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Soil conservation practices adoption in Northern Great Plains: Economic vs. stewardship motivations

Tong Wang

Department of Economics
South Dakota State University
Email: tong.wang@sdstate.edu

Hailong Jin

Department of Economics
South Dakota State University
Email: hailong.jin@sdstate.edu

Bishal B. Kasu

Department of Agronomy, Horticulture and Plant Science
South Dakota State University
Email: bishal.kasu@sdstate.edu

Jeffrey Jacquet

School of Environment and Natural Resources
Ohio State University
Email: jacquet.8@osu.edu

Sandeep Kumar

Department of Agronomy, Horticulture and Plant Science
South Dakota State University
Email: sandeep.kumar@sdstate.edu

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Objectives

- To increase our understanding towards adoption behaviors of two important soil conservation practices in U.S. Northern Great Plains.
- To study how economic and environmental motives affect adoption decisions of two soil conservation practices: diversified crop rotation (DCR) and integrated cropping and livestock system (ICLS).

Introduction

- Soil degradation has become one of the most pressing global issues
- Farm management practices such as conventional tillage, monoculture systems, and unbalanced fertilizer use can all directly damage soil health
- Farmers and ranchers play a key role in reversing the trend towards degradation
- Determinants of adoption of conservation practices vary by practice and regions.
- to our awareness no study has studied the effects of economic and environmental motives on adoption decisions of DCR and ICLS.

Materials & Methods

- 3500 survey questionnaire were sent to selected agricultural producers from Nebraska, South Dakota and North Dakota of USA.
- Out of the 3,177 eligible survey sample, 672 were completed and returned. Therefore the survey response rate was 21.2%.
- Duncan's multiple range test was performed to see whether there exists significant difference across groups.
- Bivariate probit model is chosen to model farmer's adoption decisions of DCR and ICLS adoption.

Diversified crop rotation



Integrated cropping and livestock system



Bivariate probit model estimate for DCR and ICLS adoption

Parameter	DCR		ICLS	
	Coefficient Estimates	Marginal Effect	Coefficient Estimates	Marginal Effect
Intercept	1.403 ^{**}		2.451 ^{***}	
Profit Increase	-0.285 ^{***}	-0.092	-0.659 ^{***}	-0.181
Soil Rank	-0.187 ^{**}	-0.060	-0.058	-0.016
Age	-0.015 ^{**}	-0.005	-0.002	0.000
Gender	-0.346	-0.112	0.639	0.176
Education	0.013	0.004	-0.063	-0.017
Employment source	0.152	0.049	0.010	0.003
Crop Acres	0.102 ^{**}	0.033	-0.051	-0.014
Moving possibility	-0.546 ^{**}	-0.176	-0.197	-0.054
South Dakota	0.559 ^{***}	0.180	-0.170	-0.047
North Dakota	0.762 ^{***}	0.246	-0.469 ^{**}	-0.129
ρ	0.122			

Note: One, two and three stars represent, respectively, 10%, 5% and 1% levels of statistical significance.

DCR adoption rates, by 1) required profit increase and 2) soil health priority.

Minimum profit increase			Soil health importance		
Requirement	# of farmers	Adoption rate	Ranking	# of farmers	Adoption rate
\$1	26	65.4% ^A	1 st	126	51.6% ^A
\$10	133	49.6% ^{AB}	2 nd	207	46.4% ^{AB}
\$50	242	43.8% ^{BC}	3 rd	114	37.7% ^B
\$100	120	29.2% ^C	Not ranked	225	20.9% ^C

ICLS adoption rate, by 1) required profit increase and 2) soil health priority.

Minimum profit increase			Soil health importance		
Requirement	# of farmers	Adoption rate	Ranking	# of farmers	Adoption rate
\$1	43	90.7% ^A	1 st	106	80.2% ^A
\$10	225	89.3% ^A	2 nd	196	80.6% ^A
\$50	188	67.0% ^B	3 rd	121	78.5% ^A
\$100	59	44.1% ^C	Not ranked	249	55.8% ^B

Note: Subscripts are used to denote Duncan's multiple range test results, where the numbers with same letters imply no statistically significant difference exist between the average values in different groups.

Policy implications

- To diffuse soil conservation practices more effectively, besides the government cost share programs, future efforts could be done to:
 - reduce risk perception towards conservation practices among producers;
 - improve the understanding of soil health benefits associated with those practices.

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Results

- Producers who require higher minimum profit increase for adoption are less likely to adopt conservation practices.
- Farmers who list soil health as a more influencing factor to consider in their adoption decision making are more likely to adopt the conservation practices.
- Factors that shorten the time horizon to work on the same farm, such as older age and possibility to move, significantly reduce the probability of DCR adoption.
- Crop acres have contradicting effects towards two practices, in that it contributes positively to DCR adoption yet negatively towards ICLS adoption.
- DCR adoption rates gradually increase when moving further north, with adoption rate in North Dakota highest among the three states.
- Farmers in North Dakota were less likely ICLS adopters when compared to farmers in Nebraska.

Contacts

Dr. Tong Wang, Assistant Professor and Advanced Production Specialist, Department of Economics, South Dakota State University. tong.wang@sdstate.edu