TECHNICAL EFFICIENCY OF RESOURCE CONSERVING TECHNOLOGIES IN RICE WHEAT SYSTEM: CASE OF BIHAR AND EASTERN UTTAR PRADESH IN INDIA

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Poster prepared for presentation at the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24-26, 2011

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Introduction:

Photo By: CSISA Hub, Bihar

The CSISA project is primarily funded by the Bill and Melinda Gates Foundation and USAID and is being implemented throughout India, Bangladesh, Pakistan, and Nepal.

The RCTs are promoted as a part of conservation agriculture, which is being supported by the project. These technologies are designed to reduce the strain agricultural production has on two critical natural resources: water and soil.

This study aims to evaluate the technical efficiency of farmers engaged in rice-wheat cropping systems in India who are using Resource Conserving Technologies (RCTs) as part of the intervention of the Cereal Systems Initiative for South Asia (CSISA) project.

The RCTs being investigated in this study are primarily Zero-Tillage (ZT) and Direct Seeded Rice (DSR).

Bihar and Eastern Uttar Pradesh (EUP) are the focus areas of the study.

Objectives:

1. To examine the level of technical efficiency for farmers engaged in rice-wheat cropping systems in Bihar and Eastern Uttar Pradesh
2. To identify the factors that influence the technical performance of farmers engaged in resource conserving technologies as part of their involvement in CSISA intervention.

Acknowledgements:

The Authors would like to thank assistant scientists Anurag Kumar and Raman Sharma, Professors Amelia Bello and Yolanda Garcia from the University of the Philippines Los Baños, and the interns from Kalinga Rural School of Management in Bhubaneswar, and from the department of Agricultural Economics, Acharya N.G. Ranga Agricultural University in Hyderabad.

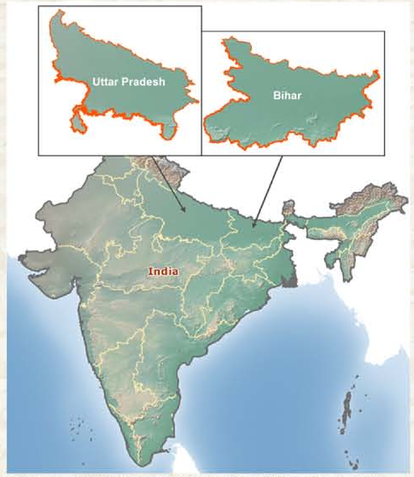

Figure 1: Location of study area, Eastern Uttar Pradesh and Bihar, India

Methods:

- Household surveys were conducted under the CSISA project in EUP and Bihar for the Kharif (rice) 2009 and Rabi (wheat) 2010 seasons.
- A total of 470 farmers were surveyed,132 in Kharif 2009 and 338 in Rabi 2010.
- In Kharif 2009, the promoted technology in Bihar was zero-tillage and direct seeded rice.
- In Kharif 2009, the promoted technology in EUP was DSR, of which:
  - 20% of farmers used zero-tillage
  - 20% of farmers used reduced-tillage
  - 60% of farmers used conventional tillage
- In Rabi 2010, all with intervention farmers are engaged in zero-tillage wheat.

Results & Discussion:

Production Function

•Diammonium Phosphate (DAP) has a positive effect on productivity for farmers who are receiving intervention in the rice season.

- DAP application was found to have an inverse effect on rice productivity for farmers without intervention.
- The amount of seed used was found to have a positive effect on productivity for both with and without intervention wheat farmers.
- Without intervention wheat farmers realized gains in productivity through increases in labor.

Technical Efficiency

- Rice farmers who were receiving intervention gain in technical efficiency through usage of DAP, participation in seed subsidy program, geographical location, and diversification of crops.
- The determinants of technical efficiency for without intervention rice farmers are: usage of DAP, education attainment, and crop diversification.
- Wheat farmer in the Rabi season who were receiving intervention are found to have usage of DAP, participation in seed subsidy program, geographical location, crop diversification, type of irrigation used, planting in a irrigated lowland field, and membership in an organization as determinants of technical efficiency.
- The determinants of technical efficiency in without intervention wheat farmers are usage of DAP, participation in seed subsidy program, and crop diversification.

VARIABLE	KHARIF 2009		RABI 2010	
	With Intervention	Without intervention	With intervention	Without intervention
	Technical inefficiency			
Constant	-0.483 (0.925)	-0.14 (0.034)	-0.14 (0.707)	0.544 (0.376)
Dummy Urea[a]	0.088 (0.785)	-	0 (1)	-0.819 (1.628)
Dummy DAP	-0.935* (0.474)	-0.863* (0.439)	-1.410*** (0.521)	-1.363** (0.647)
Dummy Chemical	-0.2 (0.227)	-0.225 (0.223)	-0.108 (0.23)	0.001 (0.106)
Age	-0.014 (0.012)	0.003 (0.006)	0.001 (0.009)	0.001 (0.003)
Years in school	-0.001 (0.031)	0.056*** (0.019)	-0.017 (0.021)	-0.004 (0.008)
Seed subsidy[b]	-0.420* (0.246)	-	-1.882** (0.89)	-0.458* (0.245)
Geographical location	0.554** (0.277)	-0.158 (0.178)	0.903* (0.455)	0.025 (0.155)
Cropping system	1.461** (0.671)	0.440*** (0.161)	-0.514* (0.31)	0.300*** (0.105)
Type of irrigation	0.144 (0.406)	0.094 (0.278)	-0.912* (0.47)	-0.19 (0.167)
Production system	-0.07 (0.29)	0.1 (0.194)	-0.508* (0.29)	-0.112 (0.08)
Type of seed	0.059 (0.565)	-0.085 (0.187)	0.055 (0.485)	0.066 (0.184)
Year working on farm[c]	-	-	0.002 (0.008)	0.001 (0.003)
Member of organization[d]	-	-	0.403* (0.229)	0.083 (0.076)

Table 1: Maximum likelihood estimates of production function
Note: *, ** and *** are statistically significant at 10%, 5% and 1% level

VARIABLE	KHARIF 2009		RABI 2010	
	With Intervention	Without intervention	With intervention	Without intervention
	Production function			
Constant	7.113*** (0.689)	8.718*** (0.97)	7.563*** (0.272)	-3.681 (2.963)
Seed	0.137 (0.111)	0.059 (1.224)	0.119* (0.062)	2.307*** (0.588)
Labor	0.102 (0.094)	0.253 (0.842)	0.016 (0.025)	2.185*** (0.767)
Urea	-0.006 (0.06)	0.816 (0.901)	0.027 (0.039)	1.054 (0.844)
DAP	0.098*** (0.032)	-1.452* (0.819)	0.007 (0.009)	-0.636 (0.508)
Chemical	-0.033 (0.069)	16.868*** (0.968)	-0.046*** (0.011)	0.02 (0.347)
Seed*Labor	-	-0.239 (0.189)	-	-0.418*** (0.154)
Seed*Urea	-	0.17 (0.212)	-	-0.254 (0.168)
Seed*DAP	-	0.066 (0.079)	-	0.193* (0.102)
Seed*Chemical	-	1.572*** (0.354)	-	0.003 (0.077)
Labor*Urea	-	-0.236** (0.108)	-	0.038 (0.026)
Labor*DAP	-	0.349** (0.162)	-	-0.055** (0.028)
Labor*Chemical	-	-3.954*** (0.556)	-	-0.004 (0.044)
Urea*DAP	-	-0.031 (0.071)	-	0.009 (0.007)
Urea*Chemical	-	-0.519 (0.615)	-	0.016 (0.029)
DAP*Chemical	-	0.084 (0.2)	-	-0.024 (0.021)
Sigma-squared	0.240*** (0.067)	0.076*** (0.018)	0.467*** (0.116)	0.075*** (0.012)
Gamma	0.366* (0.222)	0.999*** (0.000)	0.938*** (0.020)	0.619*** (0.148)
Log-likelihood function	54.616	6.070	21.272	0.176

Table 2: Determinants of technical inefficiency model
Note: *, ** and *** are statistically significant at 10%, 5% and 1% level
(a) all without intervention farmers in Kharif 2009 had used Urea
(b) without intervention farmers in Kharif 2009 didn't receive seed subsidy
(c) and (d) data not available for Kharif 2009

The mean level of technical efficiency is higher for farmers who are receiving CSISA intervention in both rice and wheat crops (table 3). Moreover, the difference of means is statistically significant at one percent for both seasons. A graphical representation of this difference is presented for rice (figure 2) and wheat (figure 3).

ITEM	WITH INTERVENTION	WITHOUT INTERVENTION	DIFFERENCE
	Kharif 2009		
Mean	0.725 (0.213)	0.600 (0.234)	0.125***
	Rabi 2010		
Mean	0.806 (0.138)	0.640 (0.213)	0.166***

Table 3: Mean technical efficiency level between with and without intervention farmers. (*** is statistically significant at 1% level)

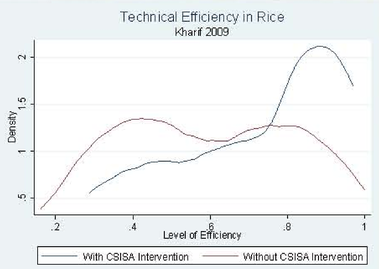

Figure 2: Comparison of technical efficiency in rice

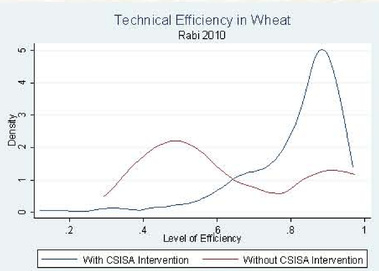

Figure 3: Comparison of technical efficiency in wheat

Conclusions:

The use of DAP fertilizer has a positive impact on technical efficiency in all groups. Moreover, farmers receiving intervention from the project are more technically efficient than those who are not.

Receiving seed subsidies contributes positively to technical efficiency. The use of a water pump for irrigation as well as planting in an irrigated lowland field are both determinants of technical efficiency in with intervention farmers in the Rabi (dry) wheat season.

Crop diversification was found to have a positive effect on technical efficiency in all cases except for with intervention wheat farmers. In this case, rice-wheat cropping was a determinant of technically efficiency. This is likely a result of the use of resource conserving technologies. The use of RCTs in the rice season is expected to have a positive impact on wheat productivity. However, further studies will have to be conducted to investigate the impact of RCTs on rice-wheat cropping systems in Bihar and Eastern Uttar Pradesh.

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