Kebribeyah, Ethiopia - Sean Sheridan for Mercy Corps

ENHANCING RESILIENCE TO SEVERE DROUGHT: WHAT WORKS?

Evidence from Mercy Corps' PRIME Program in the Somali region of Ethiopia

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MERCY CORPS

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Acronyms

ACPA	Aged and Children Pastoralists Association
AFDM	African Flood and Drought Monitor
AISDA	Action for Integrated Sustainable Development
ATE	average treatment effect
BOFED	Bureau of Finance and Economic Development
CAHW	community animal health worker
DPPB	Disaster Prevention and Preparedness Bureau
ECDD	Ethiopian Center for Disability and Development
EWS	Early warning system
FEWSNET	Famine Early Warning Systems Network
FGD	Focus group discussion
HAVOYOCO	Horn of Africa Voluntary Youth Committee
HDDS	household dietary diversity score
HFIAS	household food insecurity access scale
HHS	household hunger scale
IPC	Integrated Phase Classification
JEOP	Joint Emergency Operation Plan
JESH	Jigjiga Export Slaughterhouse
KII	Key informant interview
NDRMC	National Disaster Risk Reduction and Management Council
NRM	Natural resource management
ODK	Open Data Kit
OFDA	Office of US Foreign Disaster Assistance
PLI	Pastoralist Livelihood Initiative
PPI	Progress out of poverty index
PPS	probability-proportional-to-size
PRIME	Pastoralist Areas Resilience Improvement through Market Expansion
PSM	propensity-score matching
PSP	Participatory Scenario Planning
RAIN	Revitalizing Agricultural/Pastoral Incomes and New Markets
RDPPB	Regional Disaster Prevention and Preparedness Bureau
RUSACCOs	Rural savings and credit cooperative
SAA	Social Action and Analysis
SMFI	Somali Microfinance Institution
SPI	standardized precipitation index
USAID	United States Agency for International Development
VSLA	Village savings and loans associations
WFP	World Food Programme

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Finally, we extend our heartfelt gratitude to the households and communities which graciously donated their time and shared their personal information and stories with us. We are forever in their debt and sincerely hope that our research leads to improved programming that supports and enriches their lives.

Brad Sagara
Research and Learning Manager, Mercy Corps

Dan Hudner
Director of Research and Evaluation, Causal Design

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Executive Summary

The concept of resilience is not novel to international development, but recent crises in the Horn of Africa and Sahel have brought it to the forefront of development thinking, as shocks and stresses are increasingly recognized as inherent realities rather than theoretical risks. To effectively address these complex problems, new knowledge and understanding is required. While much research to date has focused on conceptually defining and identifying key determinants of resilience (e.g. what "matters"), less attention has been paid to understanding what "works" for resilience. This is an important gap to address, not only as an evidence base to inform current and future programming, but also to evaluate the effectiveness of programming that applies a resilience approach vis-à-vis traditional humanitarian and development programming.

With the onset of the 2015-2016 El Niño drought in Ethiopia, Mercy Corps took advantage of a unique opportunity to rigorously evaluate interventions implemented under the USAID-funded Pastoralist Areas Resilience Improvement through Market Expansion (PRIME) project. The research focuses on answering whether core PRIME interventions implemented since 2013 have effectively enabled households to quickly recover, maintain, or improve key food security and wellbeing measures in the face of drought – i.e. to be more resilient – when compared with statistically similar households in nearby areas not targeted with PRIME interventions. The study was conducted in May 2016 and focused on four heavily drought affected *woredas* in northern Somali Region's Fafan Zone.

The results are encouraging for proponents of a resilience approach: they show that PRIME had a positive impact on important wellbeing outcomes during the worst drought in decades to affect the area. In the months following the drought, households in PRIME communities were able to consume a more diverse diet, were less likely to be impoverished, and more likely to have greater household asset bases than their comparison group counterparts. Positive effects were also observed with respect to livestock ownership and management, with PRIME households having smaller, healthier, and more productive herds. These overall positive food security, economic, and livestock management outcomes are particularly significant given the sheer intensity of drought these areas faced. This study also finds that for certain outcomes, there may be complex, non-linear interactions between project impact and the intensity of the shock experienced. Depending on the intervention and shock type, benefits of project activities may be negligible at low drought intensity and overwhelmed completely at high drought intensity. Understanding this relationship is a critical methodological and programmatic question as impact evaluations of similar projects increase in number.

The new evidence from this study has significant implications for future donor and national government investments in programming in the Horn of Africa and similar contexts frequently beset by recurrent drought and other climate-related shocks. The results lend support to the efficacy of multi-year, multi-sectoral approaches aimed at strengthening systems (markets, ecological, livelihood) that enable households and communities to respond and adapt to the major shocks and stressors they face. Therefore, it is recommended that donors, governments and development agencies:

1. Increase multi-year, flexible investments in strengthening resilience in contexts experiencing recurrent crises, which enable programs to pursue long-term development goals and be responsive to meeting emergency needs.
2. Provide greater support to "systems approaches" that can bring transformative changes in the market, ecological, and governance systems that underpin people's ability to effectively manage shocks and stresses like drought.
3. Dedicate sufficient time and financial resources to effectively evaluate complex resilience-building programs, including to analyzing the impacts of specific components of multi-sectoral programs. Ensure both the methodological innovations and evidence generated influence future resilience investments.

Introduction

In 2015/2016, one of the worst droughts on record gripped Ethiopia, with an estimated 15 million people requiring food assistance for a prolonged hunger season.[1] This drought followed a trend of increasingly frequent droughts affecting greater numbers of people in Ethiopia since 2000.[2] To exacerbate the situation, traditional humanitarian and development assistance historically has fallen short of building sufficient capacity of households and communities to withstand the inevitable shocks and stresses endemic to the region, as evidenced by the perceived inability to avert or quickly recover from the 2010/2011 drought crisis in the Horn of Africa.[3] In light of these issues, the paradigm is shifting away from "segregated humanitarian support activities and development activities" toward an integrated resilience approach that seeks to better enable households and communities to withstand and recover from recurrent shocks.[4,5]

Mercy Corps, USAID, and other major humanitarian and development actors have recently adopted a resilience approach with increased investments aimed at strengthening resilience in contexts experiencing recurrent crises. With this shift has come the call for more research on resilience, and Mercy Corps and others have produced a considerable amount of evidence on what factors appear to support household resilience to drought and other natural disasters.[6] The questions to focus on now are what types of interventions—or combinations of interventions—are most effective at enhancing resilience and whether these interventions mitigate the worst effects of humanitarian emergencies and preserve development gains. The lack of empirical evidence on the effectiveness of these interventions has left the concept of resilience-focused programming vulnerable to critiques of its value vis-à-vis traditional development and humanitarian assistance programming.[7]

This study begins to fill this evidence gap by using quasi-experimental methods to explore whether Mercy Corps' USAID-funded Pastoralist Areas Resilience Improvement through Market Expansion (PRIME) project contributed to household resilience in areas of Ethiopia's Somali Regional State affected by drought associated with El Niño. Results from this study provide Mercy Corps teams with actionable evidence to inform the design and implementation of future interventions that effectively support resilience. Moreover, this research provides valuable insights for donor and peer organizations' policies and strategies for integrating a resilience approach to their programming.

This report starts by describing the evolution of resilience thinking and programming over the past decade in Ethiopia's pastoral regions that laid the foundation for PRIME, one of Mercy Corps' earliest and largest efforts in the region integrating a resilience approach to program design and implementation. A brief description of the 2015 El Niño cycle and associated drought ensues, followed by a detailed description of the methods, research questions, and study area. The results section of the report is organized into three sub-sections: the first addresses project impacts on key household wellbeing outcomes; the second presents exploratory findings on how project impact varied based on the intensity of the drought experienced; and the third explores impact on intermediate outcomes. Finally, the concluding section summarizes the main findings, provides policy recommendations, and highlights areas for further research.

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[1] Ethiopia Humanitarian Country Team (2015)
[2] Headey, D., Taffesse, A., & You, L. (2012)
[3] Headey, D. & Kennedy, A. (2012)
[4] Rajiv Shah as quoted in Headey, D. & Kennedy, A. (2012)
[5] Frankenberger, T. (2012, August 2)
[6] See: mercycorps.org/resilience
[7] IBID

The Evolution of Resilience Programming in Ethiopia

Drought response interventions for Ethiopian pastoralists have evolved over recent years, shifting from traditional food assistance aimed at addressing immediate needs and saving lives, to livelihood-focused interventions intended to bridge relief and development. An early iteration of this was the 2005 Pastoralist Livelihood Initiative (PLI), a two-year program funded by USAID and implemented by Save the Children, CARE, IRC, and ACDI/VOCA. The PLI program had the objective to "mitigate the impact of drought and other shocks by sustainably improving preparedness, livelihoods, and incomes of pastoralists."[8] The program incorporated a novel, flexible funding mechanism that allowed implementing agencies to reallocate up to ten percent of their budgets without donor permission to facilitate adaptive, innovative programming. Lessons learned from these innovations and other PLI activities led to the development of guidelines for livestock relief interventions.[9] This initiative was continued under PLI II, implemented from 2009-2013 by CARE, IRC and Mercy Corps.

This trend of innovative, livelihoods-based programming was continued by Mercy Corps with the three-year Revitalizing Agricultural/Pastoral Incomes and New Markets (RAIN) program in Somali and Oromiya Regional States, initiated in 2008. RAIN's relief-to-development program had the express purpose of enabling participants to be more resilient to the next shock, and thus worked to protect assets, to prevent food insecurity through strengthening and diversifying livelihoods, and to promote economic development. This program was unique from other traditional livelihoods-based interventions for two principal reasons. First, it was a multi-year effort focused on livelihoods and market systems financed by USAID/OFDA—a donor which had traditionally focused on shorter-term, humanitarian assistance projects.[10] Second, like PLI, RAIN combined multi-year financing with flexible humanitarian funding in which resources were not tied to specific activities and budget lines and could be reallocated to adapt activities over the life of the program to best achieve its goals. This combination provided an opportunity for even more responsive, innovative, and adaptive programming. Early warning information from the Government of Ethiopia (GoE) of impending drought in October 2010 prompted Mercy Corps to quickly direct resources to protect and prevent activities, with over $1 million USD invested by the end of February 2011 when the UN released the humanitarian appeal.[11] An integrated team of Mercy Corps Ethiopia's Emergency Response team and RAIN staff jointly managed emergency, recovery, and economic development activities, enabling the program to protect development gains through risk management rather than perpetual crisis response.

In the early phases of RAIN, much of the work hinged on convincing skeptics of the value of this approach; market facilitation activities involving the private sector in emergency response programs was unorthodox at the time and was initially subject to vocal criticism from regional government representatives. Despite early challenges in achieving the relief-to-development vision of RAIN, adaptive measures taken by project management enabled swift and effective response to the 2010/11 drought.[12] The success of RAIN activities helped change critics' perspectives, resulting in increased demand for more programs integrating humanitarian and development design, and effectively laying the groundwork for the PRIME project.[13]

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[8] Catley, A., Aklilu, Y., and Admassu, B. (2007)
[9] IBID
[10] Kleiman, S. (2013)
[11] IBID
[12] IBID
[13] IBID

The PRIME Project

Begun in 2012, PRIME is a five-year USAID investment financed through the Feed the Future and Global Climate Change facilities, and implemented by Mercy Corps with the Aged and Children Pastoralists Association (ACPA), Action for Integrated Sustainable Development (AISDA), CARE, Ethiopian Center for Disability and Development (ECDD), Haramaya University, Horn of Africa Voluntary Youth Committee (HAVOYOCO), Kimetrica, SOS Sahel, and the Friendship Support Association (FSA). The PRIME project aims to improve the lives and enhance the resilience of pastoralist communities to the effects of drought in Ethiopia's dry lands in Afar, Oromiya and Somali Regional States.

PRIME builds on the RAIN project by supporting systemic change through market-driven approaches to livestock production and livelihood diversification that simultaneously support communities to adapt to a changing climate.[14] To achieve the primary objective of increasing livestock production and improving market linkages, the project supports numerous inter-related activities which are organized into five major intermediate results[15]:

1: Improving livestock production and competitiveness

2: Enhancing households' resilience and ability to adapt to climate change

3: Increasing livelihood diversification and long-term market opportunities

4: Innovation, learning and knowledge management

5: Improving the nutritional status of children and mothers

There are a multitude of activities implemented under these intermediate results that support household resilience in a variety of ways; the descriptions that follow only detail activities implemented at large scale in the communities this study focuses on.

Improving access to financial services

The availability of financial services in the study area is limited, which prevents households from accessing credit to meet short-term needs and businesses from getting the credit they need to expand. PRIME facilitates access to financial services for both these groups in different ways. For households, PRIME engages with formal institutions (microfinance institutions and commercial banks), informal institutions (village savings and loan associations – VSLAs), and semi-formal institutions (rural savings and credit cooperatives – RUSACCOs). In the areas covered by this study, PRIME works with the Somali Microfinance Institution (SMFI) to expand its coverage and services, including for Sharia-compliant products. In addition, PRIME supports 13 RUSACCOs reaching nearly 500 clients and has helped establish over 100 VSLAs with over 2,200 clients. PRIME also uses competitive shared grants to 'buy down' the risk for private enterprise to expand into remote areas This is geared towards allowing pastoral populations to access essential products and services, such as animal medicine, sheep and goat fattening services, agricultural inputs, and energy-saving cook stoves. By expanding coverage of financial services, PRIME is working to enhance the capacity of households to mitigate the impacts of shocks by investing in alternative livelihoods or productive assets, and to better absorb shocks by meeting their immediate needs without selling off their asset base.

[14] For more details on the PRIME project, see: https://www.prime-ethiopia.org/

[15] This study did not look at the impact for IR4 and IR5 because IR4 is focused on institutional learning and the impact of these activities is difficult to ascertain at the household level. Activities under IR5 were not implemented in the study area.

Improving access to weather and market information

Participatory scenario planning facilitated by PRIME provides a forum for communities, local meteorologists, and traditional forecasters to discuss and interpret climate information, explore scenarios and their potential impacts, and jointly develop plans and contingencies to respond to risks. Examples of mitigation and preparedness activities include timely sales of livestock before the forecast dry season, diversification into more resilient animal species, planned vaccination of livestock, cash savings, and fodder and water stocking.16 These meetings have resulted in localized participatory scenario planning advisories and dissemination plans for this information to flow between government actors and community members. PRIME has also created linkages between small and large livestock traders that operate in large market centers to improve their businesses and expand their capacities to buy and sell livestock from more remote areas. By creating these linkages, PRIME aims to enable pastoralists to make informed decisions about livelihood diversification, herd management, and livestock sales.

Improving access to natural resources

PRIME facilitates access to natural resources through "soft" approaches focused on facilitation, reflection, and discussion and through "hard" approaches focused on rehabilitating existing resources or constructing new resources. Through dialogues with Rangeland Management Councils and trainings, communities are supported to rehabilitate and conserve soil and water resources, govern them in times of stress, and operationalize longer-term community action plans for rangeland management. These efforts are complemented by the construction or rehabilitation of water points and ponds to enable communities to obtain reliable water sources through rainwater harvesting in the rainy season for use during dry periods for both human and animal consumption. In addition to water points, rangeland enclosures were the key land rehabilitation activity in the study areas to increase pasture availability during dry season by decreasing overgrazing and animal trampling on pasture areas. Overall, PRIME supported the rehabilitation of 3,510 hectares of land and constructed/rehabilitated water points with a total capacity of 33,456 cubic meters.[17] By improving access to natural resources, PRIME seeks to help households to avoid unusual migration for resources and the associated disruption of basic services and everyday life. Moreover, these efforts support livestock health so animals are better able to survive droughts and continue to produce milk for improved household nutrition and incomes, even in times of stress.

Focusing on livestock production, management, and marketing

PRIME works to improve livestock and livestock markets by expanding access and availability of feed, fodder, and animal health services, boosting trade and market information, and strengthening the dairy value chain. With PRIME support, pastoralists learn techniques for fodder production and preservation to improve and maintain the physical condition of livestock and thereby increase or maintain their productivity through milk yield and quality. PRIME also supports private veterinary pharmacists, milk and livestock traders. The project builds business skills of private veterinary pharmacists, as well as warehouse management and drug handling, and links them to suppliers for veterinary drugs and other inputs. Milk sanitation and hygiene training was provided to milk producers to improve milk quality and linkages were created with a PRIME-supported dairy processing factory. An important activity in these areas was a series of trade fairs that PRIME supported along with government and private sector actors. The trade fairs allowed agro-pastoralists to access selected agricultural inputs at a reduced cost that were cost-shared by PRIME. One of PRIME's Innovation Investment Fund partners, Jigjiga Export Slaughterhouse (JESH), while not yet operational during the study, is the first and only export slaughterhouse in the region and a major investment in creating

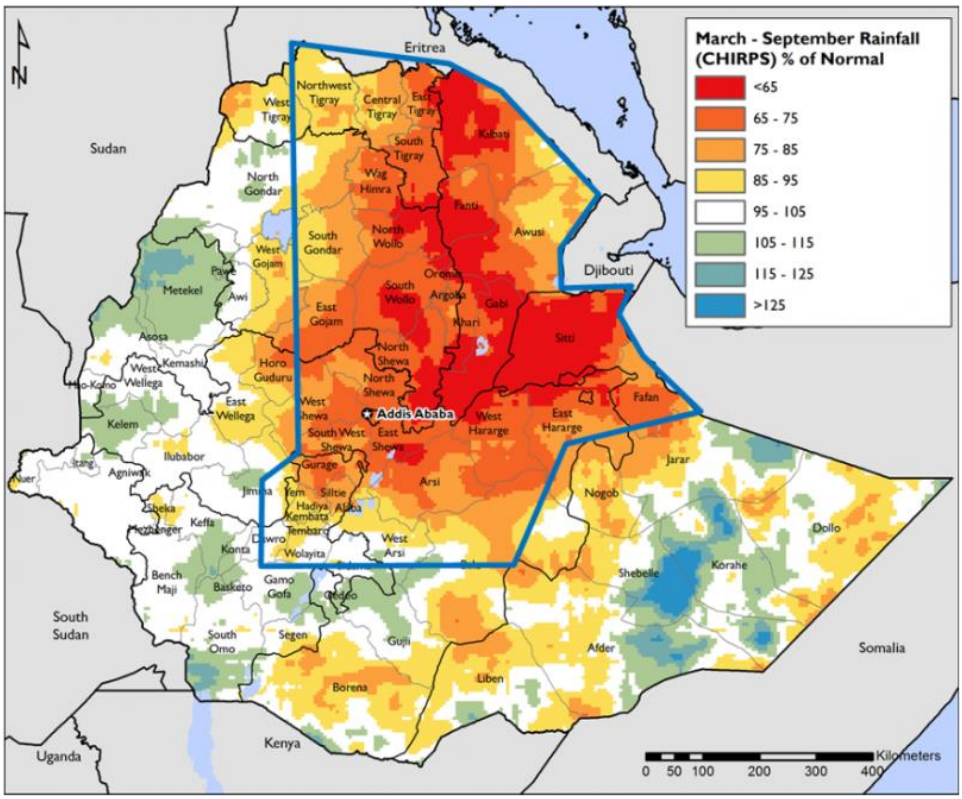
[16] Singh et. al. 2016
[17] FY2016 Annual report

local, regional and global commercial linkages. By working across the livestock value chain, PRIME seeks to ensure that pastoralists are able to leverage and manage their existing resources appropriately to optimize their products and sell them to processors and traders. This systems' level approach intends to allow producers, traders, and consumers to withstand shocks by having a healthy, durable market in place, capable of functioning even in times of stress.

El Niño and Severe Drought Conditions

The impact of the 2015 El Niño cycle was among "the strongest on record," with effects lasting through Spring 2016.[18,19] In Ethiopia, the effects of this weather phenomenon were varied, but most regions received significantly less rainfall than the 1981-2014 average (See Figure 1 below). This provided an opportunity to evaluate whether activities implemented under PRIME have enabled beneficiaries to recover, bounce back better, or avoid being affected completely when confronted by severe drought.

Figure 1: March-September 2015 rainfall as a percentage of the 1982-2014 average



SOURCE: FEWSNET (2015, DECEMBER 17)

For large areas of the north and central regions, 2015 was the driest it has been in at least 30 years; they received less than 65 percent of normal rainfall and soil moisture, a useful proxy for crop conditions.[20] These conditions resulted in water shortages, a lack of native forage for livestock grazing, and significant crop losses of between 50-90 percent.[21] Some pastoral areas experienced unusually high levels of livestock

[18] National Oceanic and Atmospheric Administration (NOAA). (2015, October 15).
[19] Climate Prediction Center, National Centers for Environmental Prediction, National Weather Service, and the International Research Institute for Climate and Society (2016, September 8)
[20] FEWSNET (2015)
[21] Ethiopia Humanitarian Country Team (2015)

disease and mortality coupled with depressed livestock prices and a severely disrupted livestock trade.[22] FEWSNET described the heavily affected Afar and northern Somali Regional States as having reduced availability of pastoral resources contributing to poor livestock conditions.[23] Pastoral income declined as livestock conditions deteriorated and prices fell as households destocked and market supply increased. Staple food prices began increasing earlier than normal across markets in northern, central and eastern Ethiopia and cereal supply was projected to remain low through June 2016 and drive above average prices through at least September. Depressed incomes and increasing food prices created an increasing food gap for poor households and resulted in an Emergency (IPC Phase 4) Classification for Southern Afar and Sitti Zone. As of late January 2016, just under half of the 2016 Appeal (US1$1.4B) was funded, and food stocks available to the three main operating agencies (NDRMC, WFP, and JEOP) were projected to be exhausted by late April 2016.[24,25]

While the intensity of this drought and its implications cannot be understated, with crisis comes opportunity. Natural disasters may be increasing in frequency and severity, but opportunities to evaluate the impact of multiple years of resilience-focused programming on household resilience to an *actual* and serious shock remain limited. Given the dearth of empirical evidence on the impact of investing in resilience, taking advantage of these opportunities is imperative to determine the value of resilience-focused programming vis-à-vis traditional development and humanitarian assistance programming. The following section describes the evaluation methodology.

Methodology

Research Questions

The primary research question this study addresses is: ***have the core PRIME interventions implemented since 2013 effectively enabled households to quickly recover, maintain, and/or improve key food security and wellbeing measures in the face of drought associated with the 2015 El Niño cycle***? This study also undertakes exploratory research to *understand the relationship between project impact on wellbeing and the severity of shock*. For example, it may be possible that the project activities only begin to benefit households as the intensity of the shock increases; likewise, this project impact may eventually diminish if households are confronted with an extraordinarily strong shock or stress. As impact evaluations on resilience-focused interventions become more prevalent, this will become an important question to answer in order to effectively estimate project impact. This study also explores secondary research questions around *whether participation in PRIME has reduced the use of detrimental coping strategies in the face of drought and attempts to identify specific mechanisms that contributed significantly to these results.*

To answer these questions, this study is guided by Mercy Corps' approach to measuring resilience that incorporates key elements of the integrated framework for resilience measurement developed by the Resilience Measurement Technical Working Group.[26] Specifically, the study collected data on the three sets of measures called out in that framework to be essential for analyzing resilience:

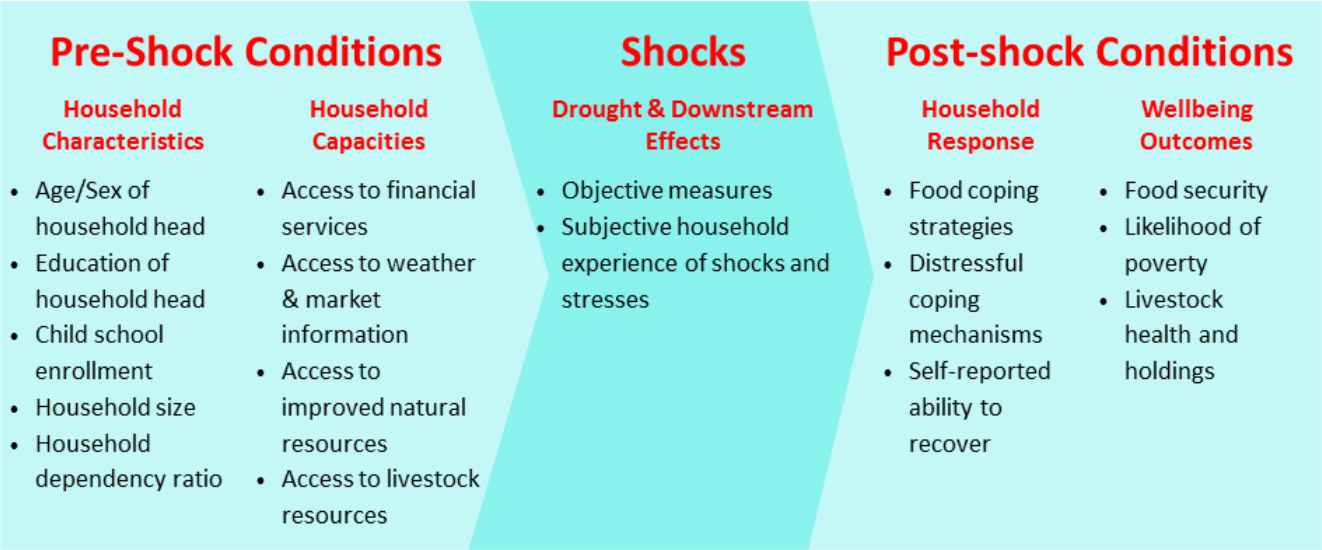
- Pre-shock conditions: captures initial states of household wellbeing, characteristics, and capacities

[22] FEWSNET (2015, December 4)
[23] FEWSNET (2015)
[24] OCHA. (2016, February 1)
[25] FEWSNET (2016 January)
[26] Frankenberger, T., Kurtz, J, and Sagara, B. (2015)

- Disturbance component: captures the severity of the shock(s) and stressors, and people's exposure and sensitivity to them
- Post-shock conditions: captures household responses to shocks/stresses and subsequent levels of household wellbeing and capacities

The figure below presents key measures this study used to answer the research questions above, organized by the three components of the integrated framework for resilience measurement.

Figure 2: Conceptual framework

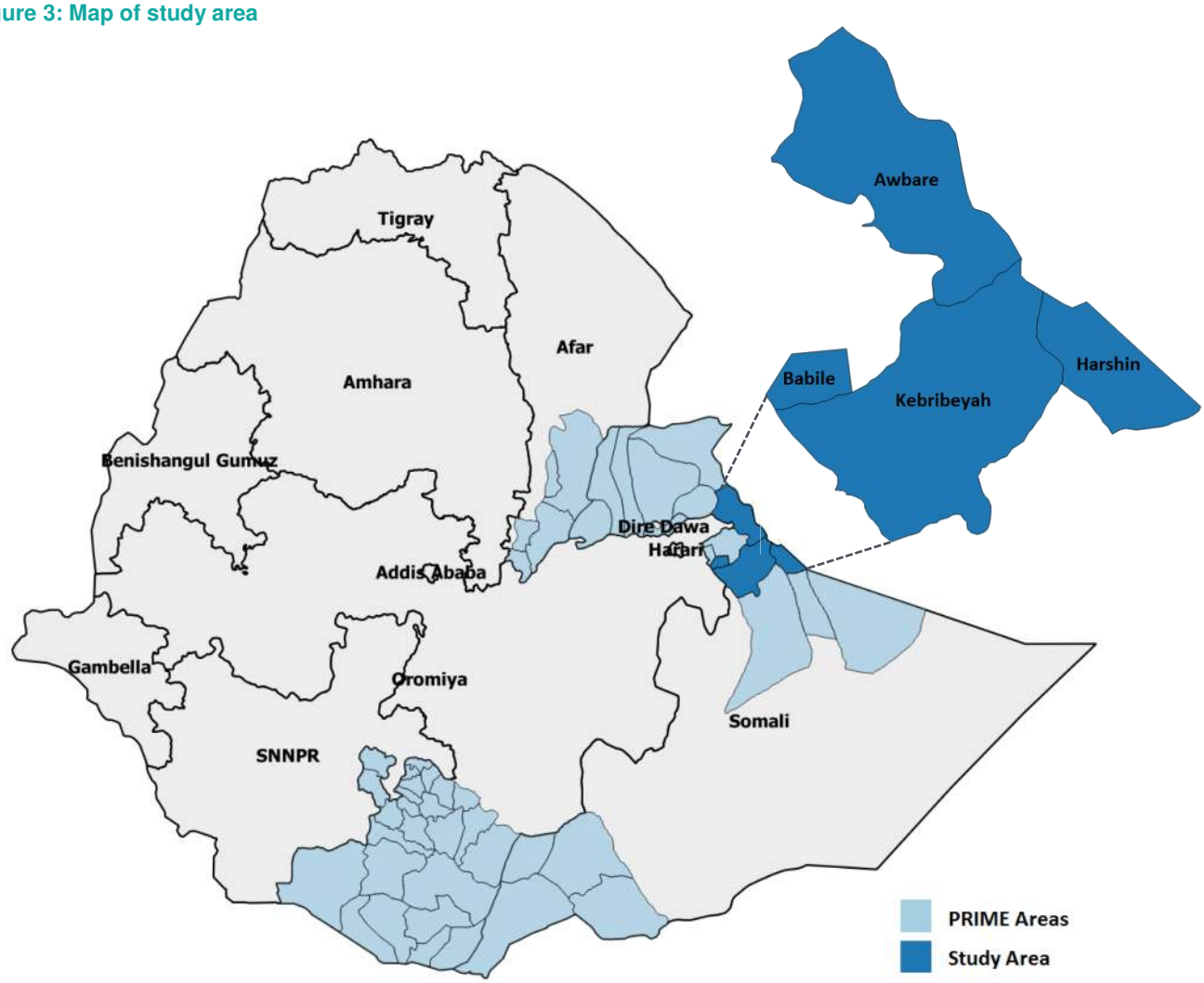


Study Area

This study focuses on Awbare, Babile (Somali), Harshin, and Kebribeyah *woredas* in northern Somali Region's Fafan Zone (see map below). [27] Livelihood strategies in this area are primarily agro-pastoralist, with the exception of parts of Harshin which are almost exclusively pastoralist. More than 185,000 hectares are under cultivation in these four woredas, with the primary crops being maize, sorghum, wheat, barley, beans groundnuts and vegetables with some variation in crop mix between *woredas*.[28] The area is also home to nearly 2.8 million livestock, primarily composed of camels, cattle, sheep and goats.[29] These four *woredas* had high exposure to drought, according to FEWSNET data, and were the most vulnerable and had the highest proportions of their populations affected by water shortages according to a rapid qualitative assessment of Fafan Zone conducted by the Government of Ethiopia in December 2015-January 2016. While other zones of Ethiopia were more severely drought affected (e.g. Zone 3, Afar, Sitti, and Somali Zone), Fafan Zone was both severely affected by drought and targeted more intensively by the PRIME project, providing a unique opportunity to understand whether PRIME interventions were supporting drought resilience. Because of this limited geographic focus, the findings from this impact evaluation should *not* be considered generalizable to the PRIME project overall.

[27] *Woreda* (also spelled *wereda)* refers to an administrative division in Ethiopia, generally corresponding to a district. *Woredas* are further sub-divided into *kebeles* the smallest administrative unit in Ethiopia
[28] RDPPB (2016)
[29] IBID

Figure 3: Map of study area



Fafan remains a priority area for humanitarian response. The aforementioned rapid qualitative assessment was conducted by the GoE Regional Disaster Prevention and Preparedness Bureau (RDPPB) and supported by UN agencies, implementing partners, and other government entities.[30,31] The assessment found that approximately 110,331 out of a total population of 1,187,022 were facing water shortages, with Awbare, Babile Somali, Harshin, and Kebribeyah *woredas* deemed the worst affected. In these *woredas* alone, an estimated 150,000 people needed emergency relief. This assessment found significant crop failures, migration, disruption of basic services such as education, and in some cases diarrheal and other disease outbreaks. Livestock conditions were in general quite poor, mainly due to lack of native forage and crop residue for animal feed, water scarcity, and consequences of overgrazing earlier in the season. Across all four *woredas*, the assessment team cited increased access to water and pasture as a primary recommendation for humanitarian assistance. With respect to food security, the January 2016 Food Security Outlook from FEWSNET listed most of the *woredas* in Fafan Zone as stressed, with the exception of Harshin, which was categorized as a crisis situation according to the IPC V2.0 Phase of Acute Food Insecurity tool.

[30] http://reliefweb.int/report/ethiopia/ethiopia-2016-humanitarian-requirements-document-hrd-snapshot-5-january-2016
[31] RDPPB (2016)

PRIME's investment in Somali Regional State is the largest of the project in terms of resources and geographic coverage. The *woredas* covered by the resilience study surround Jigjiga, the largest town in the region and seat to the regional government. Despite this proximity, these *woredas* are remote areas, underserved by many services, including agricultural inputs, animal health, and financial services. Land degradation and limited water resources force pastoralists to travel significant distances in search of grazing, especially during droughts that can be chronic in these areas.

Sampling and Estimation Strategy

As explained above in the description of the PRIME project, most activities target systems (e.g. markets, livestock health systems, rangelands, etc.) rather than individual households. As a result, the sampling strategy stratified *kebeles*[32] by intensity of PRIME activities based on a project-monitoring database. Communities that have benefitted from numerous PRIME activities are "treatment" *kebeles* and communities with no PRIME activities are "comparison" *kebeles*. PRIME tailors its activities to respective *kebeles*, and no single activity or combination of activities was implemented across all treatment *kebeles*, thus making it difficult to isolate the exact causal effect of specific activities. Results should therefore be interpreted as the combined net effect of PRIME activities. Moreover, individual households within a treated community may or may not have directly benefited from PRIME activities and identifying these households is virtually impossible since households themselves may not know whether the products or services they benefit from are from the PRIME project. Thus, the intent to treat (ITT) estimate is reported rather than the effect of the treatment on the treated. Given these constraints to measuring the impact of individual PRIME activities quantitatively, qualitative analysis is intended to provide some evidence of which interventions were most likely influential on household experience, albeit with obvious limitations of representativeness and generalizability.

Using data from the 2007 Population and Housing Census of Ethiopia, a sample of households was selected based on a two-stage cluster design. In the first stage, 26 treatment and 52 comparison *kebeles* were randomly selected using probability-proportional-to-size (PPS). The second stage involved randomly selecting 20 households from each *kebele,* using household lists updated in conjunction with *kebele* and *woreda* officials, for a planned sample size of 1,560 households. Enumerator teams could not survey one treatment *kebele* due to security issues and after further data cleaning, 1,529 completed interviews remained for analysis.

Estimation Strategy

Estimation of the impact of PRIME project activities relied on a propensity score matching (PSM) approach to create a valid counterfactual in the absence of randomized assignment. Propensity scores predicting the likelihood of receiving treatment (in this case, being targeted by PRIME) were calculated for each household based on cross-sectional recall data and time invariant household characteristics hypothesized to influence both probability of treatment and relevant wellbeing and other outcomes. All covariates used to predict the likelihood of treatment were balanced between the treatment and comparison group after weighting by the propensity score. This strategy estimates the causal effect of PRIME by comparing wellbeing outcomes of households within communities that benefited from PRIME activities against wellbeing outcomes of households with similar propensity-scores from communities that did not benefit from the project. For more details on the PSM methodology, please refer to Annex I.

[32] *Kebeles* are the lowest administrative unit in Ethiopia and are roughly equivalent to wards

One purpose of this study as outlined in the research questions above was to understand the nature of the relationship between project impact and shock severity. To this end, treatment effects were estimated using a basic primary model and, where feasible, an expanded secondary model. Both models control for the magnitude of the drought shock experienced by households to analyze whether PRIME has improved resilience to climate shocks. The main difference between these two models is whether the treatment effect is allowed to vary with the intensity of the drought, an important nuance explained in detail below.

The primary model used to estimate the majority of treatment effects reported here assumes the impacts of PRIME on household wellbeing, coping strategies, and resilience capacities are constant, regardless of the intensity of the drought the households experience. The two variations of this primary model presented below are based on the outcomes of interest: one focuses on household wellbeing (model 1a in the figure below) and the other (model 1b) focuses on response strategies, as well as intermediate outcomes, which this research treated as resilience capacities.

Figure 4: Primary impact estimation models

Model 1a	**PRIME + Drought + Household Characteristics**	❯	Wellbeing Outcomes		
Model 1b	PRIME + Drought + Household Characteristics	❯	Coping Strategies	/	Resilience Capacities

The primary model includes a binary variable indicating treatment status and controls for any household demographic characteristics that are not included in the propensity-score estimation. This model assumes that the effects of treatment are constant and reports the weighted treatment effect of being in a *kebele* targeted by the PRIME – i.e. treatment status – project and reports standard errors clustered at the community level to account for any similarities between households in the same community. The functional formula is as follows:

$$\gamma_i = \beta_0 + \beta_1 Treatment_i + \beta_2 Disaster_i + \beta_3 X_i + \mu_i \quad (1)$$

Where:

- Y_i indicates the relevant outcome variable (i.e. household wellbeing, coping strategy, or capacity)
- β_0 is a constant
- $Treatment_i$ indicates household *i*'s treatment status, i.e. whether or not they were in PRIME *kebeles*
- $Disaster_i$ is a measure of household *i*'s exposure to drought at the time of survey, as measured by the standardized precipitation index (SPI) described further below
- X_i represents relevant demographic characteristics not included in the propensity score estimation
- μ_i is the error term

Exploratory models

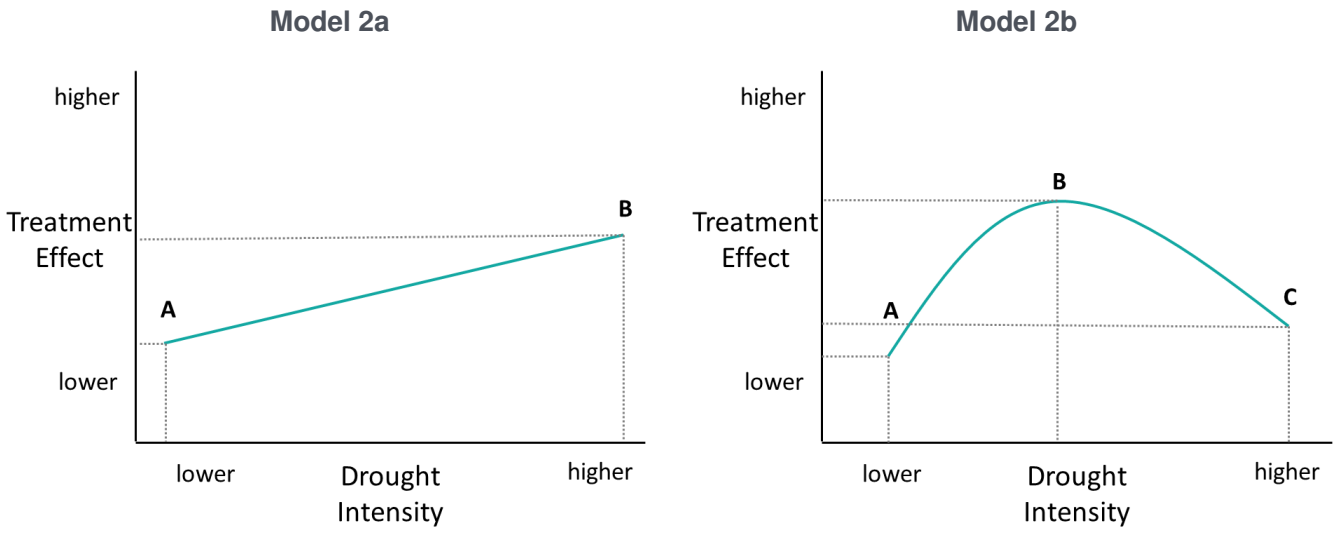
The primary model above controls for the magnitude of the drought and estimates a constant treatment effect across different intensities of drought; i.e. the impact of PRIME on household wellbeing outcomes is constant regardless of how intensely the drought affected the households. However, the impact of PRIME might vary with shock magnitude, necessitating the development and testing of alternative models. The first (2a below) introduces an interaction term that allows the treatment effect to vary linearly by drought intensity. The second (2b) introduces quadratic terms that interacts residence in a PRIME *kebele* with the level of drought exposure, which allows the treatment effect to vary non-linearly by drought intensity.

Figure 5: Exploratory impact estimation models

Model 2a	**PRIME + Drought + Household Characteristics + (PRIME × Drought)**	❯	Wellbeing Outcomes
Model 2b	PRIME + Drought + Household Characteristics + (PRIME × Drought) + $Drought^2$ + (PRIME × $Drought^2$)	❯	Wellbeing Outcomes

To better illustrate these hypothetical relationships, stylized versions of these models are provided below. The left panel depicts the linear relationship (model 2a) and the right panel depicts the quadratic relationship (model 2b). The linear model shows that as drought intensity increases, project impact consistently increases – note that slope of the line could be either positive or negative, depending on the intervention. The quadratic model allows for the possibility that treatment effects are lower when shock intensity is either very low or very high (points A and C) and maximized under "medium" intensity shocks (point B). Note that the shape of this curve (i.e. concavity/convexness etc.) and thus the location of points A, B, and C, would almost certainly vary by treatment and shock type. This model (model 2b) was determined to be the most likely representation of the effect of PRIME activities relative to shock intensity based on consultations with PRIME staff.

Figure 6: Hypothesized relationships between project impact and drought intensity



These models also reports the propensity score-weighted ATE and uses clustered standard errors at the community level. The functional form for model 2a is as follows:

$$Y_i = \beta_0 + \beta_1 Treatment_i + \beta_2 Disaster_i + \beta_3\, Disaster * Treatment_i + \beta_4 X_i + \mu_i \quad (2)$$

And model 2b:

$$Y_i = \beta_0 + \beta_1 Treatment_i + \beta_2 Disaster_i + \beta_3\, Disaster_i^2 + \beta_4 Disaster * Treatment_i + \beta_5 Disaster^2 * Treatment_i + \beta_6 X_i + \mu_i \quad (3)$$

Where:

- Y_i indicates the relevant outcome variable, in this case wellbeing outcomes
- β_0 is a constant
- $Treatment_i$ indicates household *i*'s treatment status, i.e. whether or not they were in PRIME *kebeles*
- $Disaster_i$ is a measure of household *i*'s exposure to drought at the time of survey, as measured by the standardized precipitation index (SPI) described further below
- $Disaster*Treatment_i$ is the interaction term of household i's treatment status and disaster affectedness
- $Disaster^2*Treatment_i$ is the interaction term of household i's treatment status and disaster affectedness and the quadratic term for drought intensity
- X_i represents relevant demographic characteristics not included in the propensity score estimation
- μ_i is the error term

The results for these models are reported in the section exploring whether PRIME impact varies by drought intensity and is limited to household wellbeing outcomes that were statistically significant using the basic model 1a outlined above.

Data Sources

The study employed a mixed methods approach consisting of secondary data sources, focus group discussions (FGDs), key informant interviews (KIIs), and a quantitative household survey. Each of these is described in detail below and final versions of all instruments are available upon request.

Secondary data sources

Secondary data from various government ministries, regional entities (FEWSNET), UN and other NGOs provided contextual information for this study. In addition, pursuant to Frankenberger and Smith (2015), this study leveraged data from the African Flood and Drought Monitor (AFDM) to provide an objective quantitative measure of drought intensity in the region. The AFDM is a joint venture between Princeton University and UNESCO and provides historical climate data from 1950-2008, as well as real time monitoring data since 2009.[33] The data is relevant at the *kebele* level and serves as the disaster measure outlined in the estimation formulae above. The following measures available from the AFDM were considered for analysis: the Standardized Precipitation Index (SPI), Soil Moisture Index (percent of norm), and the Normalized Difference Vegetation Index (NDVI) percentile. Ultimately, SPI was utilized as it best modeled the intensity of the drought in the region, correlated well with the other candidate measures, and has also been accepted by the World Meteorological Organization as the international standard indicator of meteorological drought.[34] The SPI is an indicator that reports the probability of observed precipitation based on a long-term precipitation record for a specific location, in this case the surveyed *kebeles*. Using this record, a probability distribution is developed and normalized such that positive SPI values indicate greater than median precipitation and negative SPI values indicate less than median precipitation. Drought events are defined when the SPI is continuously negative and reaches an intensity of -1.0 standard deviations or less.[35] McKee et. al. (1993) have developed categories and determined how rare these events are based on this probability distribution (see table below). For the models outlined above, a transformed version of the 12 month SPI is used which compares the precipitation for the 12 months preceding data collection (i.e. May 2015-April 2016) with that of previous years for the same 12 months, providing an appropriate estimation of

[33] http://hydrology.princeton.edu/~nchaney/Africa_Drought_Monitor_Webpage/Resources/ADM_Background.pdf
[34] Hayes, et al (2011)
[35] World Meteorological Organization (2012)

longer-term precipitation patterns.[36] A one month SPI is also used below, which compares the precipitation for a given month with that of previous years for the same month. By plotting this data over the 12 months preceding the survey, one can visualize how the shorter-term drought conditions evolved over time.

Table 1: Probability of drought occurrence

SPI	Category	Probability of Occurrence
0 to -0.99	Mild dryness	1 in 3 years
-1.0 to -1.49	Moderate drought	1 in 10 years
-1.5 to -1.99	Severe drought	1 in 20 years
<-2.0	Extreme drought	1 in 50 years

Qualitative Data Collection

Qualitative data facilitates understanding about the nuances of behavior, decision-making, and cultural values, and was essential to answer questions about *why* some households and communities are more resilient because of the project support, not simply whether they are resilient. Qualitative data collection relied on in-depth key informant interviews and community focus group discussions. The 16 communities selected for the FGDs and *kebele* level KIIs were identified from a sub-sample of the quantitative survey sample using *a priori* sampling, focusing on specific *kebeles* that represent a spectrum of livelihoods, economic status, and intensity of PRIME interventions in order to capture as much variation as possible. Outlined below are the data collection methods and themes explored.

Key Informant Interviews

Key informant interviews elicited individual perspectives on the research questions outlined above and related contextual information. Four broad categories of individuals were identified as important key informants, including *woreda* or regional level government officials, implementing agency representatives, community leaders, and specific community members. The *woreda* or regional representatives for government and implementing agencies included representatives from the following:

- Bureau of Livestock and Pastoral Affairs
- Bureau of Finance and Economic Development (BOFED)
- Disaster Prevention and Preparedness Bureau (DPPB)
- Regional NGO Coordinator
- Implementing agencies (HAVOYOCO, ACPA, Save the Children)

Kebele level KIIs were also conducted with community leaders, business owners, VSLA members, and NRM council members. Positive deviants, households that were somehow better able to avoid or mitigate negative effects of the drought, were identified by community members and interviewed accordingly. The

[36] The SPI was transformed as follows: all the positive values (i.e. normal to above average rain) was coded as zero and the absolute value was taken of the remaining negative values so drought intensity was therefore measured on a continuous scale ranging from zero to four, with four being the most severe drought

topics explored (see table below) for each of these entities varies and a standardized, open-ended interview outline guided KIIs.

Table 2: KII topics covered

Government/Implementing Agencies	Community leaders, business owners, VSLA and NRM council members	Positive Deviants
• Assistance provided to communities • Relationship to PRIME • Types of assistance available from other government/NGOs • Shocks experienced & impact • Shock responses and coping strategies	• Types of assistance available • Relationship to PRIME • Shocks experienced & impact • Shock responses and coping strategies • Access to natural resources • Identifying positive deviants	• Demographics • Livelihood • Shocks experienced & impact • Types of assistance available • Resources and capacities used to avoid, mitigate or recover from drought

Focus Group Discussions

Gender disaggregated FGDs captured the various points of view that exist within and between communities. Utilizing an open-ended topical outline, FGDs explored the following thematic areas:

- Shocks/stresses experienced in the 12 months prior to the survey
- Household responses to shocks and stresses and their effectiveness
- Relationships within and between communities and with government agencies (social capital)
- Collective action to prepare for, mitigate or respond to any shocks or stresses experienced by the community in the 12 months prior to the survey
- Predominant livelihoods in the community, their challenges, and any households or groups that may be excluded from or confined to certain livelihood activities

To mitigate potential coercion or alienation of certain sub-groups, multiple community guides informed of the purpose and importance of the inclusion criteria of the study identified the participants.

Quantitative Instruments

The household questionnaire administered to randomly selected households provides primary quantitative data to measure key resilience capacities, shock exposure, and wellbeing outcomes. The questionnaire gathered data on the ability of households to absorb or manage shocks in the short-term through food-based coping strategies, cash savings, migration, and social capital. In addition, questions explored whether and how households adapted their behavior to minimize risk or mitigate impact through access to and use of information, livelihood diversification, asset ownership, disaster risk reduction strategies, and use of financial services. To complement the objective secondary measures of shock exposure mentioned above, quantitative data on households' subjective experience of shocks and their corresponding ability to recover in the 12 months prior to the survey was collected. Finally, indicators of overall household wellbeing focused on livestock holdings and health over the 12 months prior to data collection, current household food security, and current economic status.

Community leaders responded to a community level questionnaire in all sampled *kebeles*. This questionnaire focused on community characteristics (demography, proximity to urban centers, natural resources, etc.), access to utilities, infrastructure and public services, social and other emergency programs, and shocks experienced by the community. The questionnaire included questions on the current status of community characteristics as well as a three year historical recall. This data facilitates the matching process described in the Estimation Strategy section above, so similar communities are matched, with the only difference being whether or not the community was targeted by PRIME activities. This also effectively controls for other development or humanitarian interventions that may be occurring in the surveyed kebeles, so any differences between PRIME and comparison communities are most likely an impact of PRIME and not of the other numerous social programs occurring in these areas.

Fieldwork and Data Management

Two male and two female qualitative interviewers were trained from 4-6 May 2016 on the qualitative instruments for the FGDs and KIIs, interviewing and transcribing skills. The final day of training consisted of a pilot test in which interviewers conducted an FGD and a KII in a nearby village not included in the study sample. Qualitative fieldwork took place from 9-29 May 2016. Data was transcribed in the field in Somali and later translated for analysis.

Quantitative fieldwork was implemented by supervisors and enumerators contracted from Green Professional Services. Five supervisors and twenty-seven enumerators received training from 9-13 May 2016 from the Mercy Corps Research and Learning Manager, including a pilot test in a nearby village. Quantitative fieldwork took place from 16 May 2016 to 2 June 2016. Data were collected using tablets running Open Data Kit (ODK) survey software. Data was backed up, transferred, and reviewed for quality regularly throughout fieldwork. Data files were extracted using ODK Briefcase and transferred to STATA v.13/14 for analysis using ODKMeta. Causal Design, with close input from Mercy Corps, conducted all household quantitative data analysis. AFDM data was requested via the website and was overlaid with household GPS coordinates to obtain *kebele*-level estimates of 1 and 12 month SPI using QGIS.

Limitations

This study has multiple limitations worth describing in detail. First and foremost this research was conducted to take advantage of the opportunity presented by the 2015/2016 drought to evaluate the impact of PRIME programming on household resilience. Given the opportunistic, post-hoc nature of this study, the methods for estimating project impact were extremely limited due to lack of baseline data representative of the specific study area and an inability to randomize the treatment assignment. Propensity score matching was the most practical and efficient estimation strategy given these constraints, but there are potential limitations to this design. In order for propensity score matching to produce unbiased estimates of project impact, two critical assumptions are made: 1) all variables related to both outcomes and treatment are included in the propensity score (aka unconfoundedness), and 2) there is sufficient overlap in distribution of propensity scores for treated and comparison groups. The first assumption is considerable, particularly since determinants of outcomes of interest are often numerous and complex and testing this assumption is not possible directly.[37,38] One option for indirectly testing this assumption is assessing balance after matching; if any differences persist in any relevant variables, this assumption may not hold true. This assumption is tested for data used in this study in Annex I, and the research team is reasonably confident that this

[37] Imbens, G. and Wooldridge, J. (2007)
[38] Angrist, J and Pishke, J. (2009)

assumption holds. Similarly, it is plausible to assume sufficient overlap in treatment and comparison group as shown by the tests presented in Annex I.

Another major limitation of this study was the inability to unpack the mechanisms that may have enabled PRIME households to be more resilient to drought than comparison households. Programs focused on supporting resilience are typically multi-sectoral and integrated; therefore assessing the necessity or value of any one activity or set of activities is methodologically challenging and this study was not designed to answer this question but instead focused on whether the entire package of activities as a whole was sufficient at enabling households to better manage drought.

Finally, the study area was restricted to four *woredas* which are not strictly generalizable to other parts of Ethiopia (including other areas targeted by PRIME) or other countries. However, it should be noted that while the specific results (e.g. magnitude of treatment effects) may not be externally valid to other contexts, it is plausible that the general findings and recommendations are relevant and informative to similar programming in similar contexts.

Results

This section presents results organized by the following: household drought experience and response; PRIME impact on household wellbeing outcomes; results of how program impact varied by level of drought intensity; and PRIME impact on intermediate program outcomes. In this section, simple descriptive statistics are used sparingly; where they are used, any differences observed between PRIME and the comparison group should not be interpreted causally. Project impact is presented in the regression results that control for other confounding factors. Throughout this section, the convention for reporting statistically significant results is as follows: one asterisk (*) corresponds with differences significant at the five percent level, two asterisks (**) for the one percent level, and three asterisks (***) for the 0.1 percent level.

Household Drought Experience and Response

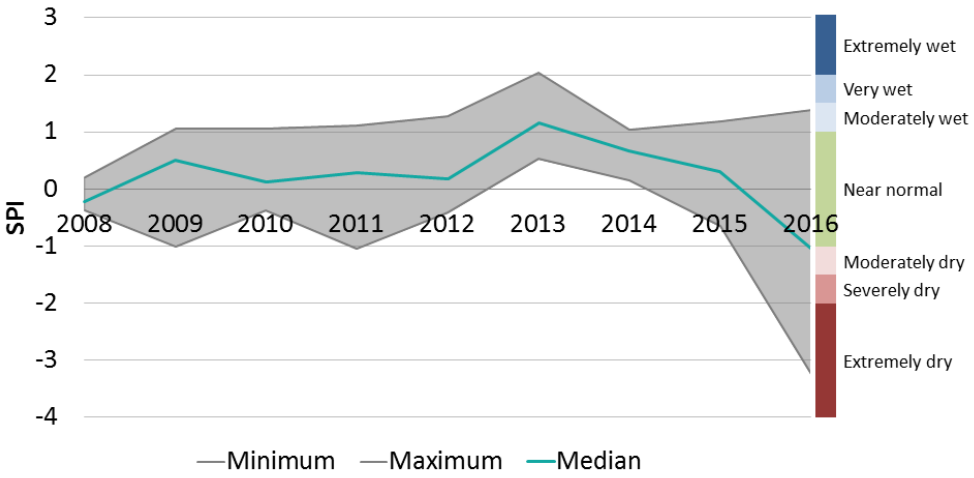
> ***"We've never seen anything like this drought…"***
>
> — Awbare Key Informant

By some measures, this is the worst drought Ethiopia has experienced in more than 50 years.[39] Drought is not new to this area, with the 2010/2011 drought making headlines and some studies indicating 2009 as a year of exceptionally widespread drought at the national level.[40] Drought can be highly localized however, and it is worth comparing how this drought affected the study areas vis-à-vis other recent drought events. The figure below plots the minimum, median, and maximum 12-month SPI for all 77 surveyed *kebeles* from 2008-2016.[41] This illustrates that according to this measure, drought had geographically varied effects in 2016, including a considerable number of *kebeles* experiencing near-normal precipitation for that period. The median *kebele* however had an SPI of approximately -1.0, which corresponds to drought conditions and

[39] FEWSNET (2015, December 4)
[40] Viste, E., Korecha, D., & Sorteberg, A. (2013)
[41] Note that the 12-month period does not correspond to a calendar year. To maintain consistency throughout the report, the 12-month period corresponds to May of the preceding year until April of the current year; 2016 therefore refers to the 12-month period from May 2015-April 2016, and so on for all other years.

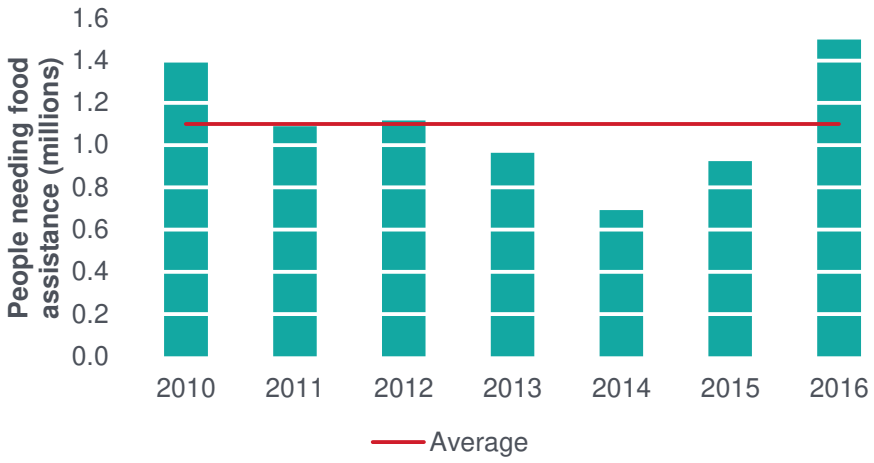
means that half of surveyed *kebeles* were experiencing drought conditions, with those at the extreme experiencing a once in 50-year drought.

Figure 7: 12-Month SPI distribution for surveyed *kebeles*, 2008-2016



Even by non-meteorological measures of drought, the 2015/2016 drought stands out as remarkable, with an estimated 1.5 million people requiring food assistance for Somali Regional State alone, just exceeding the previous high in 2010 at 1.4 million (see figure below).[42] Child malnutrition also reached record levels in Somali Regional State, with the 2015 levels of severe acute malnutrition being the highest ever reported in recent years, including the Horn of Africa crisis in 2011.[43]

Figure 8: Estimated food assistance needs for Somali regional state, 2010-2016

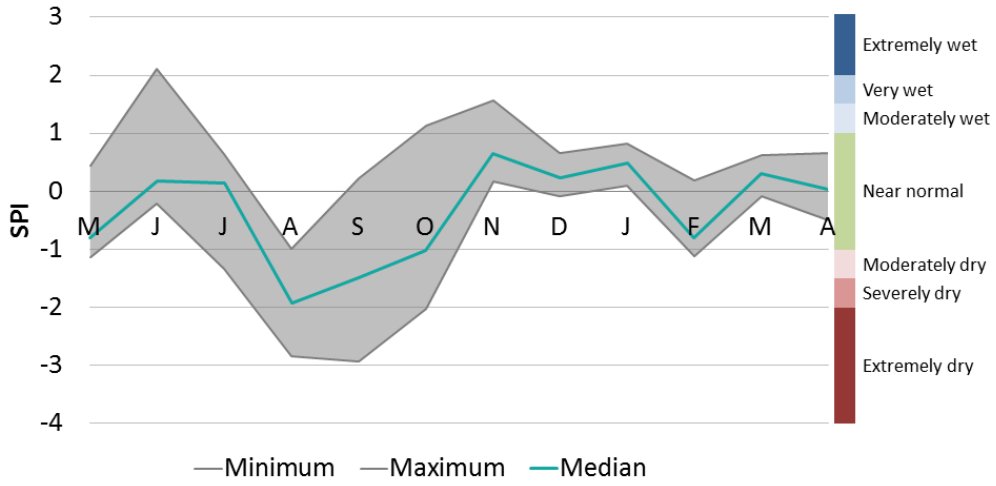


The subjective experience of this drought was qualitatively different as well, with a common refrain among FGD participants and KIIs being that this drought differed from previous ones in its complete lack of rain and long duration. This is corroborated by monthly SPI data that compares individual months with the historical record for that same month; in other words, for a given month (e.g. April 2016) the monthly SPI compares precipitation received at that location to what is "normal" for the month of April for that location. Using this

[42] Authors' calculations based on annual Ethiopian Humanitarian Requirements Documents
[43] Government of Ethiopia, Ethiopia Humanitarian Country Team. (2015)

relatively short time period illustrates how the drought evolved on a monthly basis over the 12 months prior to the data collection (see figure below).[44] Interestingly, for several months out of this 12-month period most surveyed *kebeles* were "near normal" and the range between the highest and lowest SPI was often relatively small (i.e. less than one unit), meaning relatively uniform conditions across surveyed *kebeles*. This all changed in August-October 2015 when the drought peaked according to this measure and more than half of surveyed *kebeles* experienced moderate dryness or worse. August in particular shows that nearly half of surveyed *kebeles* experienced an extreme event that should only occur every 50 years.

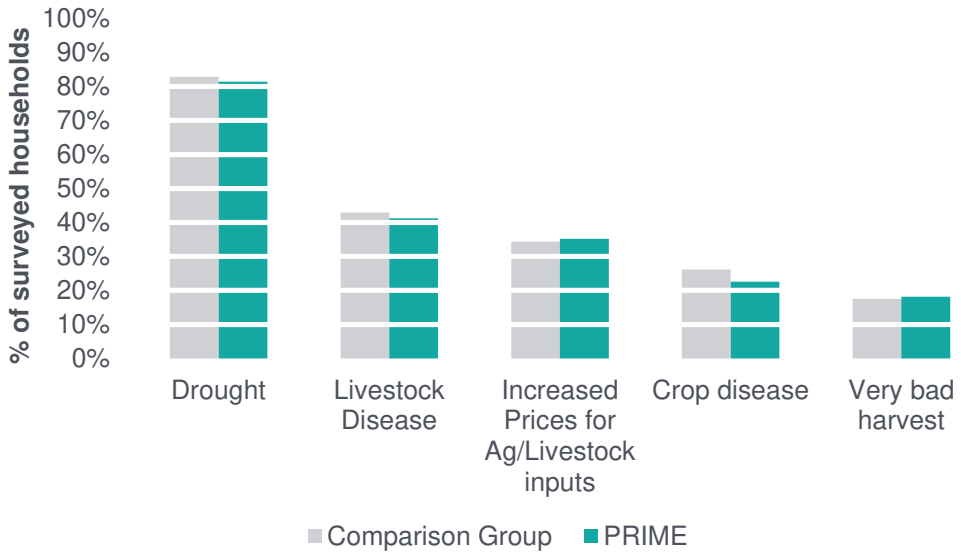
Figure 9: Monthly SPI for surveyed *kebeles* for 12 months preceding the survey (May 2015-April 2016)



Surveyed households were asked what shocks they had experienced in the 12 months prior to the study. This facilitates understanding of whether PRIME communities, relative to their matched counterparts, were better able to avoid or minimize exposure to drought or its downstream effects (livestock and crop disease, agricultural and livestock price shocks, poor harvest). The quantitative data generally does not show any evidence of this (see Figure 10 below) with households in PRIME communities and their matched counterparts reporting similar exposure to the various shocks.

[44] Note that this figure reports the 1-month SPI *not* the 12-month SPI used in estimation models. This provides a more comprehensible and "real time" visualization of the drought and is very similar to estimating the percentage of normal precipitation for a 30-day period.

Figure 10: Drought and downstream effects experienced



Shocks associated with violence, theft, conflict, or destruction of property were rarely reported, with less than five percent of the overall sample experiencing any of these types of shocks. There is some weak evidence that communities in PRIME areas may have been *more* likely to report some incidence of conflict. This could be due to the fact that project intervention areas may have better water access than the comparison areas and attract migrants from neighboring water-scarce communities, contributing to competition and conflict over resources. While data collected for this study cannot substantiate this claim, qualitative data collected by the PRIME project in May-June 2013 for a Climate Vulnerability and Capacity Analysis assessment found some evidence of conflict over water resources, particularly in this region.

Households deployed varied strategies in response to these various shocks mentioned above. A common response to crisis is to rely on social capital, or the relationships and networks available to a household that facilitate access to critical resources for maintaining lives and livelihoods. Research has shown that social capital is critical for resilience, but finite in its ability to support households and communities as the shock increases in duration or intensity.[45] Qualitative data from this study supports that claim as households and communities banded together to mitigate as much of the impact of the drought as they could, but the duration and intensity of the drought effectively depleted social capital stocks shared by the community.

> ***"The community shares natural resources, the community helps each other during times of need but the size of the drought and length it's lasting for has made it impossible for people to cope."***
>
> — Focus Group Discussion Participant

As these relations and informal social networks are depleted, households turn to alternative and increasingly severe coping mechanisms. Ideally, households living in PRIME communities would not need to resort to coping strategies, or at least avoid using particularly detrimental coping strategies with long-term implications for household wellbeing. Some common coping strategies used by all surveyed communities

[45] Frankenberger, T. (2016)

include selling livestock (especially at depressed prices), feeding livestock food meant for the household, atypical migration, and other, more detrimental or extreme coping strategies that involve selling off assets, taking children out of school or sending them to work.[46] For all but the most extreme coping strategies with long term implications for household wellbeing, PRIME and comparison communities deployed these coping strategies at similar rates. Households in PRIME communities were slightly more likely to use more extreme strategies, but because this simple comparison does not control for other relevant factors, this alone does not represent a causal relationship and the more sophisticated analysis presented in Table 3 below is required.

Figure 11: Coping strategies used in 12 months prior to survey

Table 3 below provides a more nuanced analysis of these indicators and shows that participation in PRIME had no bearing on what types of response options households used. In other words, when drought exposure and other demographic characteristics are controlled for, all households ostensibly relied on similar coping strategies to mitigate the drought effects.

Table 3: Estimated impact of PRIME on household response to drought

	Sold Livestock Below Market	Used household food for animals	Used Extreme Coping Strategies	Unusual Migration
Estimated impact of PRIME	0.970	0.793	1.496	0.706
Std. Error	(0.218)	(0.210)	(0.348)	(0.343)
n	521	1431	1519	1431
Adjusted R^2	0.028	0.023	0.017	0.022

[46] While migration is very common in pastoral societies, in this context migration of entire households is uncommon and is considered a very severe coping strategy.

Sean Sheridan for Mercy Corps

Household Wellbeing Outcomes

Given that most households across the study area in some way were affected by drought and the downstream effects, the question now becomes whether households from PRIME communities were somehow better able to maintain their wellbeing in the face of this shock. The impact of PRIME is evaluated across three categories of wellbeing measures: food security, economic status, and livestock health.

Food Security

Drought can directly reduce food availability through poor harvests and sick livestock, and possibly further reduce it through a vicious cycle of land conflict and insecurity. PRIME's interventions are theorized to help households maintain food access during shocks and stresses by facilitating access to resources for their livestock, enabling livelihood diversification, and providing access to financial services. To determine the impact of PRIME activities on household food security, three measures are used: household dietary diversity score (HDDS), the household food insecurity access scale (HFIAS) and the household hunger scale (HHS). Household dietary diversity is a proxy for food access and is highly correlated with adequate caloric and protein intake and household income.[47] The HFIAS is an experiential-based measure of food insecurity that assesses various levels of food insecurity by exploring anxiety about household food supply, quantity, quality, variety, and preferences. While this measure has the advantage of capturing a wide range of food

[47] Swindale, A. & Bilinsky P. (2006)

insecurity levels by incorporating less severe behaviors, it has limited cross-cultural comparability.[48] The HHS is specifically designed and tested for cross-cultural use and relies on the three most severe food insecurity experiences from the HFIAS. Using these three measures combined provides a more comprehensive picture of food insecurity than any individual indicator alone.

Households in PRIME communities were slightly less likely than their counterparts in the comparison group to be moderately or severely hungry, according to the HHS, and slightly more likely to have consumed a more diverse diet, according to the HDDS (see Figure 12 below). In this case, when drought exposure and other characteristics are controlled for, these differences in HHS disappear but the effects for HDDS persist. Table 4 below presents the multivariate regression results evaluating the impact of PRIME on food security outcomes.

Figure 12: Food security status by group

This analysis found that households in PRIME areas showed no differences in experiential indicators of food insecurity with comparison communities, suggesting that the subjective perception and experience of food insecurity was similar across both groups. Despite a similar experience of food insecurity, households in PRIME areas had greater dietary diversity relative to comparison households that experienced similar drought levels – averaging approximately 0.7 additional food categories per day. Considering the overall average number of food groups consumed is less than five per day for sampled households, this represents not only a statistically significant difference, but also one with substantial implications for household food security. These results warrant further scrutiny, since they could have been achieved by sacrificing resources intended for livestock, shedding household assets, or consuming less preferred or highly undesirable food. Using available economic, livestock and food-based coping strategy data, further analysis shows no evidence of these behaviors, implying a net positive impact on food security and household wellbeing.

[48] Ballard, T. Coates, J., Swindale, A. and Deitchler, M. (2011)

Table 4: Estimated impact of PRIME on food security outcomes

	HDDS	HFIAS	HHS
Estimated impact of PRIME	0.664*	0.189	-0.008
Std. Error	(0.260)	(0.139)	(0.066)
n	1497	1421	1511
Adjusted R^2	0.105	0.023	0.009

Economic Status

For populations that depend on agriculture and pastoralism for their livelihoods, drought can lead to economic insecurity and deprivation by reducing or cutting off their income sources. This can be expressed by reduced crop yields, depletion of assets through destocking, or sales of other household and productive assets. By reducing the drought's negative effects on herds and crops through, for example, improved water access and/or accessible veterinary care, PRIME aims to help families better maintain their assets, livelihoods and overall economic status.

Two measures of economic status were collected for this study: the Progress out of Poverty Index (PPI) and asset indices. The PPI is an index of ten questions selected from Ethiopia's national household income and expenditure survey that has a strong correlation with poverty and facilitates estimation of the likelihood that a household has expenditure below a given poverty line – in this application $1.25/day.[49] To assess household wealth, two measurement approaches were used in creating asset indices. The first, total asset value, is the simple sum of all assets owned multiplied by the median reported current values of those assets. The second relies on principal components analysis (PCA) to create weighted indices from the data by exploiting the underlying variation across indicators.[50] With this methodology, two indices emerged as explaining significant amounts of variation in the data: the first is comprised primarily of agricultural productivity assets and the second is comprised of household goods. Using both approaches of estimating asset indices provides a more comprehensive approximation of household wealth status.

Multivariate regression analysis showed generally positive results in this area, as households from PRIME communities were less likely to fall under the poverty line by 3.8 percentage points relative to the comparison group. While no differences between the groups were observed based on total asset value, PRIME households had more household assets relative to comparison households. However, they also had fewer agricultural productivity assets, suggesting that PRIME households are less likely than comparison households to be engaged in farming as an income source. Consultation with PRIME staff suggested that crop production in this area is a relatively recent practice compared to livestock production. Limited investment in agriculture could possibly be due to an increasing level of awareness among the PRIME

[49] Innovations for Poverty Action (2016)

[50] Using PCA, indices are created from a weighted combination of the individual assets such that each component is uncorrelated and the first component explains the largest possible amount of variation in the original data. One drawback of this approach is that it is inherently unit less and therefore difficult to interpret in "real world" terms, one is limited only to relative comparisons, in other words one can only say whether a group has more or fewer assets, but cannot provide any indication of number or monetary value of those assets. See Vyas, S. & Kumaranayake, L. (2006) for more detail.

communities of the vulnerability of different livelihood systems to increasing climate variability. Compared to crop production, livestock production tends to be better adapted to low and variable rainfall conditions.[51]

Qualitative data provides some additional evidence of trends in informed livelihood decision-making or diversification; with one positive deviant stating, "My livelihood comes from business, at the same time, I'm an agro-pastoralist, but most important for me is the business." This situation is not unique; most positive deviant households regarded by community members to be resilient and interviewed by field staff relied on some combination of livestock and/or crop production in addition to small business ownership or petty trade which was slightly less affected by drought than livestock or crop production. It was not completely unaffected however, as some positive deviants suggested that their customers had limited purchasing power due to their depressed incomes from sales of livestock/crop production.

Table 5: Estimated impact of PRIME on economic outcomes

	Poverty Likelihood ($1.25/day)	Total Asset Value (Log)	Agricultural Assets	Household Assets
Estimated impact of PRIME	-3.829***	0.148	-0.230*	0.370***
Std. Error	(1.059)	(0.097)	(0.109)	(0.108)
n	1487	1401	1519	1519
Adjusted R^2	0.492	0.053	0.049	0.165

Sean Sheridan for Mercy Corps

[51] Pantuliano, S., Wekesa, M. (2008)

Livestock Health

Supporting livestock production and management is central to the PRIME project and a key wellbeing outcome for this study. Herd size and composition is a strong indicator of economic status and wealth, and fluctuates naturally with births, deaths, and livestock management decisions regarding sales and acquisitions. Pastoralists are inclined to retain their animals during drought conditions. As drought conditions worsen, livestock health deteriorates, prices for livestock decreases and mortality rates increase. When pastoralists finally destock, they often try to protect their female cows of breeding age or just younger – these are the productive core of the herd, which could allow them to repopulate when conditions return to normal. PRIME activities work to support livestock health in times of stress through improving access to pasture and water, veterinary care, commercial destocking, and herd management practices that emphasize smaller, healthier herds.

For this study, livestock holdings, livestock sales, and livestock deaths are used to assess the impact of PRIME interventions on livestock health. Each of these indicators is reported in tropical livestock units (TLUs) to facilitate comparison across animal types. Sales and deaths are also disaggregated by small and large ruminants and breeding females.

Multivariate analysis presented in the table below shows that pastoralists in PRIME communities indeed had slightly smaller herds than the comparison group at the time of the survey.[52] Given that the changes in TLU over the 12 months preceding the survey were similar between the two groups (second column in table 6 below) this suggests that herd sizes in PRIME communities were likely smaller than the comparison group then as well, implying a relatively consistent characteristic. This is likely an indication that PRIME messaging around smaller, better-managed herds to improve overall livestock health is resonating with pastoralists in these communities. Moreover, while change in *total* TLU is similar between the two groups, pastoralists from PRIME communities appear more likely to have invested in or prioritized maintenance of cows and heifers, essential for maintaining the breeding capability of the herd. Further evidence supporting improved livestock management practices is presented below in the analysis regarding livestock mortality.

Table 6: Estimated impact of PRIME on livestock ownership

	Total Livestock Owned Currently (Log TLU)	Change in Total TLU of Livestock Over 12 Months (Level)	Change in TLU of Large Ruminants Over 12 Months (Level)	Change in TLU of Cows and Heifers Over 12 Months (Level)
Estimated impact of PRIME	-0.341*	0.877	0.764	0.840*
Std. Error	(0.130)	(1.413)	(0.593)	(0.323)
n	1519	1519	1519	1519
Adjusted R^2	0.068	0.050	0.031	0.034

Livestock sales, while traditionally not preferred by pastoralists, were common in the 12 months prior to data collection according to quantitative and qualitative data. Most distress livestock sales were reportedly at

[52] Note that this outcome indicator is log transformed to normalize the distribution of the data and the coefficient should be interpreted accordingly. See UCLA Statistical Consulting Group. (n.d.) for more details

below average prices among surveyed pastoralists. It appears that PRIME activities have had no effects on volume of sales of livestock, with pastoralists from PRIME areas selling the various types of livestock at similar volumes over the 12 months prior to the survey.

Table 7: Estimated impact of PRIME on livestock sales in last 12 months

	Total Livestock Sales 12 Months (Log TLU)	Small Ruminant Sales (Log TLU)	Large Ruminant Sales (Log TLU)	Cows and Heifers Sales (Log TLU)
Estimated impact of PRIME	0.007	0.004	-0.007	-0.015
Std. Error	(0.082)	(0.062)	(0.039)	(0.030)
n	1519	1519	1519	1519
Adjusted R^2	0.030	0.043	0.008	0.017

However, pastoralists from PRIME areas did have fewer deaths among every category of animals: the total herd, large ruminants, small ruminants, and breeding-age or near breeding-age cows. This diminished mortality rate suggests that the combination of veterinary care and improved pasture and water resources provided through PRIME allowed households to avoid losing weakened livestock. With better managed herds, pastoralists from PRIME areas may have been able to avoid the expensive process of restocking animals lost to sickness and hunger.

Significantly, PRIME households were better able to maintain their breeding stock. Both groups had a reduction in TLUs of breeding cows over the previous year, but it was smaller for the households in the project areas, meaning they directed resources and attention towards caring for their most important animals. This was also reflected in a lower mortality rate among the cows and heifers.

Table 8: Estimated impact of PRIME on livestock Mortality in last 12 months

	Total Livestock Deaths (Log TLU)	Small Ruminant Deaths (Log TLU)	Large Ruminant Deaths (Log TLU)	Cows/Heifers Deaths (Log TLU)
Estimated impact of PRIME	-0.317*	-0.284*	-0.199*	-0.189**
Std. Error	(0.131)	(0.117)	(0.0794)	(0.0682)
n	1519	1519	1519	1519
Adjusted R^2	0.076	0.106	0.041	0.048

Does PRIME Impact Vary by Drought Intensity?

As resilience has grown in popularity in the development and humanitarian space, there has been considerable investment in resilience measurement primarily focused on conceptual and theoretical questions, e.g. questions regarding “what matters for resilience.” These foundational analyses have been beneficial in refining resilience conceptually and understanding the dynamics and complexities based on real

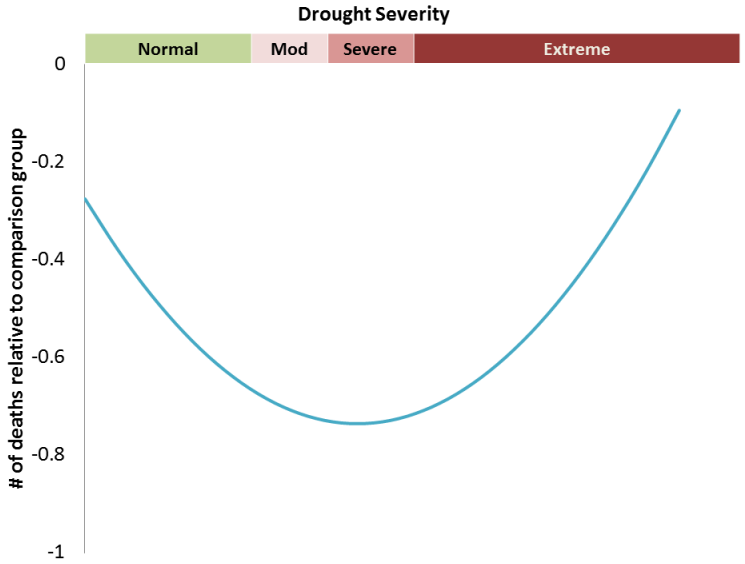
world data. As more interventions focused on enhancing resilience are funded, designed and implemented, however, resilience measurement efforts must expand beyond conceptual questions towards more evaluative questions, e.g. are programs building resilience? This section reports the results of one of Mercy Corps' preliminary attempts to address one of the many challenges to evaluating these programs through exploratory analysis on heterogeneous program impacts with respect to shock severity. Understanding whether and how program impacts may vary based on how intensely households were affected by the shock is an important question from both a methodological and a programming perspective. Methodologically, it is important in order to select the appropriate statistical model that accurately estimates the impact of the project. Programmatically, it is informative to build knowledge around which interventions vary by shock intensity, and how. This could influence program design decisions, including how to design interventions to support resilience to a moderate drought versus a severe drought.

The previous sections of this report took a conventional assumption that the impact of PRIME on wellbeing outcomes was constant across various levels of drought intensity. This assumption is tested by introducing additional terms to the basic linear model (see Figure 5 above) that interact treatment status with shock intensity (model 2a), and in the "full" model introduce a quadratic (i.e. squared) interaction term (model 2b). This implies a non-linear relationship between treatment impact and drought intensity. For example, the impact of certain livestock health interventions might not be evident under non-drought conditions and will only begin to manifest as a drought sets in. Moreover, if drought becomes *very* intense, there may be another threshold beyond which maintaining program impact on livestock health is nearly impossible. Figure 6 above visualizes this non-linear relationship. For the outcome indicators above that were found to have a statistically significant relationship with being exposed to PRIME interventions, additional statistical tests were conducted to determine whether a non-linear relationship might be present. A description of this test and the full results are available in Annex II.

For household dietary diversity, the basic linear model above showed that PRIME had a positive impact. Additional exploratory analysis on the nature of this relationship did not indicate any interaction or non-linear relationship by drought intensity (see Table 12). This suggests that PRIME activities support households to maintain dietary diversity in the face of drought, even at extremely intense levels of drought. A similar situation exists with respect to economic outcomes (i.e. poverty likelihood and asset ownership, Tables 13 and 14 respectively). For both sets of outcome indicators, the basic linear model is the best fit for the available data, with no evidence to suggest any interactions or non-linear relationships with drought intensity.

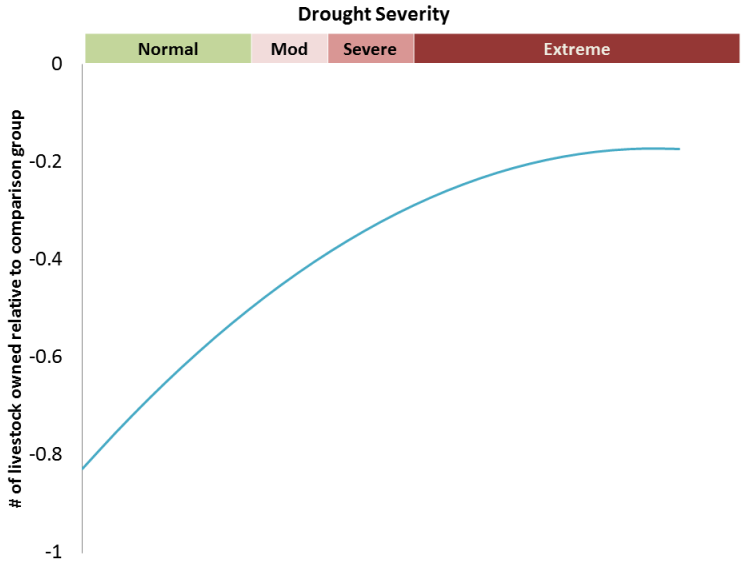
Exploratory analyses around livestock outcomes, however, suggest that project impact may be non-linear and modulated by shock intensity. This is presented in a stylized version below where the vertical axis represents the number of livestock deaths in PRIME areas relative to the comparison group (formal results available in Table 15). If the program is having an impact one would expect fewer livestock deaths than the comparison group, i.e. the difference between the groups should be larger (more negative as visualized below). The figure below shows that under "normal" conditions the difference between PRIME and the comparison group is smaller (i.e. closer to zero). As the drought intensity increases, a tipping point is reached which triggers increased project impact and data suggests that pastoralists from PRIME areas experience considerably fewer livestock deaths than their counterparts in the comparison group. Once the drought becomes very severe, a second tipping point is reached and PRIME benefits are no longer sufficient to maintain livestock health and the differences between PRIME and the comparison group again approach zero. At that second tipping point, ideally emergency assistance and safety net mechanisms are triggered to preserve these assets.

Figure 13: Demonstrated heterogeneity of PRIME impact on livestock deaths



Both alternative exploratory models (2a and 2b) were just barely rejected when evaluating PRIME impact on livestock ownership; acknowledging this, it is nevertheless informative to explore the implications of a non-linear relationship for this outcome. The figure below demonstrates that under "normal" conditions, PRIME pastoralists tend to have smaller herds, but as drought conditions increase in severity, this difference becomes smaller. One reason this may be is that non-PRIME pastoralists experience higher livestock mortality rates (as suggested above) or they are forced to sell larger portions of their herds both of which would bring their herd size closer to PRIME pastoralists.

Figure 14: Hypothesized heterogeneity of PRIME impact on livestock ownership



This data suggests that programs focusing on resilience may have heterogeneous impacts with respect to shock severity, a characteristic that is likely to vary by intervention and shock type. Understanding which interventions are modulated by shock intensity, the thresholds that trigger impact *and* the thresholds beyond

which impacts are diminished is critical to the design and management of programs focused on resilience. Building this evidence base requires the development of rigorous theoretical models that examine whether and how intervention impacts vary with shock intensity and link appropriate empirical analytical strategies to test the hypothesized relationships. Future impact evaluations of resilience-building programs must consider this in the study design.

PRIME Impact on Intermediate Outcomes

Given PRIME's apparent impact on improved key wellbeing outcomes described above, the natural next question focuses on understanding the mechanisms for these results. Answering this question, however, is exceedingly difficult in this instance for primarily two reasons. First, the program activities were tailored to the various *kebeles* and as such the "treatment" is extremely varied. Parsing out project impact of any one activity or even activity type poses a significant methodological challenge. Second, many of the PRIME activities focused on systems level change, such as improving the functioning of veterinary input supply markets, expanding services provided by formal financial institutions and providing timely and accurate weather and market information. Teasing out the impact of these types of interventions at the household level is challenging for a variety of reasons.

First, knowing which impacts to measure to capture these systems changes can be difficult as their household impact may be manifest in different ways, some easier to measure than others. Second, the diffuse impact of these systems over large population segments implies a high likelihood of spillover to comparison communities. Third, there are likely to be heterogeneous effects at the household level as some households may benefit more from certain PRIME activities while being relatively unaffected by others, making detecting impact for any single given household challenging in household surveys.

Acknowledging these challenges, additional secondary analyses on a set of three intermediate outcomes were conducted: use of financial services, access to information, and access to livestock resources. These intermediate outcomes were selected because they are theorized to result from multiple PRIME activities implemented in the study area with clear logical pathways that contribute to enhanced wellbeing outcomes during drought.

Recall that PRIME engages in several activities supporting access to financial services in the study area, including working with Somali MFI to expand coverage and services and supporting RUSACCOS and VSLAs (see PRIME project description above). In theory, increased use of savings and loans could enable people to buy food and support existing markets during a shock, thereby reducing the need for food assistance or engaging in more severe coping strategies. Household survey respondents were asked about four types of financial services, including credit, savings, insurance, and mobile banking. Use of financial services was generally low, with the exception of accessing loans; nearly half of all surveyed households had borrowed money. The savings culture is not strong in these areas and efforts to implement change are constrained by low institutional capacity to deliver innovative products like Sharia-compliant services.[53] Analysis for this study demonstrates no differences in use of any financial services between households from PRIME areas vis-à-vis the comparison group (Table 9 below). When analyzed by individual financial product (i.e. savings, loans, insurance and mobile banking), this finding of no significant differences persists.

[53] Mercy Corps (2015)

Table 9: Estimated PRIME impact on use of financial services

	Used any Financial Services
Estimated impact of PRIME	0.859
Std. Error	(0.164)
n	1519
Adjusted R^2	0.0285

PRIME also facilitates information flow through various activities, with two of the main topics being weather and livestock. The weather information is generally disseminated through participatory scenario planning activities, which connect households to weather and climate information as well as contingency plans in the event of climatic shocks. PRIME also links pastoralists to livestock health information by building community animal health workers' (CAHWs) capacities, and to market information by connecting pastoralists to large livestock traders in market centers to expand their capacity to buy livestock from more remote areas. By creating these linkages, pastoralists in PRIME areas in theory are better able to make informed decisions about herd management and livestock sales. Of these interventions focused on facilitating access to information, only access to livestock market information was demonstrably better for households from PRIME areas; no impact was detected for weather information or other livestock information regarding health and management. This finding may be evidence of spillover of PRIME activities to non-PRIME communities, particularly for weather information which is disseminated to communities in partnership with local and regional government representatives, who may in turn share similar information to other *kebeles* not directly supported by PRIME.

Table 10: Estimated PRIME impact on access to information

	HH Receives Info on Any Weather Topic	HH Receives Info on Any Livestock Topic	Received Livestock Market Info
Estimated impact of PRIME	1.208	1.216	1.885*
Std. Error	(0.237)	(0.319)	(0.582)
n	1519	1519	1519
Adjusted R^2	0.016	0.036	0.037

The third set of intermediate outcomes examined other livestock activities focused on managing soil and water resources, and improving access and availability of feed, fodder and animal health services. Through construction and rehabilitation of water points and establishment of rangeland enclosures, PRIME seeks to enable households to avoid atypical migration and support livestock health so animals are better able to survive droughts and continue to produce milk for household consumption and sales. PRIME also supports pastoralists through facilitation of animal health services provision by training private veterinary pharmacists, linking them to suppliers and expanding their coverage to more remote areas. Survey respondents were asked whether any improved water/pastureland was available and whether they had accessed any of these

resources or veterinary services. Like most of the other intermediate outcomes above, no differences were detected between households living in PRIME areas and those not targeted by the project.

Table 11: Estimated PRIME impact on livestock resources

	Livestock Resources Improved	Accessed Livestock Resources
Estimated impact of PRIME	0.887	1.167
Std. Error	(0.207)	(0.301)
n	1519	1519
Adjusted R^2	0.022	0.026

These limited findings on intermediate program outcomes, while seemingly inconsistent with the positive effects on household wellbeing, should not be given undue emphasis. This study was designed and powered for a focus on higher-level wellbeing outcomes and not evidence of systemic changes, which is arguably more difficult to detect. This highlights the challenges in evaluating programs using facilitative approaches to achieve systemic change that has significant spillover impacts, which are increasingly common to development programs incorporating a resilience focus. These challenges can be addressed in part by integrating evaluation design into program design and using varied evaluation approaches that are better suited to measuring systemic change.

Conclusions

This study begins to fill a critical evidence gap of what types of interventions work to enhance resilience to severe drought, and whether resilience-building interventions can mitigate the worst effects of humanitarian emergencies and preserve development gains. Using quasi-experimental methods, the impact of the PRIME project on household resilience was evaluated in four extremely drought affected *woredas* in Ethiopia's Somali Regional State. Overall, results show positive impact on important household wellbeing outcomes. Households in PRIME communities consumed a more diverse diet. They also had improved economic outcomes such as being less likely to be impoverished and having greater access to household assets than the comparison group. Positive effects were also observed with respect to livestock ownership and management, with PRIME pastoralists having smaller, healthier, and more productive herds. These overall positive food security, economic, and livestock management outcomes are particularly remarkable given the sheer intensity of drought these *kebeles* faced in 2015. In this context, these results provide particularly ***strong evidence that a multi-year, integrated, and flexibly funded projects like PRIME can effectively enhance household resilience to shocks like drought.***

Despite this compelling finding, questions remain for further research. This study finds some evidence that suggests there may be complex, non-linear interactions between project impact and shock severity. Depending on the intervention and shock type, project impact may be negligible at low severity and overwhelmed completely at high severity. ***Understanding how project impact varies with shock intensity will be a critical methodological and programmatic question as impact evaluations of resilience-building programs increase in number.***

Another area for further exploration is unpacking the mechanisms that have enabled PRIME households to have better wellbeing outcomes than comparison households when confronted by a severe drought. The assumption is that it is both necessary *and* sufficient for programs focused on supporting resilience to be multi-sectoral and integrated. This study addresses whether or not PRIME was sufficient (i.e. effective) at enabling households to better manage drought, but fell short of demonstrating the necessity of any one activity or set of activities. ***Impact evaluations focusing on sufficiency of resilience-building programs fill an important gap in the short term. In the near future, this emphasis must expand to evaluations of the relative value of components or combinations of components to building resilience***.

Recommendations

This study has demonstrated that investing in innovative, long-term resilience interventions, like PRIME, can help mitigate the worst effects of humanitarian emergencies and protect development gains in vulnerable communities. The results lend support to the efficacy of multi-year, multi-sectoral approaches aimed at strengthening systems (markets, ecological, livelihood) that enable households and communities to respond and adapt to the major shocks and stressors they face. Therefore it is recommended that donors, governments and development agencies:

- **Increase investments in strengthening resilience in contexts experiencing recurrent crises.** Specifically, expand the amount of multi-year, flexible funding that enables programs to pursue long-term development goals in and be responsive to meeting emergency needs. The US government should increase funding for key accounts that fund resilience programming, including Development Assistance, Economic Support Funds, and Food for Peace non-emergency accounts, while maintaining essential funding in lifesaving humanitarian accounts.

- **Provide greater support to "systems approaches", and end "siloed" single sector approaches.** Increase investment in changes in the market, ecological, and governance systems that underpin people's ability to effectively manage shocks and stresses like drought.
- **Dedicate sufficient time and technical and financial resources to effectively evaluate complex resilience-building programs.** As part of this, design and implement multi-sectoral programs to enable greater understanding of if/how specific components are contributing to resilience by integrate evaluation into program design and use varied methods suited to measuring systemic change. Ensure both the methodological innovations and evidence generated influence future resilience investments.

References

Angrist, J. and Pischke, JS. (2009) *Mostly Harmless Econometrics*. New Jersey: Princeton University Press

Ballard, T. Coates, J., Swindale, A. and Deitchler, M. (2011) *Household Hunger Scale: Indicator Definition and Measurement Guide*. Retrieved from: http://www.fantaproject.org/sites/default/files/resources/HHS-Indicator-Guide-Aug2011.pdf

Catley, A., Aklilu, Y., and Admassu, B. (2007) Introduction: Livelihoods-based relief interventions in pastoralist areas of Ethiopia. In A. Catley (Ed.), *Impact Assessments of Livelihoods-based Drought Interventions in Moyale and Dire Woredas.* Tufts University: Feinstein International Center

Climate Prediction Center, National Centers for Environmental Prediction, National Weather Service, and the International Research Institute for Climate and Society (2016, September 8). *El Niño/Southern Oscillation (ENSO) Diagnostic Discussion*. Retrieved from: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory/ensodisc.shtml

Ethiopia Humanitarian Country Team (2015) Ethiopia: Slow Onset Natural Disaster. Retrieved from: http://reliefweb.int/sites/reliefweb.int/files/resources/eth_el_nino_v2.pdf

FEWSNET (2015) *Food Security Outlook October 2015 to March 2016.* Retrieved from: http://www.fews.net/east-africa/ethiopia/food-security-outlook/october-2015

FEWSNET (2015, December 4) *Food security emergency in central/eastern Ethiopia follows worst drought in more than 50 years.* Retrieved from: http://www.fews.net/east-africa/ethiopia/alert/december-4-2015?utm_source=FEWS+NET+Daily+Digest&utm_campaign=1ea48478af-Ethiopia_Alert12_4_2015&utm_medium=email&utm_term=0_02ee344349-1ea48478af-84428741

FEWSNET (2015, December 17) *Illustrating the extent and severity of the 2015 drought.* Retrieved from: http://www.fews.net/east-africa/ethiopia/special-report/december-17-2015

FEWSNET (2016 January) *Key Message Update: Significant humanitarian needs continue in central and eastern Ethiopia.* Retrieved from: http://www.fews.net/east-africa/ethiopia/food-security-outlook-update/january-2016

Frankenberger, T. (2012, August 2). Evidence for resilience programming: Bouncing out of the cycle of crisis [Web log comment]. Retrieved from: https://agrilinks.org/blog/evidence-resilience-programming-bouncing-out-cycle-crisis-0

Frankenberger, T., Kurtz, J. and Sagara, B. (2015) Mercy Corps' Approach to Measuring Resilience: Discussion Paper #2. Retrieved from: http://resiliencehubs-mercycorps.org/wp-content/uploads/2016/04/Mercy-Corps-Approach-to-Measuring-Resilience_2015.pdf

Frankenberger, T. (2016). *The Impact of Social Capital on Managing Shocks to Achieve Resilience: Evidence from Ethiopia, Kenya, Uganda, Niger and Burkina Faso* [PowerPoint Slides]. Retrieved from:

http://www.fsnnetwork.org/sites/default/files/The%20Impact%20of%20Social%20Capital%20on%20Managing%20Shocks%20to%20Achieve%20Resilience.pdf

Government of Ethiopia, Ethiopia Humanitarian Country Team. (2015). Ethiopia Humanitarian Requirements Document 2016. Retrieved from: http://reliefweb.int/sites/reliefweb.int/files/resources/ethiopia_hrd_2016.pdf

Hayes, M., Svoboda, M., Wall, N., & Widhalm, M. (2011). The Lincoln Declaration on drought indices: Universal meteorological drought index recommended. Bulletin of the American Meteorological Society, 92(4), 485–488. https://doi.org/10.1175/2010BAMS3103.1

Headey, D., & Kennedy, A. (Eds.). (2012). Proceedings from: *Enhancing Resilience in the Horn of Africa: Synthesis of an Evidence-Based Workshop*. 13-14 December 2011, Washington DC. Retrieved from: http://cdm15738.contentdm.oclc.org/utils/getfile/collection/p15738coll2/id/127078/filename/127289.pdf

Headey, D., Taffesse, A., & You, L., (2012). Enhancing Resilience in the Horn of Africa: An Exploration into Alternative Investment Options. IFPRI Discussion Paper 01176. Retrieved from: http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/126902

Imbens, G. and Wooldridge, J. (2007) Estimation of Average Treatment Effects Under Unconfoundedness [Lecture Notes] Retrieved from: www.nber.org/WNE/lect_1_match_fig.pdf

Innovations for Poverty Action (2016) PPI Construction. Retrieved from: http://www.progressoutofpoverty.org/ppi-construction

Kleiman, S. (2013). Lessons for Effective Resilience Programs: A Case Study of the RAIN Program in Ethiopia. Retrieved from: https://d2zyf8ayvg1369.cloudfront.net/sites/default/files/RAIN%20Full%20Learning%20Study.pdf

McKee, T.B., N.J. Doesken and J. Kleist. (1993). The relationship of drought frequency and duration to time scale. *In: Proceedings of the Eighth Conference on Applied Climatology*, Anaheim, California, 17–22 January 1993. Boston, American Meteorological Society, 179–184.

Mercy Corps (2015) Financial Services Learning Brief. Retrieved from: https://prime-ethiopia.org/resources/briefs/

National Oceanic and Atmospheric Administration. (2015, October 15). *Strong El Niño sets the stage for the 2015-2016 winter weather*. Retrieved from: http://www.noaanews.noaa.gov/stories2015/101515-noaa-strong-el-nino-sets-the-stage-for-2015-2016-winter-weather.html

OCHA. (2016, February 1) *Weekly Humanitarian Bulletin: Ethiopia*. Retrieved from: http://reliefweb.int/report/ethiopia/ethiopia-weekly-humanitarian-bulletin-1-february-2016.pdf

Pantuliano, S. & Wekesa, M. (2008) Improving drought response in pastoral areas of Ethiopia. Somali and Afar Regions and Borena Zone of Oromiya Region. London: Overseas Development Institute.

Retrieved from: http://www.fao.org/fileadmin/user_upload/drought/docs/HPG%20Drought%20Response.pdf

Singh, R. Worku, M., Bogale, S., Cullis, A., Adem, A., Irwin, B., Lim, S., Bosi, L., Venton, C., (2016) Reality of Resilience: Perspectives of the 2015-2016 drought in Ethiopia. *Resilience Intel Issue No. 6.* London: BRACED. Retrieved from: http://www.braced.org/resources/i/?id=18256c98-2a10-4586-9317-17a68b45c1a7

Swindale, A. and Bilinsky, P. (2006). Household Dietary Diversity Score (HDDS) for Measurement of Household Food Access: Indicator Guide (v.2). Retrieved from: http://www.fantaproject.org/sites/default/files/resources/HDDS_v2_Sep06_0.pdf

UCLA Statistical Consulting Group. (n.d.) FAQ: How do I interpret a regression model when some variables are log transformed? Retrieved from: http://www.ats.ucla.edu/stat/mult_pkg/faq/general/log_transformed_regression.htm

Viste, E., Korecha, D., Sorteberg, A. (2012) Recent Drought and Precipitation Tendencies in Ethiopia. *Theoretical and Applied Climatology,* 122(3). Retrieved from: https://www.researchgate.net/publication/240909629_Recent_drought_and_precipitation_tendencies_in_Ethiopia

Vyas, S. & Kumaranayake, L. (2006). *Constructing Socio-economic Status Indices: How to Use Principal Components Analysis*. Retrieved from: http://heapol.oxfordjournals.org/

World Meteorological Organization. (2012). *Standardized Precipitation Index User Guide.* Retrieved from: http://www.wamis.org/agm/pubs/SPI/WMO_1090_EN.pdf

Annex I: Propensity Score Matching Results

Since treatment was not randomly assigned, there is concern of selection bias between the treatment and comparison group that will yield an inaccurate estimation of the impact of PRIME. For example, the treatment group may have been selected because it was more vulnerable and marginalized, or the comparison *kebeles* may have been excluded because they were too difficult to work in. These and other differences would make any distinctions in outcomes between the treatment and comparison group misleading. To account for this, the comparison group was limited to households similar to treatment households using propensity-score matching. First, each household's likelihood of benefitting from PRIME's activities was estimated based on the characteristics listed below. Other variables were tested, but dropped due to multi-collinearity with treatment assignment or high covariation (> 0.6) with other predictors.

Predictors Used:

- Household demographics
  - Gender of head of household (HOH)
  - Age of HOH
  - Any education for HOH (binary)
  - # of children attending school
  - Household size
  - Ratio of dependents to household size
- Use of financial services
  - Had formal loans 3 years ago
  - Received money transfers 3 years ago
  - Had informal loans 3 years ago
  - Had formal savings 3 years ago
- Income sources: binary for each of the following sources of income 3 years ago:
  - Farming
  - Livestock
  - Wage labor
  - Sales
- Affected by shocks/stresses: binary for feeling that income was threatened by the following 3 years ago:
  - Not enough water
  - Limited pasture access
  - High price of inputs
  - Low sales price of products
  - Conflict
  - Underemployment

At the community level:

- Number of environmental shocks/stresses 3 years ago
- Number of conflict shocks/stresses 3 years ago
- Number of economic shocks/stresses 3 years ago
- Share of community with cell phones 3 years ago

Weighting:

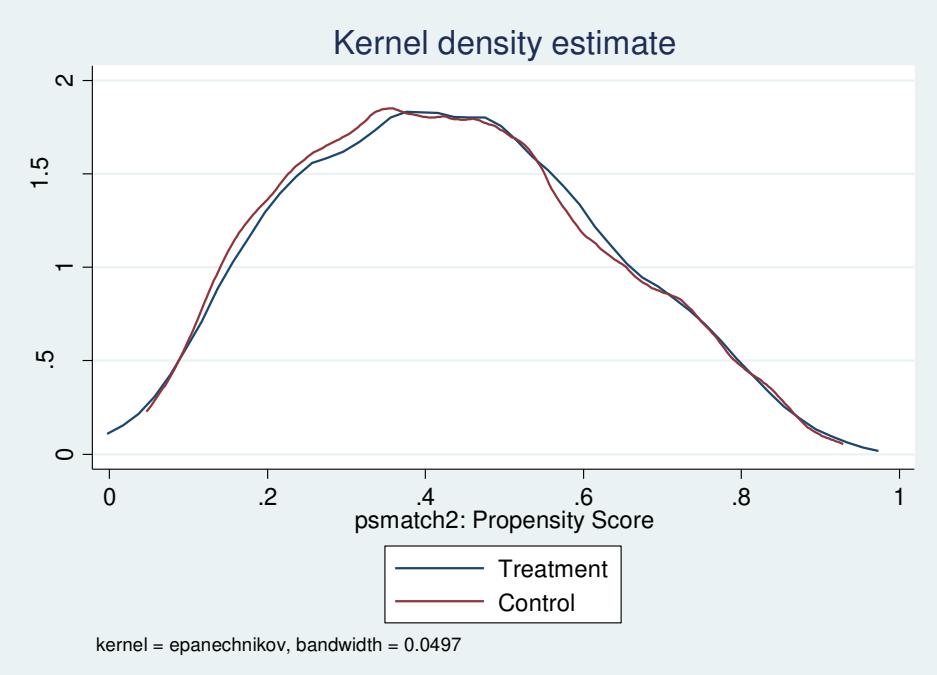
Once the propensity score was estimated, the Average Treatment Effect (ATE) weights were computed, which place a heavier emphasis on households who were just as likely to receive or not receive program activities. Where:

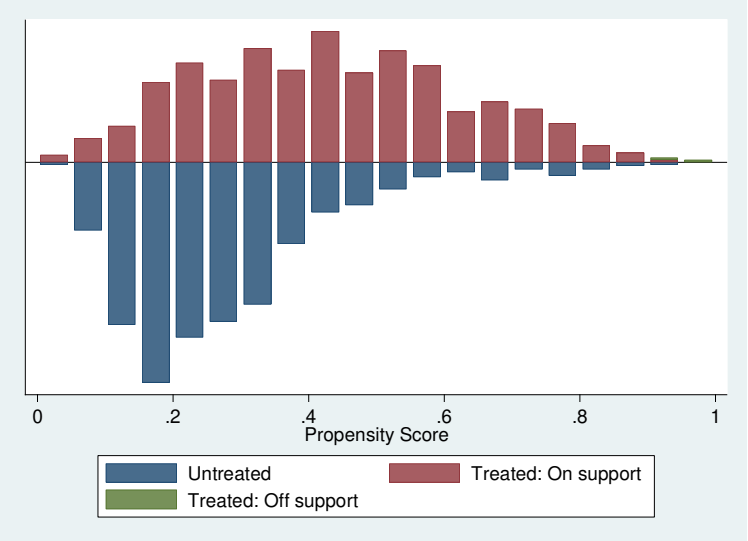
$$ATE\ weight_{treatment} = \frac{1}{Propensity\ Score}$$

$$ATE\ weight_{comparison} = \frac{1}{1 - Propensity\ Score}$$

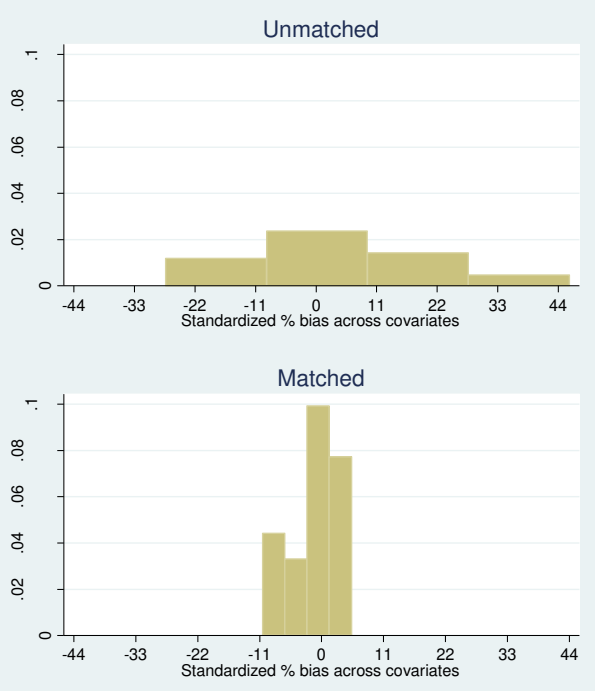
The final weighting scheme for the regressions were the product of the sample probability weight and the ATE weight listed above.

Overlap between Treatment and Comparison: The first graph for each context shows the overlap of the predicted likelihood to receive treatment (propensity-score) among treatment and comparison, after weighting. The second graph shows the proportion of treatment households, which were matched with a comparison household ("Untreated") that had a similar propensity-score. Matched households are "On Support", while unmatched households that had no equivalent comparison household are "Off Support". 494 treatment observations are on support, and two Treatment observations are off support. All 1,023 comparison observations are on support.





Bias Reduction: The graph below shows the estimated bias reduction before and after matching. Following the graph is the set of balance tests for all treatment predictors before and after matching, which shows that none of the predictors are unbalanced between treatment and control after matching.



		Treated	Control	%bias	% bias reduction	p
Sex of household head	Unmatched	0.71	0.78	-17.3		0.001
	Matched	0.71	0.70	2.2	87.4	0.744
Age of household head	Unmatched	40.97	44.65	-27.3		0.000
	Matched	41.01	41.20	-1.4	94.9	0.819
Household size	Unmatched	5.86	5.98	-4.6		0.394
	Matched	5.86	5.88	-0.7	84.3	0.908
Dependency ratio	Unmatched	0.56	0.53	12.4		0.024
	Matched	0.56	0.57	-1.9	84.9	0.764
Any education for household head (binary)	Unmatched	0.26	0.14	30.6		0.000
	Matched	0.26	0.27	-2.8	90.9	0.695
Had formal loans 3 years ago	Unmatched	0.02	0.00	14.9		0.002
	Matched	0.02	0.01	5.3	64.5	0.461
Received money transfers 3 years ago	Unmatched	0.08	0.06	7.9		0.139
	Matched	0.08	0.08	-0.7	90.6	0.914
Had informal loans 3 years ago	Unmatched	0.20	0.23	-5.4		0.327
	Matched	0.20	0.19	2.7	49.7	0.661
Had formal savings 3 years ago	Unmatched	0.07	0.04	11.8		0.026
	Matched	0.07	0.06	2.6	77.7	0.697
Farming livelihood	Unmatched	0.38	0.44	-11.4		0.039
	Matched	0.38	0.39	-2	82.4	0.752
Livestock livelihood	Unmatched	0.52	0.52	0.2		0.964
	Matched	0.52	0.56	-8.4	-3316.6	0.188
Wage labor livelihood	Unmatched	0.19	0.16	7.7		0.157
	Matched	0.19	0.22	-7.4	2.7	0.269
Sales livelihood	Unmatched	0.32	0.20	26.6		0.000
	Matched	0.32	0.32	0.1	99.8	0.994
Affected by shocks/stresses 3 years ago: Not enough water	Unmatched	0.31	0.36	-11.3		0.041
	Matched	0.31	0.35	-8.7	23	0.171
Affected by shocks/stresses 3 years ago: Limited pasture access	Unmatched	0.27	0.27	-0.2		0.976
	Matched	0.27	0.28	-3.9	-2257.9	0.543
Affected by shocks/stresses 3 years ago: High price of inputs	Unmatched	0.06	0.07	-2.5		0.656
	Matched	0.06	0.06	-1	57.7	0.869
Affected by shocks/stresses 3 years ago: Low sales price of products	Unmatched	0.15	0.15	-0.9		0.867
	Matched	0.15	0.14	1.5	-63.2	0.811
Affected by shocks/stresses 3 years ago: Conflict	Unmatched	0.01	0.03	-8.1		0.157
	Matched	0.01	0.01	1.7	79.7	0.750
Affected by shocks/stresses 3 years ago: Underemployment	Unmatched	0.09	0.05	15.8		0.002
	Matched	0.09	0.09	-1.1	93	0.876
Number of environmental shocks/stresses 3 years ago	Unmatched	1.70	2.06	-26.6		0.000
	Matched	1.70	1.77	-5	81.1	0.422
Number of conflict shocks/stresses 3 years ago	Unmatched	0.46	0.15	46		0.000
	Matched	0.46	0.48	-2.3	95	0.765
Number of economic shocks/stresses 3 years ago	Unmatched	1.99	1.89	12		0.035
	Matched	1.99	2.08	-10.5	13	0.125
Share of community with cell phones 3 years ago	Unmatched	1.88	1.90	-0.8		0.878
	Matched	1.88	1.81	4	-371.5	0.517

Annex II: Exploratory Analyses

Determining whether a more complex (full) model (e.g. model 2a and 2b in this paper) contributes additional information than a parsimonious model (Model 1a in this paper) relies on comparing the residual sums of squares (RSS) for the full and the parsimonious model. If the predicted deviations from the actual data are substantially larger under the parsimonious model vis-a-vis the full model, than the full model fits the data better and, by extension more appropriately represents the underlying relationship. For the nested models used in this paper, the F-test is an appropriate means of determining which model fits the data best.[54] The tables below present the full results of the F-tests and narrative summarizing these results is in the "Does PRIME Impact Vary by Drought Intensity" section above.

Table 12: F-test results for HDDS nested models

	HDDS		
	(1)	(2)	(3)
PRIME Impact	0.664*	0.273	-0.096
	(-0.26)	(0.393)	(-0.552)
PRIME × Shock		0.300	0.558
		(0.212)	(-0.924)
Squared Interaction			-0.064
			(-0.26)
Observations	1497	1497	1497
Adjusted R^2	0.105	0.109	0.112
F	13.730	2.010	0.950
Pr > F	0.000***	0.161	0.393

Standard errors in parentheses

Table 13: F-test results for PPI nested models

	Poverty Likelihood ($1.25/day)		
	(1)	(2)	(3)
PRIME Impact	-3.829***	-4.438**	-1.377
	(-1.059)	(1.419)	(-1.742)
PRIME × Shock		0.467	-8.576
		(1.247)	(-4.308)
Squared Interaction			2.899*
			(-1.414)
Observations	1487	1487	1487
Adjusted R^2	0.492	0.492	0.495
F	117.370	0.140	2.180
Pr > F	0.000***	0.709	0.120

Standard errors in parentheses

[54] Nested models are two or more models that are comprised of the same basic terms and the parsimonious model may be obtained from the full model by setting some parameters to zero so they effectively drop the term

Table 14: F-test results for asset index nested models

	Asset Factor 1: Agricultural Equipment			Asset Factor 2: Household Assets		
	(1)	(2)	(3)	(4)	(5)	(6)
PRIME Impact	-0.230*	-0.351	-0.354	0.370***	0.412*	0.366
	(-0.109)	(0.186)	(-0.219)	(-0.108)	(0.164)	(-0.187)
PRIME × Shock		0.093	0.443		-0.032	0.312
		(0.089)	(-0.420)		(0.070)	(-0.371)
Squared Interaction			-0.120			-0.115
			(-0.131)			(-0.113)
Observations	1519	1519	1519	1519	1519	1519
Adjusted R^2	0.049	0.051	0.06	0.165	0.165	0.17
F	7.830	1.110	1.070	14.840	0.210	0.720
Pr > F	0.000***	0.295	0.347	0.000***	0.648	0.489

Standard errors in parentheses

Table 15: F-tests results for log livestock death (TLUs) nested models

	Total TLU of Livestock Died 12 Months (Log)		
	(1)	(2)	(3)
PRIME Impact	-0.317*	-0.219	-0.275
	(-0.131)	(0.228)	(-0.267)
PRIME × Shock		-0.0758	-0.558
		(0.116)	(-0.377)
Squared Interaction			0.169
			(-0.115)
Observations	1519	1519	1519
Adjusted R^2	0.076	0.076	0.093
F	7.850	0.420	7.780
Pr > F	0.000***	0.517	0.001**

Standard errors in parentheses

Table 16: F-tests results for log livestock ownership (TLUs) nested models

	Total TLU of Livestock Owned Currently (Log)		
	(1)	(2)	(3)
PRIME Impact	-0.341*	-0.561**	-0.828**
	(-0.13)	(0.211)	(-0.272)
PRIME × Shock		0.170	0.380
		(0.0928)	(-0.375)
Squared Interaction			-0.055
			(-0.112)
Observations	1519	1519	1519
Adjusted R^2	0.068	0.073	0.08
F	7.170	3.340	2.430
Pr > F	0.000***	0.072	0.095

Standard errors in parentheses

CONTACT

Michael Jacobs
Chief of Party | PRIME Project
mjacobs@mercycorps.org

Brad Sagara
Research & Learning Manager | Research & Learning
bsagara@mercycorps.org

About Mercy Corps

Mercy Corps is a leading global organization powered by the belief that a better world is possible. In disaster, in hardship, in more than 40 countries around the world, we partner to put bold solutions into action — helping people triumph over adversity and build stronger communities from within. Now, and for the future.

MERCY CORPS

45 SW Ankeny Street
Portland, Oregon 97204
888.842.0842
mercycorps.org