Extension agents' preferences on teaching methods: An ordered probit with selection model

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Introduction:

Outreach and Extension services play an important role on enhancing human capital by communicating useful and practical research findings in a way that farmers can understand (Ojha and Sinha, 2001). The enhancement of farmers' skills (innate and learned) as well as their ability of processing information help farmers make better decisions and consequently improve their welfare (Wozniak, 1987; Anderson and Feder, 2003).

The link between research sources and farmers is strengthened by Extension services because Extension agents transfer innovations to farmers (Anderson and Feder, 2003) and provide researchers with farmers' input about those innovations as well as actual farmers' needs (Evenson, 2001). Furthermore, by educating and helping farmers to clarify their own goals and possibilities (Anderson and Feder, 2003), Extension enables them to adapt technologies to their own environment and needs which increases the rates of adoption of new technologies and consequently raises productivity levels (Ojha and Sinha, 2001; Evenson, 2001; Anderson and Feder, 2003).

According to Anderson and Feder (2003), the impact expected by Outreach and Extension programs may be affected by both actors: 1) farmers and their socio-economic characteristics which affect the way farmers operate and accept innovations; and 2) Extension agents and the way they deliver information to farmers. Therefore, a clear understanding on how Extension agents' deliver information and farmers accept it can be very crucial to accomplish the Outreach and Extension services' goals.

Studies focusing on the farmers' side have examined the educational needs of farmers (Ricard, et al., 2008; Trede & Whitaker, 1998); determined the preferences farmers have towards the different types of educational methods (Franz, et al., 2010; Radhakrishna, et al., 2003) and their perceptions towards those methods (Eckert and Bell, 2006; Ngathou, et al., 2006); as well as analyzed the effectiveness of educational methods on knowledge acquisition (Benavente, et al., 2009; Wagenet, et al., 2005; King, 1999).

At the Extension agent's level, the majority of the studies conducted have focused on identifying the challenges and alternatives of current educational methods, finding effective educational strategies for different types of audiences (Benavente, et al., 2009; Lakai, et al., 2012; Strong, et al., 2010), as well as identifying Extension agents' needs for information and

training (Bailey, et al., 2014; Gibson and Hillison, 1994; Miller and Miller, 2009; Radhakrishna and Martin, 1999).

The research available on learning methods has been primarily focused on the farmers' preferences because farmers' demographics and technologies are constantly changing (Franz, et al., 2010) and only few studies have been conducted to understand the way Extension agents deliver information. For instance, to guide Extension agents and specialists choosing teaching methods more suitable to farmers' preferences and needs, Franz, et al. (2010) identified the learning methods preferred by farmers and compared them with the teaching methods Extension agents prefer to use. However, this research does not explain how Extension agents decide what type of methods they use to teach and why they prefer those methods.

Because educators tend to teach the way they prefer to learn, allocating more efforts on explaining Extension agents' behavior when choosing different types of teaching methods could be crucial to close the gap between farmers' learning and extension' teaching preferences and, consequently, to assure the development and delivery of effective educational programs (Davis, 2006).

This study attempts to provide quantitative evidence on how Extension educators' personal preferences of learning impact on their teaching methods decisions. Specifically, the goals of this study are to explain: 1) what Extension agents' characteristics affect their selection of different types of educational methods, and 2) how their perception on farmers' reception affects this selection. Results from this study will help enhance learning among farmers by understanding educators' preferences of learning and teaching methods.

Learning and teaching methods

Extension programs have been designed to: 1) provide desired experiential opportunities for the learner, 2) reinforce the learner, and 3) provide opportunities for the learner to integrate new information with existing knowledge and skills (Richardson, 2001). Guion (2006) describes the different methods that can be used to outreach farmers and classified them on three categories depending on what objective the Extension agent seeks to accomplish:

1. *Provide experiential opportunities:* This category is known as *experiential* because it allows the audience to gain experience with the provided information. Some methods

under this category are: case study, field day, games & role play, interactive CD/video/audio, interactive workshop, on-farm test, practicum, play, demo skills.

2. *Reinforce the learner:* The methods on this group are mainly known as *reinforcement* since they help educators strengthen learning and provide motivation among the audience for continued learning. Methods under this category are: articles (EDIS/journal), newspaper articles, fax or e-mail messages, home study kits, leaf lefts or flyers, newsletters, fact sheets, notebooks, posters.
3. *Enable learners to integrate new and existing knowledge and skills:* This category of *integrative* methods allows the audience to clarify, discuss, and gain a greater understanding of the information as well as to combine new with existing information. Integrative methods are: brainstorming, buzz group, conference, convention, forum, institute, meeting, panel, seminar, symposium, teleconference, telephone TA, personal visit, and office visit.

Studies conducted at the farmers' level indicate that farmers prefer to learn with methods where they can have some experience with the information provided as well as to be supported and reinforced in the learning process. When studying farmers preferences for learning, Franz et al. (2010) found that farmers most preferred learning methods were: hands-on, demonstrations, farm visit, field day, discussion, and one-on-one.

Conceptual Model:

Greene and Hensher (2009) state that whenever preferences are measured, the strength of those preferences will provide a utility U^*, which can be described as having the following range:

$$-\infty < U_{im}^{*} < +-\infty$$

Where i indicates de individual and m indicates the subject on which preferences are being rated. If the scale to rate the preferences is defined, the above underlying utility could change to a censoring of the underlying utility. Assuming individuals are rating their preferences on an integer scale from 1 to 5, the censoring version of the underlying utility will be as follows:

$$R_{im} = 1 \; if \; -\infty < U_{im}^{*} \leq \mu_{i1}$$

$$R_{im} = 2 \; if \; \mu_{i1} < U_{im}^{*} \leq \mu_{i2}$$

$$R_{im} = 3 \; if \; \mu_{i2} < U_{im}^{*} \leq \mu_{i3}$$

$$R_{im} = 4 \; if \; \mu_{i3} < U_{im}^{*} \leq \mu_{i4}$$

$$R_{im} = 5 \; if \; \mu_{i4} < U_{im}^{*} < -\infty$$

Where μ_{ij} is the threshold specific to a person and number ($J-1$). J is the number of possible ratings, and the values ($J-1$) are needed to divide the range of utility into cells and create thresholds that are identified with the observed ratings.

When bringing individuals' characteristics into a linear function, produces a random utility function:

$$U_{im}^{*} = \beta_{i0} + \beta_{i1} x_{i1} + \beta_{i2} x_{i2} + ... + \beta_{ik} x_{ik} + \varepsilon_{im}$$

Empirical Model:

The ordered probit model presented in this paper follows the model proposed by McKelvey and Zavoina (1971, 1975) for the analysis of ordered, categorical, non-quantitative choices, outcomes, and responses. As explained by Greene and Hensher (2011), the model platform is an underlying random utility model or latent regression model,

$$y_i^{*} = \beta' x_i + \varepsilon_i, i = 1,..., n$$

In which, y_i^{*} is a continuous latent utility or "measure" observed in discrete form through censoring mechanism:

$$y_i = 0 \; if \; \mu_{-1} < y_i^{*} \leq \mu_0$$

$$y_i = 1 \; if \; \mu_0 < y_i^{*} \leq \mu_1$$

$$y_i = 2 \; if \; \mu_1 < y_i^{*} \leq \mu_2$$

...

$y_i = J \; if \; \mu_{J-1} < y_i^* \leq \mu_J$

which is a form of censoring. The μ is unknown parameter to be estimated with β.

The model contains the unknown marginal utilities, β, as well as $J+2$ unknown threshold parameters, μ_j, all to be estimated using a sample of n observations, indexed by $i = 1,...,n$. The data consist of the covariates, x_i and the observed discrete outcome, $y_i = 0, 1, ..., J$. The assumption of the properties of the disturbance, ε_i, completes the model specification. The conventional assumptions are that ε_i is a continuous disturbance with conventional cumulative distribution function (cdf), $F(\varepsilon_i \mid X_i) = F(\varepsilon_i)$ with support equal to the real line, and with density $f(\varepsilon_i) = F'(\varepsilon_i)$. The assumption of the distribution of ε_i includes independence from (or exogeneity of) X_i. The probabilities associated with the observed outcomes are given as the following equation:

$$\Pr ob[y_i = j \mid x_i] = \Pr ob[\varepsilon_i \leq \mu_j - \beta' x_i] - \Pr ob[\mu_{j-1} - \beta' x_i], \qquad j = 0, 1, ..., J$$

ε is normally distributed across observations. For the same reasons as in the binomial probit model (which is the special case of J=1), we normalize the mean and variance of ε to zero and one. We then have the following probabilities:

$$\Pr ob(y_i = 0 \mid x_i) = \Phi(-x'\beta),$$

$$\Pr ob(y_i = 1 \mid x_i) = \Phi(\mu_1 - x'\beta) - \Phi(-x'\beta),$$

$$\Pr ob(y_i = 2 \mid x_i) = \Phi(\mu_2 - x'\beta) - \Phi(\mu_1 - x'\beta),$$

…

$$\Pr ob(y_i = J \mid x_i) = 1 - \Phi(\mu_{J-1} - x'\beta)$$

For all probabilities to be positive, we must have

$$0 < \mu_1 < \mu_2 < ... < \mu_{J-1}$$

This is an extension of the univariate probit model. The log-likelihood function and its derivatives can be obtained readily, and optimization can be done by the usual means.

As usual, the marginal effects of the regressors x on the probabilities are not equal to the coefficients. When having three categories, the model thus has only one unknown threshold parameter. The three probabilities are:

$$\Pr ob(y_i = 0 \mid x_i) = 1 - \Phi(-x'\beta),$$

$$\Pr ob(y_i = 1 \mid x_i) = \Phi(\mu - x'\beta) - \Phi(-x'\beta),$$

$$\Pr ob(y_i = 2 \mid x_i) = 1 - \Phi(\mu - x'\beta)$$

For the three probabilities, the marginal effects of changes in the regressors are:

$$\frac{\partial \Pr ob(y_i = 0 \mid x_i)}{\partial x} = \phi(x'\beta)\beta,$$

$$\frac{\partial \Pr ob(y_i = 1 \mid x_i)}{\partial x} = [\phi(-x'\beta) - \phi(\mu - x'\beta)]\beta$$

$$\frac{\partial \Pr ob(y_i = 2 \mid x_i)}{\partial x} = \phi(\mu - x'\beta)\beta$$

Sample Selection Model

Based on Heckman's (1979) sample selectivity model, Wynand and van Praag (1981) and Boyes, Hoffman and Low (1989) extended the sample selection model to the binary choice models. This extension has also been developed to the ordered choice models (Greene, 2008). Greene (2008) describes the ordered probit counterpart to the standard sample selection model as follows:

First step: Selection equation, a univariate probit model,

$$d_i^* = \alpha' Z_i + u_i,$$

$$d_i = 1 \ \ if \ \ d_i^* > 0 \text{ and 0 otherwise,}$$

Second step: Ordered Probit Outcome,

$$y_i^* = \beta' x_i + \varepsilon_i, \ \ \varepsilon_i \sim F(\varepsilon_i \mid \theta), E[\varepsilon_i] = 0, \ \ Var[\varepsilon_i] = 1,$$

$$y_i = 0 \ if \ \ \mu_{-1} < y_i^* \le \mu_0$$

$$y_i = 1 \ if \ \ \mu_0 < y_i^* \le \mu_1$$

$$y_i = 2 \ \ if \ \ \mu_1 < y_i^* \le \mu_2$$

...

$$y_i = J \ if \ \ \mu_{J-1} < y_i^* \le \mu_J$$

Observation mechanism:

$[y_i, X_i]$ is observed if and only if $d_i = 1$

$[\varepsilon_i, u_i] \sim N_2[0,0,1,1,\rho]$; there is "selectivity" if ρ is not equal to zero.

This model is a straightforward generalization of the bivariate probit model with sample selection. The second step model is nonlinear.

Data

An online survey was offered to extension personnel, agribusinesses, seed dealers, agricultural consultants, researchers and government agency personnel. The questionnaire was emailed to 7,612 extension and outreach personnel across ten states in the western U.S. on December, 2012. A total of 989 responses were received (13% of response rate). A total of 143 observations were dropped from the dataset since they did not contain needed information about outreach extension methods.

The objective was to gather information about current outreach practices as well as methods of learning and teaching new information. The questionnaire contained 34 questions organized in three sections. The first section gathered information on job background and demographics; the second requested information about outreach and extension methods currently used by the respondents; and the third section focused on assessing current knowledge and perceptions respondents have about bioenergy feedstocks and biofuel markets.

Three outreach sectors were identified: 1) extension and research, 2) government, and 3) agribusiness. The government sector refers to extension agents and personnel who work in the U.S. Department of Agriculture, the extension and research sector contains all of those who work as state or county extension agents, as well as university, government or industry researchers. Finally, seed suppliers or dealers, chemical dealers, crop consultants, certified crop advisors and other agribusiness were grouped under the agribusiness sector. The 10 western states surveyed were grouped in three regions (Table 1): the Pacific Northwest Fruitful Rim, the Prairie Gateway, and the Northern Great Plains region. Prairie Gateway was the region with the highest response rate, obtaining 51% of the total responses. Kansas, Colorado, and Nebraska were the states with the highest response, representing 17%, 10.64%, and 10.17% of the total responses,

respectively. The lowest rate corresponds to the Pacific Northwest Fruitful Rim region where California and Oregon contributed only 1.18% each, of the total responses obtained.

Table 1. States classification in regions

Pacific Northwest Fruitful Rim N=130	Prairie Gateway N=433	Northern Great Plains N=255
California	Colorado	Minnesota
Idaho	Kansas	Montana
Oregon	Nebraska	North Dakota
Washington	Oklahoma	South Dakota
	Texas	

Most of the respondents had a bachelor, masters, or doctoral degree. Between 6 and 8 percent of the respondents have taken graduate course work and less than 7 percent stated to have only a vocational, associates, or high school degree.

For all regions, the majority of respondents considered crop production as their primary area of expertise. This area involves activities such as: agronomy and soils, horticulture, pesticides and integrated plant management, production management, and livestock production. A very low percentage of respondents were involved in business, marketing, and/or finance and insurance activities.

As shown in Table 2, on a likert scale from 1 (strongly disagree) to 5 (strongly agree), respondents were asked what agricultural stakeholders they frequently work with in their positions. Showing averages greater than 3.4 (between indifferent to strongly agree), respondents in both the agribusiness and the extension and research sectors affirmed they frequently work with farmers and agribusiness, while those in the government work mainly with farmers. Only respondents in the agribusiness sector in the Pacific region and those in the extension and research sector in the Northern Great Plains affirmed to work with commodity groups, showing a mean greater than 3.5.

Table 2. Target groups and reception of information perception

Perception	Stats	Pacific Northwest			Prairie Gateway			Northern Great Plains		
		Ext & Res	Gov	Agbus	Ext & Res	Gov	Agbus	Ext & Res	Gov	Agbus
I frequently work directly with farmers in my position	Mean	3.91	4.11	4.40	3.80	4.16	4.64	4.30	4.40	4.69
	Std. Dev	1.32	1.23	0.97	1.25	1.31	0.87	1.07	1.07	0.66
I frequently work directly with agribusiness in my position	Mean	3.44	2.81	4.40	3.55	3.20	4.18	3.85	3.32	4.33
	Std. Dev	1.35	1.12	0.97	1.21	1.22	0.98	1.09	1.09	0.76
I frequently work directly with commodity groups in my position	Mean	3.15	2.50	3.67	2.90	2.37	3.05	3.52	2.50	2.68
	Std. Dev	1.38	1.02	1.32	1.27	1.10	1.31	1.19	1.12	1.07
Farmers use the extension and outreach information I provide in making their decisions	Mean	3.76	3.66	4.30	3.81	3.75	3.60	4.00	3.97	3.89
	Std. Dev	1.14	0.92	0.67	0.99	0.96	1.03	1.00	0.88	0.79
Agribusiness use the extension and outreach information I provide in making their decisions	Mean	3.20	2.79	4.63	3.48	2.91	3.08	3.60	2.98	2.96
	Std. Dev	1.26	1.00	0.52	0.92	0.96	0.87	1.00	1.05	0.96
Commodity groups use the extension and outreach information I provide in making their decisions	Mean	3.23	3.02	4.25	3.46	3.04	3.18	3.73	3.18	3.23
	Std. Dev	1.31	1.01	0.71	0.91	0.94	0.98	1.04	1.05	0.99

Likert Scale: 1=Strongly disagree, 2=Disagree, 3=Neither agree nor disagree, 4=Agree, 5=Strongly agree

Extension educators and other outreach personnel ranked university extension publications, internet, and newsletters between somewhat effective and very effective, showing a mean higher than 2.7, on average. Research experiment station publications and federal agricultural agencies were sources considered effective to very effective (mean higher than 3) by the extension/research and government sectors, respectively. The least effective sources were seed company publications, farmers' organizations, and other industry publications (Table 3).

Table 3. Effectiveness of information sources extension educators and other outreach personnel use to obtain crop-related information

Information Sources	Stats	Pacific Northwest			Prairie Gateway			Northern Great Plains		
		Ext & Res N=63	Gov N=57	Agbus N=10	Ext & Res N=127	Gov N=258	Agbus N=48	Ext & Res N=64	Gov N=161	Agbus N=30
Internet	Mean	3.39	3.23	3.60	3.33	3.22	3.28	3.37	3.26	3.07
	Std. Dev.	0.82	0.75	0.70	0.68	0.74	0.77	0.66	0.74	0.80
News Media (Newspapers, TV, Radio)	Mean	2.06	2.36	2.56	2.40	2.56	2.13	2.44	2.51	2.28
	Std. Dev.	1.03	0.76	0.88	0.80	0.76	0.70	0.77	0.82	0.96
Trade, Farmer of Commodity Magazines	Mean	2.52	2.57	2.70	2.52	2.64	2.69	2.65	2.67	2.48
	Std. Dev.	0.85	0.74	0.82	0.86	0.79	0.76	0.64	0.75	0.95
Newsletters	Mean	2.79	2.72	3.00	2.66	2.76	2.55	2.71	2.66	2.76
	Std. Dev.	0.85	0.64	0.82	0.92	0.76	0.76	0.85	0.76	0.74
University Extension Publications	Mean	3.40	2.96	3.10	3.30	3.14	2.78	3.38	3.06	2.76
	Std. Dev.	0.79	0.77	0.99	0.81	0.75	0.94	0.79	0.76	0.91
Research Experiment Station Publications	Mean	3.25	2.68	3.22	3.03	2.85	2.62	3.31	2.78	2.72
	Std. Dev.	0.87	0.73	0.83	0.89	0.87	0.96	0.81	0.90	0.96
University Bioenergy Websites	Mean	2.78	2.26	2.40	2.52	2.24	2.00	2.52	2.18	1.92
	Std. Dev.	0.98	0.71	1.14	0.90	0.79	0.98	0.83	0.81	0.76
Other University Sources	Mean	2.96	2.50	2.44	2.64	2.56	2.34	2.74	2.50	2.44
	Std. Dev.	0.87	0.69	1.24	0.77	0.79	0.76	0.81	0.82	0.75
Federal Agricultural Agencies (USDA-NRCS, USDA-FSA)	Mean	2.69	3.00	2.75	2.72	3.22	2.38	2.48	3.20	2.24
	Std. Dev.	0.98	0.94	1.04	0.90	0.79	0.96	0.93	0.86	0.83
USDA Online Newsrooms, ARS Agricultural Research Magazine	Mean	2.55	2.41	2.00	2.43	2.52	1.94	2.17	2.56	2.04
	Std. Dev.	0.95	0.76	1.10	0.96	0.86	0.87	0.75	0.82	0.55
State Agricultural Agencies	Mean	2.60	2.50	2.90	2.52	2.48	2.13	2.43	2.42	2.23
	Std. Dev.	0.80	0.80	0.99	0.87	0.80	0.66	0.80	0.80	0.95
Farm Organizations (e.g. Farm Bureau)	Mean	2.17	2.38	2.43	2.35	2.28	2.08	2.25	2.20	2.09
	Std. Dev.	0.81	0.79	0.98	0.90	0.79	0.90	0.80	0.78	0.90
Commodity Organizations	Mean	2.44	2.55	3.00	2.28	2.10	2.16	2.48	2.05	2.32
	Std. Dev.	0.82	0.67	0.93	0.78	0.80	0.90	0.75	0.78	0.85
Seed Company Publications	Mean	2.26	2.56	2.43	2.26	2.22	2.59	2.27	2.22	2.43
	Std. Dev.	0.79	0.84	1.13	0.85	0.73	0.82	0.65	0.81	0.97
Other Industry Publications	Mean	2.27	2.36	2.50	2.20	2.07	2.48	2.24	2.13	2.38
	Std. Dev.	0.67	0.70	0.97	0.80	0.65	0.78	0.64	0.71	0.86
Product Documentation or Instructions	Mean	2.33	2.50	2.70	2.54	2.31	2.63	2.54	2.24	2.57
	Std. Dev.	0.83	0.80	1.16	0.82	0.77	0.90	0.87	0.80	0.77
Local Agribusinesses	Mean	2.44	2.68	3.11	2.49	2.41	2.48	2.56	2.48	2.50
	Std. Dev.	0.81	0.64	1.05	0.90	0.75	0.70	0.81	0.81	0.97

Likert Scale: 1=Not effective, 2=Somewhat effective, 3=Effective, 4=Very effective

Respondents were asked to rank the top three events they attend to learn about agricultural production. Conferences, meetings, and field days were the events most frequently ranked, showing more than 46% of the surveyed population in each region attending. Furthermore, between 20 to 40% of this population ranked extension websites, on-farm demonstrations, and interactive workshops as events extension educators and other outreach personnel attend to gather agricultural information. Seed company events and university classes were the least used events (Table 4).

Table 4. Events extension educators and other outreach personnel attend to obtain crop and other agricultural production-related information.

Information events	Stats	Pacific Northwest				Prairie Gateway				Northern Great Plains			
		Ext & Res	Gov	Agbus	Total	Ext & Res	Gov	Agbus	Total	Ext & Res	Gov	Agbus	Total
		N=63	N=57	N=10	N=130	N=127	N=258	N=48	N=433	N=64	N=161	N=30	N=255
Field days	NR	33	41	6	80	73	180	27	280	32	120	13	165
	%	52.38	71.93	60.00	61.54	57.48	69.77	56.25	64.67	50.00	74.53	43.33	64.71
Conferences	NR	36	20	9	65	86	120	30	236	41	75	22	138
	%	57.14	35.09	90.00	50.00	67.72	46.51	62.50	54.50	64.06	46.58	73.33	54.12
Meetings	NR	31	25	5	61	60	122	38	220	36	74	23	133
	%	49.21	43.86	50.00	46.92	47.24	47.29	79.17	50.81	56.25	45.96	76.67	52.16
Extension websites	NR	25	24	4	53	47	94	8	149	24	43	4	71
	%	39.68	42.11	40.00	40.77	37.01	36.43	16.67	34.41	37.50	26.71	13.33	27.84
On-farm demostrations	NR	15	14	2	31	33	89	10	132	13	60	10	83
	%	23.81	24.56	20.00	23.85	25.98	34.50	20.83	30.48	20.31	37.27	33.33	32.55
Interactive workshops	NR	11	15	-	26	15	60	6	81	14	50	3	67
	%	17.46	26.32	-	20.00	11.81	23.26	12.50	18.71	21.88	31.06	10.00	26.27
Seminars/ Lectures	NR	10	10	2	22	26	26	7	59	8	19	5	32
	%	15.87	17.54	20.00	16.92	20.47	10.08	14.58	13.63	12.50	11.80	16.67	12.55
Web-based forums	Freq	8	3	1	12	10	22	4	36	2	8	4	14
	%	12.70	5.26	10.00	9.23	7.87	8.53	8.33	8.31	3.13	4.97	13.33	5.49
University classes	NR	7	2	1	10	11	4	1	16	7	7	1	15
	%	11.11	3.51	10.00	7.69	8.66	1.55	2.08	3.70	10.94	4.35	3.33	5.88
Seed company events	NR	1	2	-	3	2	8	10	20	1	6	5	12
	%	1.59	3.51	-	2.31	1.57	3.10	20.83	4.62	1.56	3.73	16.67	4.71

NR= Number of people who ranked that source

Regarding outreach methods, extension educators where asked to rank the sources and events they frequently use to provide agricultural information to farmers. Overall, more than 50% of the respondents per region ranked field days and fact sheets as the sources they most frequently used. Extension educators working in the area of extension and research also considered seminars and community education events as sources/events they frequently use for

outreach to farmers, while the government sector ranked soil and water conservation district and USDA related events. The agribusiness sector provides information through industry-sponsored, commodity groups/grower association, and/or crop consultant/certified crop advisor events. Radio/TV, state department of agriculture programs, and programs on bioenergy were the least frequently ranked events (Table 5).

Table 5. Sources and events extension educators use the most to provide crop related information to farmers

Outreach sources and events	Stats	Pacific Northwest				Prairie Gateway				Northern Great Plains			
		Ext & Res	Gov	Agbus	Total	Ext & Res	Gov	Agbus	Total	Ext & Res	Gov	Agbus	Total
		N=63	N=57	N=10	N=130	N=127	N=258	N=48	N=433	N=64	N=161	N=30	N=255
Fact sheets	NR	37	46	7	90	83	197	29	309	41	123	20	184
	%	58.73	80.70	70.00	69.23	65.35	76.36	60.42	71.36	64.06	76.40	66.67	72.16
Newsletters	NR	18	17	3	38	42	95	25	162	17	56	14	87
	%	28.57	29.82	30.00	29.23	33.07	36.82	52.08	37.41	26.56	34.78	46.67	34.12
Programs on bioenergy	NR	7	7	-	14	14	18	2	34	6	9	2	17
	%	11.11	12.28	-	10.77	11.02	6.98	4.17	7.85	9.38	5.59	6.67	6.67
Interactive website	NR	12	13	2	27	24	53	6	83	12	18	8	38
	%	19.05	22.81	20.00	20.77	18.90	20.54	12.50	19.17	18.75	11.18	26.67	14.90
Radio/ TV	NR	1	-	-	1	15	24	2	41	2	8	1	11
	%	1.59	-	-	0.77	11.81	9.30	4.17	9.47	3.13	4.97	3.33	4.31
Field days	NR	32	34	6	72	69	161	28	258	30	101	18	149
	%	50.79	59.65	60.00	55.38	54.33	62.40	58.33	59.58	46.88	62.73	60.00	58.43
Interactive workshops	NR	19	24	2	45	25	87	13	125	32	77	8	117
	%	30.16	42.11	20.00	34.62	19.69	33.72	27.08	28.87	50.00	47.83	26.67	45.88
Seminars	NR	29	10	6	45	53	53	19	125	24	41	10	75
	%	46.03	17.54	60.00	34.62	41.73	20.54	39.58	28.87	37.50	25.47	33.33	29.41
Community Education Events	NR	33	14	1	48	64	84	16	164	40	51	9	100
	%	52.38	24.56	10.00	36.92	50.39	32.56	33.33	37.88	62.50	31.68	30.00	39.22
County, State, and Ag Representative Fairs	NR	18	13	-	31	25	64	7	96	14	30	4	48
	%	28.57	22.81	-	23.85	19.69	24.81	14.58	22.17	21.88	18.63	13.33	18.82
Industry- sponsored events	NR	11	10	4	25	40	26	34	100	18	28	23	69
	%	17.46	17.54	40.00	19.23	31.50	10.08	70.83	23.09	28.13	17.39	76.67	27.06
Commodity Groups/ Grower Association events	NR	23	12	5	40	51	32	19	102	28	25	14	67
	%	36.51	21.05	50.00	30.77	40.16	12.40	39.58	23.56	43.75	15.53	46.67	26.27
Farm service agency/ Farm bureau events	NR	3	6	1	10	14	35	5	54	1	20	2	23
	%	4.76	10.53	10.00	7.69	11.02	13.57	10.42	12.47	1.56	12.42	6.67	9.02
State Department of Agriculture programs	NR	13	5	1	19	13	35	3	51	6	19	2	27
	%	20.63	8.77	10.00	14.62	10.24	13.57	6.25	11.78	9.38	11.80	6.67	10.59
USDA/NRCS, USDA/RMA, USDA/FSA	NR	11	36	3	50	22	203	7	232	18	128	4	150
	%	17.46	63.16	30.00	38.46	17.32	78.68	14.58	53.58	28.13	79.50	13.33	58.82
Soil and water conservation district	NR	13	37	2	52	20	162	2	184	13	114	3	130
	%	20.63	64.91	20.00	40.00	15.75	62.79	4.17	42.49	20.31	70.81	10.00	50.98
Crop consultant/ Certified crop advisor programs	NR	9	9	8	26	43	28	35	106	16	18	19	53
	%	14.29	15.79	80.00	20.00	33.86	10.85	72.92	24.48	25.00	11.18	63.33	20.78
Other events	NR	8	7	-	15	6	10	2	18	10	5	1	16
	%	12.70	12.28	-	11.54	4.72	3.88	4.17	4.16	15.63	3.11	3.33	6.27

NR= Number of people who ranked that source

Model estimation results

Results of the first stage of the model are reported in Table 6. The parameter estimates for gender, education, work in agribusiness and perception that farmers use the information provided by the Extension agents are positive and statistically significant. This means that Extension agents with higher level of education are more likely to use internet. Extension agents who work on agribusiness are also more likely to use internet compared with those who work with commodity groups. An Extension agent who has the perception that farmers use the information he/she provide is more likely to use internet.

Farmers who work with farmers are most likely to use news media as well as those who primarily work with agribusiness. As for the Extension who use trade of commodity magazines, results implies that Extension agents with higher levels of education are more likely to use those magazines for learning as well as the ones who work directly with agribusiness and those who has the perception that farmers and agribusiness use the information they provide.

Table 6. First stage: use of a learning method as a binary variable

Variable	Internet	News Media (Newspapers, TV, Radio)	Trade, Farmer of commodity magazines
Constant	0.2338772	-0.1637051	-0.4388398
	(0.608)	-0.618	(0.205)
Experience	0.0137062	0.0047613	0.0149627
	(0.145)	(0.506)	(0.048)**
Gender	0.4157369	0.0682797	0.1163403
	(0.02)**	(0.617)	(0.398)
Age	-0.0144386	0.0024947	-0.0010538
	(0.112)	(0.708)	(0.879)
Education	0.5351321	0.0594041	0.3442647
	(0.004)***	(0.633)	(0.009)***
Work farmers	0.1051453	0.351409	0.0947676
	(0.43)	(1.98)*	(0.52)
Work agribussiness	0.5361783	0.4531017	0.6484476
	(0.015)**	(0.003)***	(0)***
Perception: farmers	0.4531973	0.1493835	0.42218
	(0.068)*	(0.427)	(0.027)**
Perception: agribusiness	0.3769278	0.330371	0.3012051
	(0.097)	(0.032)**	(0.063)*
N	720	726	725
Pseudo R2	0.1954	0.1074	0.1585
Log likelihood	-126.55884	-275.61065	-255.32935

Results for the second stage are shown in Table 7. Results indicate that older Extension agents tend to be more satisfied when using internet and news media to learn information; however, those agents working on Extension and Research and in the Government sector tend to be less satisfied when using news media as they learn new information. On the contrary, Extension agents with higher level of education are more likely to be satisfied when using news media.

Table 7. Second stage: use of a learning method – Ordered variable with selection

Variable	Internet	News Media (Newspapers, TV, Radio)	Trade, Farmer of commodity magazines
Constant	0.1773731	-0.1795803	-0.4494984
	(0.697)	(0.581)	(0.196)
Experience	0.0003353	-0.0059887	-0.0006891
	(0.952)	(0.271)	(0.902)
Gender	0.1242772	0.3729044	0.3856089
	(0.247)	(0)***	(0)***
Age	0.0120714	0.0126135	0.0030363
	(0.022)**	(0.017)**	(0.572)
Pacific	-0.15699	0.2542321	0.0904556
	(0.261)	(0.057)*	(0.514)
Prairie	-0.0468545	-0.0698373	-0.0267455
	(0.627)	(0.451)	(0.782)
Extension & Research	-0.2348718	-0.3458879	0.0304716
	(0.174)	(0.044)**	(0.857)
Government	0.0080977	-0.4650662	-0.0891266
	(0.96)	(0.004)***	(0.578)
Crop production	0.0479092	0.1172857	0.1644924
	(0.635)	(0.221)	(0.104)
Finance & Marketing	-0.0613753	-0.188412	0.0350754
	(0.673)	(0.166)	(0.806)
Education	0.1087833	0.2367714	0.1584976
	(0.286)	(0.019)**	(0.121)
	Internet-binary		
Experience	0.0135785	0.004246	0.0152855
	(0.151)	(0.547)	(0.043)**
Gender	0.3965586	0.0838539	0.1191864
	(0.026)**	(0.534)	(0.384)
Age	-0.0131811	0.0022648	-0.0012498
	(0.145)	(0.731)	(0.857)
Education	0.5314407	0.0455585	0.3597219
	(0.005)***	(0.712)	(0.007)***
Work farmers	0.1355841	0.3232537	0.1175495
	(0.579)	(0.061)	(0.524)
Work agribussiness	0.565403	0.5645953	0.668672
	(0.01)***	(0)***	(0)***
Perception: farmers	0.4317426	0.1119609	0.4049494
	(0.083)	(0.543)	(0.036)**
Perception: agribusiness	0.3828186	0.304577	0.2788416

	(0.092)	(0.044)**	(0.087)
	Threshold parameters		
Threshold 1	0.6094179	-0.3142803	-0.1914728
	(0.053)	(0.304)	(0.557)
Threshold 2	1.920851	0.9593332	1.187629
	(0)	(0.001)	(0)
Threshold 3	2.972314	2.19474	2.441016
	(0)	(0)	(0)
Rho	0.4284716	0.5677692	0.3240332
Log likelihood at convergence	-816.105	-985.9015	-985.9015

Discussion and Conclusions

Determining outreach and learning methods would help Extension and other outreach agents provide information and design programs that suits farmers' needs. The sources extension educators primarily prefer to obtain agricultural-related information were internet, extension websites, newsletters, university extension publications, conferences, meetings, interactive workshops, field days, and on-farm demonstrations. Furthermore, in the particular case of those extension agents working in the extension/research and the government sectors, other sources such as research experiment station publications and federal agricultural agencies are widely used. These results agree with Lakai, et al. (2012), who identified effective educational strategies that help Extension agents to acquire desired competencies. They found that 74% of the surveyed extension agents prefer face-to-face small group training workshops and only 5% prefer a combination or two or more delivery methods; however and different from finding in this paper, their least preferred delivery methods were electronic and printed learning materials. Lakai, et al. (2012) argue that the preference of Extension agents for face-to-face small group training workshops offered at a nearby location may help to minimize training costs.

Regarding outreach methods, all the Extension and outreach agents surveyed most frequently delivered information through field days and fact sheets. Seminars and community education events were preferred for educators working in the area of extension and research. Agents working in the government sector preferred soil and water conservation district and USDA related events, while those working in the agribusiness sector used industry-sponsored, commodity groups, grower association, and crop consultant events for outreach to farmers.

These findings are similar to those in studies about farmers' preference for extension delivery methods. Franz, et al. (2010) examined the learning methods farmers prefer and compared them with the preferred teaching methods of extension agents and specialists. This study found that farmers preferred learning methods were: hands-on, demonstrations, farm visits, field days, discussions, and face-to-face. Farmers showed a mixed preference towards online-methods, newsletters, books/manuals, on-farm tests, meetings, and lectures. Radio was the least preferred method. Radhakrishna, et al. (2003) found that longleaf pine landowners in South Carolina preferred newsletters, publications, and field tours. However, internet was the least preferred delivery method, which may be due to the significant negative correlation between age and technology delivery systems found in their study. Franz, et al. (2010) recommend the use of the internet as a delivery method with farmers who utilize it. Radhakrishna, et al. (2003) concluded that there is a need to maintain updating Extension agents on demographic changes and its consequent change in the demand of different delivery methods.

Conclusions

Results of the survey indicate that Extension agents work primarily with farmers and agribusiness groups. Their current preference for learning and outreach methods agrees with other studies on farmers' preferences about delivery methods. The use of field days, seminars, and community education events are important to maintain networking among farmers and the industry (Franz, et al., 2010). The use of the internet will depend on the age and technical knowledge of clientele and demand will increase as demographic characteristics change. Consequently, it is important to continue to study changes on the preference of delivery methods as technological and agriculture advance.

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