Adoption of agricultural technologies visa vis agricultural extension in Ethiopia: Theoretical tenets and empirical evidences

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Outline

1. Introduction
2. Adoption estimation methods
3. Adoption levels
4. Factors affecting adoption
5. Adoption and yield gaps
6. Implications for research and development

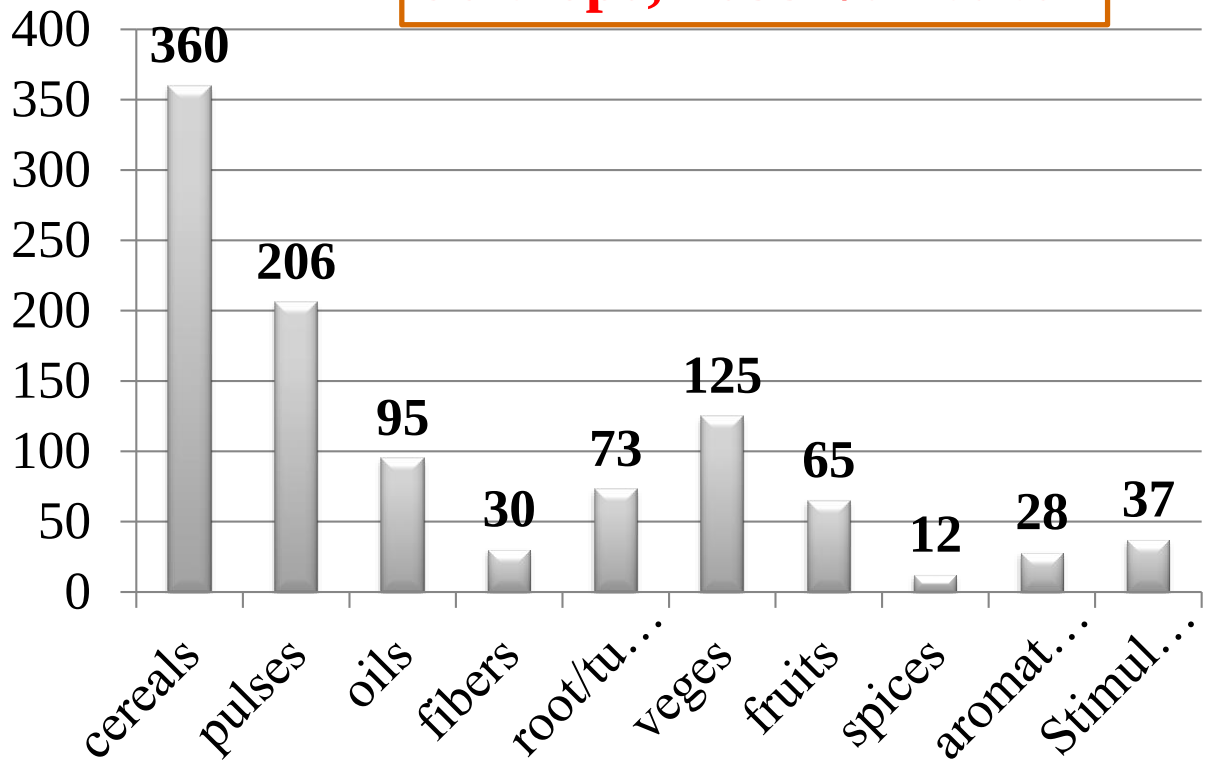
Introduction

- Considerable investment in agricultural research and development in Ethiopia;
- A number of technologies released;
- Huge investment in extension to ensure the use of technologies along with associated practices;
- Gradual increases in productivity levels for many agricultural commodities especially for crops
- Ample studies conducted and documented adoption of improved agricultural technologies mainly focusing on crops

Agricultural Technology supply

96 crops; 1035 Varieties

Crop	Varieties
Wheat	104
Maize	66
Tef	36
Barley	53
Sorghum	44
Rice	30
Coffee	37
Haricot bean	57
Field pea	37
Faba bean	30
Chickpea	23
Sesame	21
Potato	35
Tomato	34



Source: Fantaun (2015)

Introduction (cont…)

- Adoption levels are good indicators of the technology transfer in the research-extension continuum;
- Many adoption studies often target identification of determinant factors;
- The studies differ in terms of area coverage, method of data collection and analytical tools used;
- This paper presents:
  - Overview of estimation methods and associated challenges;
  - Estimated adoption levels over years of crop technologies;
  - Commonly identified factors affecting adoption; and
  - Implications for research and development;

Estimation methods

Estimation methods

- In general, estimation methods vary based on:
  - The considered analysis unit:
    - Responding households vs land allocated,
    - Farm level vs plot level
  - Method of data generation
    - Household surveys using pre-tested and structured questionnaires
    - Community surveys
    - Expert judgements
    - DNA fingerprinting

Estimation methods

- Technology adoption studies conducted prior to 2010
  - Mostly focused on improved wheat and maize varieties and associated agronomic practices (inorganic fertilizer use)
  - most of the studies are highly location specific, conducted either around research centers and/or project intervention areas
  - generally based on small sample sizes due mainly logistical and analytical difficulties
- Hence the studies did not provide sufficient evidence that would allow generalizations indispensable for policy making at national and regional levels

Estimation methods

- Recent crop technology studies (since 2010)
  - Focused on a broad range of commodities and technological components
  - Based on representative samples (large size) thus provide reliable estimates at a national level
  - Collected data at various scales
    - plot,
    - farm (household) and
    - community

Crops considered

- The agricultural economics directorate focused on the following commodities :

Cereals	1. Teff 2. Maize 3. Wheat 4. Barley 5. Sorghum
Pulses	1. Faba bean 2. Chickpea 3. Lentil 4. Common beans
Roots and Tubers	1. Potato

Estimated adoption levels

Estimated adoption levels

Crop	Estimated adoption rate (%)	Indicator	Data Collection Method	Area coverage	Study Year	Source
Maize	31.0	HHs	HH Survey	National	2010	De Groot, 2014
	55.9	HHs	HH Survey	East Wollega, West Shewa and West Arsi zones of Oromiya	2014	Chilot et.al, 2016b
	61.4	HHs	DNA finger printing			
Wheat	62.5	HHs	HH survey	National	2010	Chilot et.al, 2013
	52.8	Area	HH survey			
	62.0	HHs	HH survey	East Wollega, West Shewa and West Arsi zones of Oromiya	2014	Chilot et.al, 2016b
	96.0	HHs	DNA finger printing			
Food Barley	39	Area	HH survey	National	2010	Yigezu et.al, 2015
Teff	76.0	HHs	HH survey	C. highland	2012	

Estimated adoption levels

Crop	Estimated adoption rate (%)	Indicator	Data Collection Method	Area coverage	Year	Source
Chickpea	19.4	Area	HH survey	National	2010	Chilot et.al, 2015
	17.4	Households	HH survey			
	10.3	Area	Community survey			
	13.9	HH	Community survey			
	13.1	Area	Expert survey			
Lentil	12.0	HH	HH survey	National	2010	Chilot et.al, 2016a
	15.6	Area	HH survey			
	13.4	Area	Community survey			
	7.1	HH	Community survey			
	10.8	Area	Expert survey			
Faba bean	11	Area	HH Survey	National	2010	Yigezu et.al, 2015

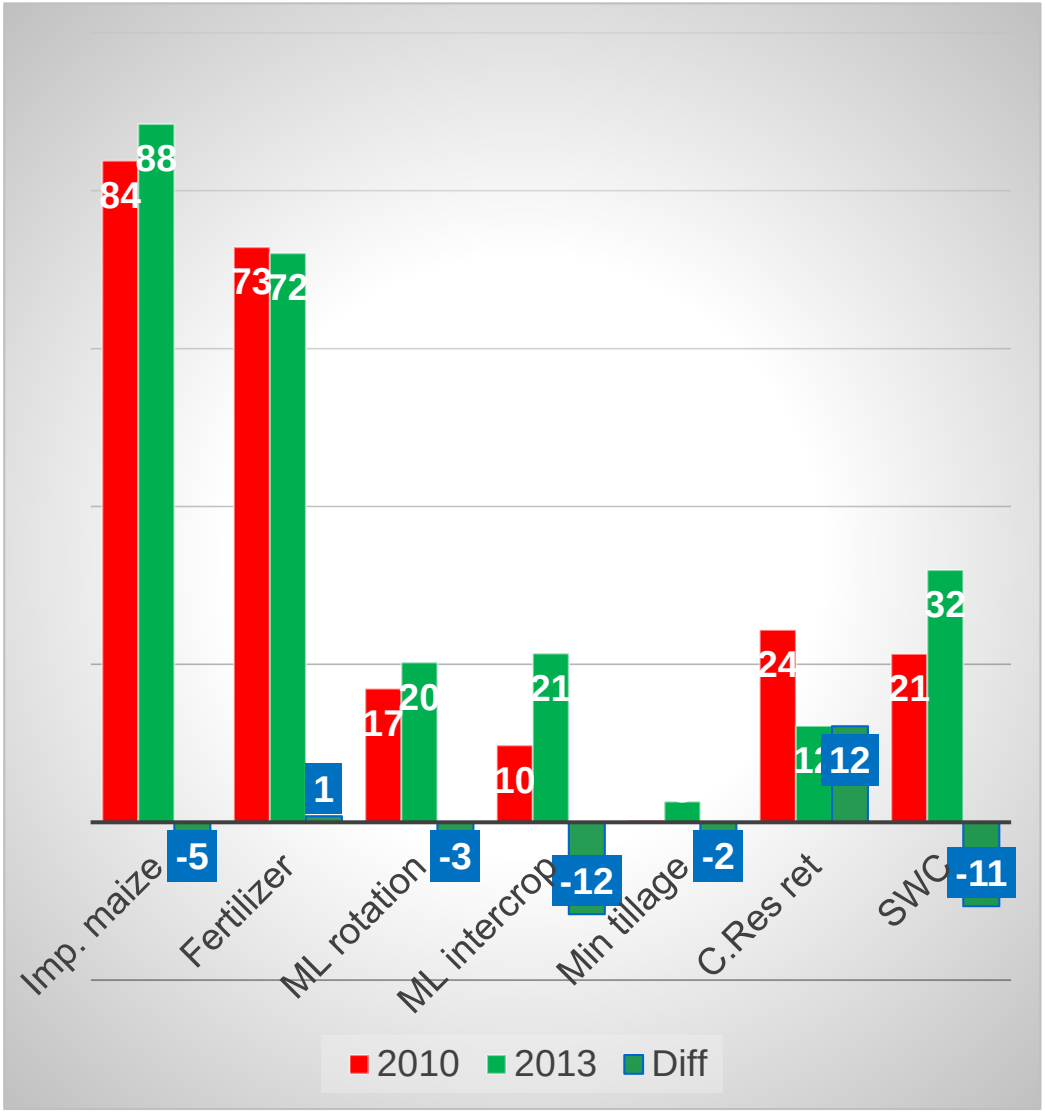
Estimated adoption levels, potato by region

Variety	Year of release	Amhara	Oromia	SNNPR	All
Jalene	2002	2.3	7.5	17.4	8.9
Gudene	2003	0.8	7.8	17.4	6.5
Menagesha	2002	0.0	8.3	0.6	4.6
Bule	2005	1.1	6.3	0.4	3.6
Holland	2009	0.0	2.7	0.2	1.5
Guassa	2006	1.3	0.6	8.6	0.8
Sisay	1987	0.9	1.0	0.1	0.8
New clones		0.0	1.3	0.4	0.7
Wechecha	1997	0.3	0.8	0.0	0.6
Tolcha	1993	0.3	0.5	0.8	0.3
Gera	2003	0.4	0.0	0.0	0.1
Diagmeng	2002	0.0	0.6	0.0	0.1
Belete	2009	0.5	0.0	0.3	0.1
Gorobella	2002	0.1	0.0	0.0	0.0
Shenkola	2005	0.0	0.0	0.0	0.0
All Improved		7.8	37.0	28.7	28.6

Source: Demise & Chilot (2016)

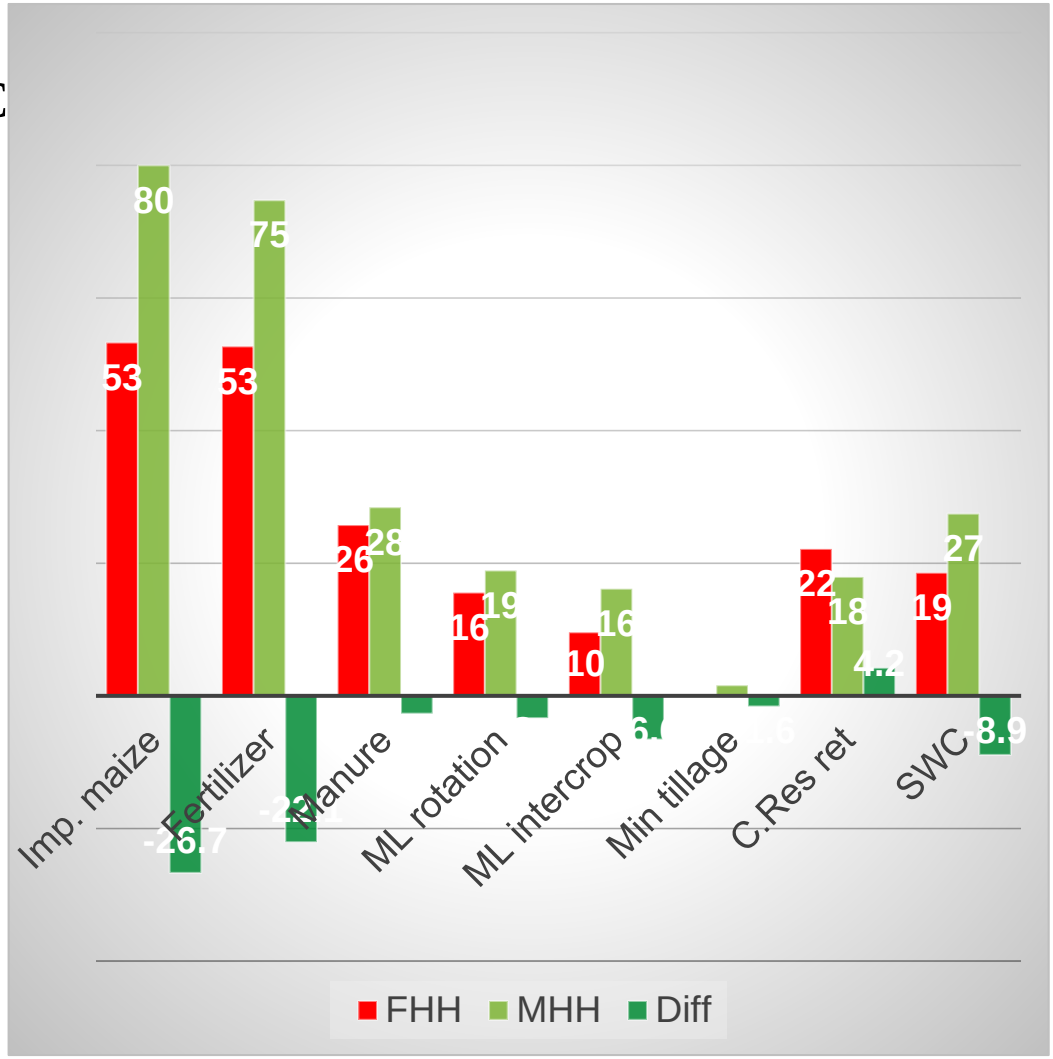
Adoption of SAIP in maize production in 2010 and 2013, Ethiopia (%HH)

- Among the SAIPs promoted in the study areas, only two components are widely adopted
  - improved maize varieties &
  - inorganic fertilizers
- Of the 2 widely used SAIPs, the level of adoption of improved varieties is the highest
- Similarly, the level of adoption of inorganic fertilizer remained almost at the same level
- The level of use of other SAIPs, however, remained fairly at a low levels

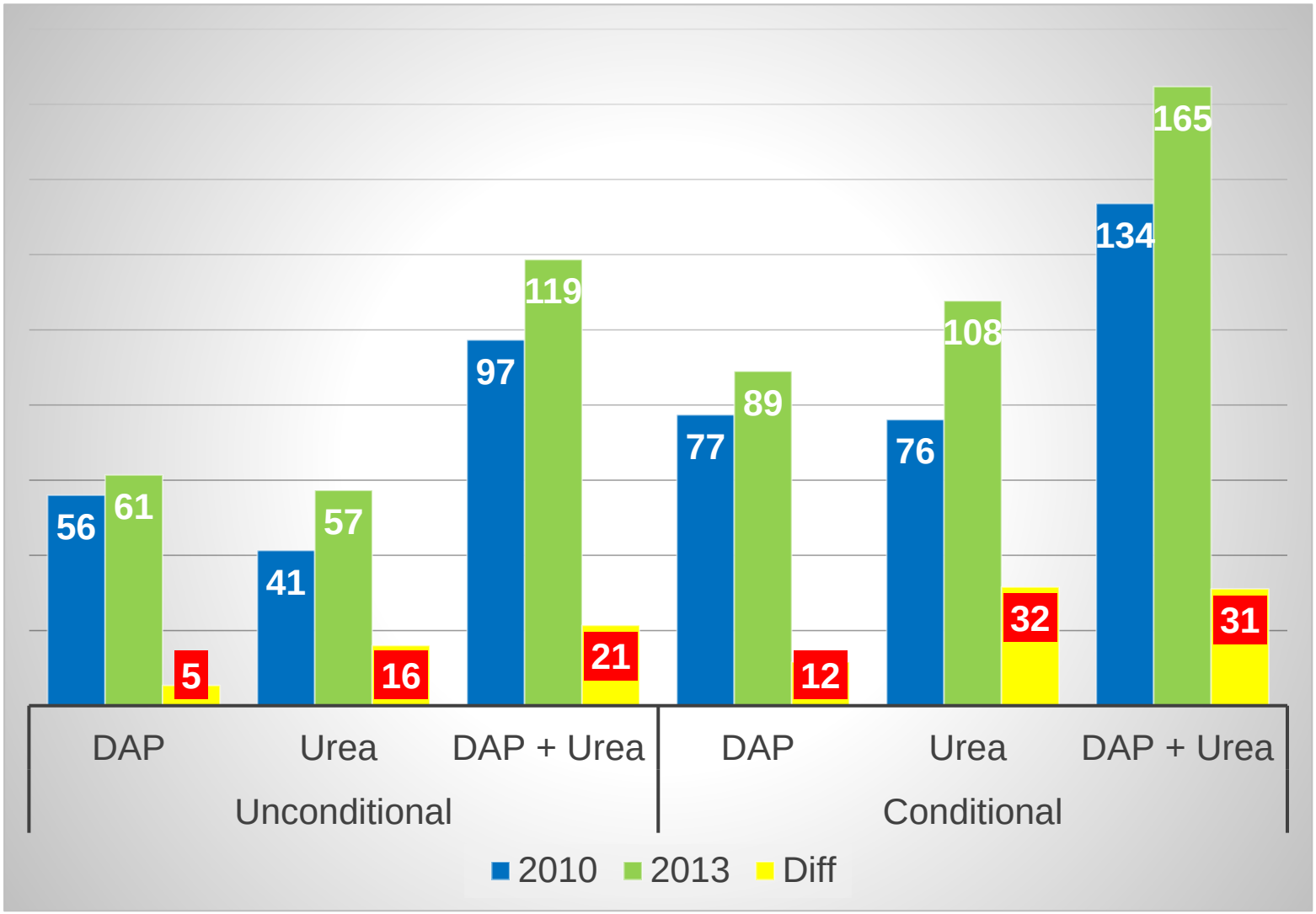


Adoption of SAIP by gender in 2010 and 2013, Ethiopia (%HH)

- level of adoption of IMV, IF, and ML-intercropping and SWC practices is significantly higher among MHH than among FHH
- level of use of manure, ML rotations and stubble-mulch, appears to be similar among the two groups of HHs
- level of use of min. tillage practices not only low but also did not differ by gender of the HHs suggesting a lot remains to be done to demonstrate economic benefits



Intensity of Commercial Fertilizer Use on Maize Production by Year (kg/ha)



Summary of adoption levels

- In general, the estimates indicate
  - Awareness of improved varieties among smallholder farmers is higher for cereals than pulses;
  - Among the cereals, awareness of wheat and maize varieties is widespread compared to other cereal crops;
  - Adoption rates of improved varieties is much higher for cereals than pulses;
  - Among the cereals adoption levels of improved varieties of wheat and maize are not only high but also fairly well distributed across regions and even districts;
  - Adoption levels of improved pulse crops is highly localized (e.g. chickpea and lentil)

Estimated adoption levels

- In spite of the high adoption rates observed for improved wheat and maize varieties, very few farmers grow recently released varieties.
  - This is, in part, due to the capacity and nature of the formal seed system and in part to farmers' lack of awareness of the existence of the recently improved varieties due to limited information flow;
- Among the complementary agricultural practices, adoption of commercial fertilizers is the highest followed by herbicides;
- Intensity of inorganic fertilizer has improved considerably over years;

Commonly identified factors affecting adoption

Determinants of adoption

- In terms of determinants of adoption
  - most of the studies identified similar set of variables to have a significant influence on adoption of improved crop varieties, off course with varying levels of magnitude.
- Among the factors considered include:
  - Socio-demographic factors that are related with experiences, family labor, education, and social capital;
  - Resource ownership related with land and livestock owned;
  - Access to services: access to extension services, participation in technology promotion events like field days, access to all weather road;
  - Access to markets: input and output markets

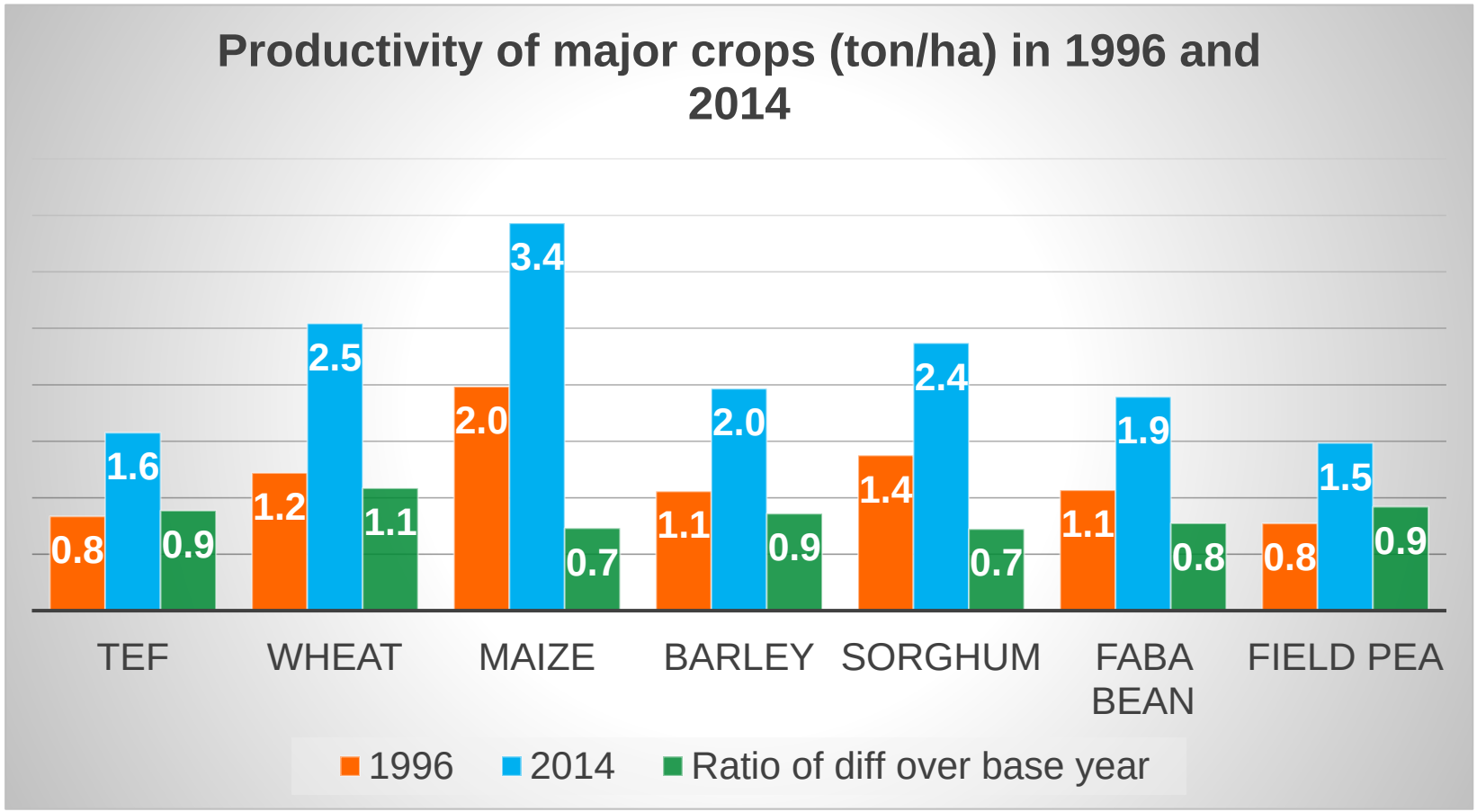
Factors of adoption

- Among the SHF, relatively well off famers (owning at least a pair of oxen and above average farm size) have a higher probability of adoption compared to resource constrained farmers;
- Most of the studies provide evidence that education (at least attainment of primary education) and access to credit significantly and positively influenced technology adoption;
- Access to extension has a mixed effect on technology adoption (in some cases positive, in few cases neutral, and even negative);
- Three adoption categories identified: full, partial and non-adopters providing evidence of the importance of data collection at plot level;

Factors of adoption (cont…)

- In addition, there are systemic issues mainly associated with the poor performance of the seed system that has direct implication to adoption of improved crop varieties
  - The limited engagement of seed system actors in demand creation;
  - One fits all approach in seed demand assessment and supply;
  - Skewed focus of the formal seed system to few crops and to hybrids;
  - More focus on potential areas

Adoption and yield gaps


Productivity of major crops (ton/ha) in 1996 and 2014
0.8
1.6
0.9
1.2
2.5
1.1
2.0
3.4
0.7
1.1
2.0
0.9
1.4
2.4
0.7
1.1
1.9
0.8
0.8
1.5
0.9
TEF
WHEAT
MAIZE
BARLEY
SORGHUM
FABA BEAN
FIELD PEA
1996
2014
Ratio of diff over base year

Adoption and yield gaps

- Yield estimates under different regimes of technology adoption indicates the opportunity to increase productivity through improved adoption:
- Considering the yield achieved at
  - Research fields: researcher managed fields with improved variety and recommended practices
  - Farmer fields:
    - Farmer managed with improved variety and recommended practices;
    - Farmer managed with local variety and recommended practice;
  - National estimated yield
    - Considers all possible combinations and is based on CSA estimation

Adoption and yield gaps

Crops	National average yield (quintals/ha)	Farmers' field yield (quintals/ha)	Research field yield (quintals/ha)	Variety considered
Teff	11.67	13 - 23	15 - 27	Kena
Bread wheat	16.25	35 - 47	44 - 50	Gasay
Durum wheat	16.25	24 - 40	23 - 68	Flakit, Obsa
Maize	21.22	50 - 60	80 - 110	Morka
Field pea	10.95	15 - 20	28 - 40	Ambericho
Haricot beans	10.43	18 - 22	20 - 30	SUG - 131

Adoption and yield gaps (cont…)

- **Food and Malt barley**

Category	Use of technology	Food barley	Malt Barley	Source
		Average yield (range) in t/ha	Average yield (range) in t/ha	
Research field	• Improved variety • recommended practices, and • researcher managed	~3.8 (2.4–5.2)	~3.3 (2.3–4.3)	MoA, 2012 MoA, 2011
Farmers' field	• Improved variety • Recommended practices, and • Farmer managed	~2.7 (2.1–3.3)	~2.8 (1.9–3.8)	
Farmers' field	• Local variety • recommended practices, and • Farmer managed	2.02	-	Berhanu et al., 2011
National yield level*	National production system ten years average	1.49	1.49	CSA (2004 – 2014)
Varieties considered		Abdane, Cross 41/98, EH 1493 Gobe, Felamit Golden Eye, Walker	Grace, Traveller	

Adoption and yield gaps (cont…)

- **Faba bean**

Category	Yield range (quintals/ha)	Use of improved varieties and practices	Source
Research field	23 – 50 (~36)	• Improved variety • recommended practices, and • researcher managed	MoA, 2014
Farmers' field with research recommended practice	20 – 44 (~32)	• Improved variety • Recommended practices, and • Farmer managed	MoA, 2014
Farmers' field under farmers' practice	18 – 20 (~19)	• Improved variety • Farmers' practices • Farmer managed	Kibebew Assefa et al., 2011
National yield level	11.2 -18.4 (~15)	National production system	CSA (2004 – 2014)

Relationship of maize production and productivity with perceived household food security by year, Ethiopia

- HH in the food secure group
  - enjoyed higher productivity
  - produced more maize per HH
- food secure HH cultivated significantly higher maize area than the food insecure group
- maize area for both household categories declined significantly in 2013 from the base year

Year	Parameter	Food unsecured HH	Food secured HH	Diff	t-value
2010	Prod (ton/HH)	1.6	2.9	1.3	7.9***
	Prod (ton/ha)	2.1	2.8	0.7	6.1***
	area (ha/HH)	0.9	1.1	0.3	4.2***
2013	Prod (ton/HH)	1.6	2.7	1.0	7.1***
	Prod (ton/ha)	2.8	3.1	0.3	2.4***
	area (ha/HH)	0.7	0.9	0.3	5.1***

Source: EIAR (unpublished)

Adoption and yield gaps (cont…)

- The yield gaps indicate that there is huge potential to boost production
  - For some crops like maize and wheat, productivity level can be doubled through better adoption of improved varieties and associated agronomic practices

- The results indicate the crucial role in narrowing the yield gaps
  - agronomic practices
  - overall management

Implications for research and development

Implications for research and development

- The huge variability of adoption levels across crops implies:
  - The need to enhance adoption through stronger research-extension linkages for the various commodities
  - Enhancing the performance of the seed system;
- The yield gaps across the different scenarios indicate the need for further investment to remove/ease the influence of limiting factors on adoption;
  - Access to services (extension, technology promotion events etc)
  - Access to input and output markets
  - Improving the performance of the formal seed system

Implications for research and development

- The huge divergence of adoption levels between DNA fingerprinting based estimates and farmers responses for wheat indicates the limited knowledge of farmers about the varieties they grow;
  - This has also implication of genetic resource conservations
  - Further work on wheat and maize on progress
- The balance between increased adoption and genetic resource conservation is very crucial
  - Strengthening the on-going efforts of genetic resource conservation;
  - Promotion of integrated seed system where both the formal and informal seed system co-exist;

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Thank you for your attention