

# Welfare Dynamics and Drought in Ethiopia

January 2018

Habtamu Fuje\*

This paper was prepared for the CSAE Conference to be held from 18-20 March 2018 at the University of Oxford

## *Abstract*

This study analyzes the recent change in welfare, and its link with droughts using a panel data. Between 2012 and 2016, real consumption of households has decreased both in rural areas and small towns. The adverse welfare trend is more pronounced among the poor and those residing in some regions. We apply fixed effects and difference-in-difference techniques to study the impacts of droughts on welfare of the affected households. The results show that drought affected households have experienced 11.4% decrease in their consumption. The impact of drought has been much stronger on poor households. Access to safety-net appears to attenuate the impacts of drought on beneficiaries.

**Keywords:** Drought, welfare, DiD, fixed effects

**JEL:** I3, Q18, Q54

---

\* The author would like acknowledge the following individuals who have provided constructive comments and suggestions: Tom Bundervoet, Pierella Paci, Nobuo Yoshida, Dean Jolliffe, Kathleen G. Beegle, and Hibret Maemir. Correspondence: [HFuje@worldbank.org](mailto:HFuje@worldbank.org) or [Habtamu.Fuje@columbia.edu](mailto:Habtamu.Fuje@columbia.edu).

## 1. Introduction

Ethiopia has seen tremendous growth success in the past decade with double digit growth, mainly driven by growth in agriculture and services (World Bank, 2016). The Ethiopian Poverty Assessment (World Bank, 2015) has documented that Ethiopian households have enjoyed a decade of robust welfare improvements. However, the Poverty Assessment also noted that the progress in welfare has not been favorable to the poor households who have not seen much growth—even a worsening—in their consumption during 2005-2011 period. Growth in agriculture and services, particularly the former, has contributed significantly to welfare improvement, and regions that were initially poor have seen faster welfare improvement (World Bank, 2015).

As an agrarian economy dependent on smallholder rainfed agriculture—located in one of the world's most drought prone regions—Ethiopia has also historically been susceptible to drought and, despite recent economic growth, wellbeing remains highly vulnerable to drought. Several previous studies have analyzed the impacts of droughts on consumption (Dercon et al., 2005; Foltz et al., 2013), food security (Demeke et al., 2011), poverty trap (Carter et al., 2007), long-term nutrition outcomes (Dercon and Porter, 2014), asset/wealth and inequality (Little et al., 2006; Thiede, 2014). Since Dercon et al.'s 2005 finding that rural families that have experienced drought during the 1999-2004 period have experienced a 20 percent decrease in consumption, the country has recorded impressive economic growth. In addition, Ethiopia has established one of the largest safety net programs in sub-Saharan Africa—the Productive Safety Net Program (PSNP)—aimed at addressing food insecurity in the historically drought-prone parts of the country. Whether this growth success and safety net programs have developed resilience at household level remains to be studied. The current study revisits the impacts of the recent droughts on welfare and its difference across regions, by poverty status of the households, and access to the PSNP.

This study analyzes the recent dynamics in welfare using the panel Ethiopian Socioeconomic Survey (ESS) conducted in 2012, 2014 and 2016. It provides a thorough analysis of changes in real consumption for households in rural areas, small and large towns, and heterogeneity of consumption growth across regions and for poor and non-poor households. The panel data allows us to track and analyze dynamics of consumption, mobility of households into and out of poverty, and identify households that were chronically and transiently poor since 2012. In addition, these three waves of ESS provide a unique opportunity to study the impacts of two recent droughts—that occurred in 2011/12 and 2015/16—on household wellbeing.

The analysis of ESS data shows that real consumption has declined between 2012 and 2016. Households in some regions like Oromia and SNNP have also seen stronger decline in consumption than others. The two recent droughts have contributed to this adverse welfare trend. They have caused at least an 11.4 percent decline in average consumption of drought affected households. The impact on consumption of drought affected poor households, relative to the unaffected poor households, is stronger. While, the impact on drought affected non-poor households—relative to the unaffected non-poor households—has been low. The PSNP appears to mitigate the adverse welfare effects of drought among beneficiary households. Those households that are covered by the PSNP have seen statistically insignificant decline in consumption, while those not covered by the PSNP experienced significant decline.

The rest of the report is organized into two sections. The first section describes recent dynamics in welfare by analyzing changes in real consumption between 2012 and 2016 in rural areas, small and large towns, and across regions. The section also describes mobility of households into and out of poverty. The next section focuses on investigating the impacts of drought—both descriptively and using various econometric techniques such as fixed effects(FEs) and difference-in-difference (DiD)—on real consumption.

## 2. Recent Dynamics in Welfare

Before proceeding, we briefly describe the ESS data used in this report. The ESS, part of the World Bank supported Living Standards Measurement Study—Integrated Surveys on Agriculture (LSMS-ISA), started as the Ethiopian Rural Socio-economic Survey (ERSS) in 2012, covering only rural areas and small towns. In these rural areas and small towns, a sample of about 3,470 and 500 households were interviewed, respectively. The 2012 sample was re-interviewed in 2014, and an additional urban sample of (about 1,490) households were added, resulting in the dropping of the R in the ERSS. The third wave of the ESS was conducted in early 2016, re-interviewing the rural and small town-sample for the third time and the urban sample for the second time. The ESS has a very low attrition rate of 5% and 2% during wave 2 and 3 in rural areas and small towns. In large towns, the attrition rate is a bit high (16%).

### 2.2. Changes in Consumption

Consumption expenditure (on food and non-food items) for the three waves of ESS is expressed in 2016 prices, and spatial adjustments are also made to account for differences in living cost across regions. To convert the nominal consumption into a spatially adjusted real consumption, consumer price index (CPI) is used to perform temporal adjustment, i.e. convert all consumption values into 2016 prices, and Fisher spatial index is used for spatial adjustment.

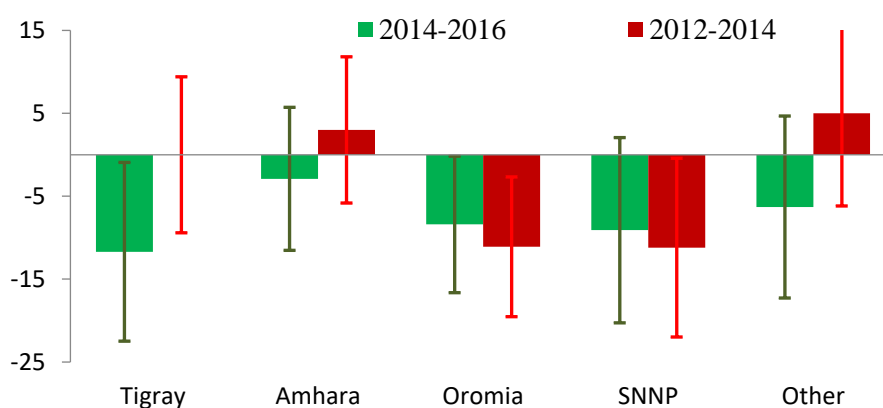
Real consumption has declined slightly during the 2012-2016 period. The decline in real consumption is statistically significant in rural areas, where it declined by Ethiopia Birr (ETB) 341 (7.2%) between 2014 and 2016. While, the slight decline observed in small towns and increase in large towns are not statistically significant (Table 1).

**Table 1: Changes in Median Real Consumption**  
(During 2014-2016 and 2012-2014)

		(1)	(2)	(3)
Timeframe		Rural	Small Towns	Large Towns
2014-2016	Median consumption	-341***	-480	318
		(125)	(453)	(354)
	% Growth	-7.2***	-7.8	3.7
		(2.7)	(7.4)	(4.1)
N		6,291	852	2,645
2012-2014	Median consumption	-141	-221	
		(122)	(464)	
	% Growth	-2.8	-3.4	
		(2.4)	(7.1)	
N		6,556	916	

The decline in consumption is pronounced in rural areas and small towns of some regions. Real consumption has decline in Tigray (11.7%) and Oromia (8.4%) regions during between 2014 and 2016. The decline in consumption has been steady in Oromia region where it has declined by about 11.1 percent during 2012-2014 period as well (Figure 1, and Table A.1-A.2 in the Annex).<sup>1</sup>

**Figure 1: Growth (%) of median Consumption**  
(Rural areas and Small Towns)



Note: The 95% confidence intervals for the percentage changes in consumption are represented by the corresponding lines. Consumption is real adult equivalent. Large towns are excluded from the first wave of ESS and hence not included in this figure.

## 2.2. Mobility of Households

Given the changes in consumption documented above, it is useful to analyze mobility of households into and out of poverty. Before proceeding, it is important to clarify the poverty definition used in this study. Households are classified as poor if their consumption is below a unique threshold (ETB 4,360 per adult equivalent), which is the 40<sup>th</sup> percentile of the 2016 consumption distribution. In all the three waves of ESS, households that earn less than ETB 4,360 per adult equivalent per year (in 2016 prices) are considered as poor. This is the amount of income for households that are on the 40<sup>th</sup> percentile of consumption expenditure distribution in 2016. The same threshold is applied to the previous two waves of the ESS after the consumption figures have been adjusted to reflect 2016 prices. It should, however, be noted that this definition is different from the official poverty definition, and should not be treated as the official poverty line.

There is a substantial movement in and out of poverty. The movement is captured and presented in seven mobility matrices for three periods—from 2012 to 2014, 2012 to 2016 and 2014 to 2016—in rural areas, and small and large towns (Table 2).

<sup>1</sup> The ESS is representative at regional level for the four major regions (Amhara, Tigray, SNNP, and Oromia). However, the sample size is not large enough in the remaining regions (i.e. Afar, Somali, Benshagul Gumuz, Gambela, Harari and Dire Dawa), and the sample from these regions could be combined as one to create ‘Other’ regions.

In rural areas, only 55-56 percent of those who were poor in 2012 remained poor by 2014 and 2016. The rest have managed to lift themselves out of poverty. Similar mobility is observed between 2014 and 2016. On the other hand, 26 and 32 percent of those who were non-poor in 2012 have fallen below the poverty line by 2014 and 2016, respectively (Table 2).

In small and large towns, mobility out of poverty is more visible. More than half of small town residents who were poor in 2012 have managed to move out of poverty in 2014 and 2016. Similarly, only 13-20 percent of those who were non-poor in 2012 have fallen into poverty in subsequent years. In large towns, only 31 percent of those who were poor in 2012 have remained poor in 2016, and only 7 percent of those who were non-poor in 2016 have fallen to poverty in the following year (Table 2).

Mobility in and out of poverty is so high that only a small fraction of households were chronically poor. In rural areas, for instance, about 12 percent of households were poor during all the survey years (2012, 2014 and 2016). The share of households that were chronically poor is even lower in small towns (6%) and large towns (7%). Similarly, only 36 percent of rural households managed to remain above the poverty line during the entire study period. In effect, only one out of every three rural households were non-poor during 2012-2016 period. More households in small towns (59%) and large towns (83%) have managed to stay out of poverty (Figure 2).

About 20 percent of rural households have been transiently poor, and another 31 percent have been in poverty only once. In effect, two out of three rural households have been in poverty at least once. Similarly, about one in every three households in small towns was living below the poverty line at least once (Figure 2).

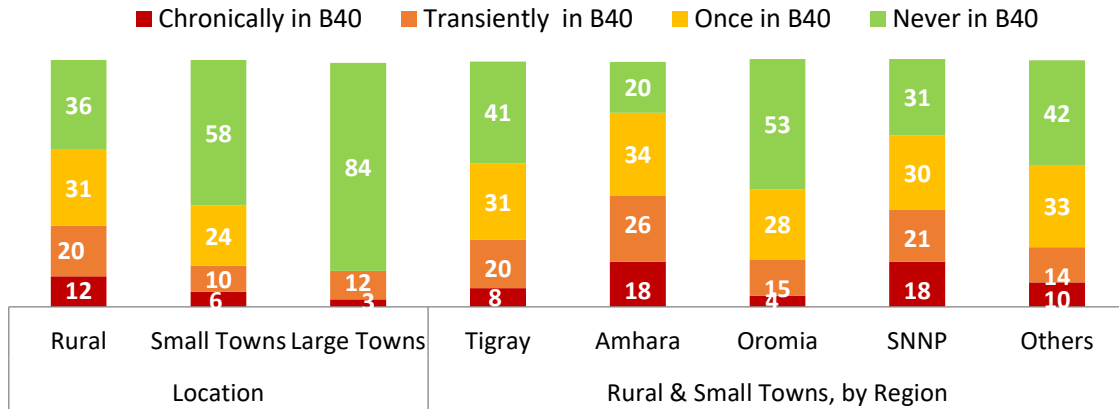
A large share of households residing in rural areas and small towns of Amhara (19%) and SNNP (17%) regions were chronically poor. In these two regions, only a small fraction of households have managed to remain out of poverty during the entire study period. In these two regions, 20-26 percent of households were transiently poor, and another 31-33 percent were poor once. This means that four out of five households in Amhara region were poor at least once, and one out of three households was in similar situation in SNNP region (Figure 2).

A small fraction of households in Oromia (5%) and Tigray (8%) regions were chronically poor. In these regions, large share of the population managed to remain out of poverty continuously (Figure 2).

**Table 2: Transition into and out of Poverty**  
(During 2012-2014, 2014-2016 and 2012-2016)

		Rural				Small Towns				Large Towns	
		2014		2016		2014		2016		2016	
		<i>Non-poor</i>	<i>Poor</i>	<i>Non-poor</i>	<i>Poor</i>	<i>Non-poor</i>	<i>Poor</i>	<i>Non-poor</i>	<i>Poor</i>	<i>Non-poor</i>	<i>Poor</i>
2012	<i>Non-poor</i>	74	26	68	32	86	13	81	20		
	<i>Poor</i>	44	56	45	55	59	41	54	50		
2014	<i>Non-poor</i>			70	30			83	18	93	7

**Figure 2: Share (%) of Households that were Chronically or Transiently Poor**



Note: ‘Transiently poor’ refers to being in poverty twice (out of three survey waves) for rural and small town households, whereas it refers to being in poverty once (out of two) for large town households.

These chronically poor households have lower physical and human capital, high dependence ratio, and high food insecurity, and are often led by females. In Table 3, we present the baseline (2012) characteristics of these households relative to those that have been transiently, once, or never in poverty. The results show that, especially compared to those that have never been in poverty, these households tend to be headed by less educated individuals, and have high dependence ratio and large family size. Ownership of productive assets such as land and cattle, and unproductive asset such as cellphone and radio is less common among these households. Similarly, large proportion of these households reported facing high food insecurity. However, the baseline characteristics of these chronically poor households are not much different from that of the transiently poor households (Table 3).

**Table 3: Baseline (2012) Characteristics of Chronically Poor Households**  
(relative to other households)

	Chronically in B40	Transiently in B40	Once in B40	Never in B40
<i>Household heads' characteristics:</i>				
Gender (% of male)	82.4	82.8	78.5	76.9
Age	44.7	45.7	44.9	42.5
Years of Education	1.1	1.1	1.7	2.9
No education (%)	99.2	98.0	96.8	89.6
Primary education (%)	0.7	2.0	2.6	5.6
Secondary education (%)	0.1	0.1	0.6	4.8
Household size	5.8	5.7	5.0	4.6
Number of children under 5 years	1.1	1.0	0.9	0.8
Dependence ratio	161.3	158.4	142.8	130.3
<i>Asset ownership</i>				
Cattle (number)	2.6	3.2	3.2	3.7
Landholding (ha)	0.9	1.2	1.2	1.3
Fixed phone (% HHs)	1.5	0.7	3.1	4.3

Cellphone (% HHs)	14.2	13.5	21.3	42.0
Radio (% HHs)	19.5	24.6	32.4	46.9
Bicycle (% HHs)	1.2	1.3	2.9	3.3
<i>Food Security (Self-reported):</i>				
Food shortage in the past 7 days (% of HH)	31.2	19.0	17.9	12.5
Food shortage in the 12 months (% of HH)	44.4	38.7	30.8	25.4
Experienced food price hikes	28.5	26.2	25.8	26.6
<i>Access to services:</i>				
% HHs within 2km from road	28.6	25.2	23.5	22.0
Distance from market (km)	67.4	67.1	63.1	64.5
Distance from border (km)	277.6	276.4	289.8	308.4

Note: HH stands for household.

### 3. Impacts of Drought

#### 3.1. Recent Drought Episodes and Welfare

During the study period (2012-2016), Ethiopia has experienced two major drought episodes that required massive food security responses: 2011-2012 and 2015-2016. Both droughts have been described as one of the worst in decades.

In some areas, the 2011-2012 drought across the Horn of Africa was considered as one of the worst in the past six decades. In three Horn of Africa countries—Ethiopia, Somalia, and Kenya—a total of 12 million people were in need of assistance. The worst affected regions include northern Kenya, southern Ethiopia, and south-central Somalia (Oxfam, 2011, 2012).

Similarly, the 2015 and 2016 droughts are thought to be one of Ethiopia's worst droughts in the past five decades. About 10.2 million people in Ethiopia needed assistance. The drought was a result of rain failure during both *Meher* (the main harvest) and *Belg* (spring harvest) seasons in 2015. It affected Afar and the northern Somali region, central and eastern Oromia, eastern Amhara and southern and central Tigray region (WFP, 2016, 2017).

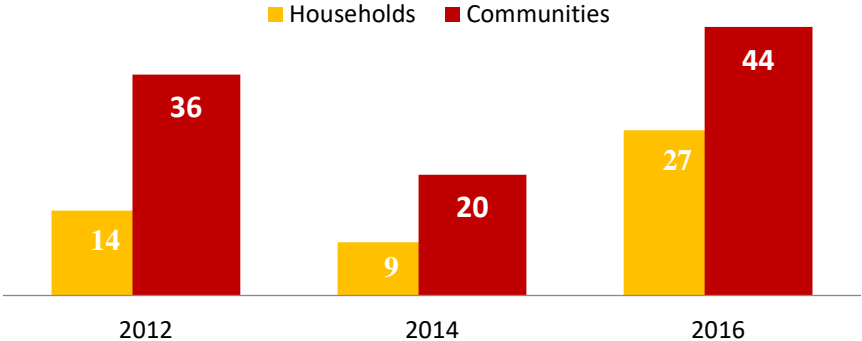
The three waves of the ESS conducted in 2011/12, 2013/14 and 2015/6 ask farm households whether they have experienced drought in the past 12 months prior to the survey date. Community leaders were also asked if drought has affected households in their communities during the past 24 months. The results are presented in Figure 3. Before proceeding into discussion of the reported drought, it is important to note some of the major limitations of perception based drought data. First, it is based on households'/communities' recollection of rainfall patterns in recent years. Even if households are likely to have a vivid memory of droughts that affected their livelihoods in a major way, their memories tend to be time bound. Second, households with fewer coping strategies and those that are experiencing other idiosyncratic shocks might feel the pressure of slight rainfall declines and are more likely to report them as droughts. This could introduce an upward bias in the estimated drought effects.

The results show that 27 percent of the farm households have reported that they have experienced drought in the 12 months leading up to the 2016 survey. Similarly, 14 percent of the farm

households have reported drought in the 12 months preceding the 2012 survey. While, only one out of eleven households reported drought in the months before the 2014 survey. Similarly, about 44 and 36 percent of households reside in communities that reported drought episodes in 2016 and 2012, respectively (Figure 3).

The results from community/household reporting are qualitatively similar: more households have faced drought in the months leading up to the 2012 and 2016 surveys. As it is based on a short recall period of 12 months, we will focus on analyzing the impacts of drought as reported by households.

**Figure 3: Proportion (%) of Farm Households Affected by Drought**  
*(As reported by the households & their communities)*



Source: Staff calculation based on the ESS (2012-2016)

Note: The percentage of drought-affected households, as reported by the community, refers to the share of households that reside in communities where community leaders have reported drought as a major adverse event in the past 24 months.

Here, we present a descriptive analysis of drought impacts on farm households’ consumption expenditure and its growth over time, and the poverty status of households affected by drought.<sup>2</sup>

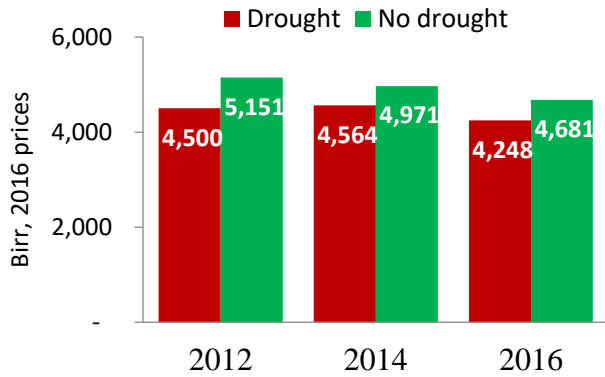
During major drought years, drought affected households have had lower consumption, compared to the unaffected households. In 2012, the median income of drought affected households was ETB 4,532, which is lower than that of unaffected households by ETB 651 (14.5%). Similar consumption gap (of 10.2%) was observed in 2016, whereas the consumption gap in 2014 was not statistically significant (Figures 4a-4b).

**Figure 4a: Median Consumption of Farm Households by Drought Exposure**

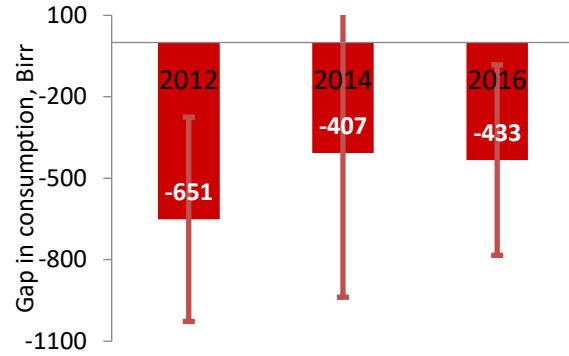
**Figure 4b: Gap in Consumption between Drought Affected/Unaffected Households**

<sup>2</sup> The analysis of drought impact focuses exclusively on farm households. All non-farm households are excluded in the results presented this section.





Note: Drought is as reported by the households.

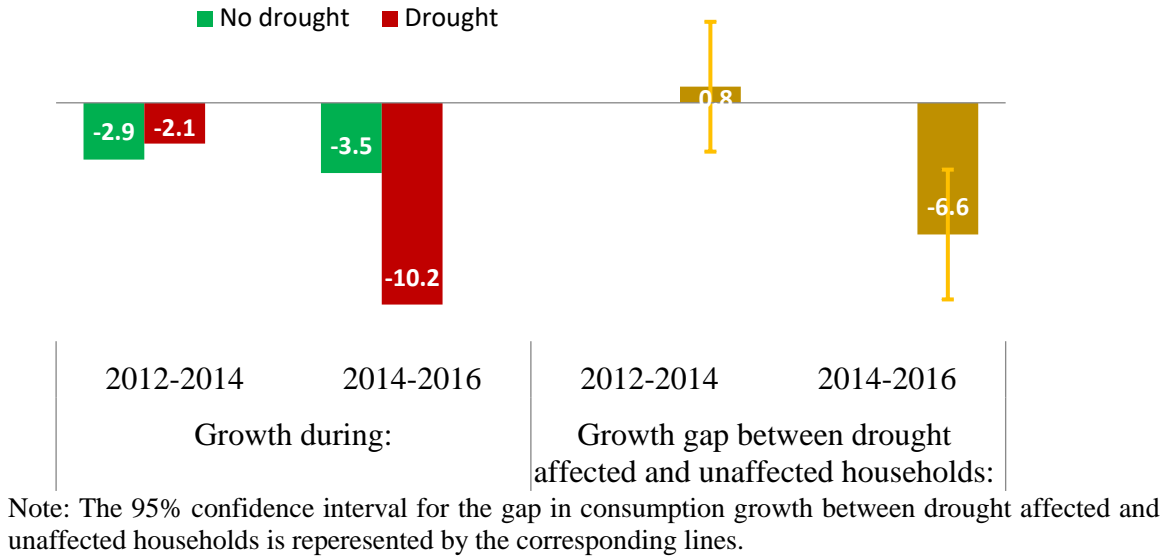


Note: The 95% confidence interval is represented by the corresponding lines.

Furthermore, consumption growth analysis shows that households exposed to drought have had lower annualized consumption growth during 2014-2016 period. Figure 5 presents consumption growth during 2012-2014 and 2014-2016 periods for those households that were exposed (vs. not exposed) to drought in 2014 and 2016, respectively.

Overall, consumption has been declining for all households. However, the median consumption of households that were affected by drought—in the months leading up to the 2016 survey—has declined by 10.2 percent per annum between 2014 and 2016. While, that of unaffected households declined only by 3.5 percent. The ‘growth’ gap (-6.6%) is statistically significant. While, the consumption growth gap (during 2012-2014) between those households that have reported drought in the 12 months before the 2014 survey and the unaffected households is not statistically significant (Figure 5).

**Figure 5: Annualized (Median) Consumption Growth for Farm Households and Current Drought Exposure**



### 3.2. Impacts of Drought on Welfare and Mobility

#### 3.2.1. Empirical Approach

Findings presented in Section 2 show that real consumption has declined during 2012-2016. Descriptive results indicate that drought affected households have experienced decreases in their consumption. Below, we investigate how the two recent droughts might have contributed to this adverse changes in welfare. For farm households in Ethiopia, which are dependent on rainfed agriculture, consumption is driven by rainfall, and drought induced decline in production could adversely affect consumption. After controlling for household characteristics ( $X$ ), the impact of drought ( $D_{it}$ ) on household  $i$ 's consumption in a given year ( $t$ ) could be framed as follows:

$$Y_{it} = \gamma_i + \omega D_{it} + X' \beta + \varepsilon_{it} \quad (1)$$

...where  $Y_{it}$  is real adult equivalent consumption (in logarithm) of household  $i$  in year  $t$ ;  $D_{it}$  is a dummy equal to one if household  $i$  has reported experiencing severe drought in the past 12 months and zero otherwise;  $\gamma_i$  is household FEs;  $t$  refers to survey year 2012, 2014 and 2016;  $X$  is a vector of time variant household characteristics; and  $\varepsilon_{it}$  is a random error term.

The above specification is used to estimate the overall/national impact of drought on household welfare, as measured by drought induced percentage decline (captured by  $\omega$ ) in real consumption.

*Regional Heterogeneity:* However, the impacts of drought on welfare are likely to show considerable variations across regions, and poor households with limited means to absorb shocks could suffer substantially higher welfare losses than non-poor households. To analyze the

differential impacts of drought across regions we interact drought dummy with region FEs ( $Region_i$ ) as follows:

$$Y_{it} = \gamma_i + \sum_r [(\omega_r D_{it} * Region_{ri}) + X' \beta + \epsilon_{it}] \quad (2)$$

...where  $r$  (in  $Region_{ri}$  and  $\omega_r$ ) refers to the region in which household  $i$  resides and it includes Tigray, Amhara, Oromia, SNNP, and ‘Others’;  $\omega_r$  is the drought induced percentage decline in consumption in region  $r$ .  $Region_{ri}$  is a dummy equal to one if household  $i$  resides in region  $r$  and zero otherwise. Note that including  $Region_{ri}$ , which is time invariant, as an additional covariate will not be necessary as the household FEs are already included.

*Differential Impact on the Poor:* To analyze the differential impacts of drought on households that were poor at the baseline survey in 2012, we interact their baseline poverty status with drought dummy. For this analysis, the baseline survey is used to determine poverty status of households, and the recent two waves (2014 and 2016) are used for drought impact analysis. In other words, the differential impact on poor households (i.e. those who were in poverty at baseline), relative to non-poor is analyzed by interacting drought with two dummies for poor and non-poor households as follows:

$$Y_{it} = \gamma_i + \omega_p D_{it} * Poor_{ib} + \omega_{np} D_{it} * NonPoor_{ib} + X' \beta + \mu_{it} \quad (3)$$

...where  $t=2014, 2016$ .  $Poor_{ib}$  is a equal to one if household  $i$  is poor during the baseline survey in 2012 and zero otherwise.  $NonPoor_{ib}$ , which is orthogonal to  $Poor_{ib}$ , is a dummy equal to one if household  $i$  is non-poor in 2012 and zero otherwise. The coefficients  $\omega_p$  and  $\omega_{np}$  capture the impact of drought (% change in consumption) on poor and non-poor households, respectively.<sup>3</sup>

*Drought and Safetynet:* Poor households that have access to public transfers under the PSNP are more likely to better manage drought shocks than other poor households. Access to safetynet transfers could attenuate the impacts of drought. To estimate the potential counter effects of the PSNP, an interaction term (drought and PSNP) is used:

$$Y_{it} = \gamma_i + \sum_{s=0}^1 [\omega_s D_{it} * PSNP_{sit}] + \theta PSNP_{1it} + X' \beta + e_{it} \quad (4)$$

...where  $PSNP_{sit}$  stands for two orthogonal dummies ( $PSNP_{0it}$  and  $PSNP_{1it}$ ) pertaining to access to safetynet through the PSNP.  $PSNP_{1it}$  is a dummy equal to one if household  $i$  is a PSNP beneficiary, and zero otherwise.  $PSNP_{0it}$  is a dummy equal to one if the household is not a PSNP beneficiary, and zero otherwise.  $\omega_1$  and  $\omega_0$  capture the impact of drought on PSNP and non-PSNP households, respectively.

---

<sup>3</sup> Note that as  $Poor_{ib}$  and  $NonPoor_{ib}$  are constant over time, including them in Equation 3, along with the household FEs, is not possible.

To estimate the differential counter effects of the PSNP among households that were poor (and non-poor) at baseline, an estimation with triple interaction (drought, poor and PSNP) is conducted:

$$Y_{it} = \gamma_i + \sum_{s=0}^1 [(\omega_{p,s} Poor_{it} + \omega_{np,s} NonPoor_{ib}) * D_{it} * PSNP_{sib}] + X' \beta + \epsilon_{it} \quad (5)$$

The vector of coefficients  $(\omega_{p,0} \ \omega_{p,1} \ \omega_{np,0} \ \omega_{np,1})$  indicates the impact of drought on (poor non-PSNP, poor PSNP, non-poor non-PSNP, non-poor PSNP) households relative to the drought-unaffected households with the same poverty status and access to PSNP, respectively.

*Impacts of Recent (2015/16) Drought:* As discussed above, according to international organizations and humanitarian sources, Ethiopia experienced one of its worst droughts in decades in 2015/16 with the failing of two consecutive rainy seasons (*Belg* and *Meher*) in 2015. By the end of 2015, more than 10 million people were estimated to be in need of food aid (UNICEF, 2016; WFP, 2016, 2017). Despite its severity, the drought does not, surprisingly, seem to have affected production much: the crop production report from the 2015/16 *Meher* season shows a mere 1 percent decline in production relative to 2014/15.<sup>4</sup> The ESS offers a unique opportunity to study the drought and its impacts, given that the drought was bracketed by two successive rounds of the survey (2014 and 2016).

To analyze the impact of this recent drought on welfare, two empirical approaches are implemented: (1) DiD using 2014 and 2016 data, and (2) FEs estimates, as in Equation 1, with an additional interaction term between survey year FEs and drought.

In the DiD approach, households that were not affected by drought in 2014 are divided into two groups based on their drought exposure in 2016: a treatment group consisting of those that were affected by drought and a control group consisting of those that have not been affected. More specifically, the following classic DiD estimation is performed:

$$Y_{it} = \alpha + I(t = 2016) + Drought_i + \omega Drought_i * I(t = 2016) + X' \beta + \epsilon_{it} \quad (6)$$

...where  $Drought_i$  is a dummy equal to one if household  $i$  has experienced drought in 2016, but not in 2014, and zero if the household is not affected by drought in both years.  $I(t = 2016)$  is an indicator function which equal to one if the survey year is 2016 (post-drought) and zero if it is 2014 (pre-drought).

In the FEs approach, data from the entire survey period (2012-2016) is used to estimate the impacts of drought in different years:

$$Y_{it} = \gamma_i + \sum_k [(\omega_k D_{it} + 1) * I(Year = k)] + X' \beta + \epsilon_{it} \quad (7)$$

---

<sup>4</sup> CSA (2016). Agricultural Sample Survey: Report on Area and Production of Major Crops. Federal Democratic Republic of Ethiopia: Central Statistics Agency.

...where  $k$  refers to survey year (2012, 2014 or 2016);  $I(\text{Year} = k)$  is an indicator function equal to one if the survey year is  $k$  and zero otherwise; and  $\omega_k$  is the percentage change in consumption due to drought in year  $k$ .

### 3.3.2. Results

In this section, results from a more rigorous econometrics analysis of the impacts of drought on consumption are presented. Furthermore, we explore the heterogeneity of the drought impacts across regions, on poor and non-poor households, and those households with (without) access to the PSNP.

Table 4 presents the FEs estimates (equation 1 and 2) with different specifications. The household FEs and time-varying household characteristics are included in the four regressions presented in Table 4. Columns 1 and 3 are results from implementation of equation 1 with and without additional indicators of *asset ownership* and *self-reported food insecurity*. Similarly, columns 2 and 4 are results from equation 2 with/without these additional covariates. Specifications that control for asset and food insecurity are the preferred models. The list of control variables is presented in Table A.5.

Exposure to drought has reduced real consumption of affected households by 11.1 percent. When households' asset holdings and perceived food insecurity are not controlled for, impact of drought on consumption is even higher: 13.7 percent decline (Table 4).

The impacts exhibit considerable heterogeneity across regions. In some regions such as Oromia and SNNP, drought has had vigorous impacts. Drought, for instance, has decreased consumption by 20.4 percent in Oromia region. Similar decreases in consumption were recorded in SNNP (15.7%) and Amhara (9.8%) regions. While in Tigray region, drought has not reduced household consumption. Strangely, households affected by drought in 'Other' regions appear to have experienced increases in consumption (Table 4).

**Table 4: Impacts of Drought on Consumption (%)**

	(1)	(2)	(3)	(4)
	Overall	By region	Overall	By region
Overall/National impact:	-13.7*** (1.9)		-11.1*** (2.0)	
<i>Impact in each region:</i>				
Tigray		0.0 (6.7)		2.5 (6.7)
Amhara		-10.1*** (3.5)		-9.8*** (3.6)
Oromia		-24.3*** (3.5)		-20.4*** (3.6)
SNNP		-18.6*** (3.8)		-15.7*** (3.8)

Other		14.3**		16.7**
		(6.7)		(6.8)
<i>R-square</i>				
Overall	0.07	0.08	0.10	0.12
Within	0.05	0.06	0.08	0.08
Between	0.10	0.11	0.14	0.16
Number of observations	9,305	9,305	9,268	9,268
Number of households	3,522	3,522	3,521	3,521
<i>Covariates included:</i>				
Household FEs	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes
Asset ownership	No	No	Yes	Yes
Self-reported food insecurity	No	No	Yes	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent consumption (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.5 in the Annex.

Analysis of the differential impacts of drought on poor and non-poor households shows that drought has a more severe impact on the poor. It reduced consumption of poor households by 19.1 percent during 2014-2016 period. While, it reduced the consumption of non-poor households by only 12.6 percent (Table 5, column 4). This is after controlling for all covariates. Column 1 shows the estimated impact when asset ownership and reported food insecurity is not controlled for.

Here, we briefly analyze the counter effects of the PSNP in mitigating adverse welfare changes associated with drought. Like most safety-net programs that target a small segment of the population that are economically disadvantaged, capturing beneficiary households in a national survey is challenging. Only 10.4 percent of households included in the ESS were the PSNP beneficiaries either in the form of direct transfer or public works. This, unfortunately, weakens the statistical power to definitively state magnitude of the PSNP effect in attenuating the adverse impact of drought. The overall direction of effect could likely be accurate, but the magnitude need to be taken with a grain of salt.

Households that have access to public transfers under the PSNP appear to have better managed shocks. Between 2014 and 2016, their consumption did not decline because of drought. Even though the coefficient is negative, after controlling all relevant variables, households that have access to the PSNP did not seem to face statistically significant decline in consumption (Table 5, column 5). The magnitude of decline for the PSNP households is high, even statistical significant in a parsimonious specification (Column 2). This indicates that there is a substantial difference in the counter effect of the PSNP among recipient households.

Poor households without access to the PSNP have experienced significant declines in consumption, whereas the decline in consumption of the poor households that have access to the PSNP is small and barely statistically significant (Table 5, column 3 and 6). However, the

magnitude of the decline and the standard error are quite high, which suggests that the effectiveness of the PSNP varies considerably among beneficiaries.

**Table 5: Differential Impacts of Drought on the Poor and the PSNP Households**  
(% Change in Consumption during 2014-2016)

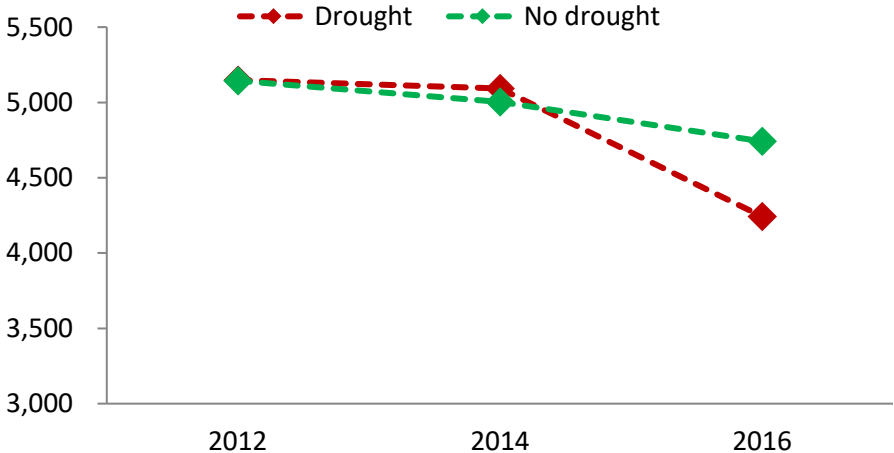
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Impact on drought affected:</i>						
Non-poor households	-15.4*** (2.9)			-12.6*** (3.1)		
Poor households	-24.2*** (3.7)			-19.1*** (3.8)		
<i>Impact on drought affected:</i>						
Non-poor households		-21.6*** (2.6)			-18.6*** (2.8)	
Poor households		-9.3* (5.0)			-3.2 (5.1)	
<i>Impact on drought affected:</i>						
Non-poor non-PSNP HHs			-19.9*** (3.2)			-17.5*** (3.4)
Non-poor PSNP HHs			1.1 (6.6)			6.3 (6.7)
Poor non-PSNP HHs			-24.8*** (4.2)			-20.3*** (4.3)
Poor PSNP HHs			-24.6** (9.5)			-17.8* (9.6)
<i>R-square</i>						
Overall	0.04	0.04	0.05	0.09	0.09	0.11
Within	0.07	0.07	0.07	0.11	0.11	0.11
Between	0.05	0.04	0.05	0.11	0.11	0.11
Number of observations	6,291	6,291	6,291	6,269	6,269	6,269
Number of households	3,371	3,371	3,371	3,369	3,369	3,369
<i>Covariates included:</i>						
Household FEs	Yes	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Asset ownership	No	No	No	Yes	Yes	Yes
Self-reported food insecurity	No	No	No	Yes	Yes	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent consumption (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.5 in the Annex.

The impacts of the most recent drought (2015/16), estimated using the DiD and FEs approaches, are presented in Table 6 and 7, respectively. Table 7 presents result from FEs estimation where

drought is interacted with three dummies corresponding to the three survey years. Table 6 shows a classical DiD estimate by comparing the average consumption of drought affected and the unaffected households, before the recent drought (in 2014) and after drought (in 2016). These two groups of households had similar consumption trends prior to the recent drought (Figure 6). This comparable pre-drought trend in consumption addresses a major limitation of the DiD approach, which relies on a strong assumption that the two groups of households have had similar consumption trajectories before drought affected the group.

**Figure 6: Trends of Consumption for Drought Affected and Unaffected Households**



Note: The drought affected households are those that have experienced drought in 2016, but were not affected by drought in 2014. While, the unaffected households are those that have not experienced drought in both 2014 and 2016.

The recent drought has reduced consumption by at least 6.8 percent (Tables 6 and 7). The DiD estimates, which capture the differential effects of drought on affected households by comparing their consumption growth with that of the unaffected households, show that these households’ consumption has declined by 8 percent (Table 6, column 3).<sup>5</sup> The FEs estimate, which captures the differential effects of drought in different years, picks up a comparable impact: due to the recent drought, a 6.8 percent decline in consumption is observed (Table 6).

The DiD estimates from the three specifications indicate that the recent drought has reduced households’ real consumption. As expected, when more control variables are added, the estimated impact decreases (Table 6, from column 1 to 3). The coefficient of the drought dummy is positive—indicating that the drought affected households have had higher consumption prior to their exposure to drought. The coefficient of ‘post-2014’ dummy is negative, and this shows that

<sup>5</sup> Column 3 is the preferred specification with a full set of covariates.



consumption of all households has declined over time, i.e. after the recent drought of 2015/16 (Table 6).

The FEs estimates capture the drought induced declines in consumption of affected households in different years. During the two years (2012 and 2016), when major droughts have affected many households, strong adverse effects on consumption have been recorded. The 2012, more accurately the 2011/12, drought decreased consumption of affected households by 10.2 percent. Similarly, as noted earlier, the recent drought (2015/16) led to a 6.8 percent decline in consumption (Table 6).

**Table 6: Impacts of Recent (2015/16) Drought on Consumption**  
(DiD Estimates)

	(1)	(2)	(3)
Post-2014*Drought (i.e. impact)	-16.1*** (3.4)	-9.8*** (3.2)	-8.0** (3.1)
Post-2014	-4.4*** (1.7)	-9.5*** (1.6)	-10.0*** (1.6)
Drought	6.0** (2.4)	7.5*** (2.3)	10.6*** (2.2)
R-square	0.13	0.27	0.33
Number of observations	5,719	5,698	5,698
<i>Covariates included:</i>			
Household characteristics	Yes	Yes	Yes
Asset ownership	No	Yes	Yes
Self-reported food insecurity	No	Yes	Yes
Distance from public services	No	Yes	Yes
Region FEs	No	No	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent consumption (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.5 in the Annex.

**Table 7: Impacts of Recent (2015/16) Drought on Consumption**  
(FES Estimates)

	(1)	(2)
<i>Impacts of drought (% change in consumption) in the year:</i>		
2016	-11.3*** (2.5)	-6.8*** (2.6)
2014	-0.4 (3.8)	1.4 (3.9)
2012	-11.0*** (3.1)	-10.2*** (3.2)
<i>R-square</i>		
Overall	0.08	0.12
Within	0.08	0.11
Between	0.09	0.16
Number of observations	9,305	9,268
Number of households	3,522	3,521
<i>Covariates included</i>		
Household FEs	Yes	Yes
Household characteristics	Yes	Yes
Asset ownership	No	Yes
Self-Reported food insecurity	No	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent consumption (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.5 in the Annex.

The discussion so far focused on the impact of droughts on overall household welfare by analyzing its adverse effects on total consumption expenditure on food and non-food items. Documenting the impact on food consumption alone could provide an insight about the food security implications of severe droughts. The estimations of drought's impacts on total consumption, presented in Tables 3-5, are repeated with expenditure on food items as a dependent variable. The results are presented in Tables A.4-A.7.

Households that are exposed to droughts are forced to cut back their food consumption by 12 percent—compared to a 11.4 percent decrease of total consumption. The recent drought (2015/6) led to a 9.2 percent decline in food consumption. Drought induced decline in food consumption shows similar (like total consumption) heterogeneity across regions. Poor households decreased their food consumption by 10 percent, and the non-poor households faced only a 6.9 percent decrease. It should be noted that the corresponding declines in total consumption were 9.3 and 6.9 percent, respectively. Readers who are interested in understanding the food security implications of drought should examine the results in Table A.6-A.9.

#### 4. Conclusion

It has been well documented that welfare of Ethiopia households has historically been prone to vulnerability due to natural shocks such as drought. This paper analyzes the recent dynamics in welfare and investigates the role of droughts in explaining the unfavorable welfare changes using the ESS panel data.

The results indicate that real consumption has declined between 2012 and 2016. The decline in consumption has been sharp for poor households and those residing in Oromia and SNNP regions. Mobility in and out of poverty is so high that only few households have been in poverty during the entire study period (2012-2016). Poverty is mainly transient in nature, especially in rural areas where a third of the households have been in poverty at least once. On the other hand, only 12 percent of the rural households were chronically poor.

The two recent droughts (2011/12 and 2015/16) have contributed to the adverse welfare trends observed in the recent years. Drought has decreased consumption of affected households by more than 11 percent. The impact of drought exhibits heterogeneity across regions, and among poor (and non-poor) households as well as those with (without) access to safety-net support under the PSNP. Poor households, especially those without access to safety-net, appear to have suffered more welfare losses because of drought.

## References

- Carter, Michael R., Peter D. Little, Tewodaj Mogues, and Workneh Negatu. "Poverty Traps and Natural Disasters in Ethiopia and Honduras." *World Development* 35, no. 5 (2007): 835–56.
- Demeke, Abera Birhanu, Alwin Keil, and Manfred Zeller. "Using Panel Data to Estimate the Effect of Rainfall Shocks on Smallholders Food Security and Vulnerability in Rural Ethiopia." *Climatic Change* 108, no. 1–2 (2011): 185–206.
- Dercon, Stefan, John Hoddinott, and Tassew Woldehanna. "Shocks and Consumption in 15 Ethiopian Villages, 1999--2004." *Journal of African Economies* 14, no. 4 (2005): 559–85.
- Dercon, Stefan, and Catherine Porter. "Live Aid Revisited: Long-Term Impacts of the 1984 Ethiopian Famine on Children." *Journal of the European Economic Association* 12, no. 4 (2014): 927–48.
- Foltz, Jeremy D., Jared Gars, Mutlu Özdoğan, Belay Simane, and Ben Zaitchik. "Weather and Welfare in Ethiopia." 2013 Annual Meeting, August 4-6, 2013, Washington, D.C. Agricultural and Applied Economics Association, 2013.
- Little, Peter D., M. Priscilla Stone, Tewodaj Mogues, A. Peter Castro, and Workneh Negatu. "'Moving in Place': Drought and Poverty Dynamics in South Wollo, Ethiopia." *The Journal of Development Studies* 42, no. 2 (2006): 200–225.
- Oxfam. "East Africa Food Crisis: Poor Rains, Poor Response," 2011.
- . "Food Crisis in the Horn of Africa: Progress Report July 2011–July 2012," 2012.
- Thiede, Brian C. "Rainfall Shocks and Within-Community Wealth Inequality: Evidence from Rural Ethiopia." *World Development* 64 (2014): 181–93.
- World Bank. "Ethiopia - Priorities for Ending Extreme Poverty and Promoting Shared Prosperity: Systematic Country Diagnostic." The World Bank, 2016.
- . "Ethiopia Poverty Assessment." The World Bank, 2015.

## Annex

**Table A.1: T-test for Changes in Median Consumption by Region**  
(Rural and Small Towns during 2014-2016 and 2012-2014)

Region	(1) Tigray	(2) Amhara	(3) Oromia	(4) SNNP	(5) Other
<i>Growth</i>					
<i>Period:</i>					
2014-2016	-502*	-106	-612**	-307	-268
	(292)	(186)	(244)	(230)	(261)
N	746	1,565	1,419	1,776	1,637
2012-2014	2	123	-667**	-509**	254
	(250)	(186)	(265)	(255)	(295)
N	772	1,622	1,479	1,905	1,694

**Table A.2: T-test for Percentage Changes in Median Consumption by Region**  
(Rural and Small Towns during 2014-2016 and 2012-2014)

Region	(1) Tigray	(2) Amhara	(3) Oromia	(4) SNNP	(5) Other
<i>Growth</i>					
<i>Period:</i>					
2014-2016	-11.7**	-2.9	-8.4**	-9.1	-6.3
	(5.5)	(4.4)	(4.2)	(5.7)	(5.6)
N	746	1,565	1,419	1,776	1,637
2012-2014	0.0	3.0	-11.1**	-11.2**	5.0
	(4.8)	(4.5)	(4.3)	(5.5)	(5.7)
N	772	1,622	1,479	1,905	1,694

**Table A.5: List of Control Variables Included in the Regression Analyses**

Variables	Options	Reference Group	Excluded from the FEs regression?
<b>Household Characteristics</b>			
<i>Head's characteristics</i>			
Gender			Yes
Age (years)			
Age square			
Education level	Primary Secondary Tertiary	Yes	
Marital status	Never married Married	Yes	

Variables	Options	Reference Group	Excluded from the FEs regression?
Religion	Polygamous Divorced Separated Widow Orthodox Protestant Muslim Other (Specify)	Yes	
Household size			
Number of children under 5 years of age			
Number of children between the age of 5 and 14 years			
Number of adult members			
Dependency ratio			
<b>Asset ownership</b>			
Cattle ownership (number)			
Landholding (hectare)			
Ownership status of primary residence	Privately owned Rented Others specify		
Number of rooms in the primary residence			
Type of primary residence's wall	Wood and mud and mud/cement Others	Yes	
Is the roof of primary residence corrugated iron sheet?			
Type of primary residence's floor	Mud Concrete/ceramic Others		
Type of toilet in the primary residence	Flush toilet (shared/private) Pit latrine, private Pit latrine, shared Forest or Others	Yes	
Energy used for lighting the primary residence	Electricity Light from dry cell with switch	Yes	

Variables	Options	Reference Group	Excluded from the FEs regression?
Energy used for cooking	Kerosene lamp Others Firewood Charcoal kerosene/Butane/gas/electric Others		
Does any member of the households own fixed phone?			
Does any member of the households own mobile phone?			
Does any member of the household own radio?			
Does any member of the household own bicycle?			
<b>Self-reported food insecurity</b>			
In the past 7 days, did you worry that your household would not have enough food?			
In the past 12 months, did you worry that your household would not have enough food?			
In the past 7 days, did adult household members have at least 3 meals per day?			
Has the household faced food price increases in the past 12 months?			
<b>Distance from public services:</b>			
Road			Yes
Permanent market			Yes
Border post			Yes

**Table A.6: Impacts of Drought on *Food Consumption* (%)**

	(1)	(2)	(3)	(4)
	Overall	By region	Overall	By region
Overall/National impact:	-15.2*** (2.1)		-12.0*** (2.3)	
<i>Impact in each region:</i>				
Tigray		1.1 (7.5)		4.6 (7.5)
Amhara		-13.3*** (4.0)		-12.6*** (4.0)
Oromia		-26.2*** (3.9)		-21.2*** (4.1)
SNNP		-19.7*** (4.2)		-16.6*** (4.3)
Other		16.4** (7.5)		19.6*** (7.6)
R-square (within group)	0.05	0.05	0.07	0.08
Number of observations	9,305	9,305	9,268	9,268
Number of households	3,522	3,522	3,521	3,521
<i>Covariates included:</i>				
Household FEs	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes
Asset ownership	No	No	Yes	Yes
Self-reported food insecurity	No	No	Yes	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent food consumption expenditure (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.6 in the Annex.



**Table A.7: The Differential Impacts of Drought on the Poor and the PSNP Households**  
*(% change in Food Consumption)*

	(1)	(2)	(3)	(4)	(5)	(6)
<i>Impact on drought affected:</i>						
Non-poor households	-16.9*** (3.4)			-12.0*** (3.6)		
Poor households	-28.9*** (4.3)			-22.7*** (4.4)		
<i>Impact on drought affected:</i>						
Non-poor households		-25.4*** (3.0)			-20.8*** (3.2)	
Poor households		-8.5 (5.8)			0.1 (5.9)	
<i>Impact on drought affected:</i>						
Non-poor non-PSNP HHs			-22.0*** (3.7)			-17.8*** (3.9)
Non-poor PSNP HHs			2.1 (7.7)			10.1 (7.8)
Poor non-PSNP HHs			-31.1*** (4.8)			-25.8*** (4.9)
Poor PSNP HHs			-23.9** (11.0)			-14.9 (11.1)
R-square (within group)	0.06	0.06	0.07	0.10	0.10	0.10
Number of observations	6,397	6,397	6,397	6,375	6,375	6,375
Number of households	3,477	3,477	3,477	3,475	3,475	3,475
<i>Covariates included:</i>						
Household FEs	Yes	Yes	Yes	Yes	Yes	Yes
Household characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Asset ownership	No	No	No	Yes	Yes	Yes
Self-reported food insecurity	No	No	No	Yes	Yes	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent food consumption expenditure (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.6 in the Annex.

**Table A.8: Impacts of Recent (2015/16) Drought on Food Consumption**  
(DiD Estimates)

	(1)	(2)	(3)
Post-2014*Drought (i.e. impact)	-19.4*** (3.6)	-13.3*** (3.5)	-11.1*** (3.4)
Post-2014	-4.3** (1.8)	-8.4*** (1.8)	-9.0*** (1.7)
Drought	8.9*** (2.6)	9.0*** (2.5)	12.3*** (2.5)
R-square	0.11	0.22	0.27
Number of observations	5,719	5,698	5,698
<i>Covariates included:</i>			
Household characteristics	Yes	Yes	Yes
Asset ownership	No	Yes	Yes
Self-reported food insecurity	No	Yes	Yes
Distance from public services	No	Yes	Yes
Region FEs	No	No	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent food consumption expenditure (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.6 in the Annex.

**Table A.9: Impacts of Recent (2015/16) Drought on Food Consumption**  
(FEs Estimates)

	(1)	(2)
<i>Impacts of drought (% change in consumption) in the year:</i>		
2016	-10.1*** (3.5)	-9.2** (3.6)
2014	-1.0 (4.3)	1.2 (4.4)
2012	-14.1*** (2.8)	-9.1*** (2.9)
R-square (within group)	0.08	0.10
Number of observations	9,305	9,268
Number of households	3,522	3,521
<i>Covariates included:</i>		
Household FEs	Yes	Yes
Household characteristics	Yes	Yes
Asset ownership	No	Yes
Self-Reported food insecurity	No	Yes

Note: \*\*\* indicates significant at 1%, \*\* significant at 5% and \* significant at 10%. The dependent variable is the logarithm of real adult equivalent food consumption expenditure (in 2016 prices with Fisher spatial adjustment). The list of covariates included is presented in Table A.6 in the Annex.