
Adoption of cereal-legume intercropping and improved varieties in post-war northern Uganda: Impact on crop income and labour

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Introduction

- ❑ Agriculture today is challenged to contribute to:
 - ❑ Food security and economic development
 - ❑ Enhanced resilience to CC
 - ❑ Mitigation co-benefits
- ❑ Recent work highlights the role of CSA (World Bank, 2015; AGRA, 2014; FAO, 2013).
- ❑ Single technologies vs packages
- ❑ Awareness exposure and adoption of technologies

Objectives

1. To assess determinants of adoption of cereal-legume intercroops and improved varieties
2. Quantify impact of adoption on crop income and labour-use.

Theoretical model: multinomial ESR

- 1st step: Multinomial logit model of adoption analysis.

$$\pi_{ij}^* = X_i \beta_j + \varepsilon_{ij} \quad (1)$$

$$I = \begin{cases} 1 \text{ iff } \pi_{i1}^* > \max_{h \neq 1}(\pi_{ij}^*) \text{ or } \omega_{i1} < 0 \\ \vdots & \vdots & \vdots \\ K \text{ iff } \pi_{iK}^* > \max_{k \neq j}(\pi_{ij}^*) \text{ or } \omega_{iK} < 0 \end{cases} \quad \text{for all } j \neq k \quad (2)$$

Where $\omega_{ih} = \max_{j \neq h}(\pi_{ij}^* - \pi_{ih}^*) < 0$

$$p_{ih} = pr(\omega_{ih} < 0 | X_i) = \frac{\exp(X_i \beta_j)}{\sum_{k=i}^K \exp(X_i \beta_k)} \quad (3)$$

□ 2nd step: Impact assessment.

$$\left\{ \begin{array}{l} \text{Regime 1: } Q_{i1} = Z_i \alpha_1 + \sigma_1 \lambda_1 + v_{i1} \text{ if } I = 1 \\ \quad \quad \quad \vdots \\ \text{Regime } K: Q_{iK} = Z_i \alpha_K + \sigma_K \lambda_K + v_{iK} \text{ if } I = K \end{array} \right. \quad (4)$$

□ Counterfactual analysis: adopters with actual adoption.

$$\left\{ \begin{array}{l} E(Q_{i2}|I = 2) = Z_i \alpha_2 + \sigma_2 \lambda_2 \\ \quad \quad \quad \vdots \\ E(Q_{iK}|I = K) = Z_i \alpha_K + \sigma_K \lambda_K \end{array} \right. \quad (5)$$

□ Counterfactual analysis: adopters had they not adopted.

$$\left\{ \begin{array}{l} E(Q_{i2}|I = 2) = Z_i \alpha_1 + \sigma_1 \lambda_1 \\ \quad \quad \quad \vdots \\ E(Q_{iK}|I = K) = Z_i \alpha_1 + \sigma_1 \lambda_1 \end{array} \right. \quad (6)$$

Empirical approach

- ❑ All estimations were done in STATA version 13.
- ❑ Choice of explanatory variables to include in adoption analysis was guided by literature.
 - ❑ HH characteristics:
 - ❑ Information:
 - ❑ Credit, group and personal values
 - ❑ Wealth and wellbeing
 - ❑ Experience with climatic shocks
 - ❑ Plot level variables
 - ❑ Sub-county dummies

- ❑ Selection instruments in outcome equations:
 - ❑ past experience with climatic shocks,
 - ❑ information sources,
 - ❑ information type.

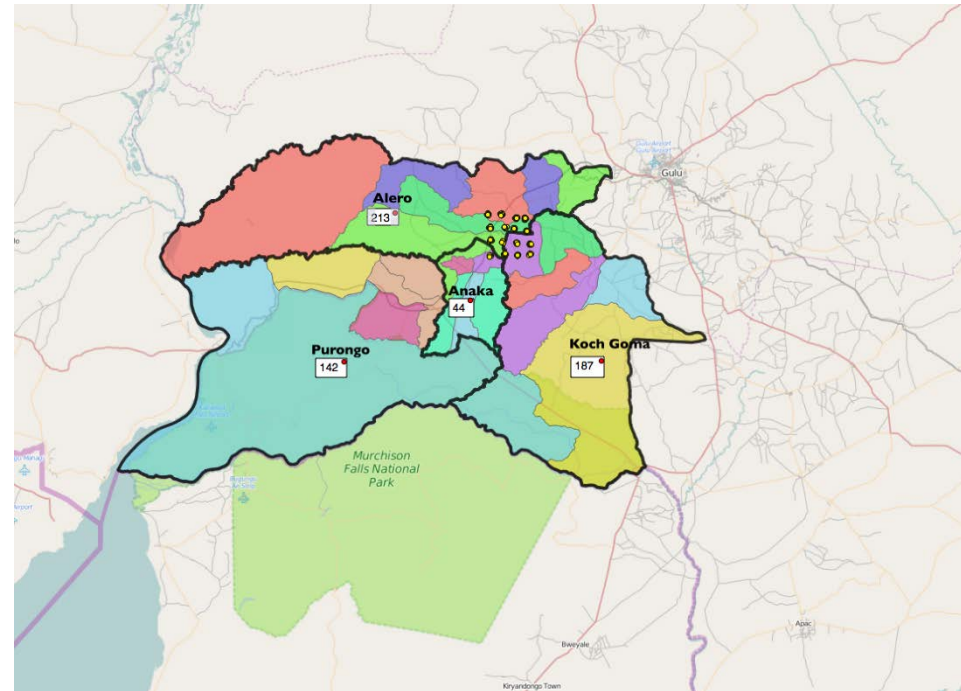
- ❑ A simple falsification test (Di Falco and Veronesi, 2013) to test validity of the instruments

CSA technologies and proportion of plots on which implemented

Choice	Technology	Intercrop	Improved varieties	Plots (%)
1	I_0V_0	-	-	67
2	I_1V_0	✓	-	13
3	I_0V_1	-	✓	15
4	I_1V_1	✓	✓	5

Study site and data

- ❑ Intra-household gender survey was conducted in October, 2014
- ❑ The sampling design combined PPS and simple random sampling.
- ❑ A total of 535 households and 2,445 farming plots



Results

Descriptive statistics

Variable	Mean values				
	I_0V_0	I_1V_0	I_0V_1	I_1V_1	Whole sample
HHHmale	0.94(0.24)	0.94(0.25)	0.89^{***}(0.31)	0.90 [*] (0.29)	0.93(0.25)
Literacy	0.10(0.15)	0.10(0.15)	0.12^{**}(0.17)	0.13^{**}(0.17)	0.10(0.16)
Dependratio	0.54(0.19)	0.55(0.20)	0.57^{**}(0.19)	0.53(0.22)	0.54(0.19)
InfoFamily	0.40(0.49)	0.41(0.49)	0.51^{***}(0.50)	0.42(0.50)	0.42(0.49)
InfoNGO	0.31(0.46)	0.30(0.46)	0.41^{***}(0.49)	0.37(0.49)	0.32(0.47)
InfoRadio	0.25(0.43)	0.27(0.45)	0.11^{***}(0.31)	0.12^{***}(0.33)	0.23(0.42)
Credit	0.14(0.35)	0.17(0.38)	0.18(0.38)	0.33^{***}(0.47)	0.16(0.37)
Wellbeing	-1.26(0.36)	-1.31^{**}(0.27)	-1.30^{**}(0.29)	-1.31(0.28)	-1.28(0.33)
Agricassets	0.08(0.29)	0.05^{**}(0.17)	0.08(0.23)	0.09(0.25)	0.08(0.26)
Drought	0.67(0.47)	0.70(0.46)	0.80^{***}(0.40)	0.67(0.47)	0.69(0.46)
Plotarea	0.92(0.92)	1.17^{***}(1.10)	1.39^{***}(1.20)	1.92^{***}(1.36)	1.07(1.05)
Distplot	1.37(2.92)	0.90^{***}(1.82)	1.64(3.85)	0.86^{**}(1.62)	1.33(2.92)
Agrochem	0.02(0.15)	0.04^{**}(0.21)	0.05^{**}(0.21)	0.10^{***}(0.29)	0.03(0.18)

Determinants of adoption: Multinomial logit regression

Variable	I_1V_0	I_0V_1	I_1V_1
	Coeff.	Coeff.	Coeff.
Age of the household head	-0.88^{***} (0.30)	-0.03(0.30)	-0.24(0.46)
Literacy	0.03(0.50)	0.90^{**} (0.47)	0.60(0.67)
Dependency ratio	0.43(0.39)	0.97^{***} (0.38)	0.03(0.49)
Number of older adults (>46)	0.46^{***} (0.12)	0.07(0.12)	0.09(0.18)
Receives remittances	0.17(0.35)	-0.10(0.31)	0.99^{***} (0.37)
Information on crop production	0.01(0.17)	0.14(0.18)	0.57^{**} (0.29)
Information from family member	-0.05(0.14)	0.27^{**} (0.13)	-0.17(0.21)
Information from NGO	-0.02(0.16)	0.50^{***} (0.14)	0.24(0.26)
Information from radio	0.16(0.16)	-0.67^{***} (0.20)	-0.87^{***} (0.31)
Loan fully repaid	0.22(0.18)	-0.03(0.17)	0.85^{***} (0.25)
Agricultural assets index	-1.04^{***} (0.44)	0.06(0.25)	-0.28(0.49)
Experienced drought	-0.03 (0.14)	0.46^{***} (0.16)	-0.25(0.23)
Area of plot	0.25^{***} (0.06)	0.36^{***} (0.06)	0.66^{***} (0.07)
Distance of plot from homestead	-0.08^{**} (0.04)	0.034^{**} (0.02)	-0.05(0.03)
Applied agrochemicals	0.58[*] (0.34)	0.55(0.36)	1.03^{***} (0.40)

Impact of adoption on crop income

Technology	Actual crop income (USD/ha)	Counterfactual crop income if farm household did not adopt (USD/ha)	Treatment effect (USD/ha)
Intercropping	119.53 (2.86)	77.35 (1.71)	42.18*** (3.33)
Improved varieties	120.32 (2.61)	81.73 (1.67)	38.59*** (1.70)
Intercropping plus improved varieties	153.11 (6.34)	79.50 (3.15)	73.62*** (7.08)

Impact of adoption on Labour use: Multinomial ESR

Type of labour	Crop activity	Treatment effects		
		I_1V_0	I_0V_1	I_1V_1
Female family labour <i>(person days)</i>	Land preparation	3.87 ^{***} (1.17)	2.47 ^{***} (0.54)	4.28 ^{***} (0.24)
	Weeding	7.29 ^{***} (0.33)	4.83 ^{***} (0.28)	9.09 ^{***} (0.61)
	Harvesting	6.69 ^{***} (0.21)	3.61 ^{***} (0.20)	6.42 ^{***} (0.40)
Male family labour <i>(person days)</i>	Land preparation	6.00 ^{***} (0.24)	4.12 ^{***} (0.21)	8.44 ^{***} (0.43)
	Weeding	2.47 ^{***} (0.17)	3.08 ^{***} (0.16)	3.34 ^{***} (0.37)
	Harvesting	3.49 ^{***} (0.18)	2.19 ^{***} (0.12)	3.76 ^{***} (0.40)
Female hired labour <i>(person days)</i>	Land preparation	1.00 ^{***} (0.16)	0.37 ^{***} (0.11)	0.46 ^{**} (0.24)
	Weeding	3.19 ^{***} (0.39)	1.51 ^{***} (0.38)	2.21 ^{***} (0.60)
	Harvesting	0.74 ^{**} (0.35)	1.46 ^{**} (0.65)	0.76 (0.48)
Male hired labour <i>(person days)</i>	Land preparation	2.35 ^{***} (0.36)	1.21 ^{***} (0.37)	0.78 ^{**} (0.32)
	Weeding	0.23 ^{**} (0.07)	1.35 ^{***} (0.54)	-0.06 (0.07)
	Harvesting	0.34 ^{**} (0.16)	0.90 ^{***} (0.24)	0.07 (0.10)

Conclusion

- ❑ Economic payoffs are higher when intercropping and improved varieties are adopted as a package.
- ❑ Adoption of intercropping and improved varieties increases workload
 - ❑ The increase in workload is at stages when HHs tend to already experience shortage of labour.
- ❑ Literacy, access to information, access to credit with increased ability to repay, and active participation in groups are important determinants of adoption.

Recommendations

- ❑ Collaboration with government extension agents in educating farmers about the characteristics, application, and benefits of the technologies.
- ❑ Training farmers on profitable agricultural investments and encouraging them to repay the borrowed credit e.g. through group lending.
- ❑ Research to identify and promote labour-saving technologies that can be combined with intercropping and improved varieties.
- ❑ Further research to determine whether the economic gains compensate for the workload

THANK YOU