

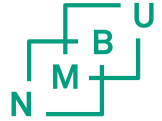
# The Impact of Ethiopia's Productive Safety Net Program (PSNP) on Fertilizer Adoption by Smallholder Farmers: Evidence from Tigray, Northern Ethiopia

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# Introduction



- There is a need to intensify agriculture to enhance food security in SSA
- Low fertilizer use is seen as one reason for low agricultural productivity in the continent
- Various approaches are used to enhance fertilizer use
  - Subsidies
  - Extension advise
  - Higher yielding crops and varieties
  - Improve market access
- There are many studies of these types of interventions in SSA

# Introduction

- Productive safety net programs are an alternative approach to enhance household food security
- Ethiopia has been trying to improve productivity of farmers by introducing improved agricultural inputs, methods and market access and enhance food security with its Productive Safety Net Program (PSNP).
- The PSNP aims to enhance capability of poor farmers to come out of food insecurity (Hoddinott et al. 2012; Ministry of Agriculture and Rural Development 2009).

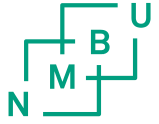
## Research Question

**How important are productive safety net programs in enhancing fertilizer use among targeted poor and food insecure households?**

# Earlier studies & our contribution

- Most earlier studies focus on impacts of Food-for-work or PSNP membership on the likelihood of adoption (Bezu and Holden (2008); Gilligan et al. (2009); Hoddinott et al. (2012))
- Gilligan et al. (2009) and Hoddinott et al. (2012) use matching methods to study early impacts of PSNP (2005-2010) on likelihood of fertilizer use
- Our contribution
  - Study **use and intensity of use of fertilizer**
  - Use panel data for a **longer time period** (2006-2015)
  - Control for selection into the program with a **control function approach** (controls for observables and unobservables)


# Theory & hypotheses



Theoretically, one may on the one side hypothesize that

- a) access to PSNP protects households and makes them more able to invest in own production and thus enabling a transition out of poverty (PSNP → Fertilizer use )

On the other hand, another hypothesis may be that

- b) protection through PSNP reduces the incentives of households to invest (PSNP → Fertilizer use ) and thereby creates a dependency on PSNP.
- Empirical studies are thus needed to find out which of these effects is more important or dominant.

# Data

- Data for this study is collected from 12 *woredas* in the highlands of Tigray region, northern Ethiopia.
- This data set builds on a panel data of six rounds starting from 1998 and extending to 2015.
- This study employs the last three rounds; namely, the survey rounds in 2006, 2010 and 2015.
- We have 339 households in 2006, 440 households in 2010 and 631 households in 2015.

# Intensity of fertilizer use, kg/farm household, by year



	Unbalanced panel			Balanced panel		
Year	Obs.	Mean	S.D.	Obs.	Mean	S.D
2001	377	8.5	14.2	280	9.2	19.8
2003	351	18.7	24.1	280	20.4	26.0
2006	339	25.8	39.8	280	24.6	35.4
2010	440	44.8	57.5	280	44.7	52.7
2015	631	111.0	111.8	280	128.6	121.2

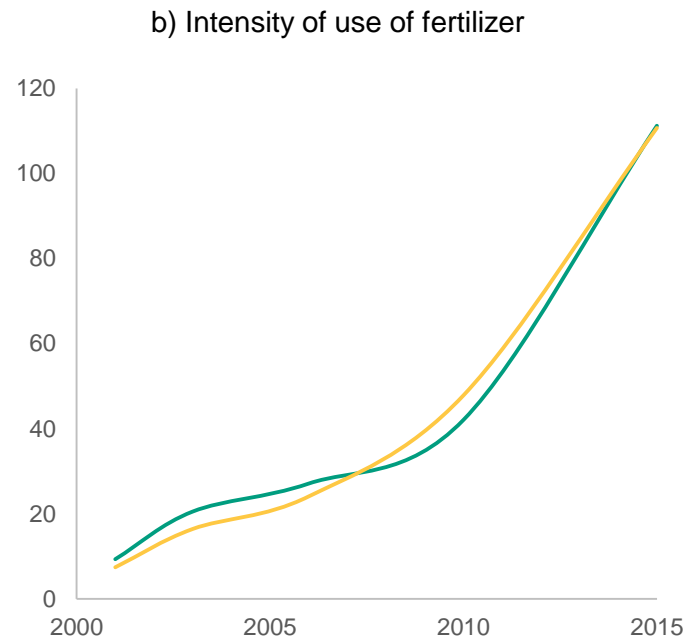
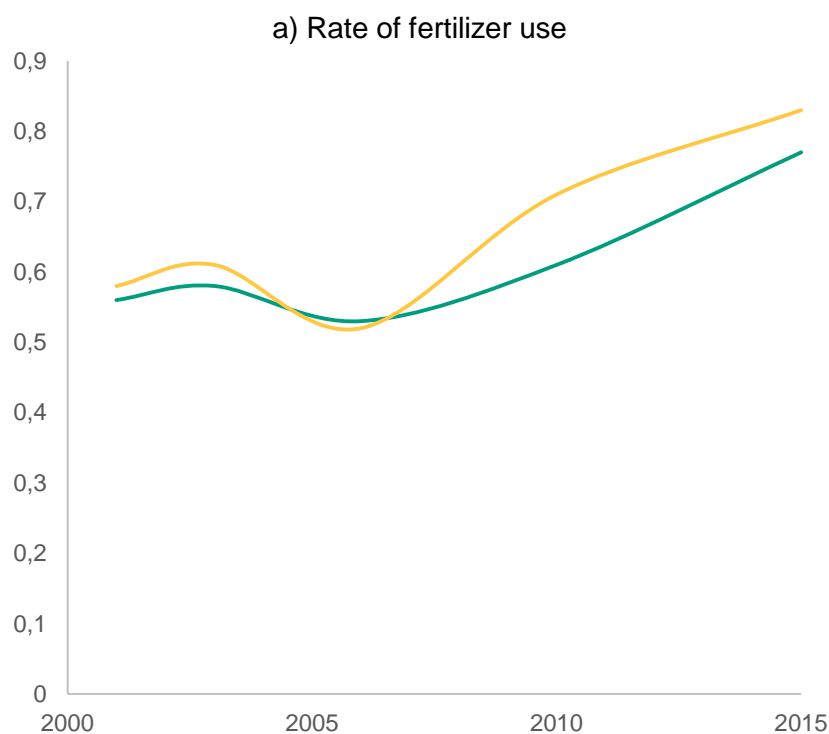
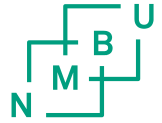
# Fertilizer use of PSNP members vs. non-members



-	Adoption shares		t-value	KGs per household		t-value	KGs per hectare		t-value
	Mem-ber	Non mem-ber		Mem-ber	Non member		Mem-ber	Non mem-ber	
<b>2001</b>	0.58	0.56	-0.36	7.4	9.3	1.3	8.2	9.4	0.81
<b>2003</b>	0.61	0.59	-0.49	16.4	20.5	1.55	16.3	16.2	-0.07
<b>2006</b>	0.52	0.53	0.24	24.6	27.8	0.63	25.4	22.1	-0.67
<b>2010</b>	0.71	0.61	-2.32**	47.8	42.1	-1.05	45.7	36.6	-2.2**
<b>2015</b>	0.83	0.77	-2.32**	110.7	111.2	0.06	54.2	53.4	-0.14



# Use and intensity of use, PSNP members vs non-members



— Adoption non member    — Adoption member

— Intensity non member    — Intensity member

# Empirical Approach



- The model we estimate can be stated as follows.
- Suppose  $F_{it}$  stands for the amount of fertilizer (in kilograms) that a farm household used in a specific year  $t$ .

$$F_{it} = f(K_{it}, H_{it}, A_{it}, V_{it}, M_{it}) \quad (7)$$

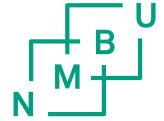
Where;

- $K$ = the labour and physical endowments of the household (HH head literacy, number of adult members in the HH and area of land that the HH owns).
- $H$ = vector of household level features (sex of the household head, age of the household head and household size).

# Cont'd

- **$A$** = a vector of agro-ecological factors ( mean of rainfall of the current production season, perception on land quality and access to irrigation)
- **$V$**  = distance to nearest road and to the wereda center as a proxy for infrastructure, market access and agricultural development support services such as microcredit and improved input supply.
- **$M$**  is the treatment variable and refers to whether the household is a member of the public works component of the PSNP or not.

# Cont'd



- We assume that this equation is linear and specify it as follows.
- $$F_{it}^* = \beta_0 + \beta_1 K_{it} + \beta_2 H_{it} + \beta_3 A_{it} + \beta_4 V_{it} + \delta M_{it} + c_i + Merr + \varepsilon_{it}$$
- PSNP membership status is the treatment variable in this study
- Membership in the PSNP is a result of a government plan to include poor farmers into the program.

# PSNP membership: Selection

- This creates selection issues. We handle this by using a control function approach in a panel context and an IV regression
- We estimate the PSNP membership ( $M_{it}$ ) as a function of a set of variables which explain the fertilizer adoption decision ( $X_{it}$ ) and an instrument variable ( $Z_{it}$ ) in the following form
- $$M_{it} = B_i X_{it} + \gamma_i Z_{it} + V_{it}$$

# Identification strategy

- The **main criterion for selection into PSNP** was whether a household had been receiving food assistance in the three consecutive years before the start of the PSNP in 2005
- The **instrumental variable** we use is a **dummy variable** which indicates whether the *tabia* where the household resides had been exposed to shortage of rainfall for three consecutive years before the start of the PSNP
  - **Household received less than average rainfall for the community three years in a row (2003-2005)**

# Results: Membership selection

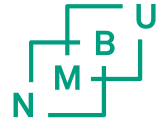
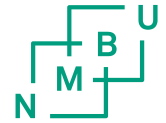


Table 5 CRE panel Probit regression of Membership to the Public Works component of the PSNP

VARIABLES	First stage CRE probit			
	Instrument only	with controls		
Instrument variable, low rainfall dummy	0.315*** (0.095)	0.294*** (0.103)		
IMR from attrition probit	0.003 (0.086)	-0.090 (0.109)		
Additional control variables	No	Yes		
Constant	-0.279* (0.150)	-0.278 (0.499)		
Observations	1409	1409		
Number of households	670	670		

# Table 6 Impact of PSNP membership on Fertilizer Use decision



VARIABLES	Control Function Estimations			
	Treatment only	With additional control variables		
Public works membership	0.252***	0.240***		
	(0.090)	(0.088)		
CF Residual PW	-0.271**	1.213***		
	(0.134)	(0.337)		
Lambda (attrition IMR)		-0.154		
		(0.126)		
Control variables	No	Yes		
Constant	0.457***	-1.214**		
	(0.068)	(0.479)		
Observations	1409	1409		
Number of households	670	670		



Table 7 Impact of PSNP membership on Intensity of Fertilizer Use

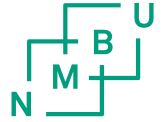
Variable	Control Function CRE panel tobit			
	Treatment only	With controls		
Public works membership	0.487***	0.471***		
	(0.175)	(0.162)		
CF Residual PW	-0.742***	2.293***		
	(0.259)	(0.517)		
Lambda(attrition IMR)	-0.508***	-0.352*		
	(0.178)	(0.214)		
Control variables	No	Yes		
Constant	2.854***	0.006		
	(0.299)	(0.814)		
Observations	1409	1409		
Number of households	670	670		

Standard errors in parentheses\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$  (the standard errors for the tobit are bootstrapped with 400 iterations)

# Conclusion

- This paper sets out to explore whether PSNP has stimulated fertilizer use in the semi-arid areas of northern Ethiopia where returns to fertilizer use obviously are conditional of realized rainfall distribution after the fertilizer use decision has been made
- In general **we find a sharp increase in fertilizer use over the period our household panel covers**
  - This seems to be **due to the general promotion of fertilizer use by the Ethiopian government**
- We found also that PSNP membership enhanced use and intensity of use of fertilizer among members.

# Conclusion: Limitations



- A limitation of the study is that we **have not assessed the indirect effect of PSNP on fertilizer use through its land conservation effect** that may have contributed to enhanced productivity of fertilizer use
- This benefit accrues to member as well as non-member households as the PSNP public works conservation investments are on communal land as well as on private land of members and non-members
- Such investments lead to longer-term enhancement of the food security situation of rural smallholder farms in Ethiopia: **An area for future research**