Farmer trade-offs between pest control and pollinator health: Evidence from a choice experiment with Midwestern Cucurbit Farmers

GRC Presentation

Linghui Wu

April.21st

University of New Hampshire

Outline

- Introduction
- Goal
- Methods
  - Survey
  - Model Framework (conditional logit and mixed logit)
- Preliminary Results
- Discussion
- Future Work

University of New Hampshire

Introduction

- Pollinator importance to cucurbits farm
- Pollinator worldwide decline facts → neonics exposure
- Previous literature on farmers knowledge of honey bees, wild bees and neonics exposure.
  - Farmers vary in their characteristics, preferences (heterogeneity) affects their responses to strategies
- Using a stated-preference method (choice experiment) to elicit farmers preferences

University of New Hampshire

Goal

- Farmers knowledge of pollination services and neonics exposure on insects
  - WTP on changing practices to these impacts;
  - Which new knowledge have net impacts on farm profitability

Survey of Cucurbit Farmers

- Section A. Farm Operations
  - Crop type, farm size and locations, land uses around farms;
- Section B. Management Practices on Farm
  - Current insect and bees management strategies. Knowledge of using managed bees.
- Section C. Integrated Pest Control and Pollination
  - Knowledge of bee types, bee qualities, pesticides exposure to bees, habitat and other factors affecting bee health
  - Choice experiment
- Section D. Pollinator Habitat
  - Knowledge of pollinator habitat
- Section E. Demographics
  - Socio-demographic information (age, gender, education, farming experiences)

Choice Attributes

Description of Attributes	Levels
Pest Control (30% decrease in effectiveness, 15% decrease in effectiveness, 0 no change in effectiveness, 15% increase in effectiveness)	-30%, -15%, 0, 15%
Wild Pollinators (0 no change in population size, 10% increase in population size, 20% increase in population size, 30% increase in population size)	0, 10%, 20%, 30%
Pesticide Leaching (0 no decrease in pesticide leaching, 10% deacrease in pesticide leaching, 20% decrease in pesticide leaching, 30% deacrease in pesticide leaching)	0, 10%, 20%, 30%
Managed Pollinators (50% chance of strong hive, 65% chance of strong hive, 80% chance of strong hive, 95% chance of strong hive)	50%, 65%, 80%, 95%
Additional Costs ($/acre increase in spending)	0, 40, 80, 120

University of New Hampshire

Sample CE Question

Please examine the characteristics of each pest management option below. It is important for us to know which option you prefer based ONLY on the described characteristics and costs, though you may typically consider many other factors when making these decisions on your farm.

	OPTION A	OPTION B
 **PEST CONTROL**	**0%** NO CHANGE IN EFFECTIVENESS	**↓ 15%** DECREASE IN EFFECTIVENESS
 **WILD POLLINATORS**	**↑ 20%** INCREASE IN POPULATION SIZE	**↑ 10%** INCREASE IN POPULATION SIZE
 **PESTICIDE LEACHING**	**↓ 10%** DECREASE IN PESTICIDE LEACHING	**↓ 20%** DECREASE IN PESTICIDE LEACHING
 **MANAGED POLLINATORS**	**80%** CHANCE OF STRONG HIVE	**65%** CHANCE OF STRONG HIVE
 **ADDITIONAL COSTS**	**$0/acre** INCREASE IN SPENDING	**↑ $120/acre** INCREASE IN SPENDING

University of New Hampshire

Survey Methods

- We followed Dillman et al.'s (2008) mail survey methodology
  - A preview letter describing purpose of the study;
  - The survey instrument;
  - A reminder postcard;
  - A second copy of the survey to non-respondents only;
  - A second reminder postcard to non-respondents only;

The Survey

- Mail survey
- Number of CE question per survey: 3
- Versions of the survey: 4
- Survey period: 2019 February-March
- 106 responses out of 2,543
  - Response rate = 4.17%

University of New Hampshire

Summary Statistics of Ind. Chars

Variable	Description	Obs	Mean	SD	Min	Max
Farming Years	The respondent farming years	552	33.86	15.16	1	75
Family Farming Years	The respondent's family farming years	510	84.56	42.49	5	218
Income Source	farming is main source of income (1), otherwise (0)	552	0.75	0.43	0	1
Age	Respondent's Age	552	55.78	12.8	18	80
Gender	Respondent's Gender	552	0.96	0.2	0	1

Data Analysis

- Discrete choice models (conditional logit model and mixed logit model) to analyze answers for the CE questions (option A, option B and Neither)
- Examine farmers' preferences for insect and pollinators management strategies through their responses of the choice experiment questions (pest control, wild pollinators population size, pesticide leaching, managed pollinators hives qualities, additional costs)
- Examine whether there is a tendency that farmers prefer to maintain the current situation (the status quo effects)
- Examine whether farmers knowledge and individual characteristics have impacts on their choice responses.
  - Farming experiences, age, gender, education, knowledge of wild/managed pollinators/pesticides.

Model Framework

- Random Utility Theory (Thurstone. 1927)
- Discrete Choice Analysis (McFadden. 1974)

Empirical Strategy: Conditional Logit Model

- Conditional logit model with alternative specific constant
- $U_{ij} = asc_{ij} + x'_{ij}\beta + z'_i\gamma_j + \varepsilon_{ij}$
  - i: individuals; j: options (option 1, option 2, neither)
- x'_{ij} chars change with alternatives and individuals
  - pest, wild, wq, mngd, cost
- z'_i chars do not change with alternatives but change with individuals
  - Farm chars; Farming Experience, Socioeconomics
- asc_{ij} intrinsic preference for the alternative
- ε_{ij} captures unobserved characteristics
- Note this case assumes a general stable preferences across individuals

Empirical Strategy: MWTP

- $MWTP_k = -\frac{\beta^k}{\beta^{price}}$

Empirical Strategy: Mixed logit

- Clogit:
  - cannot account for preference heterogeneity among respondents (unless it is related to observables)
  - IIA property: can lead to unrealistic predictions

- Mixed logit:
  - The mixed logit model extends the standard conditional logit model by allowing one or more of the parameters in the model to be randomly distributed

Empirical Strategy

- $U_{ij} = asc_{ij} + x'_{ij}\beta_i + z'_i\gamma_j + \varepsilon_{ij}$
- Limit of conditional logit model
  - Respondents have same preferences; assumption of independent error terms, IIA
- Mixed logit model overcomes these limitations by allowing the coefficients in the model to vary across decision makers
- $\beta = \bar{\beta} + \sigma_\beta$
- Allowing the coefficients to vary implies that we allow for the fact that different decision makers may have different preferences
  - IIA no longer holds

Distribution of each random coefficient

- Random Parameters follow a Normal Distribution
- Coefficient of the cost variable is fixed
  - the distribution of the MWTP for an attribute is then simply the distribution of that attribute's coefficient
  - restrict the price variable to be positive for all individuals.

Conditional Logit Results

	Conditional Logit Model		Welfare Measure	
	Coeff. Mean	Coeff. Std	MWTP	95% Confidence Interval
Pest	.02413925***	0.0068111	2.2397726	[0.88328275, 3.5962625]
Wild	0.00377964	0.0100459	0.16829186	[-1.5494979, 1.8860816]
Wq	-0.00020044	0.0095775	-0.19675546	[-1.8223582, 1.4288472]
Mngd	0.0112075	0.0063511	0.58296432	[0.01567944, 1.1502492]
Cost	-.01082248***	-	-	-
ASC	-1.3774019	-	-	-
ASC×FY	0.01158988	-	-	-
ASC×IS	1.1278204*	-	-	-
ASC×Male	0.58253141	-	-	-
N	552			
Pseudo R2	0.1246			
Log Likelihood	-159.64589			

University of New Hampshire

Discussion of Prilimiary Results

- The coefficient of the alternative-specific constant is not statistically significant which suggests that we find no evidence there is a status quo bias.
- Farmers WTP $2.23 for management that increases the pest control effectiveness
- WTP for managed pollinators, wild pollinators, and pesticide leaching are not statistically significant
  - Even though the WTP are not statistically significant, the WTP for managed pollinators ($0.58) is higher than WTP for wild pollinators ($0.17) which means farmers care more about wild pollinators;
  - WTP for pesticide leaching is negative $0.20 which means farmers are less like likely to pay a small amount to reduce pesticide leaching compared to their current management strategies

University of New Hampshire

Future Work

- Mixed Logit Results
- Knowledge of farmer
- 2nd round of mailing surveys (increase response rate)

University of New Hampshire