Adoption of Soil Fertility Management Technologies in Malawi: Impact of Drought Exposure

Samson P. Katengeza, Stein T. Holden, Monica Fisher

Research Dissemination Conference for National Commission for Science & Technology, 28th and 29th September, 2017, Sunbird Nkopola Lodge, Mangochi

FRIDAY 29 SEPTEMBER 2017

Introduction

Background

Malawi continues facing twin problems of drought and low levels of nitrogen use, leading to persistent food insecurity.

Investments in technologies that increase nutrient intake, nutrient maintenance, and drought resilience, pertinent to food security.

Such technologies include organic and inorganic intergrated soil fertility management (SFM) e.g. organic manure and maize-legume intensification.

Objective

To examine adoption and adoption intensity of organic manure and maize-legume intercropping and how drought exposure affects farmer uptake.

Why organic manure and maize-legume intercropping?

- ✓These are popular technologies among smallholder farmers in Malawi and hence timely to get a better understanding of their adoption pattern over a close to ten year period.
- ✓The government has taken a leading role through programs such as the ASWAp to promote such technologies hence need for more evidence on adoption and yield impact.

Hypotheses

1. Drought shocks increase the likelihood of adopting maize-legume intercropping and organic manure.

2. Fertilizer use intensity vis-a-vis fertilizer subsidies crowds out organic manure and maize-legume intercropping.

3. Increase in fertilizer price is associated with higher likelihood of adopting organic manure and maize-legume intercropping.

4. Increase in population density drives adoption of potentially land-saving technologies such as maize-legume intercropping

Material and Methods

Data

4 waves of panel data collected between 2006 and 2015 in Kasungu, Lilongwe, Machinga, Zomba, Chiradzulu and Thyolo districts.

450 households randomly sampled in 2006 following IHS2.

378 resurveyed in 2009, 350 in 2012 and in 2015, resulting in four rounds of unbalanced panel data.

Data

Adoption has increased from 30% in 2006 to 53% in 2015 for organic manure and from 33% to 76% for intercropping.

On intensity there is a decrease for organic manure use between 2006 and 2015 but an increase in the share of farmed area allocated to maize-legume intercrop.

Technology	**2006**	**2009**	**2012**	**2015**
Applied manure (1=yes)	0.30	0.43	0.49	0.53
Manure quantity (Kg/ha)	2182	1616	1526	1456
Maize-legume intercropping (1=yes)	0.33	0.45	0.53	0.76
Farm size share of intercropping	0.27	0.25	0.34	0.37

Model specification

$$C_{it} = \beta_0 + \beta_1 W_{dt} + \beta_2 F_{it} + \beta_3 P_{it}^{f} + \beta_4 Pd_{ivt} + \beta_{ix} Z_{it}, +\alpha_i + \varepsilon_i$$

C_{it} = Dependent variable

a. 1 if adopted, 0 otherwise.

b. Quantity of organic manure (Kg/ha).

c. Farm land share under maize-legume intercropping (1:0).

W_{dt} = Exposure to previous early and late dry spells (days).

F_{it} = Fertilizer use (Kg/ha).

P_{it}^{f} = Fertilizer real price.

Pd_{ivt} = Population density.

Z_{it} = Set of household characteristics.

Estimation issues

Parameters are estimated with Mundlak-Chamberlain (MC) device using probit & tobit with a control function (CF).

Estimates could be affected by attrition bias in longitudinal data.

- ✓MC to control for time-constant unobservable factors that affect attrition.

Estimates potentially also affected by endogeneity resulting from non-random selection of FISP beneficiaries and self-selection in fertilizer use intensity.

- ✓A CF approach to solve endogeneity problem.

Results

Organic manure models

Variable	Adoption (1=yes)	Manure use (Kg/ha)
Late dry spell	0.020**	0.132**
Fertilizer use (Kg/ha)	0.348***	2.176***
Fertilizer price (Mk/Kg)	0.004***	0.021***
Fertilizer subsidy	0.032	0.147
Population density	1.524***	6.132**

Maize-legume intercropping models

Variable	Adoption (1=yes)	Farm size share
Early dry spell	0.039*	0.015**
Late dry spell	0.035***	0.015***
Fertilizer use (Kg/ha)	0.391***	0.115***
Fertilizer price (Mk/Kg)	0.003**	0.001**
Fertilizer subsidy	-0.009	-0.001
Population density	0.368	0.434**
Southern region dummy	1.246***	0.520***

Discussion and conclusion of results

1. Exposure to early and late dry spells increase the likelihood of adoption and adoption intensity of SFM technologies.

✓Farmers respond to occurrence and risks associated with dry spells on perception that intercropping and organic manure help them to hedge against resulting production losses.

✓While irrigation technology is an expensive option, organic manure and maize-legume intercropping offer smallholder farmers lower-cost options to hedge against droughts.

✓Hence need for coordinated efforts to ensure such technologies are available and disseminated to farmers.

Discussion and conclusion of results

2. There is positive effects of fertilizer use & fertilizer price but insignificant effect of fertilizer subsidy on adoption.

✓Subsidies for fertilizer do not necessarily crowd out organic manure or maize-legume intercropping.

✓The significant positive effect of fertilizer price is compensated by positive and significant (complementary) relationship between fertilizer use and organic manure and maize-legume intercropping.

✓Such complementarities can be enhanced through extension efforts. Promotion of SFM can facilitate further extraction of such synergistic effects.

Discussion and conclusion of results

3. Population density increases adoption intensity of intercropping and both adoption and adoption intensity of organic manure.

✓Intensification takes place on small farms through adoption of land-saving technologies as population growth continues putting pressure on land.

✓Maize-legume intercropping is a land-saving technology as it maximizes output per unit land.

✓Promotion of legumes such as pigeon peas and soya beans can facilitate such intensification.

Acknowledgment

1. NORAD-funded NORHED "Climate-Smart Natural Resource Management and Policy (CLISNARP)" project.
2. NORAD-funded NOMA program.
3. CGIAR Independent Science and Partnership Council
4. Rodney Lunduka for collecting data for the first survey in 2006 and jointly responsible for the second round (2009) survey with the second author.
5. Julius Mangisoni for facilitating the third round (2012) survey in collaboration with the second author.

Access

Samson P. Katengeza, Stein T. Holden and Monica Fisher (2017). Adoption of Soil Fertility Management Technologies in Malawi: Impact of Drought Exposure. CLTS Working Paper No. 11/2017. Centre for Land Tenure Studies, Norwegian University of Life Sciences, Ås, Norway.

Thank you for your attention