Factors Influencing Farmers’ Adoption of Modern Rice Production Technologies and Good Management Practices in the Philippines

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The policy issue

The adoption of rice technologies provides opportunities to increase rice production and farming income

Unfortunately, it is rare that all farmers are able and willing to adopt new technologies because of the deterrents to adoption imposed by various socioeconomic, institutional and environmental factors

Objectives

Assess the determinants of technology adoption in rice production in the Philippines

Evaluate the factors influencing the adoption of certified seed (CS) technology and integrated crop management practices (ICMPs) in rice production




Definition of terms

Certified seeds	:	seeds that are pure, clean, full and uniform in size, and have a minimum germination rate of 85%
	:	have a 10 percent yield advantage relative to farmers’ seeds
Integrated crop management (ICM) system	:	integrates different rice technologies and addresses the overall health of crops by collectively using all available methods (regulatory, physical, cultural, chemical and biological)
	:	showcases proven crop management technologies such as high-quality seeds, site-specific nutrient management, integrated pest management, controlled irrigation and postharvest technologies

Estimation of binary choice models

Farmer's choice is represented as:

$$y_i = \begin{cases} 1 \text{ if the farmer adopts CSs} \\ 0 \text{ if the farmer does not adopt CSs} \end{cases}$$

The binary adoption variable has a probability function:

$$f(y) = p^y(-p)^{1-y}$$

Factors affecting CS adoption is represented by a latent variable U_i^* :

$$U_i^* = X_i\beta + e_i \qquad i = 1, 2, ..., N$$

The probability of CS adoption is estimated by a logit model:

$$P_i = P[y_i = 1] = \frac{e^{x_i\beta}}{1 + e^{x_i\beta}}$$

Estimation of count data models

A Poisson regression model is used to investigate the adoption of ICMPs

If Y is a Poisson random variable, then its probability density function can be represented as:

$$f(y_i \mid x_i) = P(Y_i = y_i) = \frac{e^{\lambda} \lambda^{y}}{y!}, \qquad y = 0, 1, 2, 3, \ldots$$

The parameter λ_i usually take a log linear functional form defined as:

$$\ln \lambda_i = x_i ' \beta$$

The log-likelihood function for a Poisson regression model is given as:

$$\ln L = \sum_{i=1}^{n} \left[-\lambda_i + y_i (x_i^{'} \beta) - \ln y_i ! \right]$$

Data and variables

- A data set consisting of 3,164 samples from the Rice Based Farm Household Survey of PhilRice is used in the analysis
- Data were collected in the top 30 rice-producing provinces in the Philippines during the crop year 2006/07
- Explanatory variables included in the binary and count data models were classified into six groups:

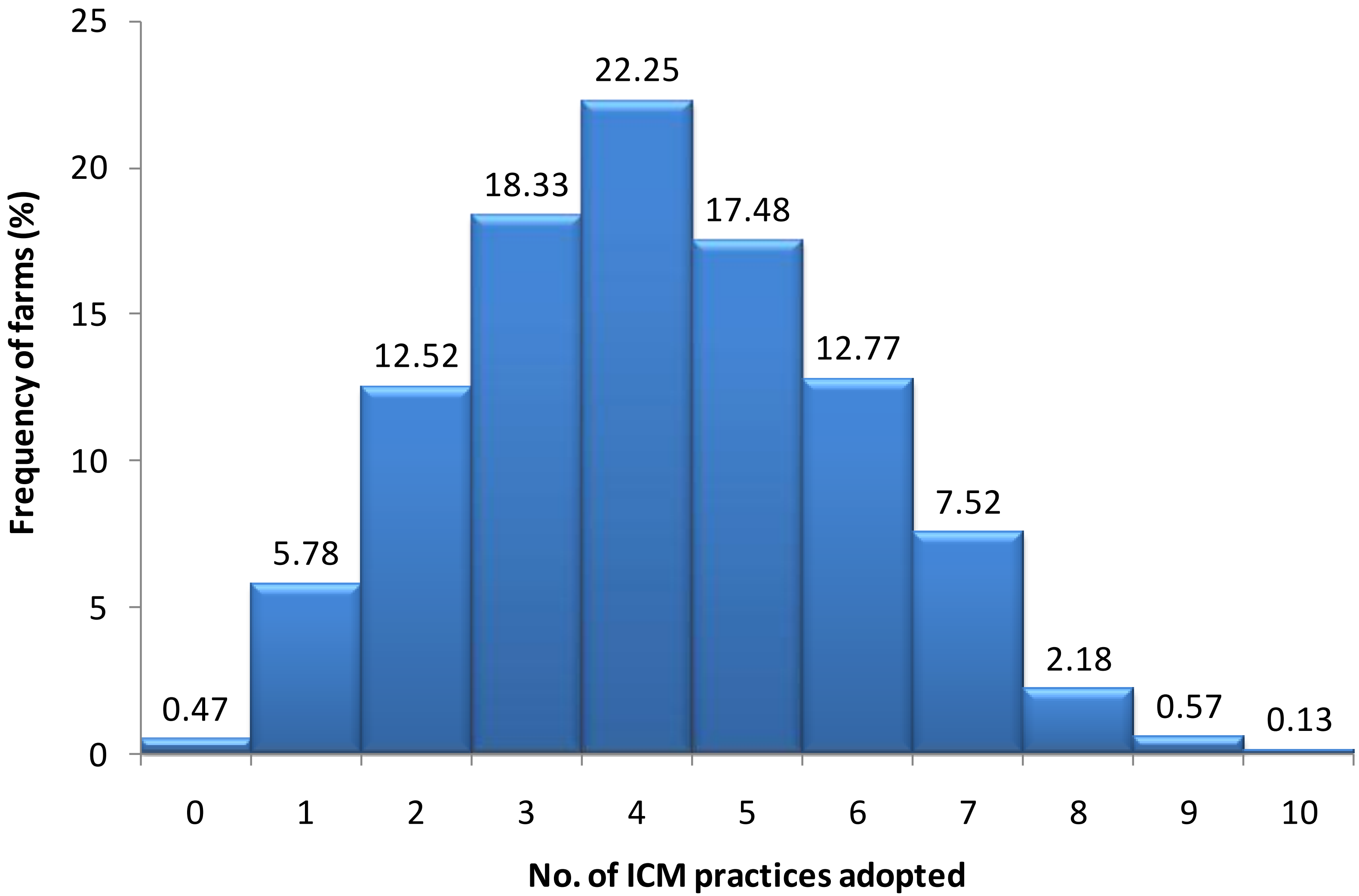
Classification	Variables
Farmer characteristics	Gender, years of schooling, farming experience, household size
Farm assets/resources	Cultivated area owned, machinery ownership, non-rice income
Institutional factors	Farm size, distance to nearest market, credit access
Extension	Participation in on-farm demonstrations, attendance at training sessions, access to extension workers
Biophysical conditions	Sufficient water irrigation, NPK deficiency, drought-prone area, submergence-prone area
Farmer behaviour	Risk aversion, profit orientation

Data and variables

Practice	Definition of best management practices in rice farming	Frequency of adopters (%)
ICM 1	Use of certified inbred and/or hybrid seeds	30
ICM 2	Use of modern varieties	90
ICM 3	Use of recommended seeding rates	24
ICM 4	Straight-row planting or proper spacing of seedlings	27
ICM 5	No high and low soil spots after levelling (land preparation)	45
ICM 6	Use of minus-one element technique	1
ICM 7	Use of leaf colour chart	2
ICM 8	Use of organic fertilizer, rice straw soil incorporation and use of carbonized rice hulls	45
ICM 9	Use of alternate wetting and drying (intermittent irrigation technique)	49
ICM 10	Use of water technologies for supplemental irrigation (shallow tube wells, surface water pumps, etc.)	24
ICM 11	Thresh palay right after harvest (postharvest management)	65
ICM 12	Use of machine in land preparation and harvesting (mechanization)	13

Data and variables

Distribution of total ICMPs adopted by farmers



Results

Variable	Logit Model				Poisson Model			
	Parameter estimates		Marginal effects		Parameter estimates		Marginal Effects	
	Coef.	Std error	Coef.	Std error	Coef.	Std error	Coef.	Std error
Constant	-2.097	0.2527 [a]	-0.4254	0.0500 [a]	1.1391	0.0531[a]	4.7307	0.2957 [a]
Farmer characteristics:								
Gender (x_1)	0.0359	0.1356	0.0072	0.0272	-0.0204	0.0286	-0.0846	0.1203
Schooling (x_2)	0.0649	0.0137 [a]	0.0132	0.0028 [a]	0.0101	0.0029 [a]	0.0421	0.0125 [a]
Experience (x_3)	-0.0052	0.0034	-0.0011	0.0007	-0.0005	0.0007	-0.002	0.003
Household size (x_4)	-0.0488	0.0189 [a]	-0.0099	0.0038 [a]	-0.0072	0.0040 [c]	-0.0301	0.0169 [c]
Farm assets/resources:								
Area cultivated owned (x_5)	-0.0017	0.0009 [c]	-3.3453	0.1784^{-3} [c]	-0.0003	0.0002	-0.001	0.0008
Machinery ownership (x_6)	0.6168	0.0922 [a]	0.131	0.0202 [a]	0.0984	0.0203 [a]	0.4086	0.0871 [a]
Non-rice income (x_7)	0.0012	0.0005 [a]	0.2426^{-4} [a]	0.9549^{-4} [a]	0.1867^{-4}	0.1021^{-3}	0.7754^{-4}	0.4301^{-3}
Institutional factors:								
Farm size (x_8)	0.1027	0.0452 [b]	0.0208	0.0092 [b]	0.0151	0.0096 [c]	0.0628	0.0404 [c]
Distance to nearest market(x_9)	-0.0032	0.0059	-0.0006	0.0012	0.002	0.0012 [c]	0.0081	0.0051 [c]
Credit access (x_{10})	0.3538	0.0840 [a]	0.0724	0.0173 [a]	0.0403	0.0181 [b]	0.1675	0.0765 [b]

Farmers’ education, machinery ownership, access to affordable credit, irrigation water supply, capacity-enhancement activities and profit-oriented behaviour significantly increase the adoption of CSs and ICMPs

Results

Variable	Logit Model				Poisson Model			
	Parameter estimates		Marginal effects		Parameter estimates		Marginal Effects	
	Coef.	Std error	Coef.	Std error	Coef.	Std error	Coef.	Std error
Extension:								
Participation in on-farm demo (x_{11})	0.4897	0.1223 [a]	0.1067	0.0282 [a]	0.0819	0.0268 [a]	0.3403	0.1137 [a]
Attendance at training session (x_{12})	0.3078	0.0848 [a]	0.0629	0.0174 [a]	0.0837	0.0183 [a]	0.3475	0.0786 [a]
Access to extension workers (x_{13})	0.2395	0.0842 [a]	0.0482	0.0168 [a]	0.1737	0.0182 [a]	0.7215	0.0824 [a]
Biophysical conditions:								
Sufficient water irrigation (x_{14})	0.4445	0.1094 [a]	0.0852	0.0196 [a]	0.064	0.0226 [a]	0.266	0.0960 [a]
NPK deficiency (x_{15})	-0.1798	0.0908 [b]	-0.0363	0.0182 [b]	-0.0109	0.0195	-0.0451	0.082
Drought-prone area (x_{16})	-0.2967	0.1296 [a]	-0.0575	0.0239 [a]	-0.1601	0.0280 [a]	-0.665	0.1211 [a]
Submergence-prone area (x_{17})	-0.4079	0.1581 [a]	-0.0764	0.0271 [a]	-0.0716	0.0333 [b]	-0.2974	0.1408 [b]
Farmer behaviour:								
Risk aversion (x_{18})	0.0597	0.1226	0.0122	0.0253	-0.0576	0.0273 [b]	-0.2391	0.1155 [b]
Profit orientation (x_{19})	0.1964	0.0868 [b]	0.0394	0.0172 [b]	0.0786	0.0186 [a]	0.3264	0.0796 [a]

Soil and nutrient deficiencies are impediments to the adoption of CS technology and ICMPs

Extension-related variables have the biggest impact on technology adoption based on the estimated marginal effects, odds ratios and IRRs

Policy implications

Options to increase technology adoption:

1. **Extend farmers' access to factors that can be exploited with government policy intervention in the short to medium term**
   - Broaden the delivery of extension-related activities: training, on-farm demonstrations, advisory services and collaboration with farmer co-operators
   - Delivery of mechanization options suited to the needs of small farmers to overcome seasonal bottlenecks in labour demand
   - Improve accessibility and affordability of rural credit
   - Minor public works in the construction and rehabilitation of irrigation infrastructure

Policy implications

2. Offset negative factors that are treatable in the short to medium term

- Improve the drought management of farmers through the adoption of drought-resistant rice varieties and rainwater harvesting technologies
- Public investment on small-scale irrigation technologies to mitigate perennial droughts
- Adoption of submergence-resistant rice varieties to overcome submergence on farms
- Government support for the construction of drainage systems and waterways and other earthwork services to improve the farming landscape in flood-prone areas

Policy implications

3. Lessen the negative impacts of factors that are difficult to tackle in the short to medium term

- Overcome problems of lack of education by improving the delivery of existing primary education in rural areas;
- Rice production policies and interventions should be implemented in a way that does not discriminate against smallholders
- Provide an economic environment that encourages a more businesslike approach to rice production

End of presentation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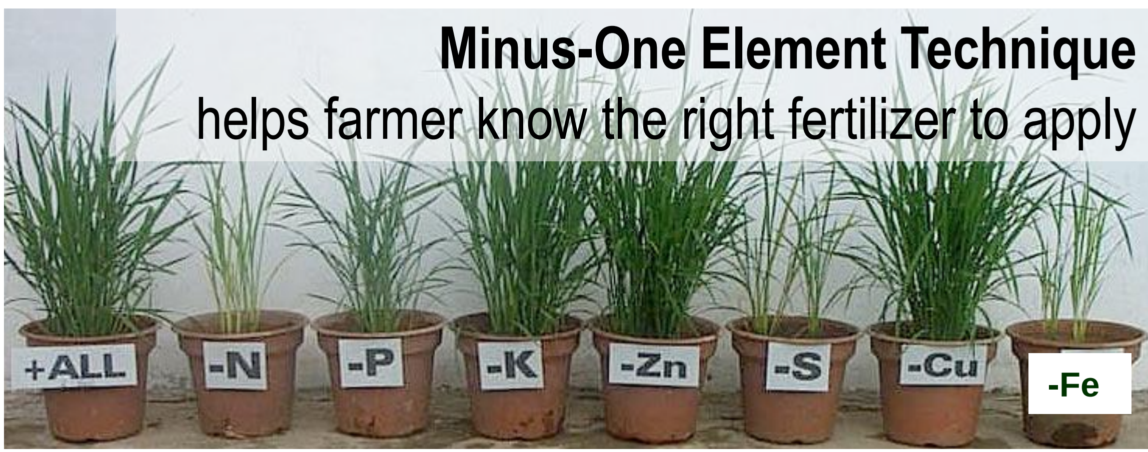

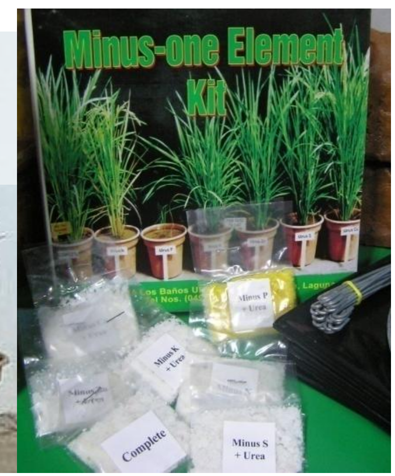


Plastic drum seeder


Ride-on attachment for hand tractor


Brush cutter harvester


4 in 1 mini-combine





Definition of terms

Eight key checks of the PalayCheck or integrated crop management system:

- ✓ Use of high quality seeds of a recommended variety
- ✓ No high and low soil spots after land levelling
- ✓ Practice of synchronous planting after a fallow period
- ✓ Ensuring a sufficient number of healthy seedlings
- ✓ Ensuring sufficient nutrients from tillering to early panicle initiation and flowering
- ✓ Avoiding excessive water or drought stress that could affect the growth and yield of the crop
- ✓ No significant yield loss due to pests
- ✓ Cutting and threshing the crop at the right time

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Logit Model:
Predicted 1s that were actual 1s (%) = 58.20
Predicted 0s that were actual 0s (%) = 72.98
Power of prediction (%) = 71.52
Log likelihood function = -1785.545
Prob[ChiSqd > value] = 0.0000
McFadden R2 = 0.0773

Poisson Model:
Log likelihood = -6151.876
McFadden pseudo R^2 = 0.0295295

Soil and nutrient deficiencies are impediments to the adoption of CS technology and ICMPs.