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Florida Farmers' Multi-BMPs Adoption: A Survey Analysis

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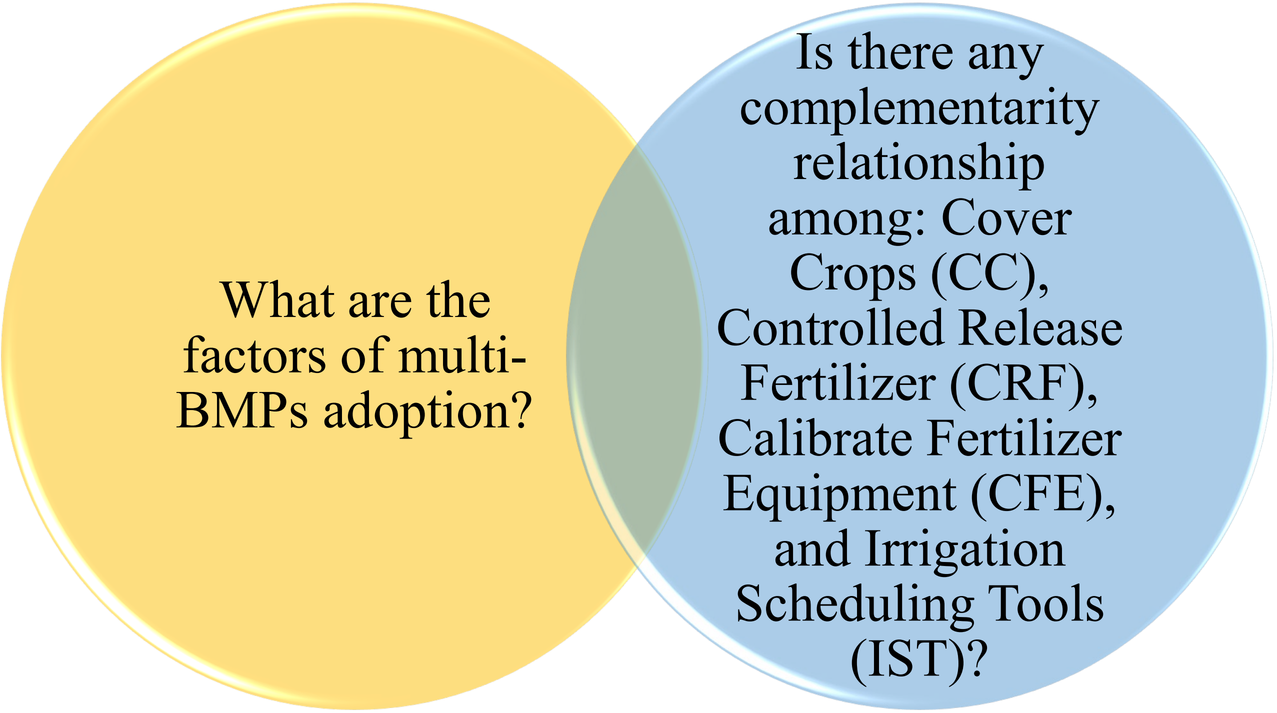
Motivation

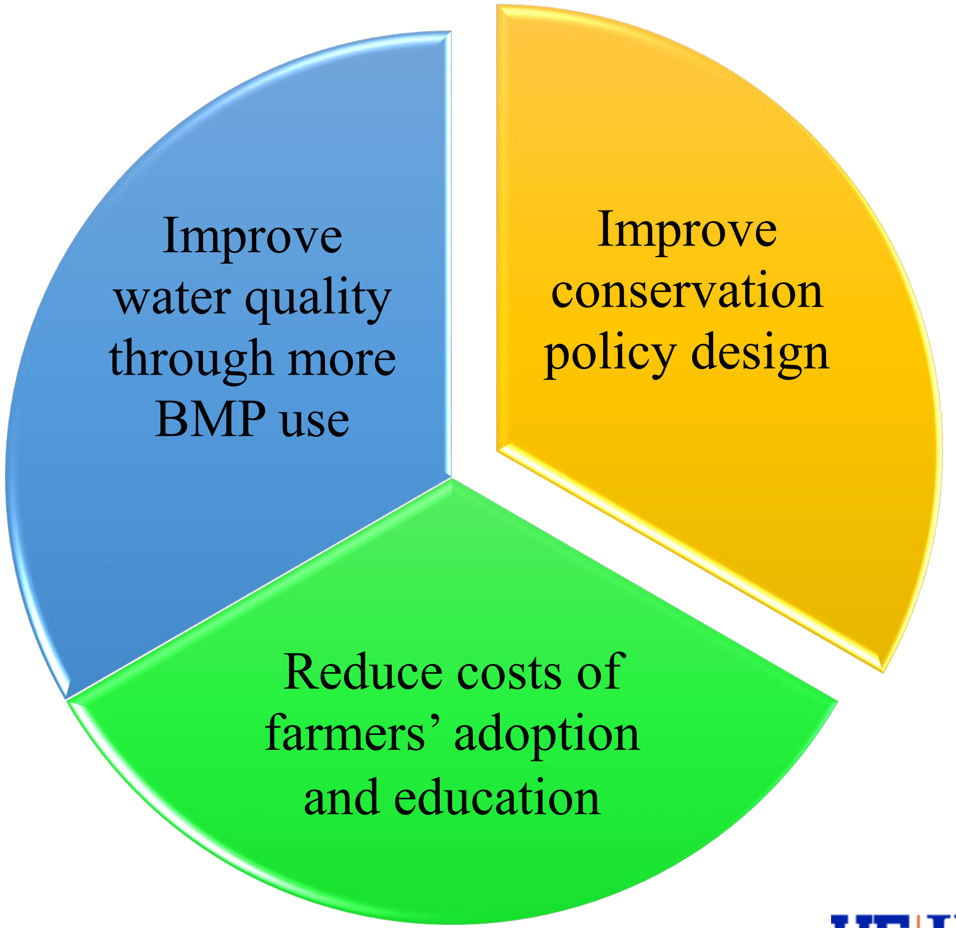
Using agricultural Best Management Practices (BMPs) can reduce the negative impact on the environment (Frydenborg and Frydenborg 2016), and are thought to be more beneficial when adopted simultaneously (Khana, 2009).

Research Objectives

Main Research Questions



Research Objectives



Hypotheses

- H_{01}: Multi − BMPs adoption′s factors are similar to single BMP adoption′s factors
- H_{02}: Multi − BMPs adoption depends on the type of the grown crops
- H_{03}: CRF & CFE are complements
- H_{04}: CRF & CC are complements
- H_{05}: CRF & IST are complements
- H_{06}: CFE & IST are complements
- H_{07}: CFE & CC are complements
- H_{08}: CC & IST are complements

Literature Review

Single-BMP Adoption (Baumgart-Getz et al., 2012)

Personal Capacity Factors

- Age,
- Education,
- Farming experience;
- Information;
- Networking

Other Capacity Factors

- Farm size;
- Capital;
- Income;
- Heritage;
- Land quality;

Attitudes & Awareness

- Environmental awareness;
- Risk aversion

Multi-BMPs Adoption

Variablity (Fleming, 2014)

- Soil
- Production methods

Attitudes, conservation program, & information (Deny et al., 2018; Adrian et al., 2005; Price & Leviston, 2014)

- Farmers' attitudes & perceptions of Ag. technologies' use
- Ability to learn
- Use of Agronomic information resource

Knowledge & Farm characteristics (Adrian et al., 2005)

- Farm size
- Education

Few studies are focusing on multi-BMP adoption &
Each study has a different focus and approach

Literature Review

Complementarity in agricultural practices:

Holley et al., 2020: Prescribed grazing practices & pasture management

Perry et al., 2016: Conservation tillage & glyphosate tolerant soybeans

Rusle, 2013: Contour-strip & conservation tillage

Reeves, 1994: Cover crops & conservation tillage

Few studies investigated complementarity among agricultural practices

Methods & Procedures

• Adoption Factors Model

- Assuming that each farmer has a sole alternative among BMP bundles options (Y_i), and their choices are affected by factor X.

- The MNL model specifies the following relationship between the probability of opting for Y_i and set of explanatory variables X (Green, 2011):

$$Pr(Y_i = j) = \frac{e^{\beta^i_j X_i}}{\sum_{j=0}^{n} e^{\beta^i_j X_i}} \; (1),$$

Where:

- Y: the latent variable on the observed choice of alternative j of BMP adoption by the i^{th} individual,
- $j \in [0;n]$, with 0 “non-adopter”, 1”BMP bundle 1”, …. etc.
- P_{ij} : the probability that the i^{th} individual chooses alternative j;
- X_i : independent variables;
- β_j : vector of coefficients on each X.

- To interpret the effects of explanatory variables on the probabilities, marginal effects are usually derived as (Green, 2011):

$$\delta_j = \frac{\partial P_j}{\partial X_i} = P_j\left[\beta_j - \sum_{k=0}^{j} P_k \beta_k\right] = P_j(\beta_j - \bar{\beta}) \; (2)$$

- The model is estimated using the maximum likelihood method.

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Methods & Procedures

• Complementarity Model

Cassiman and Veuglers (2006) consider that two activities are complements when three conditions are satisfied:

- (a) The performance of the two activities A_1 and A_2 outweighs the performance of one activity : $\Pi(1,1)-\Pi(0,1) \geq \Pi(1,0)-\Pi(0,0)$, (2)
- (c) Excluded variable: an increase in X_i increases only A_1 directly, because of complementarity X_i should increase also A_2 indirectly
- (b) Correlation: the activities A_1 and A_2 need to be positively correlated

In presence of an adoption data, the testing takes part through a bivariate Probit model as mentioned in condition (c), regressing the practices BMP_1, BMP_2 on a given exogenous variables X_i:

$$\begin{cases} BMP_1 = X_1\alpha_1 + \varepsilon_1^i,\ BMP_1^i = 1\ if BMP_1 > 0, 0\ otherwise, & (3) \\ BMP_2 = X_2\alpha_2 + \varepsilon_2^i,\ \ BMP_2^i = 1\ if BMP_2 > 0, 0\ otherwise, & (4) \end{cases}$$

- Where:
- **α** is the parameter estimate of the exogenous variable X_i,
- **ε** is the error terms

Under complementarity, X_i that affects only one of the two activities directly, should be significant in both regressions (3) and (4), because complementarity induces an indirect effect from this variable on the adoption of the other activity.

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Methods & Procedures

• Complementarity Model

- The estimation of the model by maximum likelihood is then given by:

$$Pr(BMP_1, BMP_2|X_1, X_2, z_1, z_2) = B[q_1 a_1, q_2 a_2, q_1 q_2 \rho], BMP_j = 0, 1 \; for \; j = 1, 2 \quad (5);$$

Where: $q_j = 2BMP_j - 1$ & $a_j = \frac{\alpha_j' X_j}{\exp(\gamma_j' z_j)}$ & B(.) is the bivariate normal CDF. The log-likelihood to be maximized is :

$$\sum_i ln \, Pr(BMP_1, BMP_2) \; (6).$$

Thus, for our study, six bivariate probit models were estimated :

(1)CRF & CFE,
(2)CRF & CC,
(3) CRF & IST,
(4)CFE & CC,
(5)CFE & IST,
(6) CC & IST.

Data

- The survey was administered online by the Florida Survey Research Center in March 2018. UF/IFAS extension agents, grower associations, and producer magazines distributed the survey link and access code. The final sample: N= 192

Results & Discussion

- 1. Adoption Statistics

	Single BMP	Two BMPs	Three BMPs	Four BMPs
Growers %	34%	26%	26%	13%

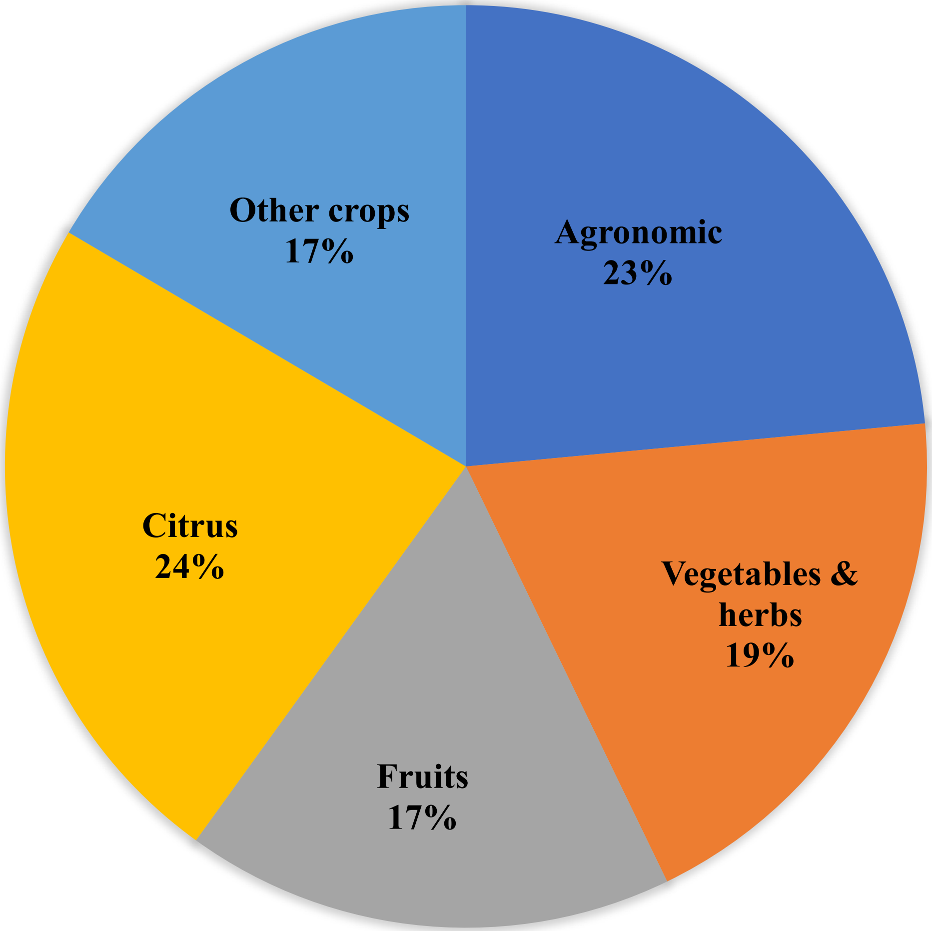
CC	IST	CRF	CFE	Acres%	Growers%
		X	X	18.59%	7%
X		X		0.001%	1%
	X	X		0.41%	5%
	X		X	0.58%	10.41%
X	X			21.42%	1.04%
X			X	0.04%	1.6%
X		X	X	0.25%	5.21%
	X	X	X	17.19%	17.19%
X	X	X		0.12%	0.05%
X	X		X	0.001%	3.125%
X	X	X	X	0.38%	12%

Results & Discussion

- **1. Descriptive Statistics**

Other & Independent variables	Obs	Mean (std.err)	Min	Max
Ownership	192	0.875 (0.3315835)	0	1
Multi-BMP Adoption	192	0.651 (0.4778869)	0	1
Total Acreage	192	1384 (5369.065)	0	48000
Number of Locations	192	3.759 (10.69159)	0	40
Number of Crops	192	3.827 (9.890798)	0	55

GROWERS BY CROP TYPE %



Results & Discussion

2. Multi-BMPs Adoption Factors

Variables / Adoption	Margins dy/dx (Delta-method std. errors)			
	Single adoption (Base outcome)	Double-BMPS ado.	Triple-BMPs ado.	Quadruple-BMPs ado.
Nb. of locations	0.0005 (0.0037)	0.0032 (0.0036)	0.0004 (0.0029)	-0.0042 (0.0034)
Ownership	0.1232 (0.1182)	-0.0591 (0.1040)	-0.1938* (0.0865)	0.1297 (0.1137)
Agronomic produces	-0.1826* (0.0733)	0.0910 (0.0776)	0.0348 (0.0787)	0.0567 (0.0592)
Total acreage	0.00004 (0.0000)	0.000009 (0.0000)	-0.000006 (0.0000)	-0.000007 (0.0000)
Vegetables	-0.2464** (0.0809)	0.0502 (0.0907)	0.0960 (0.0807)	0.1002* (0.0584)
Fruits	-0.2724** (0.0871)	0.1308 (0.0847)	0.0143 (0.0864)	0.1273* (0.0592)
Nb of grown crops	0.0035 (0.0065)	-0.0172 (0.0129)	0.0063 (0.0060)	0.0075* (0.0031)
Citrus	-0.4744*** (0.0895)	0.1653* (0.0724)	0.2597*** (0.0649)	0.0494 (0.0607)

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Results & Discussion

3. Complementarity: Bi-probit analysis

Log Likelihood				**-234.36**
Wald Chi2 (8)				**12.03**
Pr>Chi2				**0.1498**
			Coeff. (Std.err)	
Cover Crops (CC)	**Total acreage**		-0.00002 (0.00003)	
	Nb. locations		-0.019 (0.014)	
	Ownership		0.396 (0.351)	
	Nb of grown crops		**0.029*** (0.012)	
	Constant		-0.957** (0.345)	
Irrigation Scheduling Tools (IST)	**Total acreage**		-0.0000007 (0.00001)	
	Nb. locations		-0.01 (0.013)	
	Ownership		-0.157 (0.311)	
	Nb of grown crops		**0.065*** (0.033)	
	Constant		0.152 (0.320)	
Arthrho		**0.114**	**0.128**	**0.372**
Rho		**0.114**	**0.126**	
LR test of Rho	**0.000**			
Chi 2 (1)	**0.798**			
Pr>Chi2	**0.372**			

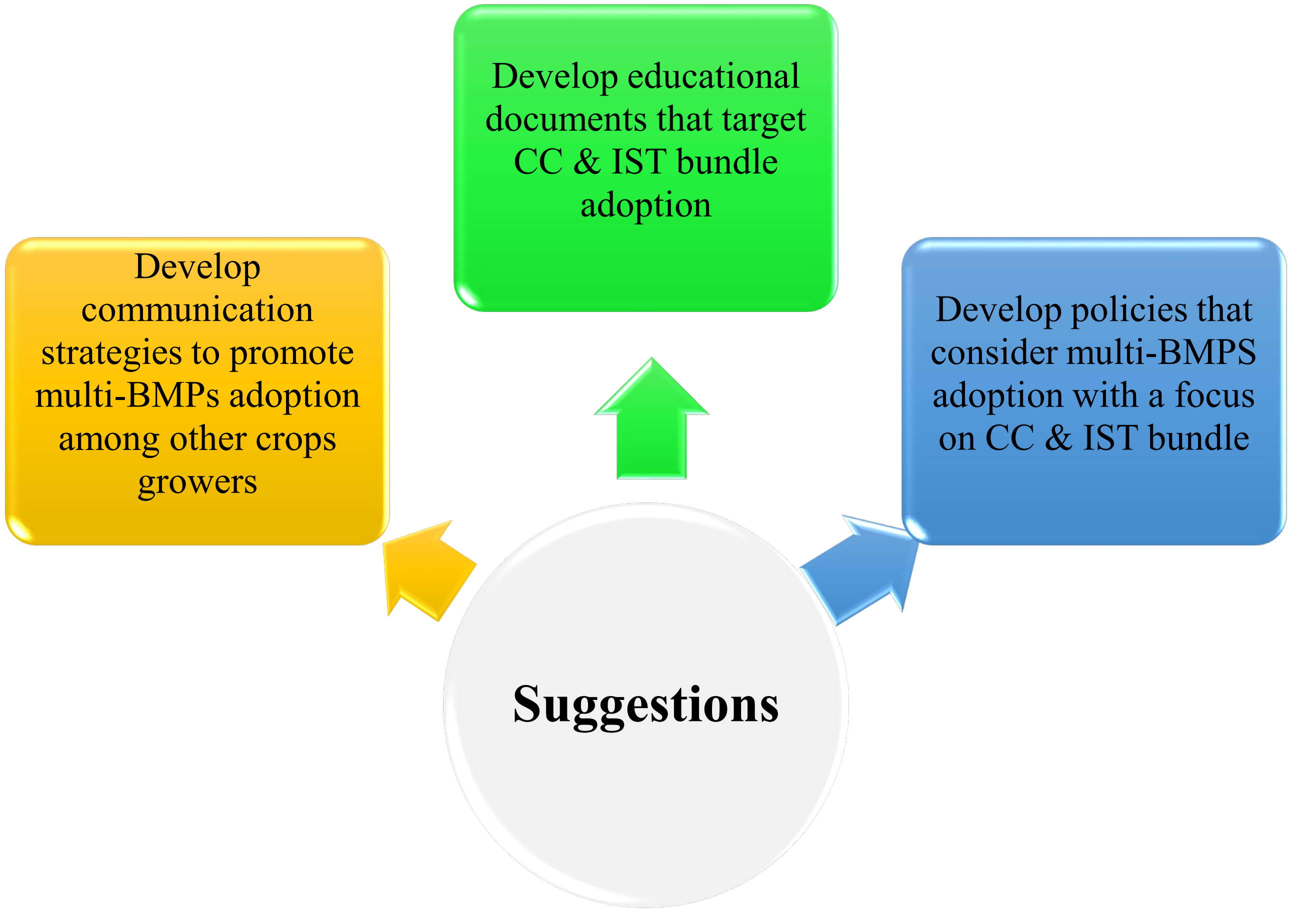
Results Summary

- Multi-BMPs adoption decision depends on the nature of the grown crops
- Vegetables, fruits, citrus, and agronomic producers are adopting more than one BMP compared to other crops growers
- CC & IST are complements

Conclusion and suggestions

Conclusion

- RH_{01}: Multi − BMP adoption′s factors are not similar to single − BMP adoption′s factors
- FRH_{02}: Multi − BMPs adoption depends on the type of the grown crops
- RH_{03}: CRF & CFE are not complements
- RH_{04}: CRF & CC are not complements
- RH_{05}: CRF & IST are not complements
- RH_{06}: CFE & IST are complements
- RH_{07}: CFE & CC are complements
- FRH_{07}: CC & IST are complements



Research Lacks

Relatively small data

No demographic data

Further Research

- Extend this research to other states & other BMPs
- Explore complementarity among other BMPs

Multi-BMPs Adoption Factors

		Coefficients (std. errors)		
Adoption Variables	**Single adoption**	**Double-BMPS ado.**	**Triple-BMPs ado.**	**Quadruple-BMPs ado.**
Nb. of locations	Base outcome	0.0117 (0.0246)	0.0008 (0.02276)	-0.038 (0.03526)
Ownership		-0.757 (0.74)	**-1.334*** (0.69071)	0.6327 (1.23048)
Agronomic produces		**1.0392*** (0.5029)	0.8584 (0.53596)	**1.1436*** (0.6534)
Total acreage		0.00001 (0.00004)	-0.00004 (0.00005)	-7E-05 (0.00012)
Vegetables		**1.1217*** (0.60011)	1.3625* (0.5763)	**1.7554*** (0.67823)
Fruits		**1.5155*** (0.60627)	**1.1129*** (0.6463)	**2.0638**** (0.70983)
Nb of grown crops		-0.081 (0.07279)	0.0117 (0.02357)	**0.0529*** (0.02813)
Citrus		**2.4712***** (0.651)	**2.9677***** (0.65223)	**2.1665**** (0.83017)
Constant		-0.543 (0.79273)	-0.306 (0.7232)	**-2.978*** (1.27836)

	=-
Loglikelihood	223.281
LR Chi2 (24)	63.38
Pr > Chi2	0.000
Pseudo R2	0.1243

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