Profit Scale	-	-	0.0915**	0.00735	-	-	-	-
			(0.0406)	(0.794)				
Profit Pts	-	-	-	-	0.00175	-0.000640	-	-
					(0.314)	(0.535)		
Env Health 1	-	-	0.00929	-0.000530	-	-	-	-
			(0.748)	(0.975)				
Env Health 2	-	-	-	-	0.0161	-0.0365	-	-
					(0.696)	(0.181)		
$E - P$	-	-	-	-	-	-	-0.00116	-0.000518
							(0.322)	(0.447)
Aware	0.0353	0.00306	0.0358	0.00363	0.0386	0.000823	0.0338	0.0125
	(0.247)	(0.870)	(0.239)	(0.847)	(0.219)	(0.964)	(0.279)	(0.499)
Control	-0.0471	0.0369*	-0.0396	0.0377*	-0.0362	0.0276	-0.0420	0.0293
	(0.119)	(0.0531)	(0.195)	(0.0510)	(0.264)	(0.168)	(0.188)	(0.133)
Social	0.0204	0.0105	0.0188	0.0102	0.0117	0.0106	0.0121	0.0147
	(0.406)	(0.473)	(0.444)	(0.491)	(0.645)	(0.444)	(0.634)	(0.306)
Llfarmprac	-0.00205	0.0201	-0.00852	0.0205	-0.00506	0.0121	-0.00907	0.0130
	(0.951)	(0.320)	(0.799)	(0.313)	(0.881)	(0.524)	(0.791)	(0.510)
LlhumanhealWQ	0.00265	-0.0477**	0.00683	-0.0479**	-0.00230	-0.0332*	-0.000967	-0.0321*
	(0.938)	(0.0152)	(0.841)	(0.0155)	(0.948)	(0.0860)	(0.978)	(0.0897)
Harmwq	0.0289	-0.00118	0.0375	-9.92e-05	0.0295	0.00277	0.0340	0.00145
	(0.322)	(0.944)	(0.206)	(0.995)	(0.331)	(0.867)	(0.258)	(0.927)
Effibmp	0.0281	-0.0113	0.0322	-0.0108	0.0295	-0.0103	0.0364	-0.00793
	(0.311)	(0.485)	(0.242)	(0.506)	(0.312)	(0.505)	(0.206)	(0.607)
Norm	-0.0110	0.0101	-0.0110	0.0109	0.00117	0.00328	-0.0102	0.00175
	(0.705)	(0.563)	(0.702)	(0.540)	(0.969)	(0.846)	(0.737)	(0.920)
Riskamonfin	0.0796***	0.00787	0.0716**	0.00701	0.0735**	0.00852	0.0733**	0.00998
	(0.00657)	(0.667)	(0.0157)	(0.708)	(0.0162)	(0.640)	(0.0158)	(0.583)
Riskbhealsafe	-0.0251	0.0273	-0.0236	0.0267	-0.0213	0.0162	-0.0273	0.0151
	(0.389)	(0.120)	(0.424)	(0.144)	(0.482)	(0.326)	(0.364)	(0.362)
Risk Perc	0.00593	-0.000521	-0.00335	-0.00147	0.0138	0.00122	0.0107	-0.00222
	(0.774)	(0.965)	(0.875)	(0.905)	(0.524)	(0.923)	(0.616)	(0.855)
Observations	292	292	291	291	274	274	278	278

pval in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7: LC Regression for Conventional Tillage

	No Env			Env Health 1			Env Health 2			$E-P$		
	Class 1	Class 2	pvalue	Class 1	Class 2	pvalue	Class 1	Class 2	pvalue	Class 1	Class 2	pvalue
Class Size	0.65	0.35		0.64	0.36		0.56	0.44		0.62	0.38	
Conventional	0.92	1.23		0.85	1.33		0.87	1.23		0.88	1.27	
Predictors												
Gender												
Male	-1.35**	-2.84**	0.03	-1.80*	-3.35*	0.10	-1.69**	-2.15**	0.02	-1.42**	-2.99**	0.05
Female	-0	-0		-0	-0		-0	-0		-0	-0	
Age	-0.02*	0.12*	0.10	-0.02**	0.05**	0.03	-0.02**	0.07**	0.04	-0.02**	0.08**	0.02
Edu	-0.09*	0.50	0.32	-0.08	0.02	0.86	-0.08	0.12	0.75	-0.08	0.12	0.73
Generation												
1	1.48**	0.64**	0.02	1.28**	2.08**	0.03	1.56***	1.44***	0.01	1.46***	1.88***	0.01
2	0.36**	-1.03**		-0.05**	0.93**		-0.09***	0.77***		0.02***	1.07***	
3	-0	-0		-0	-0		-0	-0		-0	-0	
Gross Sales	-0.06	-1.51	0.17	0.13***	-0.74***	0.00	0.04**	-0.96**	0.02	0.03**	-1.05**	0.05
Riskamonfin	0.40***	-2.57***	0.00	0.41***	-0.79***	0.00	0.48***	-1.18***	0.00	0.42***	-1.11***	0.00
Riskbhealsafe	0.25	-0.31	0.29	0.02	0.47	0.37	0.32	-0.15	0.29	0.29	-0.11	0.35
Covariates												
Env Var	-	-		0.11	-0.19	0.85	-0.03	0.04	0.29	-20.67**	11.74**	0.03
Profit Var	-	-		2.82**	2.51**	0.03	40.03**	31.0***	0.02	-	-	
Aware	-0.03	0.05	0.53	0.07	-0.12	0.51	0.06	-0.08	0.51	0.06	-0.10	0.51
Control	0.19*	-0.17*	0.08	0.14	-0.05	0.53	0.18	-0.07	0.20	0.16	-0.08	0.25
Social	2.54***	1.81***	0.01	2.45	2.01	0.12	2.54**	1.97**	0.02	2.49**	1.96**	0.05
Llfarmprac	0.05	-0.09	0.80	0.13	-0.23	0.26	0.14	-0.19	0.25	0.15	-0.24	0.20
LlhumanhealWQ	0.03	-0.05	0.70	0.06	-0.11	0.94	0.11	0.14	0.23	0.09	-0.15	0.45
Harmwq	-0.12	0.22	0.14	-0.04	0.07	0.31	-0.17**	0.22**	0.03	-0.10*	0.16*	0.10
Effibmp	0.02	-0.03	0.83	0.01	-0.02	0.66	0.03	-0.03	0.78	-0.01	0.02	0.46
Norm	0.03	-0.06	1	0.08	-0.14	0.38	0.12	-0.14	0.49	0.12	-0.19	0.31
RiskPerc	4.48*	3.96*	0.06	4.58**	3.80**	0.02	4.55*	3.98**	0.05	4.56**	3.87**	0.02
Observtions	673			673			673			673		

Table 8: LC Regression for Conservation Tillage

	No Env			Env Health 1			Env Health 2			$E-P$		
	Class 1	Class 2	pvalue	Class 1	Class 2	pvalue	Class 1	Class 2	pvalue	Class 1	Class 2	pvalue
Class Size	0.55	0.45		0.58	0.42		0.61	0.39		0.61	0.39	
Conservation	0.74	1.13		0.74	1.16		0.79	1.11		0.77	1.14	
Predictors												
Gender												
Male	1.34	4.87	0.22	0.79	6.51	0.14	1.04***	2.91***	0.01	0.47	6.99	0.17
Female	-0	-0		-0	-0		-0	-0		-0	-0	
Age	-0.04*	0.02*	0.06	-0.03	0.01	0.19	-0.04**	0.02**	0.02	-0.03*	0.02*	0.09
Edu	-0.06	0.14	0.74	-0.02	0.17	0.63	-0.08	0.16	0.60	-0.07	0.19	0.61
Generation												
1	-1.82*	-0.20*	0.09	-1.32*	0.01*	0.09	-1.39	-0.51	0.14	-1.57*	0.02*	0.07
2	-0.49*	0.32*		-0.36*	0.51*		-0.36	0.14		-0.47*	0.32*	
3	-0	-0		-0	-0		-0	-0		-0	-0	
Gross Sales	0.73***	-0.09***	0.00	0.68***	-0.02***	0.01	0.78***	-0.01***	0.00	0.67***	-0.03***	0.00
Riskamonfin	0.92***	-0.93***	0.00	0.98***	-0.58***	0.00	1.16***	-0.90***	0.00	0.97***	-0.83***	0.00
Riskbhealsafe	-0.23	0.10	0.60	-0.41	0.10	0.21	-0.02	-0.30	0.55	-0.31	0.45	0.22
Covariates												
Env Var	-	-		-0.13	0.18	0.50	-0**	0.01**	0.05	-14.37*	-21.88*	0.06
Profit Var	-	-		2.51**	2.97**	0.03	31.82***	42.85***	0.01	-	-	
Aware	-0.10	0.13	0.31	-0.23*	0.31*	0.09	-0.15	0.23	0.11	-0.13	0.21	0.22
Control	0.04	0.11	0.65	-0.03	0.21	0.41	-0.03	0.23	0.35	0.02	0.14	0.88
Social	2.09*	2.54*	0.06	2.29	2.29	0.62	2.09*	2.60*	0.03	2.23	2.39	0.69
Llfarmprac	-0.22	0.27	0.26	-0.16	0.21	0.76	-0.11	0.16	0.66	-0.18	0.28	0.26
LlhumanhealWQ	-0.20	0.24	0.16	-0.16	0.21	0.18	-0.12**	0.19**	0.04	-0.09	0.14	0.77
Harmwq	0.11**	-0.14**	0.03	0.02	-0.02	0.33	0.24***	-0.39***	0.00	0.16**	-0.24**	0.02
Effibmp	0.05	-0.06	0.25	0.04	-0.05	0.42	-0.04	0.08	0.96	-0.13	0.22	0.44
Norm	-0.05	0.07	0.75	0.06	-0.08	0.48	-0.05	0.09	0.77	-0.06	0.09	0.92
RiskPerc	3.87***	4.83***	0.01	3.90**	4.84**	0.02	4.03***	4.73***	0.01***	3.91***	4.92***	0.01
Observtions	673			673			673			673		

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