Public Disclosure Authorized

Public Disclosure Authorized

WPS7716

Policy Research Working Paper 7716

Early Warning, Early Action

The Use of Predictive Tools in Drought Response through Ethiopia's Productive Safety Net Programme

Mareile Drechsler
Wolter Soer

WORLD BANK GROUP
Finance and Markets Global Practice Group
June 2016

Policy Research Working Paper 7716

Abstract

This paper investigates the use of early warning tools as part of Ethiopia's Disaster Risk Management framework. Analyzing, in particular, the Livelihoods, Early Assessment and Protection tool, Livelihood Integrated Assessment and Hotspots Assessments, the paper delineates the scope and objectives of existing early warning tools, their commonalities and limitations. From a disaster risk financing and insurance perspective, the paper investigates possible enhancements in the existing early warning framework and its use that could facilitate greater timeliness of drought response. The paper argues that based on the existing early warning instruments and continued improvements to the early warning systems, it is possible to enable early action during the onset of a drought.

This paper is a product of the Disaster Risk Financing and Insurance Program (DRFIP), a partnership of the World Bank's Finance and Markets Global Practice Group and the Global Facility for Disaster Reduction and Recovery, with funding from the UK Department for International Development. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The authors may be contacted at mdrechsler@worldbank.org and wsoer@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Produced by the Research Support Team

Early Warning, Early Action: The Use of Predictive Tools in Drought Response through Ethiopia's Productive Safety Net Programme

Mareile Drechsler[1] and Wolter Soer[2]

JEL codes: H84 Disaster Aid, Q54 Climate, Natural Disasters and Their Management, Global Warming, I38 Government Policy, Provision and Effects of Welfare Programs

Keywords: Early Warning, Disaster Risk Management, Disaster Risk Financing and Insurance, Productive Safety Net Programme, Shocks and Vulnerability to Poverty

---

This paper is a product of the Disaster Risk Financing and Insurance Program (DRFIP), a partnership of the World Bank's Finance and Markets Global Practice Group and the Global Facility for Disaster Reduction and Recovery, with funding from the UK Department for International Development. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org.

Many thanks, first and foremost, to Ato Tadesse Bekele, Engida Mena and Zinet Ahmet at the National Disaster Risk Management Commission (NDRMC) for their support of this project. Thanks also to John Aylieff, Samir Wanmali, Alemtsehai Alemu and Ezgimelese Tecleab at the World Food Programme (WFP) for their cooperation, provision of data and instructive comments. Stephen Anderson and Mark Lawrence at the Food Economy Group (FEG) provided helpful background information regarding the HEA methodology and LIAS tool. Many thanks are also due to Zerihun Mekuria at FEWS NET, who shared LIAS data used in this analysis and provided key background information on the sources and uses of LIAS data. Catherine Porter (Heriot-Watt University) conducted economic analyses and simulations of indicative drought-related poverty used in this paper. Background data and information were provided by Kelly Johnson, Segen Tewelde, Adeyabeba Mitiku Beyene, Elizabeth Farmer and Laura Campbell. Many thanks to Daniel Clarke and Ruth Hill, who have been very generous with their time and greatly helped in shaping this paper through many instructive discussions. Finally, many thanks to Richard Choularton (WFP) and Sarah Coll-Black (World Bank) for the provision of peer reviewer comments.

[1] Finance and Markets Global Practice, World Bank Group, Washington DC, USA.
E-mail: mdrechsler@worldbank.org.
[2] Social Protection and Labor Global Practice, World Bank Group, Washington DC, USA.
E-mail: wsoer@worldbank.org.

Table of Contents

Acronyms

BPR	Business Process Re-engineering
DP	Development Partner
DPPA	Disaster Prevention and Preparedness Agency
DPPC	Disaster Prevention and Preparedness Commission
DRM	Disaster Risk Management
DRMFSS	Disaster Risk Management and Food Security Sector
DRM SPIF	Disaster Risk Management Strategic Programme and Investment Framework
DRMTWG	Disaster Risk Management Technical Working Group
EWRD	Early Warning Response Directorate
EWS	Early Warning System
FCB	Federal Contingency Budget
FDRE	Federal Democratic Republic of Ethiopia
FEG	Food Economy Group
FEWS NET	Famine Early Warning Systems Network
FSCB	Food Security Coordination Bureau
FSCD	Food Security Coordination Directorate
GoE	Government of Ethiopia
GTP	Growth and Transformation Plan
HEA	Household Economy Approach
HEP	Health Extension Program
HICES	Household Income and Expenditure Survey
HRD	Humanitarian Response Document
IFPRI	International Food Policy Research Institute
LEAP	Livelihoods, Early Assessment and Protection
LIAS	Livelihood Impact Assessment Sheet
LIU	Livelihood Integration Unit
MoANR	Ministry of Agriculture and Natural Resources (former Ministry of Agriculture and Rural Development (MoARD))

MoFEC	Ministry of Finance and Economic Cooperation (former Ministry of Finance and Economic Development (MoFED))
NDRMC	National Disaster Risk Management Commission
NGO	Non-Governmental Organization
NMA	Ethiopia's National Meteorological Agency
NPDPM	National Policy on Disaster Prevention and Management (1993)
NPDRM	National Policy and Strategy on Disaster Risk Management (2013)
PAD	Project Appraisal Document
PIM	Project Implementation Manual
PSNP	Productive Safety Net Programme
RFM	Risk Financing Mechanism
SNNPR	Southern Nations, Nationalities and Peoples' Region
TLU	Tropical Livestock Units
TSF	Targeted Supplementary Feeding
UN	United Nations
WFP	World Food Programme
WMS	Welfare Monitoring Survey
WRSI	Water Requirement Satisfaction Index

I. Introduction

Ethiopia is frequently and severely affected by drought, with 70%[1] of the Ethiopian population at risk of disasters and climatic variability. This is epitomized by the 2011 drought in the Horn of Africa, which affected more than 12 million[2] people across Ethiopia, Somalia, Djibouti and Kenya. Droughts are associated with high economic costs, reducing Ethiopia's GDP by 1% to 4% in major event years[3], causing a drag on economic growth and slackening the speed with which the poor can be lifted out of poverty. Today, approximately 42%[4] of GDP is generated through agricultural production and 85%[5] of the population is employed in the sector, resulting in the vulnerability of many Ethiopians to hydro-meteorological hazards such as drought. Severe droughts occurring every three to five years cause crop loss and the starvation of livestock, leading to food insecurity among the affected population and jeopardizing the lives and livelihoods of many Ethiopians. Since 2000, approximately 6.2 million people have been affected by climatological hazards every year[6], leading to the issuance of humanitarian appeals for assistance to an average of 2.5 million people annually[7] who suffer from food insecurity.

In light of the large adverse impacts of drought within Ethiopia, the Government of Ethiopia (GoE) has developed jointly with its Development Partners (DPs) early warning systems (EWS) that permit a timely recognition of impending droughts. EWS that are compiled regularly include, inter alia, the Livelihoods, Early Assessment and Protection (LEAP) tool developed in 2008 by the GoE and the World Food Programme (WFP), the Livelihood Impact Analysis Sheet (LIAS) developed in 2008 by the GoE and USAID, hotspots assessments conducted by the Early Warning and Response Directorate (EWRD) as well as other ad hoc assessments to determine the need for assistance in specific areas within Ethiopia.

EWS are used to feed into Ethiopia's well-established drought response mechanisms, notably the Productive Safety Net Programme (PSNP) and humanitarian appeals, by means of which assistance is provided to the affected populations. The PSNP, which was developed by the GoE and its DPs and launched in 2005, has provided assistance to almost 8 million chronically food insecure households in 2015, of which 6.6 million beneficiaries were participating in public works activities, and 1.4 million labor-poor beneficiaries received direct support[8]. Since 2008, the PSNP has a drought response mechanism[9], which permits the rapid scale-up[10] of the PSNP to include additional beneficiaries that are pushed into transitory food insecurity due to drought, and to extend the duration of payments made to

[1] World Bank (2014b).
[2] UN OCHA (2011).
[3] OECD (2014).
[4] World Bank, World Development Indicators.
[5] CIA World Fact Book, https://www.cia.gov/library/publications/the-world-factbook/geos/et.html.
[6] Based on Guha-Sapir, Below and Hoyois, EM-DAT database. Average number of people affected by drought based on EM-DAT data, taking into account droughts in 2003, 2005, 2008, 2009, 2011 and 2015.
[7] Based on HRD Appeals for the years 2005 to 2014 (average beneficiaries across the assessments for the main harvesting seasons *belg* and *meher*).
[8] FDRE Ministry of Agriculture and Natural Resources, Rural Job Opportunity Creation and Food Security Sector, Food Security Coordination Directorate (2016).
[9] Under PSNP III, drought response was managed through the Risk Financing Mechanism (RFM). Under PSNP IV, from July 2015 onwards, the RFM has been replaced with the Federal Contingency Budget (FCB).
[10] In this paper, the term scalability / scale-up designates the inclusion of additional beneficiaries and extension of payments to existing beneficiaries in response to drought. While the FCB can be disbursed also in non-PSNP districts (*woredas*) within PSNP regions, the term scale-up does not refer to the geographic expansion of PSNP coverage beyond current PSNP regions.

existing PSNP beneficiaries. In particular, the PSNP successfully scaled up during the Horn of Africa drought in 2011, supporting an additional 3.1 m beneficiaries for 3 months, and extending the duration of transfers for 6.5[11] million of the existing 7.6 million beneficiaries[12]. The PSNP's response to the drought occurred within two months, contrasting with a time lag between the availability of early warning information and a response based on HRD appeals of up to eight months[13]. The PSNP's response to the 2011 drought was widely credited with preventing the worst impacts of the drought, leading to comparatively less severe drought impacts within Ethiopia relative to its neighboring countries[14].

Due to the high frequency of droughts in Ethiopia and concomitantly large number of food insecure households, drought response also relies on the issuance of humanitarian appeals to cover those needs that are not met through the PSNP. The Humanitarian Requirements Document (HRD) is developed by the GoE on the basis of bi-annual needs assessments following the main harvest seasons *meher* and *belg*[15]. The Government regularly issues emergency appeals requesting emergency assistance to secure the consumption needs of vulnerable people due to the continued negative effects of the failure of *meher* and *belg* rains. PSNP contingency budgets are typically already used earlier in the year to provide a rapid response. While Ethiopia's 2016 US$1.4 billion appeal has received over US$758 million from the Ethiopian government and the international community, leading to a coverage of the appeal by 54%, significant life-saving gaps remain across all sectors[16].

Responding to drought effectively has been a priority within the GoE, and has been advanced at the policy and institutional level as well as through the establishment of the current drought response framework. Progress is promoted, in particular, through Ethiopia's 2013 National Policy and Strategy on Disaster Risk Management (NPDRM), which looks to further enhance Ethiopia's resilience against natural hazards and to mitigate the harmful effects of droughts. In line with these objectives, a key factor in protecting household welfare from the impacts of drought shocks is the timeliness of drought response. In particular, research by the International Food Policy Research Institute (IFPRI)[17] has shown that responding early during the onset of a drought can be up to three times as cost-effective as responding late.

The availability and use of robust, accurate predictive tools can greatly enhance the timeliness of drought response, facilitating early action during the onset of a drought. It is the objective of this paper to provide an overview of the existing EWS in Ethiopia, to delineate connections between different EWS, with a view to identifying possible enhancements in the existing drought response framework that could lead to increased timeliness of drought response. The paper will argue that an early intervention is less costly in terms of protecting lives and livelihoods than a late intervention, and can be achieved through greater – or renewed – use of existing early warning tools. The paper will argue furthermore that the

[11] Slater and Bhuvanendra (2014).
[12] FDRE Ministry of Agriculture, Disaster Risk Management and Food Security Sector, Food Security Coordination Directorate (2011).
[13] Hobson and Campbell (2012).
[14] World Bank (2011).
[15] Throughout the year, three to four government-led multi-agency needs assessments are conducted (see Haan, Majid and Darcy, 2006).
[16] UN OCHA (2016).
[17] Clarke and Vargas Hill (2012).

existing EWS that have been developed in Ethiopia can be used to inform early action, and based on the continued collection of EWS data and continued improvements to the corresponding tools, there is scope for using EWS to inform an early and timely drought response.

The paper is structured as follows: section 2 will present the policy and institutional background for Disaster Risk Management (DRM) in Ethiopia. Section 3 will provide an overview of the existing drought response framework within Ethiopia. Section 4 presents existing early warning tools in Ethiopia, in particular, the LEAP and LIAS tools, as well as the GoE's bottom-up early warning framework, hotspots assessments and the use of the Integrated Food Security Phase Classification. Section 5 investigates the timing of the availability of early warning information, as opposed to the HRD appeal process, and links this to the Ethiopian seasons. It discusses also the welfare benefits of an early drought response. Section 6 discusses and concludes.

II. Policy and institutional background

Recognizing the need to systematically address drought risks and to protect Ethiopians from the loss of lives, livelihoods and income, the GoE has taken significant steps to systematically manage disaster risks. Efforts to manage drought risks date back to 1974, when the Relief and Rehabilitation Commission (RRC) was established in the aftermath of the severe 1973 drought. In 1995, the RRC was transformed into the Disaster Prevention and Preparedness Commission (DPPC). The strategic oversight of DRM in Ethiopia was vested in the National Disaster Prevention and Preparedness Committee (NDPPC), with the DPPC acting as NDPPC's Secretariat to implement DRM policies and decisions. In 2004, DPPC was renamed the Disaster Prevention and Preparedness Agency (DPPA) and given narrower responsibilities to focus on emergency response, while a new Food Security Coordination Bureau (FSCB) was created to address issues of chronic food insecurity[18].

In 2007, as part of a government-wide Business Process Re-engineering (BPR), the GoE transferred the responsibilities of the DPPA to the Ministry of Agriculture and Rural Development (MoARD[19]), which led the establishment of the Disaster Risk Management and Food Security Sector (DRMFSS). The responsibilities for strategic oversight of DRM within Ethiopia were vested in DRMFSS, and its responsibilities included coordinating DRM activities across line ministries involved in integrating DRM at the sectoral level. DRMFSS was composed of the Early Warning and Response Directorate (EWRD) and the Food Security Coordination Directorate (FSCD). The institutional landscape for DRM in Ethiopia has recently undergone further change, with the creation of the National Disaster Risk Management Commission (NDRMC) as an autonomous federal government office accountable to the Prime Minister. The role of NDRMC is to lead the implementation of the National Disaster Risk Management Policy. The responsibilities vested in DRMFSS have been separated, such that the EWRD has been included in the new NDRMC and the FSCD forms part of the MoANR under the new Rural Job Creation and Food Security sector.

At the policy level, the GoE has developed a National Policy and Strategy on Disaster Risk Management (NPDRM) in 2013, and has recently developed the Disaster Risk Management Strategic Programme and Investment Framework (DRM-SPIF). Key goals of the NPDRM include the enhancement of Ethiopia's

[18] World Bank and GFDRR (2011).

[19] In 2015, the Ministry of Agriculture and Rural Development was renamed Ministry of Agriculture and Natural Resources (MoANR), with a separate ministry created for the livestock and fisheries sectors, which are now governed by the Ministry of Livestock and Fisheries (MoLF).

capacity to withstand the impact of natural hazards at the national, local, community and household level, and to significantly reduce the damages associated with disasters by 2023. The NPDRM is organized around the Hyogo Framework for Action's priority areas and promotes an integrated, multi-sectoral approach in the context of broader sustainable development efforts in Ethiopia. The DRM-SPIF is a tool to facilitate the National Policy and Strategy on DRM by addressing existing gaps and limitations in Ethiopia's DRM capacity and establishing an integrated DRM system. The DRM-SPIF is also envisaged to contribute to Ethiopia's ambitious Growth and Transformation Plan II (GTP II[20]), which sets forth goals to enable Ethiopia to become a middle-income, carbon-neutral, and climate-resilient economy by 2025 with growth rates of at least 11 percent per annum during the planning period. To achieve the GTP II goals and objectives, GoE has followed a "developmental state" model with a strong role for the government in many aspects of the economy. It has prioritized key sectors such as industry and agriculture as drivers of sustained economic growth and job creation[21].

III. Drought response within Ethiopia

Against the policy and institutional backdrop outlined above, Ethiopia currently relies mainly on the Productive Safety Net Programme (PSNP) and humanitarian appeals to address drought risks[22]. The need to develop systems and institutions to respond to drought has been recognized in Ethiopia at least since the 1970s and 1980s, when two major droughts caused widespread food insecurity and mortality. The catastrophic drought of 1983 caused 300,000 deaths and affected 7.75 million Ethiopians[23]. The severity of the crisis necessitated large-scale international humanitarian assistance, underscoring the importance of establishing a sound drought response framework. To manage drought risks systematically, in 2005 the GoE began implementing jointly with its DPs the Productive Safety Net Programme to respond to food insecurity and droughts, and has established a seasonal needs assessment process to monitor food security and issue humanitarian appeals where necessary.

III.1 The Productive Safety Net Programme (PSNP)

The PSNP represents the second-largest social safety net in Sub-Saharan Africa[24], and provides cash or food assistance, depending on availability of food in the market, to chronically food insecure households in chronically food insecure *woredas* (districts). Since 2005, transfers have been made for six months in a given calendar year, and are equivalent in value to 15 kg of cereals per household member per month, or its cash equivalent. Under the current PSNP IV, which commenced in 2015, the transfer value will be adapted to 15 kg of grain and 4 kg of pulses in order to increase the nutritional value of the transfer. Beneficiary selection within the PSNP is completed based on geographic and community targeting. Based on a history of emergency food needs, the GoE identified the most food insecure *woredas*. As a second step, beneficiaries are selected within communities according to pre-identified criteria.

[20] FDRE (2015).
[21] World Bank (2014b).
[22] Additionally to the PSNP and humanitarian appeals to address drought risks, the GoE's GTP II includes objectives to enhance resilience to drought risks. These include, for instance, initiatives to strengthen natural resource management and watershed development, as well as scaling up best practices to help mitigate vulnerability to drought. Furthermore, the GTP II envisages reducing the vulnerability to drought risks through small and large scale irrigation development (FDRE, 2015).
[23] Guha-Sapir, Below and Hoyois, EM-DAT database.
[24] Following South Africa's Child Support Grant, see World Bank (2014a).

Evaluations of the PSNP have shown that the program has significantly reduced food insecurity and distress sales of assets. Data collected for the 2014 PSNP highlands impact evaluation[25] show that food security has improved significantly in PSNP localities: the average PSNP beneficiary household reported a food gap of approximately 3 months between 2006 and 2010. This has dropped to 2.04 months in 2012 and 1.75 months in 2014. Moreover, the PSNP has led to a significant decrease in distress asset sales. While in 2010, 54% of public works beneficiary households made distress sales to meet food needs, by 2014, this has dropped to 25%. It has also been found that livestock holdings by the poorest PSNP public works participants have increased markedly, from 0.5 Tropical Livestock Units (TLU) in 2006 to 1.65 TLU in 2014.

Drought response through the PSNP is conducted through the use of the PSNP's contingency budgets. Under the PSNP III program, which was in effect between 2009 and 2015, drought response was managed through the use of *woreda* and regional contingency budgets, as well as the Risk Financing Mechanism (RFM). Thereby, *woreda* contingency budgets were designed to address inclusion and exclusion errors[26] as well as unexpected needs of chronically food insecure households. Regional contingency budgets were designed to address unexpected needs of the chronically food insecure population, and transitory food insecurity. Regional contingency budgets were to be used prior to the release of funds under the RFM, unless the severity of the shock was beyond the capacity of regional budgets[27]. The PSNP III's RFM was designed specifically to respond to drought shocks. In particular, the mechanism both extends the transfer amount to existing beneficiaries, and includes additional beneficiaries that suffer from food insecurity as a result of drought.

Under the PSNP IV, amendments have been made to the mechanisms to respond to drought. The PSNP IV came into effect in July 2015, and no longer includes a regional-level contingency budget, in order to have a more discretionary use of these resources in response to future shocks. Under PSNP III regional contingency budgets could be rolled forward to the next season, while under PSNP IV this is no longer possible. However, the program continues to use *woreda*-level contingency budgets to address beneficiary inclusion and exclusion errors and minor transitory shocks. Major drought shocks are addressed, under PSNP IV, through its federal-level contingency budget, which has replaced the PSNP III's RFM. Under PSNP IV, part of the core budget is allocated to scale up the activities of PSNP IV using the federal contingency budget (FCB) and in 2016 an amount of approximately US$ 50 m[28] was allocated for this purpose.

III.2 Seasonal needs assessments and HRD process

Additionally to a response through the PSNP, drought risks within Ethiopia are typically addressed through the issuance of humanitarian appeals. Appeal numbers are determined based on a seasonal needs assessment conducted following the main harvesting seasons *meher* and *belg*.

[25] See Berhane, Hirvonen and Hoddinott (2015).
[26] An inclusion error may occur when a food secure household is erroneously included in the PSNP. An exclusion error would occur when a food insecure household is excluded from the PSNP. Inclusion and exclusion errors may arise for a diverse range of reasons, including a failure to review beneficiary lists on a regular basis at the *woreda* level, migration or death of beneficiaries, misconceptions regarding the beneficiary selection criteria, and so forth.
[27] See World Bank (2009).
[28] This amount may be increased in the second half 2016 as part of the 2016/2017 annual PSNP plan.

HRD appeal numbers are based on a bottom-up assessment process and agreed assumptions of need, as follows (Source: Food Economy Group 2015):

(i) ***Pre-harvest assessment triggered***: The pre-harvest needs assessment is triggered by the Disaster Risk Management Technical Working Group (DRM TWG[29]) and conducted by *woreda*-level staff. Assessments are conducted within two weeks before or after each rainy season, depending on rainfall conditions.

(ii) ***Pre-harvest assessment:*** *Woreda*-level staff conduct an initial assessment of the number of people in need of food assistance. Assessments are based on a range of information, including rainfall and crop production data. *Woreda*-level staff submit needs estimates to the zones, which revise and compile needs estimates. Zonal-level beneficiary estimates are submitted to regional governments, who compile and revise beneficiary estimates again.

(iii) ***Main seasonal needs assessments:*** The main seasonal needs assessments are conducted by multi-agency teams dispatched by the federal government to the regions. In particular, assessments are conducted in specific *woredas*. Agreement is reached on which *woredas* to visit through coordination between assessment teams and the regional-level governments, based on pre-harvest assessment results. In determining beneficiary numbers, checklists are used to guide teams through the assessment process. Beneficiary numbers were calculated initially based on the Household Economy Approach (HEA, see section 4.2 for further details), and were computed using the LIAS spreadsheet. The spreadsheet produces, as a final output, the number of people in need of food assistance. Two different thresholds are used: A Livelihood Protection Threshold[30], below which households are unable to meet food needs whilst upholding their livelihood strategy, and a Survival Threshold[31], below which households are unable to meet food needs. As of 2015, the DRM TWG decided to discontinue the use of LIAS data, as it was recognized that LIAS baseline data are outdated for the highlands regions. At present, seasonal needs assessments are therefore mainly based on the use of checklists.

(iv) ***Drafting of HRD Document:*** Based on compiled beneficiary numbers, the federal-level HRD Editorial Committee drafts the HRD document. The HRD Editorial Committee is composed of representatives of DRMFSS, the UN and NGOs. The Committee compiles the received assessments and presents these to the EWRD at DRMFSS.

[29] The DRM Technical Working Group is a multi-sectoral forum led by DRMFSS, including GoE representatives, DPs and humanitarian partners.

[30] The Livelihoods Protection Threshold represents the total income required to sustain local livelihoods, in particular: (i) ensuring basic survival, (ii) maintaining access to basic services, such as health and education expenses, (iii) sustaining livelihoods in the medium to longer term through purchases of seeds, fertilizer, veterinary drugs, etc., (iv) achieving a minimum locally acceptable standard of living through purchase of clothing, coffee and tea, etc. See USAID and FDRE Disaster Risk Management and Food Security Sector, MoARD: *The Livelihoods Integration Unit Uses of the Baseline Information and Analysis.*

[31] The Survival Threshold represents the total income required to cover: (i) 100% of minimum food energy needs (2100 kcals per person), (ii) the costs associated with food preparation and consumption, such as salt, soap, kerosene, and/or firewood for cooking and basic lighting, (iii) any expenditure on water for human consumption. The Survival Threshold is the line below which intervention is required to save lives. See USAID and FDRE Disaster Risk Management and Food Security Sector, MoARD: *The Livelihoods Integration Unit Uses of the Baseline Information and Analysis.*

(v) ***Review of draft HRD document by DRMFSS:*** DRMFSS confirms the summary provided by the HRD Editorial Committee with regional governments. Beneficiary numbers are revised as needed based on guidance from the regional governments.

(vi) ***Submission of beneficiary numbers to the State Minister:*** DRMFSS submits the agreed beneficiary numbers to the DRMFSS State Minister, who undertakes a further review of the numbers.

(vii) ***Final review by the national DRM Council:*** Following the approval of beneficiary numbers by the DRMFSS State Minister, a final review and approval of beneficiary numbers and of the assessment is conducted by the National DRM Council. The national DRM Council is composed of relevant line ministers and is chaired by the Deputy Prime Minister.

(viii) ***Finalization of HRD:*** Upon confirmation of the final beneficiary numbers by the National DRM Council, beneficiary numbers are submitted to the HRD Editorial Committee. The HRD Editorial Committee integrates beneficiary numbers into the Humanitarian Requirements Document (HRD) without further review and publishes the document.

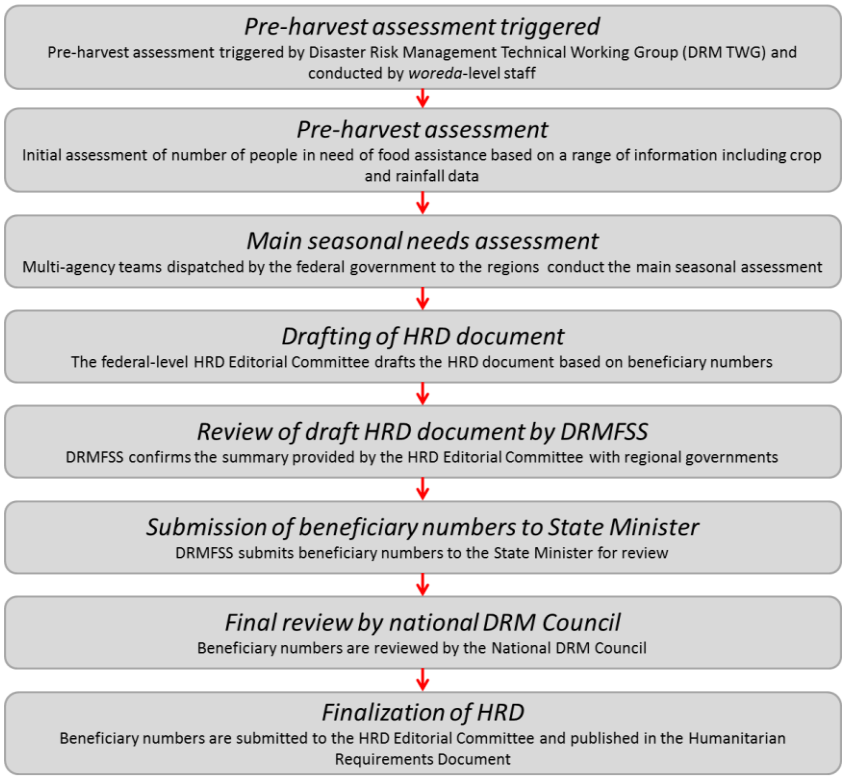

FIGURE 1: SEASONAL NEEDS ASSESSMENT AND HRD PROCESS

In Ethiopia, three to four government-led multi-agency seasonal needs assessments are carried out each year. The main seasonal needs assessment is conducted in November or December following the *meher* rains, with a second assessment conducted following the shorter *belg* rains. Additionally, two mid-season assessments during the *meher* and *belg* seasons are conducted[32]. Ethiopia's early warning system is linked into the needs assessment process, where early warning data are used to inform decisions at key points.

[32] Haan, Majid and Darcy (2006).

III.3 Risk layering through the Continuum of Response

Drought-risk management within Ethiopia will be based on the consecutive use of the PSNP core budget, PSNP *woreda*-level budgets, PSNP federal level contingency budgets and funds raised through the HRD appeal process. This consecutive process of using available funds is specified, within PSNP IV, in the Continuum of Response[33] summarized in Table 1. Note, in particular, that according to the PSNP IV Programme Implementation Manual (PIM), the PSNP FCB will be the first line of financing for response to transitory food needs in PSNP regions, and humanitarian resources will be used for food needs in PSNP regions only if the FCB is insufficient to meet the anticipated needs. Non-food requirements are met entirely by humanitarian resources.

TABLE 1: CONTINUUM OF RESPONSE

Funding Source and Purpose	**Trigger**	**Where Resources can be Used**	**Implementation Responsibility**
Woreda Contingency Budget			
To address exclusion error identified through appeals To address transitory needs[34]	• Appeals • Ongoing (improved) Early Warning[35]	Anywhere within woreda where the safety net is implemented	• Woreda Food Security Desk (WFSD)
Federal Risk Financing/Contingency Budget			
To address transitory needs	• Annual Needs Assessment and other hotspot assessments (real time early warning data)	In regions where the safety net is implemented	• In existing operational areas – WFSD. • In non-operational areas - WEWRD[36] and other humanitarian actors as appropriate
Ad Hoc Humanitarian Response			
To address transitory needs	• Annual Needs Assessment and other hotspot assessments	Nationwide	• All actors with operational capacity (WFSD, WEWRD, WFP and other UN actors NGOs etc.)

The use of resources according to the Continuum of Response can be linked to a risk layering approach (see Annex 2 for further details), whereby different risk financing instruments are made available depending on the frequency and severity of the disaster event. In particular, chronic poverty is addressed through the PSNP's core caseload. High frequency, low severity droughts occurring on a bi-annual or annual basis in specific *woredas* are addressed through the PSNP's *woreda*-level contingency

[33] While the continuum of response has been agreed by government and PSNP stakeholders for some time in practice the use of humanitarian resources has been triggered before the contingency budgets have been fully utilized in all major recent drought events.

[34] This budget can both be used to respond to (i) transitory needs among safety net clients (by increasing the number of months of support); and (ii) transitory needs among non-safety net clients (by adding them temporarily to the programme payroll).

[35] These improvements will both focus on the simplification of the data needed to trigger response, but also the development of analytical capacity to use and make effective and rapid decisions on the basis of these data. This is in line with the DRM-SPIF's agenda of ensuring that early warning and risk assessment tools are harmonized into one system to allow effective decision-making.

[36] Woreda Early Warning and Response Directorate.

budget. Slightly more severe, less frequent droughts are financed through the use of the PSNP's federal-level contingency budget. Finally, for very severe, low frequency droughts, assistance is provided through the HRD process. In this manner, Ethiopia can achieve a cost-effective and timely drought response framework. A methodology to assess the economic cost of sovereign disaster risk financing strategies available to GoE is provided in Clarke, Coll-Black, Cooney and Edwards (2016).

Figure 2 illustrates the cumulative risk layers in Ethiopia, based on historic PSNP beneficiary numbers, additional beneficiaries included in the PSNP due to the use of the RFM, historic HRD appeal numbers and simulated poverty estimates[37]. As the figure shows, expenditures under the RFM were made in the Ethiopian financial years 2011/2012 and 2014/2015[38]. Moreover, the figure shows that HRD emergency appeals have been issued every year during the period 2005 to 2015, demonstrating the high frequency and intensity of drought events. The figure compares the provision of resources with indicative, simulated total poverty numbers (both chronic and transitory) that were computed based on consumption data obtained from household survey data combined with yield reduction estimates obtained through the LEAP tool. Indicative poverty numbers have been computed to isolate the impact of drought-related crop loss on consumption-based poverty, as estimated through household survey data. Simulated poverty numbers provide transparent, objective estimates of drought-related poverty. However, the figures do not represent best estimates of poverty numbers, and do not take into account either the geographical focus of the PSNP or potentially relevant political considerations.

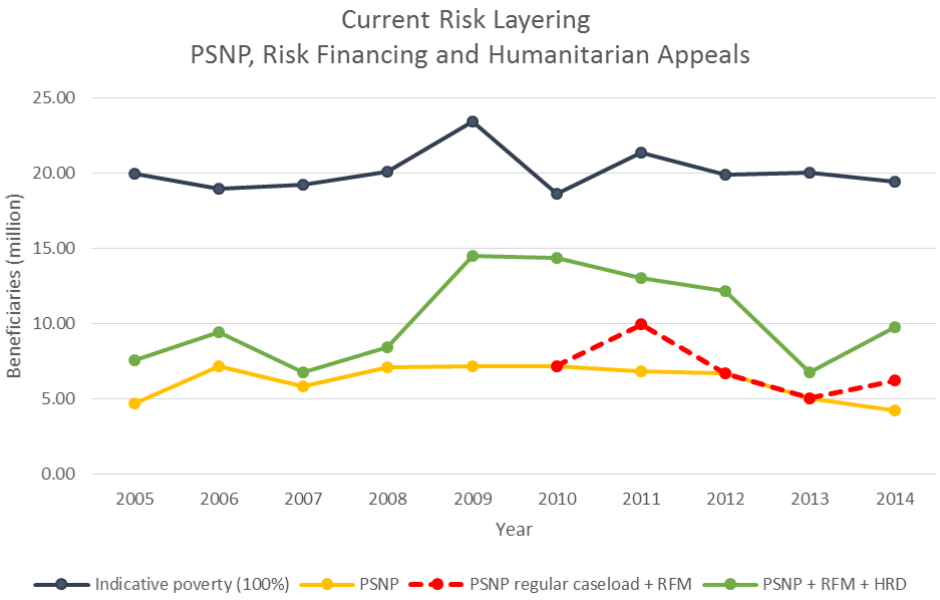

FIGURE 2: DROUGHT RISK FINANCING THROUGH THE PSNP AND HRD WITHIN ETHIOPIA

[37] Simulations of transitory poverty, based on household survey data (HICES / WMS) and WRSI crop loss data were conducted by Catherine Porter (Heriot-Watt University). For further details on the data sources used and estimation method, please refer to Annex 1.

[38] Under the Risk Financing Mechanism (RFM), support to existing PSNP beneficiaries is extended and additional, transitorily food insecure households are included in the program. The most significant support provided through the RFM arises through strengthening resilience for existing beneficiaries, to ensure that investments made are not eroded.

IV. Early warning systems

Ethiopia has a range of EWS that permit the early recognition of the onset of a drought. These tools include, inter alia, the LEAP and LIAS tools, a bottom up early warning system, hotspots analyses and the Integrated Food Security Phase Classification[39]. The following sections will provide an overview of the methodologies used in each of the tools, with a view to assessing how the existing EWS can be used within Ethiopia's drought response framework.

IV.1. The LEAP early warning tool

IV.1.1 The LEAP tool methodology

LEAP[40] was initiated during PSNP I in 2006 and was developed to estimate food aid beneficiary numbers, and to develop indices for early response in terms of food security. Under PSNP III and IV respectively, the LEAP tool was chosen as a trigger to release PSNP funds under the RFM and FCB. Based on LEAP data indicating a drought of sufficient strength to trigger contingency funds, the PSNP would respond to drought in a timely manner. By providing early warning information during the onset of a drought, the LEAP tool facilitates early action, thereby mitigating the adverse impacts of droughts on food security.

The objective of the LEAP tool is to provide estimates of the number of people in need of food assistance during each of the main harvest seasons *meher* and *belg*, at the *woreda*, regional and national scale. To obtain estimated beneficiary numbers, the LEAP tool performs the following steps (Source: Hoefsloot et al. 2013):

(i) ***Calculation of planting date:*** Based on crop and rainfall data, the LEAP tool computes the estimated planting date for a range of crops. Thereby, planting dates are computed for each crop and geographic region individually, depending on current rainfall data. Planting dates are computed as a sowing window start dekad[41] and a sowing window end dekad. To determine the planting dekad within this window, LEAP identifies two consecutive dekads in which certain rainfall thresholds are exceeded (these thresholds are crop and location specific). This is usually a good approximation of farmers' decision to start planting.

(ii) ***Calculation of Water Requirements Satisfaction Index (WRSI)[42]:*** The computation of the WRSI is based on a number of input parameters. Specifically, these include rainfall, the planting start and end dates computed in (i), potential evapotranspiration, soil water holding capacity, crop type, the water use rates of a growing crop, the geographical area where the crop is grown, and the length of the growing period. All of these parameters are static except rainfall, which

[39] Additionally to the LEAP and LIAS tools and hotspots assessments, a range of other early warning data are collected regularly in Ethiopia. These include, for instance, Integrated Food Security Phase Classification data are collected by FEWS NET (see section IV.7).Moreover, the European Commission's Joint Research Centre (JRC) uses remote sensing to monitor agricultural and pastoral vegetation in the Horn of Africa on a real time basis.

[40] Initially, the LEAP project included the LEAP tool, a contingency finance facility, contingency plans, and national capacity building activities. LEAP was initiated following the implementation of a sovereign index insurance pilot conducted by WFP and GoE. With time, LEAP focused increasingly on the development of the LEAP tool and provision of the tools intermediary and final outputs.

[41] A dekad is a time interval of approximately ten days. Every month has three dekads, such that the first two dekads have 10 days, and the third is comprised of the remaining days of the month.

[42] The Water Requirements Satisfaction Index (WRSI) is an indicator of crop performance based on the availability of water during a growing season. A WRSI value of 100% would indicate that water requirements for plant growth are fully satisfied.

changes over time. Based on the WRSI for individual crops, LEAP permits the calculation of a basket WRSI reflecting the WRSI for a basket of crops grown in a given area.

(iii) ***Calculation of yield reduction:*** As an intermediary output, the LEAP tool computes yield reduction estimates. A 0% yield reduction would reflect that the harvest would be at its potential, and a yield reduction of 100% would reflect a complete crop failure. Yield reduction is computed for each crop and each region, and is dependent on actual evapotranspiration, total water requirement without water stress and a yield response factor representing the effect of a reduction in evapotranspiration on yield losses[43]. Based on yield reduction estimates for individual crops, LEAP permits the calculation of yield reduction of a basket of crops grown in a given area.

(iv) ***Calculation of estimated beneficiary numbers:*** Based on previously computed WRSI data in combination with past beneficiary numbers and demographic data, the LEAP tool computes estimated beneficiary numbers. In particular, the LEAP tool uses a logarithmic model to compute needs based on the following parameters:

a. ***Needs in case of optimal rainfall*****:** Number of people in need of assistance in case of optimal rainfall in any given region. In particular, the level of needs in case of optimal rainfall may be interpreted as the number of chronically food insecure people, as their status of food insecurity is independent of crop performance.

b. ***Population at risk of food insecurity*****:** This number corresponds to the maximum number of beneficiaries in the case of the most severe drought possible, and should include the entire population at risk of food insecurity due to drought in a given area. To optimally estimate this parameter, this variable should be based on field assessments to assess the number of people faced with drought-related food insecurity. However, in the absence of recently updated data, LEAP selects the maximum historical beneficiary number recorded in a given area.

c. ***Lowest observed value of RWRSI:*** The Regional Water Requirements Satisfaction Index (RWRSI) is defined as the weighted average of woreda-level combined WRSI, where the weights are given by the population for each woreda. The lowest observed RWRSI reflects the lowest drought index based on historical data, reflecting the most severe drought on record in a given area. In cases where a drought occurs that is more severe than the most severe past drought, the model used is able to extrapolate the associated level of needs.

d. ***Optimal RWRSI:*** The optimal RWRSI refers to the optimal rainfall conditions relative to a given region. Although a value of WRSI of 100% would reflect optimal crop growth conditions, the optimal RWRSI may be less than 100% depending on local conditions.

e. ***Systemic failure level:*** This parameter estimates the complete failure of the crop seasons, reflecting the level of water stress beyond which community coping mechanisms are exhausted and beneficiaries require external assistance to meet food needs. The parameter is difficult to estimate, as it depends on farming practices and farmers' skills. However, the failure level should be selected such that it is significantly lower than the lowest observed value of RWRSI (see c. above). One possibility for selecting the systemic failure level is to use a value of WRSI of 50, below which crops are assumed to fail, or to link the systemic failure level to the lowest observed value of RWRSI by scaling down the lowest observed value of RWRSI through a constant assumed to be the threshold beyond which crops fail.

[43] Doorenbos and Kassam (1979).

Based on the parameters described in a. to e., the LEAP tool computes estimated beneficiary numbers at the *woreda*, regional and national level to facilitate an early drought response through the PSNP's drought risk financing mechanisms.

Figure 3 illustrates the inputs, intermediary outputs and final outputs of the LEAP tool, as explained above.

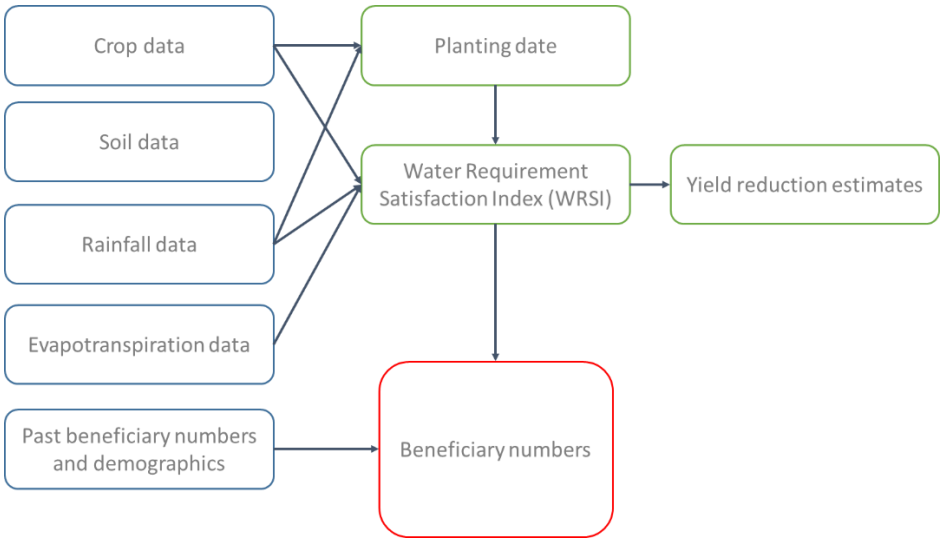

FIGURE 3: LEAP INPUTS (BLUE), INTERMEDIATE OUTPUTS (GREEN) AND FINAL OUTPUT (RED). (REPRODUCED FROM HOEFSLOOT ET AL. 2013).

IV.1.2 Planned extensions of the LEAP tool

As the LEAP tool makes use of current data to estimate WRSI and hence, yield reduction early on during the season, the LEAP tool is able to detect droughts during their onset[44]. The LEAP tool therefore represents a powerful model to recognize the onset of a drought early, allowing for a timely and cost-effective drought response[45].

To further hone the benefits of the LEAP tool in drought prediction, the tool is being refined on a continual basis. In particular, limitations of the tool are associated mainly with insufficient data or uncertainty surrounding the input parameters to the LEAP tool. Ongoing efforts to extend and enhance the scope of the LEAP tool center on the following modifications:

(i) ***Beneficiary estimates:*** A limitation of the LEAP tool consists in the use of subjective information in the calculation of beneficiary numbers. Specifically, the calculation of the population at risk of food insecurity rests on the use of historical beneficiary numbers. As detailed in section III.2 above, the estimation of beneficiary numbers as part of the seasonal needs assessments process includes not only externally verifiable data, but also some degree of subjective, informed

[44] Depending on the time within the crop growth stage at which yield reduction is calculated, the tool assumes a normal value of WRSI for the rest of the season. For this reason, early in the season yield reduction estimates are inaccurate if the season performs below normal.

[45] A number of WRSI models were run for Ethiopia. Moreover, crop areas and calendars have been constructed in great detail, thereby further refining the WRSI crop monitoring tool.

judgment to account for risk factors different than drought (Hoefsloot et al. 2013). In particular, as section III.2 showed, beneficiary numbers are subject to a detailed review process which can lead to changes in estimated beneficiary numbers. Given that historical beneficiary data are thus informed not only by current drought data but also by informed judgements, the LEAP tool is being extended to base beneficiary estimates on household livelihoods data (see section IV.2 below).

Due to the use of historic beneficiary numbers in computing needs, LEAP early warning information has so far not been used to inform insurance[46]. Upon the integration of household livelihood data to compute beneficiary numbers and hence elimination of subjective information in the computation of beneficiary numbers, the LEAP tool could serve as a basis for weather index insurance.

(ii) ***Integration of market and price data:*** A further constraint of the LEAP tool in its current version is that the tool does not take into account market and price data. In particular, the ability of households to acquire food is determined not only by drought conditions (impacting on farmers' ability to produce crops and livestock), but also by their ability to buy food in the market. Farmers' ability to buy food is determined, for instance by the availability of food in the market, the distance of the household to the market, and food prices. To enhance the accuracy of beneficiary estimates obtained through the LEAP tool, the LEAP tool is being reviewed to include these variables.

(iii) ***Integration of data for pastoral regions:*** Ethiopia is composed of a range of diverse livelihood zones, with livestock production representing a key source of income particularly in the regions of Afar, Borena and Somali. At present, the LEAP tool is centered mainly on developing beneficiary numbers for the crop seasons *meher* and *belg*. By integrating a pastoral index into the tool, LEAP could additionally generate beneficiary estimates for pastoral areas. GoE and WFP are currently in the process of extending the LEAP tool to integrate pastoral information.

(iv) ***Flood monitoring:*** Additionally to drought, flood risks represent a major hazard in Ethiopia, with floods leading to average annual losses of US$ 200 million[47]. It is therefore envisaged that the LEAP tool could be enhanced by integrating a flood index, such that it could serve as a flood monitoring tool to generate beneficiary estimates for floods.

IV.2 The LIAS tool

IV.2.1 The LIAS tool methodology

The Livelihood Impact Analysis Sheet (LIAS) is an early warning tool that estimates beneficiary numbers based on the Household Economy Approach (HEA). LIAS was developed and collected initially through the Livelihood Integration Unit (LIU), which was established in 2006 as a USAID-funded project based in the former DPPA. The LIU was in operation until 2015, and was housed in the EWRD as part of DRMFSS. The objective of the LIU was to improve the accuracy and objectiveness of seasonal needs assessments in Ethiopia, by integrating an understanding of local livelihoods into the needs assessment process[48].

[46] At the micro-level, it is possible for LEAP data to be used to inform insurance. This would, however, require a detailed local-level index design process.

[47] World Bank (2014b).

[48] FDRE Disaster Risk Management & Food Security Sector, MoARD and USAID: The Livelihoods Integration Unit Uses of the Baseline Information and Analysis.

The HEA is a method for assessing the vulnerability of rural populations to economic shocks and changes, based on their livelihood patterns and market information. It links together the concepts of risk, vulnerability and capacity in the context of livelihood security. This can be expressed in the following formula:

$$R = f\left(h, \frac{v}{c}\right)$$

Where R designates risk, h refers to hazard, v to vulnerability, c to coping and $f(\cdot)$ is a function that maps hazard, vulnerability and coping to risk. Thereby, risk quantifies the risk of food or livelihood insecurity, hazard measures the shock a household experiences, vulnerability is a measure of how strongly any given shock would impact on a given household, and the coping capacity measures how well households are able to respond to a shock. The HEA method involves six steps to predict the number of people at risk of food and livelihood insecurity:

(i) ***Livelihood zoning:*** Ethiopia comprises a diverse range of livelihood zones, with livelihoods varying depending on climate, soil, access to markets and crop or livestock production. The first step in the HEA method is to develop a livelihood zone map, which lays out zones within which people share similar patterns of access to foods (e.g. producing the same crops, keeping the same types of livestock, etc.) and have the same access to markets.

(ii) ***Wealth breakdowns****:* A key factor in the ability of a household to generate income and acquire food is wealth. Wealth is determined, for instance, by land ownership, livestock holdings, capital, education, skills, labor availability and social capital. As part of the second step of the HEA method, a wealth breakdown is developed, whereby within each livelihood zone, different wealth groups are defined. The output of the second step of the HEA method is a wealth breakdown.

(iii) ***Quantification of livelihood strategies:*** Once households are grouped into livelihood zones and wealth categories, baseline data is generated. The baseline data shows the contribution of crops, livestock, and other sources to household's food intake and cash income, on the assumption that the year is an average year. The baseline year serves as a comparison year.

(iv) ***Hazard analysis:*** To understand how hazards such as drought risks affect the livelihood strategy of any given household, it is necessary to understand the economic consequences of any given hazard. In particular, the economic outcome is obtained by mathematically computing the impact of the hazard on livelihood baselines.

(v) ***Analysis of coping capacity:*** To mitigate the impact of a shock, household can use coping strategies. Thereby, some coping strategies are harmful as they diminish the household's asset base. Examples include unsustainable sale/slaughter of livestock, distress migration of households, excessive sale of firewood, or the sale of productive assets. Other coping strategies have a relatively low cost, such as, for instance, reduced expenditure on non-essential items, harvesting of reserve crops, or the consumption rather than sale of any crop surplus[49]. In this step, the extent to which households are able to cope with drought is analyzed, taking account only of low-cost coping strategies that do not reduce the household's productive capacity in the long term.

[49] Boudreau (2009).

(vi) ***Outcome analysis:*** As a final outcome, the LIAS tool produces estimates of the number of people in need in any given *woreda*. Thereby, two different thresholds are used: the livelihood protection threshold and the survival deficit. If total household income falls below the livelihood protection threshold, households are required to employ high-cost coping strategies to meet their food requirements. If household income falls below the survival deficit, they are unable to meet their food requirements even when livelihood-damaging coping strategies are used. The LIAS tool estimates beneficiary numbers by *woreda* both for households that fall under the livelihood protection threshold, and for households falling below the survival threshold, based on the magnitude of the drought shock.

The HEA method is summarized in Table 2, illustrating how food security outcomes are linked to vulnerabilities, capabilities and hazard information.

TABLE 2: THE HEA METHOD. (REPRODUCED FROM BOUDREAU 2009).

	f (Vulnerabilities / Capabilities	**Hazard)**	**=Risk**
The LIU System	**Livelihood Baselines** Gathered through intensive fieldwork once every five to ten years (depending on changes in fundamental economy) by highly trained teams	**Hazard Analysis** Hazard information is gathered during the seasonal assessments by GoE, UN, NGO and other staff; ongoing monitoring (of prices especially) adds to information base	**Outcome Analysis** Conducted for seasonal assessment and at other times of year and for other purposes as required

IV.2.2 Collection and use of LIAS data

Within Ethiopia, LIAS data have been collected on a bi-annual basis for the two main harvesting seasons *meher* and *belg*. Following a pilot in 2008 in the region Southern Nations, Nationalities and Peoples (SNNPR), LIAS data have been collected throughout Ethiopia. In particular, the collection of LIAS data has formed part of the main seasonal needs assessments process, as described in step iii of section III.2 above. LIAS beneficiary estimates are conducted prior to the initiation of the review process to inform Humanitarian Appeal Numbers, and are developed using a clearly defined, transparent methodology. Due to these features, LIAS estimates represent a useful source of early warning information to inform drought response.

While the HEA methodology represents a key tool within Ethiopia's early warning framework, the role of the LIAS tool within the seasonal needs assessment process has been subject to changes over time associated with changes to the definition of beneficiary numbers. In particular, during the years 2009 to 2010, beneficiary numbers reflected in the Humanitarian Requirements Document were based on initial LIAS estimates of food insecure households falling below the livelihood protection threshold, therefore including in the estimation of food insecure households those beneficiaries that have not made use of high-cost coping strategies. After 2010, the definition of beneficiary numbers reflected in the HRD was changed to reflect LIAS survival deficit numbers. The change of definition of beneficiary estimates led to lesser overall number of beneficiaries considered in the HRD process, as only those beneficiaries who were not able to meet food requirements even if damaging coping strategies were used were considered in humanitarian appeals. HRD beneficiary numbers therefore reflect the number of people at

risk of greater mortality as a result of drought; HRD beneficiaries are therefore also called emergency beneficiaries.

The collection of LIAS data has been impacted by changing ownership of the data collection process and capacity constraints with respect to the implementation of the HEA methodology. In particular, between 2008 and 2011, LIAS data were collected systematically in all *woredas*. However, in 2011, the USAID-funded LIU project closed, leading to changing ownership of the data collection process. While the LIU continued to be located within DRMFSS until 2015, data collection after 2011 has been less systematic, with LIAS data collected in some *woredas* between 2011 and 2015 and not in others. A key constraint impeding the collection of LIAS data after 2011 has been a shortage of qualified technical staff. Moreover, a lack of familiarity with the HEA methodology among seasonal assessment teams has led to the increasing use of checklists and decreasing use of the HEA methodology in the determination of beneficiary numbers (for an overview of available LIAS data, refer to Annex 1). As of 2015, the use of LIAS data has been discontinued, as it was recognized that LIAS baseline data are outdated for the highlands regions.

The HEA methodology and LIAS tool have formed key inputs into the seasonal needs assessment process. Moreover, as LIAS data are collected in June and November respectively, which is approximately mid-way through the *meher* and *belg* harvest seasons, LIAS data may provide an early indication of drought conditions, allowing for a timely drought response. In the absence of the LIAS tool / HEA method, seasonal needs assessments are based mainly on checklists, leading to a less systematic and transparent data collection process. Recognizing the need for a renewed use of LIAS data, USAID has issued an RFP during 2015 to update LIAS baselines for the highlands regions. Work on updating baselines will be conducted during 2016, with a view to obtaining updated baselines for all regions in Ethiopia.

IV.3 Complementarities between the LEAP and LIAS tools

The LEAP and LIAS tools complement each other in enabling a successful drought response. In particular, the two tools have a different focus, with the LEAP tool focused mainly on the impacts of a drought shock as measured by WRSI on HRD numbers, and the LIAS tool focused on assessing the implications of a range of variables – including market access and prices – on livelihood strategies. Each tool sheds light on the question of food security within Ethiopia from a different angle, with the LEAP tool providing a dynamic, macro-level assessment of drought risk, and the LIAS tool providing a detailed bottom-up view. It has therefore been proposed that LEAP and LIAS data should be integrated to a greater extent. For instance, LIAS data can be used within LEAP, as follows[50]:

(i) To check planting dates and the length of crop cycles within LEAP;
(ii) To determine where certain crops are grown and to adjust LEAP accordingly;
(iii) To identify the areas where drought is likely to have the most severe impacts on livelihoods based on LIAS data on households' dependence on self-grown crops for food;
(iv) To support the development of a LEAP pastoral index based on LIAS data for pastoral areas.

[50] Hoefsloot et al. 2013.

In combination, the results of the LEAP and LIAS tools can therefore provide a more detailed picture of drought and associated food insecurity in Ethiopia; this was proposed already early during the development of the LEAP tool in 2006.

IV.4 Bottom-up Early Warning System

Recognizing the need to closely monitor droughts based on early warning data, the GoE has developed a bottom-up early warning framework through which monthly food security reports are produced. These are based on the use of checklists, as well as incident command systems. The bottom-up early warning system provides early warning data on a more continual, and less discrete, collection of early warning data, and could be used to replace the current seasonal needs assessment process. The bottom-up early warning systems could also be used to enable early action, as the gradual development of droughts is identifiable based on the collected data.

The successful deployment and maintenance of a bottom-up early warning system is likely to depend on strong implementation mechanisms at all levels of government, as well as the availability of technically qualified staff to collect and analyze early warning data. Moreover, to employ data collected through a bottom-up early warning process to inform early action, it is necessary to establish a clear connection between the collected data and drought-related need; this requires detailed data analysis, as well as a process to store and share data. Moreover, in employing a bottom-up early warning system within a drought response framework, it may be useful to combine and triangulate results obtained from different data sources, to enable the verification and comparison of results obtained through each source of early warning data individually.

IV.5 Hotspots assessments

Additionally to the use of the LEAP and LIAS tools to detect droughts and their impacts, the NDRMC (former EWRD) conducts hotspots assessments on a quarterly basis. The objective of the assessments is to monitor the food security situation in Ethiopia, to be able to initiate early action where hotspots are identified. Hotspots assessments as well as other *ad hoc* assessments can also be launched by the NDRMC to monitor a deteriorating food security situation and enable early action.

Hotspots analyses are conducted using a uniform set of food security and nutritional criteria to ensure comparability across regions. Hotspots analyses have two key objectives: (i) to prioritize the allocation of scarce financial resources, and (ii) to conduct Targeted Supplementary Feeding (TSF) in identified hotspot *woredas*. Table 3 below details the classes of hotspots assessments and their description.

TABLE 3: HOTSPOT CLASSES AND THEIR DESCRIPTION (REPRODUCED FROM FDRE 2014B).

	Area of concern / hotspot level classification	**Class description**	**General IPC Equivalent**
Priority 1	Very severe	Hazards of high damaging level have occurred and affected the lives and livelihoods of the population with very severe lack of adequate food security and may include excess mortality, very high and increasing malnutrition, and irreversible livelihood depletion.	Humanitarian Emergency
Priority 2	Severe	Hazards of high damaging level have occurred and affected the lives and livelihoods of the population	Acute Food and Livelihood Crisis

		with high stress and lack of adequate food security which resulted in high level of malnutrition and accelerated depletion of livelihood assets.	
Priority 3	Moderate	Hazards have occurred and affected the lives and livelihoods of the population moderately so that most households are at risk to adequate food security in a stable manner.	Moderate Food Insecure or Chronically Food Insecure

In particular, as part of the Continuum of Response, hotspots assessments are used to allocate resources when the PSNP's federal contingency budget and HRD resources are insufficient to meet the needs of the food insecure population. If this case arises, hotspots analyses are used to prioritize *woredas* that are in particularly critical need of food assistance. Moreover, hotspots assessments are used to identify *woredas* to be included in TSF, with TSF usually being conducted in priority 1 *woredas*. TSF may also be conducted as a results of (i) routine screening in Amhara, Oromiya, SNNP and Tigray and in Afar and Somali where the Health Extension Programme (HEP) is functional; (ii) six-monthly screening in Afar and Somali where HEP is not functional and; (iii) ad-hoc screening, in between the six-monthly screening, in Afar and Somali if the food security deteriorates. Screening is managed by the Woreda Health Office and implemented by health extension workers, and identifies children who are moderately or severely acutely malnourished[51].

IV.6 Integrated Food Security Phase Classification

A further tool to monitor food security consists in the Integrated Food Security Phase Classification (IPC). The IPC consists of a set of standardized tools that integrate food security, nutrition and livelihood information to classify the severity and magnitude of food insecurity, in order to facilitate early action to respond to drought. Thereby, the IPC makes use of an evidence-based approach based on international standards, to measure food security on a common scale that allows for comparability of situations across countries and over time. The IPC makes a distinction between chronic and acute food insecurity, where initial tools have been developed to measure and assess chronic food insecurity. To measure acute food insecurity, the IPC provides a classification according to five phases as detailed in Table 4 below. Thereby, the severity of the food security situation is assessed both for the time the analysis is conducted, and for a future point in time, to enable proactive decision-making as the food security situation evolves.

TABLE 4: THE IPC 2.0 FOOD SECURITY SCALE

Phase	Description
None / Minimal	More than four in five households (HHs) are able to meet essential food and non- food needs without engaging in atypical, unsustainable strategies to access food and income, including any reliance on humanitarian assistance.
Stressed	Even with any humanitarian assistance at least one in five HHs in the area have the following or worse: Minimally adequate food consumption but are unable to afford some essential non-food expenditures without engaging in irreversible coping strategies.
Crisis	Even with any humanitarian assistance at least one in five HHs in the area have the following or worse: Food consumption gaps with high or above usual acute malnutrition, OR Are marginally able to meet minimum food needs only with

[51] FDRE (2014a).

	accelerated depletion of livelihood assets that will lead to food consumption gaps.
Emergency	Even with any humanitarian assistance at least one in five HHs in the area have the following or worse: Large food consumption gaps resulting in very high acute malnutrition and excess mortality, OR Extreme loss of livelihood assets that will lead to food consumption gaps in the short term.
Famine	Even with any humanitarian assistance at least one in five HHs in the area have an extreme lack of food and other basic needs where starvation, death, and destitution are evident. (Evidence for all three criteria of food consumption, wasting, and CDR is required to classify Famine.)

In Ethiopia, the IPC 2.0 scale is used by the Famine Early Warning Systems Network (FEWS NET) in the development of food security maps. FEWS NET food security maps additionally provide information on the location of the provision of humanitarian assistance. Within Ethiopia's broader early warning framework, the IPC system could be used to substantiate the results obtained through the existing early warning tools. Specifically, the IPC could be used to act as an overlay that could structure the decision making process to respond to droughts, particularly due to the system's design that enables the simplification of complex information into actionable knowledge and response objectives.

IV.7 Potential for use of early warning tools to inform early action

As outlined above, Ethiopia has a set of instruments to predict droughts, thereby enabling early action before the food security impacts of the drought become critical, that is, following the lean season (or dry season in pastoral areas) after the harvest. Based on the available early warning systems, it is possible to define triggering events that would set off a drought response. Potential triggers that could be considered include, for instance, LEAP's intermediary outputs (WRSI or crop yield reduction estimates), or estimated beneficiary numbers based on either the LEAP or LIAS tools, or a combination thereof. In particular, by combining data obtained from the different early warning systems, it is possible to triangulate data sources to obtain a more accurate estimate of drought-related food insecurity. Based on pre-defined, objective triggers, the timeliness of drought response through Ethiopia's PSNP could be enhanced, as detailed in section V below.

The accuracy of early warning information is dependent on the quantity and quality of input data, and the robustness of the tool's methodology in predicting a disaster. The LEAP and LIAS tools are already based on a substantive amount of information[52]. However, the predictive accuracy of the tools will be enhanced further with time, as more and better data becomes available and the tools are being refined. With the development of the LEAP and LIAS tools, the GoE, WFP and wider donor community within Ethiopia have made significant advances in developing the necessary instruments to facilitate early action. The processes of further extending the LEAP tool and re-initiating the use of the HEA methodology as part of seasonal needs assessments would further enhance Ethiopia's early warning framework, thereby facilitating early action to protect lives and livelihoods from the adverse impacts of droughts.

[52] For instance, the LEAP tool makes use of different pre-loaded rainfall datasets, including the Rain Fall Estimate (RFE) datasets RFE 1 and RFE 2 produced by the United States Climate Prediction Center, ARC2 and TAMSAT data, as well as data produced by the NMA (Ethiopia's National Meteorological Agency).

V. Timing of early warning and drought response

V.1 Timeline of drought impacts and early warning information

In responding to drought events, the timeliness of the response is key in preventing harmful welfare impacts of the drought. The existing early warning tools in Ethiopia can be used to facilitate early action during the onset of a drought, thereby preventing the adverse welfare impacts of droughts.

Early action could be based on variables obtained from the existing early warning systems. For instance, as detailed in section IV.1.1, the LEAP tool produces the intermediate outputs of planting dates, WRSI and crop loss, as well as the final output of beneficiary numbers. Intermediary outputs are available for every dekad (10 day interval) as rainfall data is collected on a continual basis. While outputs can be produced by the LEAP tool at any point in time, the accuracy of estimates increases as the season progresses and the rainfall pattern during the season emerges. If intermediate outputs – such as crop loss – or the final output of beneficiary estimates are computed early during any given season, the LEAP tool assumes a normal rainfall pattern for the remainder of the season, leading to less accurate estimations. LEAP output variables are most accurate when computed in December for the *meher* season, and in July for the *belg* season. However, it would be possible to use the LEAP tool to predict drought as early as August / September in any given year, thereby enabling a timely drought response as early as December[53]. This could make a critical difference in protecting lives and livelihoods, as detailed in Section V.2 below.

Currently, the LEAP early warning information is produced jointly by GoE and the WFP, based on available rainfall data. LEAP outputs are developed and monitored within the NDRMC (former DRMFSS) as part of the GoE's overall drought monitoring and assessment framework. While LEAP data constitutes a key component of Ethiopia's early warning framework, at present, the data is not made available publicly.

As detailed in section IV.1.2, LIAS data have been collected on a bi-annual basis as part of the seasonal needs assessment process. LIAS data are collected during the months of November for the *meher* season, and in June for the *belg* season, and have been collected and held within the LIU at DRMFSS. Additionally to DRMFSS, LIAS data have been held within DP institutions, NGOs and private sector companies.

[53] At present, LEAP can produce WRSI extended to the end of the season based on climatology. A further enhancement of the tool could consist in the integration of probabilities of end of season results based on seasonal forecasts. By extending the LEAP tool in this manner, it would be possible to show higher risks of a poor end of the season, and hence a greater need to act earlier.

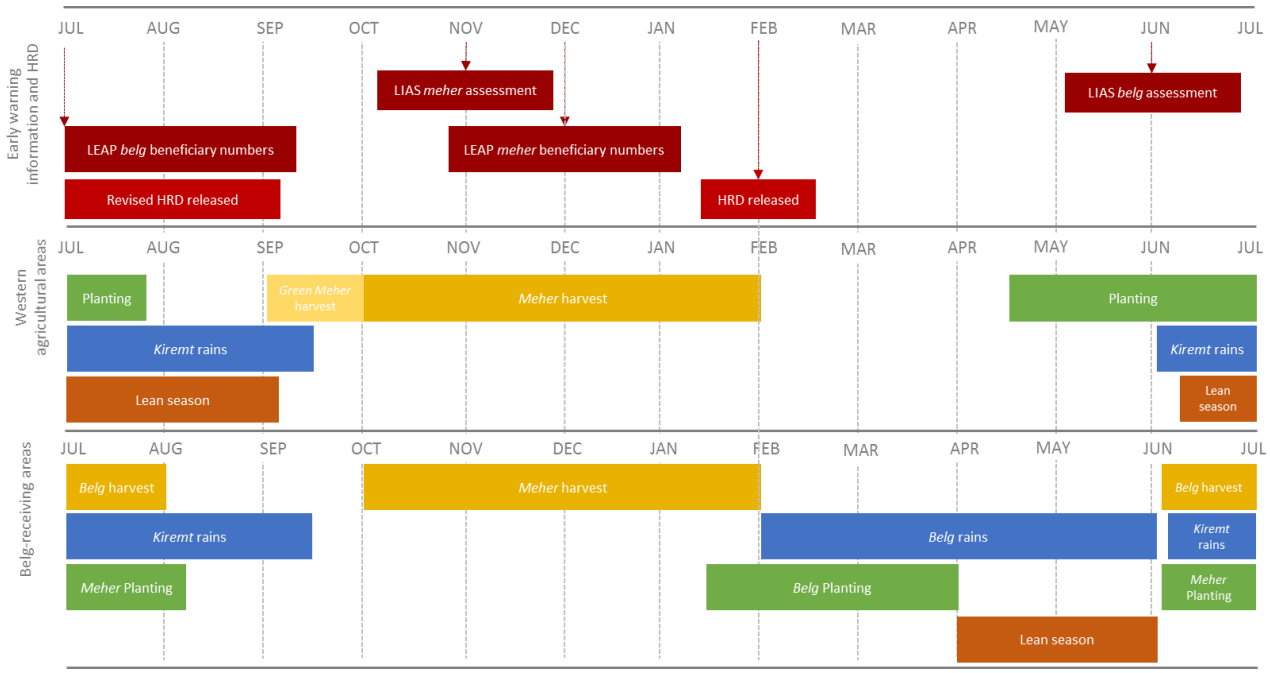

FIGURE 4: TIMELINE OF EARLY WARNING INFORMATION, HRD APPEALS, PLANTING, HARVESTING AND LEAN SEASONS (BASED ON FEWS NET 2015 AND HOBSON AND CAMPBELL 2012)

Figure 4 provides a timeline of the collection of early warning information, as compared to agricultural and lean seasons within Ethiopia and the HRD process. In particular, as the figure shows, LIAS and LEAP estimates of beneficiary numbers are available during the *meher* harvest season[54], in the months November to December for the LIAS and LEAP tools respectively. In comparison, the HRD appeal document is released typically in February, two to three months following the availability of early warning data. Further delays in drought response typically arise as humanitarian funds are secured following the release of the HRD. In particular, in Ethiopia, the time lag between the availability of early warning information and a response based on HRD appeals can take as long as eight months[55]. In comparison, the time lag between early warning and response through the PSNP's FCB (former RFM) can be reduced to as little as two months[56].

Figure 5 illustrates the use of coping strategies as droughts progress, providing an indication of actions farmers may take to protect their livelihoods and lives. The figure is stylized in the sense that there will be much variation in the response of individual farmers to a drought depending on their specific circumstances. However, based on the literature in this field[57], the sequence of the use of coping strategies tends to follow a pattern.

[54] Based on the FAO crop calendar, the bulk of the *meher* harvest (for barley, teff, wheat and maize) takes place during the months of October, November and December (FAO, 2016).

[55] Prior to the launch of the PSNP there have been initiatives to issue a national contingency plan in August/September, thereby allowing more time for mobilization, particularly in years with severe droughts and correspondingly large funding requirements. This was followed by early appeals in November to December with separate pastoral area updates later during the year.

[56] Hobson and Campbell, 2012.

[57] Clarke and Hill, 2013, Dercon, 2004, and Alemu, 2008.

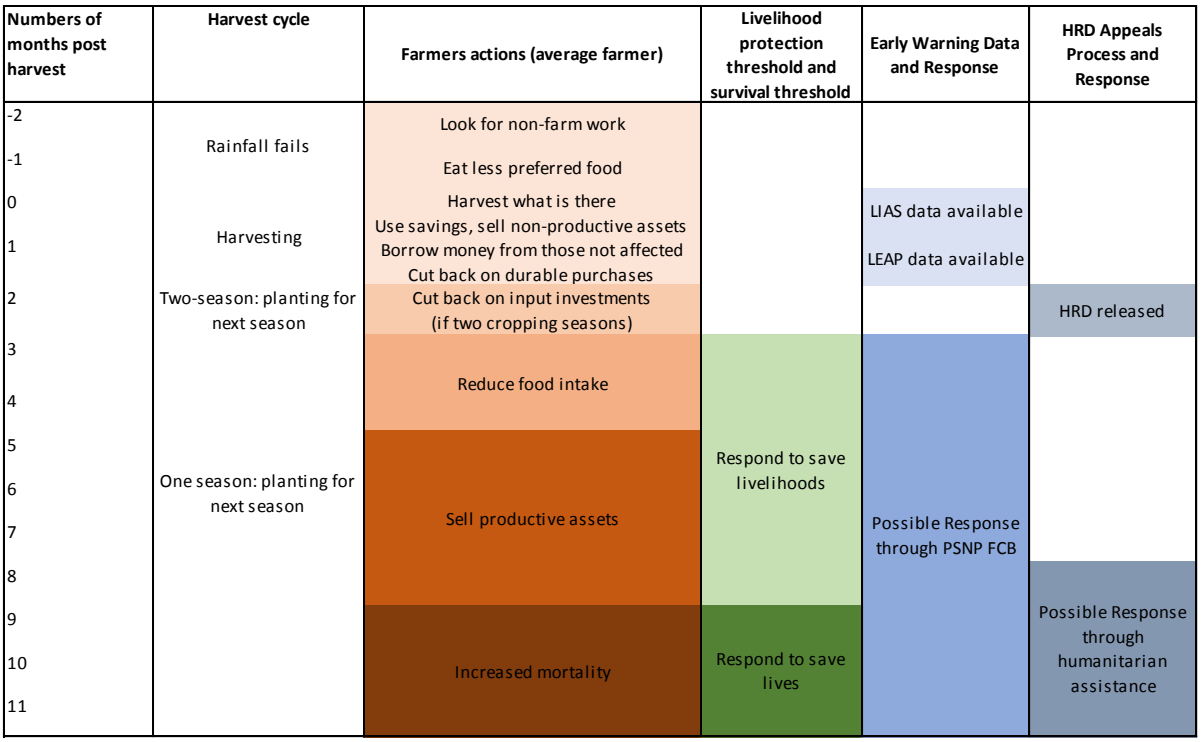

FIGURE 5: A STYLIZED TIMELINE OF DROUGHT, FARMER COPING STRATEGIES AND RESPONSE VIA PSNP FCB AND HRD APPEALS (ADAPTED FROM CLARKE AND HILL 2012)

Typically, if crops are lost due to the failure of rains, during the first two months following the harvesting season households employ relatively low cost coping strategies. These may include changing the composition of their food intake, looking for alternative employment opportunities, selling non-essential assets or borrowing money. When the use of these initial coping strategies is insufficient to ensure adequate food security, households may resort to higher cost coping strategies, such as reducing food intake and selling productive assets[58], or, for farmers in *belg*-receiving areas, investing less in farming inputs for the next season. These coping strategies may have long-term impacts on the household's livelihood strategy, and would be used by households between two and eight months following the main harvesting season as grain stocks decline and foods needs cannot be met. Upon the exhaustion of all high-cost coping strategies, drought-related mortality increases; this would occur approximately 10 or 11 months following the main harvest. Household consumption at this point would fall below the survival threshold and live-saving interventions become necessary.

Timely interventions to address food insecurity resulting from drought can prevent the need of farmers to employ high-cost coping strategies, thereby protecting lives and livelihoods. On the assumption that interventions through the PSNP's FCB would be possible within two months of the release of early warning information (Hobson and Campbell, 2012), a drought response would be feasible during the

[58] As Clarke and Hill (2013) discuss, based on evidence of the use of coping strategies, it is not clear whether households typically employ the coping strategy of reducing food intake or selling productive assets first. However, Lybbert et al. (2004) shows that drought in Southern Ethiopia did not cause farmers to sell livestock, indicating that typically farmers try to avert the loss of productive assets and use this coping strategy only when all other coping strategies are insufficient to secure food requirements.

early stages of the use of harmful coping strategies by farmers (three to eight months following the main harvesting season), and prior to the phase where live-saving interventions become necessary (nine to eleven months following the main harvesting season). Moreover, seasonal monitoring data are available earlier than LEAP and LIAS data, enabling the detection of a failed start of a season, as well as rainfall deficits prior to the final phase of crop development. Jointly, monitoring and early warning data could therefore enable a timely drought response[59]. In contrast, interventions through HRD appeals are typically associated with time delays as funds are raised, leading to response interventions during the time where coping strategies are near their exhaustion and emergency assistance is required (eight to eleven months following the main harvesting season). The timing of HRD appeal funding makes the HRD process particularly well-suited to addressing emergency needs that may arise when PSNP FCB funds are exhausted early.

V.2 The welfare benefits of a timely drought response

The impacts of droughts on household welfare have been studied in the academic literature. In particular, a body of research in Ethiopia has demonstrated that droughts have significant adverse impacts on household consumption and may cause households to lose valuable productive assets. Droughts also negatively affect farmers' health, leading to a higher incidence of morbidity caused by the development of a range of diseases.

Investigating the impacts of droughts on household consumption, Dercon, Hoddinott and Woldehanna (2005) show that experiencing a drought at least once in the previous five years lowers per capita consumption by 20%. Moreover, the authors show that 41% of households lose productive assets and 77% of households experience a loss of income and consumption as a result of droughts. In a similar spirit, Yamano, Alderman and Christiaensen (2005) showed that crop losses associated with droughts result in reduced consumption, affecting the growth of Ethiopian children particularly in the 6-24 months age group. Estimates suggest a 50% crop loss results in a reduction of 9 mm of height over six months. A recent study by Devarajan et al. (2013) shows that a severe drought in Ethiopia would cause an immediate reduction in consumption of 6 percentage points. The authors show also that droughts may lead to significant increases in food prices, which may further jeopardize farmers' ability to secure their food needs.

A late response to droughts will imply a greater need for providing food assistance. This link has been studied by Alemu et al. (2008), who find that in Ethiopia, grain storage will decline following the main *meher* harvesting season. In particular, on average grain storage of the median farmer in Ethiopia will last up to seven months following the *meher* harvest, with a decreasing proportion of all farming households having grain in storage as the season progresses (Clarke and Hill, 2012). As illustrated in Figure 6, the duration of the stocks depends on farm size, with just 35% of the stocks of small farmers lasting six months, while more than 60% of the stocks of large farms did. After ten or eleven months following the *meher* harvest, the proportion of farms that hold grain storage is low for all farm sizes.

[59] A timely drought response is key not only due to food insecurity, but also due to non-food needs. In particular, in a severe drought, water, and health become more important as the food security outcomes tend to be more severe. These sectors often have less capacity and are more costly per person. Timely intervention is therefore key to enable a comprehensive drought response in both the food and non-food sectors.

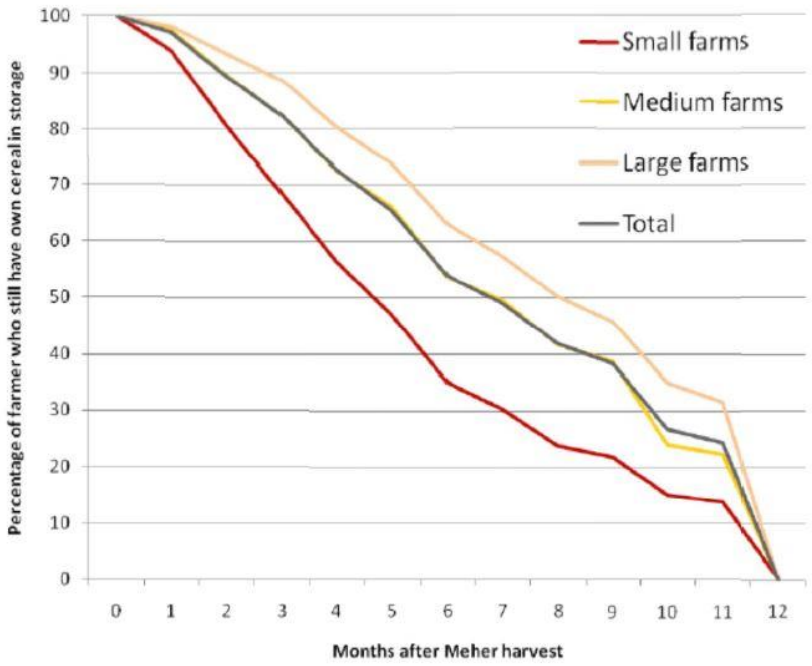

FIGURE 6: GRAIN STORAGE FOLLOWING MEHER HARVEST (REPRODUCED FROM ALEMU ET AL. 2008)

Droughts may also cause significant long-term welfare losses, as farmers lose productive assets and are not able to recuperate their asset base following the drought shock. For instance, Dercon 2004 showed that even ten years after the mid-1980s drought in Ethiopia, cattle holdings were only two-thirds of their size prior to the drought. The author showed also that households that reduce consumption and sell assets due to droughts are particularly severely affected in the long run. Investigating data from southern Ethiopia, Lybbert (2004) finds that pastoralists whose stock of cattle had been reduced to 15 head of cattle or less did not recover, and reduced their herd of cattle further. Only a third of households that lost more than 25% of their cattle were able to recover to 95% of their cattle stock over three years (see also Clarke and Hill, 2012).

Droughts are associated not only with malnutrition, but also with other adverse health impacts. Dercon and Krishnan (2000) show, rainfall shocks have a significant impact on BMI, with poor rainfall leading to a loss of BMI by 0.9%. Dercon and Hoddinott (2003) argue that body weight may also be correlated with the peak season, such that the body is used as a storage of energy in anticipation of future lean periods. This evidence indicates that the allocation of energy over seasons is not efficient.

VI. Discussion and conclusion

Ethiopia is vulnerable to frequent and severe droughts, hampering the country's strong growth potential and jeopardizing the significant development progress it has made over the past ten years and continues to make today. To strengthen its disaster risk management framework and ensure an effective response to droughts, the GoE has developed the National Policy and Strategy on Disaster Risk Management, and put in place the Disaster Risk Management Strategic Program and Investment Framework (DRM-SPIF) to enable the realization of the objectives set out in the National Policy of Disaster Risk Management. Moreover, the GoE has convened development partners, raised investments, established institutions

and facilitated the development of information to manage drought risks. Based on these significant advances, Ethiopia is well-placed to further reduce its vulnerability to drought risks.

A key feature in sound and sustainable drought risks management is the ability to respond early. In particular, as this paper showed, the large adverse impacts of droughts are compounded when assistance is provided late. A late response to droughts is associated with reductions in consumption, long-term welfare losses, malnutrition and excess mortality. By using early warning systems to trigger early action, it is possible to reduce the negative impacts of droughts on household welfare, and to protect Ethiopian farmers from the loss of lives and livelihoods.

With the LEAP and LIAS tools, combined with hotspots assessments, Ethiopia has the building blocks for a sound framework for early warning. Based on the LEAP and LIAS tools, it is possible to define early no-regrets triggers for the release of the PSNP's FCB. In particular, the LEAP and LIAS tools produce a range of variables, such as WRSI, yield reduction, and beneficiary numbers that could be used to define early no-regrets triggers. Basing actions during the onset of a drought on clearly defined triggers could lead to an increase in the timeliness of drought response, and would enhance the objectivity and transparency of the process to respond to droughts. For instance, the LEAP tool could be used to produce early warning data as early as August / September during a given calendar year, enabling a drought response by December, thereby protecting lives and livelihoods from the adverse impacts of droughts. The integration of seasonal climate forecasts into LEAP will provide a stronger basis for applying earlier crop production and needs estimates from LEAP.

The GoE and its DPs are continually improving the existing warning tools to address current limitations. For instance, the GoE, ACCRA and Oxfam are jointly developing a tool to estimate need based on *woreda* risk profiles. Moreover, the NDRMC is working on the development of a multi-sector early warning system based on *woreda* risk profiles, thereby further enhancing its existing early warning framework. In addition, the existing LEAP tool is being refined to include market data, to incorporate information to predict need in the pastoral regions of Afar, Somali and Borena, and to predict needs associated with flood risks. Similarly, LIAS baselines for the highlands regions are being updated in the course of 2016, to reinitiate the collection of LIAS data; with updated baselines and continued investment in the tool, it would be possible to reinitiate the use of LIAS data as part of seasonal needs assessments. These extensions and improvements will further strengthen Ethiopia's early warning systems. Moreover, as more and better data become available with time, the predictive accuracy of the LEAP and LIAS tools will be improved further. The LEAP and LIAS tools in combination with hotspots and IPC assessments could be used jointly to trigger early action, where different sources of data could be triangulated to enhance accuracy.

Ethiopia's current drought response mechanisms are centered on the use of PSNP contingency budgets and the HRD appeals process. The integration between the PSNP's FCB and HRD Appeal process could be enhanced further by combining fast, early action based on early warning data with a slower response through the HRD process. In particular, approximate early warning-based no-regrets triggers could be used as a mechanism to effectively address needs associated with high-frequency, low-intensity drought events. Early warning data collected during the beginning of a rainy season (for instance, in August / September for the *meher* season and in April / May for the *belg* season) could be used to trigger early action, thereby preventing some of the worst impacts of a drought. By contrast, the HRD process could

be used to respond to residual needs associated with low-frequency, high-intensity events. This could enable a cost-effective and timely drought response.

Key advantages of this approach would include that implementing a risk layering approach could allow Ethiopia to match the timing of the availability of resources more closely with need. Moreover, with sufficient financing for the PSNP's FCB, humanitarian appeals could be used to address high intensity events only, allowing Ethiopia to reduce its recourse to humanitarian resources in addressing drought risks. Finally, by combining risk financing instruments as part of a risk layering approach, Ethiopia could enhance the predictability of funding, such that the timing of funding would coincide, to a greater extent, with need. The implementation of a risk layering strategy could therefore also limit the negative welfare impacts associated with a late response to drought.

As this paper has argued, droughts cause a toll on development, dampen growth and divert scarce resources from development efforts. The systematic management of drought risks is therefore an important factor in enabling Ethiopia to sustain its impressive growth trajectory over the past ten years, and facilitating Ethiopia's further progress towards its goal of becoming a middle-income country by 2025. The objective of further enhancing its drought management capacity is expressed, for instance, in the DRM SPIF:

"As aggressive goals of broad based economic growth and social development are envisioned for the country in the coming five years, a comprehensive Disaster Risk Management (DRM) system is called for to reduce disaster risk and the impacts of disasters, and to protect development gains." (FDRE 2014d)

The DRM-SPIF also reiterates the importance of early warning information in enabling a sound DRM framework:

"*The GTP emphasizes the importance of strengthening Ethiopia's existing early warning system and the capacity to respond to disasters*" (FDRE 2014 d).

Leveraging the scope of existing early warning tools to inform early action, further improving the early warning framework and enhancing the role of early warning tools within the Continuum of Response would allow Ethiopia to progress further in achieving these objectives, thereby protecting its development gains and ultimately safeguarding the lives and livelihoods of Ethiopians vulnerable to drought risks.

References

Dawit Alemu, Gezahegn Ayele, Befekadu Behute, Yodit Beyone, Reno Dewana, Belay Fekadu, Ruth Vargas Hill, Nicholas Minot, Shahidur Rashid, Alemayehu Taffesse and Nigussie Tefera (2008): *Cereals Availability Study in Ethiopia, 2008. Development of a spatial equilibrium modelling approach to study the impact of policy intervention on cereals availability*. European Union, 2012.

Guush Berhane, Kalle Hirvonen and John Hoddinott (2015): *The Implementation of the Productive Safety Nets Programme, 2014: Highlands Outcomes Report*. International Food Policy Research Institute.

Tanya Boudreau (2009): *Solving the risk equation: People-centred disaster risk assessment in Ethiopia.* Humanitarian Practice Network at overseas Development Institute. Discussion Paper 66.

Daniel Clarke and Ruth Vargas Hill (2012): *Cost-Benefit Analysis of the African Risk Capacity Facility.* International Food Policy Research Institute (IFPRI).

Daniel Clarke, Sarah Coll-Black, Naomi Cooney and Anna Edwards (2016): *A methodology to assess indicative costs of risk financing strategies for scaling up Ethiopia's Productive Safety Net Programme*. World Bank Policy Research Working Paper.

Stefan Dercon, Stefan, and Pramila Krishnan (1997): *In Sickness and in Health: Risk-Sharing within Households in Rural Ethiopia.* Working Paper no. 97/12. Oxford: Centre Study African Economies, 1997.

Stefan Dercon and John Hoddinott (2003): *Health, Shocks and Poverty Persistence.* World Institute for Development Economics Research Discussion Paper No. 2003/08.

Stefan Dercon (2004): *Growth and* Shocks*: evidence from Rural Ethiopia*. Journal of Development Economics 74 (2): 309-29.

Stefan Dercon, John Hoddinott and Tassew Woldehanna (2005): *Shocks and consumption in 15 Ethiopian Villages, 1999-2004.* Journal of African Economies 14(4): 559-585.

Shantayanan Devarajan, Delfin S. Go, Maryla Maliszewska, Israel Osorio-Rodarte, and Hans Timmer (2013). *Stress-testing Africa's recent growth and poverty performance*. Technical report, The World Bank.

Jan Doorenbos and Amir Kassam (1979): *Yield response to water*. FAO Irrigation and Drainage Paper No. 33. Rome, FAO.

FAO (2016): *GIEWS Country Brief Ethiopia*. Available at http://www.fao.org/giews/countrybrief/country/ETH/pdf/ETH.pdf

FDRE Disaster Risk Management & Food Security Sector, MoARD and USAID: *The Livelihoods Integration Unit Uses of the Baseline Information and Analysis*.

FDRE Ministry of Agriculture, Disaster Risk Management and Food Security Sector, Food Security Coordination Directorate (2011): *Productive Safety Net and Household Asset Building Programs Annual Work Plan and Budget for 2011/12 (2004 EFY).*

FDRE (2014a): *Productive Safety Net Programme Phase IV Programme Implementation Manual*. Ministry of Agriculture, Federal Democratic Republic of Ethiopia.

FDRE (2014b): *Hotspot (Woredas of Concern) Classification Guideline.* Early Warning and Response Directorate, Disaster Risk Management and Food Security Sector.

FDRE (2014c): *National Policy and Strategy on Disaster Risk Management*. Federal Democratic Republic of Ethiopia.

FDRE (2014 d): *Disaster Risk Management Strategic Programme and Investment Framework.* Disaster Risk Management and Food Security Sector. Ministry of Agriculture, Federal Democratic Republic of Ethiopia.

FDRE (2015): *The Second Growth and Transformation Plan (GTP II) (2015/16-2019/20). Draft*. National Planning Commission. September 2015.

FDRE Ministry of Agriculture and Natural Resource Rural, Job Opportunity Creation and Food Security Sector, Food Security Coordination Directorate (2016): *Productive Safety Net Programme (PSNP IV) Annual Work Plan and Budget for 2015/16 (2008 EFY).*

FDRE and Humanitarian Partners (2016): *Humanitarian Overview 2016*. Joint Government and Humanitarian Partners' Document. Available at https://www.humanitarianresponse.info/fr/system/files/documents/files/ethiopia_-_synopsis_of_hrd_2016_-_as_presented_in_geneva_7_december.pdf

Famine Early Warning Systems Network (FEWS NET) (2015): *Ethiopia Food Security Outlook October 2015 to March 2016*. Available at http://www.fews.net/sites/default/files/documents/reports/Ethiopia_OL_2015_10.pdf

Food Economy Group (FEG) (2015): *PSNP Contingency Fund Decision Making Study*. Unpublished manuscript.

D. Guha-Sapir, R. Below, Ph. Hoyois - EM-DAT: *The CRED/OFDA International Disaster Database*. www.emdat.be – Université Catholique de Louvain – Brussels – Belgium.

Nicholas Haan, Nisar Majid and James Darcy (2006): *A review of emergency food security assessment practice in Ethiopia*. Humanitarian Policy Group (HPG) Research Report. A study commissioned by and prepared for the World Food Programme, Rome.

Laura Hammond and Daniel Maxwell (2002), *The Ethiopian Crisis of 1999–2000: Lessons Learned, Questions Unanswered*. Disasters, 26: 262–279.

Ruth Vargas Hill and Catherine Porter (2015): *Shocks, Safety Nets and Vulnerability to Poverty in Ethiopia*. Available at https://www.researchgate.net/publication/281774460_Shocks_Safety-nets_and_Vulnerability_to_Poverty_in_Ethiopia

Matthew Hobson and Laura Campbell (2012): *How Ethiopia's Productive Safety Net Programme (PSNP) is responding to the current humanitarian crisis in the Horn.* Available at http://odihpn.org/magazine/how-ethiopia%C2%92s-productive-safety-net-programme-psnp-is-responding-to-the-current-humanitarian-crisis-in-the-horn/

Peter Hoefsloot, Sandro Calmanti, Muktar Reshid and Anna Law (2013): *LEAP version 3.0 for Ethiopia user manual.* Government of Ethiopia, World Food Programme and World Bank.

Travis J. Lybbert, Christopher B. Barrett, Solomon Desta, and D. Layne Coppock (2004): *Stochastic Wealth Dynamics and Risk Management among a Poor Population*. The Economic Journal 114: 750–777.

OECD (2014): *Climate Resilience in Development Planning: Experiences in Colombia and Ethiopia.* OECD Publishing. http://dx.doi.org/10.1787/9789264209503-en

Save the Children and Food Economy Group (2013): *Livelihoods at the Limit: Reducing the Risk of Disasters and Adapting to Climate Change. Evidence from the Consolidated Household Economy Analysis Database.*

Save the Children and Food Economy Group (2014): *Livelihoods at the Limit: The Story of Household Economy Analysis. Developing an Approach to Prevent Food Crises.*

Rachel Slater and Dharini Bhuvanendra (2014), *Scaling up existing social safety nets to provide humanitarian response*. Overseas Development Institute / Humanitarian Futures Programme / King's College London. Available at http://www.humanitarianfutures.org/wp-content/uploads/2013/12/Annex-3-Scaling-up-Social-Protection.pdf

UN OCHA (2011): *Humanitarian Requirements for the Horn of Africa Drought 2011*. Available at http://www.unocha.org/cap/appeals/humanitarian-requirements-document-horn-africa-drought-2011

UN OCHA (2016): *Ethiopia: Drought Response Situation Report No. 01 (as of 4 April 2016)*. Federal Disaster Risk Management Technical Working Group.

USAID and FDRE Disaster Risk Management and Food Security Sector, MoARD: *The Livelihoods Integration Unit Uses of the Baseline Information and Analysis.*

World Bank (2009): *Ethiopia - Third Adaptable Program Loan Productive Safety Net Project*. World Bank, Washington D.C.

World Bank and GFDRR (2011): *Ethiopia: Disaster Risk Financing and Insurance Country Note*. World Bank, Washington D.C.

World Bank (2011): *Food Aid Project Helps Millions of Ethiopians Face Drought*. Feature Story. Available at http://www.worldbank.org/en/news/feature/2011/10/04/food-aid-project-helps-millions-of-ethiopians-face-drought

World Bank (2014a): *The State of Social Safety Nets 2014.* World Bank, Washington D.C. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/18376/879840WP0FINAL00Box385208B00PUBLIC0.pdf

World Bank (2014b): *Ethiopia Fourth Productive Safety Nets Project – Project Appraisal Document*. World Bank, Washington D.C.

World Bank (2014c): *Financial Protection Against natural Disasters. An Operational Framework for Disaster Risk Financing and Insurance*. Available at https://olc.worldbank.org/sites/default/files/Financial%20Protection%20Against%20Natural%20Disasters.pdf

Takashi Yamano, Harold Alderman, and Luc Christiaensen (2005): *Child Growth, Shocks, and Food Aid in Rural Ethiopia*. American Journal of Agricultural Economics.

Annex 1: Data Sources Used and Computation of Beneficiary Numbers

Data sources

Simulated zonal-level poverty data

In order to obtain objective, transparent and verifiable estimates of the extent of poverty associated with drought events, simulations of poverty numbers given a certain drought shock were produced based on econometric analyses. In particular, the analysis is based on consumption data obtained from the combined 2010 / 11 Household Income and Consumption Expenditure and Welfare Monitoring Surveys (HICES/WMS), which contain information on approximately 25,000 households in a nationally representative sample. To estimate the number of people in poverty, HICES consumption data was used, in particular, expenditure on food and other items. Simulated poverty numbers were produced at the zonal level, as HICES / WMS survey data is not representative at the *woreda* level.

The poverty line used was 1075 Ethiopian Birr (1996 prices), which is the cost of 2200 kcal per adult equivalent per day, plus very basic non-food items such as cooking fuel. To compute the 90% and 75% poverty lines respectively, which reflect the number of people living in extreme poverty, consumption of less than 1980 kcal and 1650 kcal per day were used.

Simulated poverty numbers have been calculated using baseline 2010/11 consumption data. Poverty numbers for the year 2010 therefore reflect the numbers of people living in poverty based on actual consumption, as reflected in survey data. For all other years, simulated poverty numbers are calculated by combining the 2010 baseline poverty numbers with deviations of the rainfall and crop loss data from the baseline year. In particular, baseline consumption was adjusted for the amount of rainfall/crop loss in subsequent/previous years, multiplied by the impact on consumption as per the regression model of Hill and Porter (2014).

WRSI crop loss data was provided by Disaster Risk Management and Food Security Sector (DRMFSS) and WFP, and represents an intermediate output of the LEAP tool (see section IV.1.1). LEAP crop loss data was unavailable for the zones 509, 1301 and 1501.

The approach used here to simulate poverty numbers based on consumption and crop loss data has advantages and limitations. In particular, limitations of the approach pursued here include that the conducted estimations are not adjusted for population differences between baseline years, nor for growth in consumption other than that which is generated by rainfall differences (i.e. no structural changes). Advantages include that the approach taken is objective and transparent, and has a clear focus on drought-induced consumption poverty. Finally, estimated poverty numbers isolate the effect of drought on poverty as conflating factors, as the effects of economic, social, or program changes over time on consumption poverty are not taken into account.

HRD Appeal Numbers (emergency numbers)

HRD appeal numbers are based on Humanitarian Requirements Documents, as published by GoE and its Humanitarian Partners on a bi-annual basis. Specifically, HRD Appeals correspond to the main agricultural seasons *meher* and *belg*, with the HRD appeal numbers for the *meher* season typically published in March, and updated for the *belg* / *gu* / *ganna* / *sugum* season in July. The *meher* assessment thereby takes into account beneficiary numbers estimated after the rains during the months of June to September in the cropping areas, and after the October to November rains in the pastoral

areas. The *belg* assessment is based on beneficiary estimations following the February to May rains in the cropping and pastoral regions.

HRD *meher* and *belg* beneficiary numbers are available at the *woreda* level, with *meher* beneficiary numbers available for the years 2005 to 2014 and *belg* beneficiary numbers available from 2004 to 2015. HRD *belg* beneficiary numbers were unavailable for the year 2012. Total HRD / emergency numbers are the sum of the *meher* and *belg* beneficiary numbers.

Productive Safety Net Programme Regular Caseload

PSNP beneficiary numbers are available on an annual basis at the *woreda* level from PSNP annual work plans, which are developed by the Ministry of Agriculture and Natural Resources (MoANR, former MoARD). The PSNP annual work plans reflect planned, rather than actual beneficiary numbers. However, typically deviations between actual and planned PSNP beneficiary numbers are relatively small.

PSNP III Risk Financing Mechanism Beneficiary Numbers

The number of additional beneficiaries who received transfers as a result of the use of the PSNP III's Risk Financing Mechanism (RFM) was computed based on quarterly expenditure data for the PSNP Program. In particular, PSNP expenditures at the *woreda* level were obtained from the PSNP Interim Financial Reports (IFRs) produced by the Ministry of Finance and Economic Cooperation (MoFEC, former Ministry of Finance and Economic Development) of the Government of Ethiopia. To obtain *woreda*-level beneficiary estimates, *woreda* level expenditures for a given months of the Ethiopian calendar were converted in the corresponding Gregorian calendar month within each quarter. In accordance with the PSNP's regulation of a maximum of 15 labor days per person per month, final beneficiary numbers were obtained by dividing expenditures by the daily salary and number of labor days per person. Expenditures under the RFM were made in the Ethiopian financial years 2011/2012 and 2014/2015. RFM beneficiary numbers used in Figure 2 are based on disbursement requests for the PSNP's Risk Financing Mechanism.

LEAP Beneficiary Numbers

LEAP beneficiary numbers at the woreda, regional and federal level were obtained from Disaster Risk Management and Food Security Sector (DRMFSS) and World Food Programme (WFP) respectively. In particular, LEAP *meher* beneficiary numbers at the woreda, regional and federal level were made available by WFP for the years 2008 to 2015, and reflect estimates of beneficiary numbers based on planting dekad 29 for each year. LEAP beneficiary numbers for the *meher* season were available for the regions Amhara, Oromiya, SNNPR, Tigray and Gambella, and were unavailable for the regions Afar, Somali, Benishangul - Gumuz, and Harari.

LEAP *belg* beneficiary numbers at the zonal level, regional and federal level were obtained from DRMFSS for the years 2008 to 2014. Beneficiary numbers for all years reflect the planting dekad 36. Beneficiary numbers for the *belg* season was available for the regions Amhara, Oromiya, SNNPR and Tigray, and unavailable for Gambella, Afar, Somali, Benishangul - Gumuz, and Harari.

LIAS Beneficiary Numbers

LIAS spreadsheets were obtained from FEWS NET, and provide woreda-level beneficiary estimates, both for the survival deficit and livelihood protection threshold. In this analysis, beneficiary numbers reflect the number of people falling below the survival deficit. HEA baseline data representing the year 2008

was available for all regions. LIAS spreadsheets were available for the years 2009 to 2014 for some regions, as follows:

Year	Season	Region
2009	*Meher*	▪ Amhara ▪ Oromiya ▪ SNNPR ▪ Tigray
	Belg	▪ Oromiya
2010	*Meher*	▪ Amhara ▪ Oromiya ▪ SNNPR
	Belg	▪ SNNPR ▪ Tigray
2011	*Meher*	▪ Amhara ▪ Tigray
	Belg	N/A
2012	*Meher*	N/A
	Belg	N/A
2013	*Meher*	▪ Tigray
	Belg	▪ Amhara
2014	*Meher*	▪ Oromiya
	Belg	▪ Amhara ▪ SNNPR

Process to match data sources

Data sources were matched manually on a *woreda* by *woreda* basis. This included, in particular, matching *woreda* level HRD appeal numbers, PSNP core caseload numbers, expenditures associated with the use of the PSNP III's Risk Financing Mechanism, and beneficiary numbers based on the LEAP and LIAS tools. Possible limitations in data matching were associated with different transcriptions of Amharic district names, and the evolving structure of districts over time. *Woreda*-level data sources (HRD appeal numbers, PSNP regular caseload, PSNP RFM beneficiary numbers, LEAP *meher* beneficiary numbers and LIAS beneficiary numbers) were matched with zonal-level data (simulated poverty estimates and LEAP *belg* beneficiary numbers) using the HICES / WMS zone code names.

Annex 2: The use of sovereign disaster risk financing instruments in a risk layering approach

The government's key role in emergency relief and recovery implies that natural disasters, such as droughts, are often associated with significant fiscal risks. In particular, disasters often necessitate emergency relief interventions, such as, for instance, the provision of food or medical aid in case of a drought, representing a significant contingent liability to the government. Following a disaster event, countries therefore often experience macroeconomic instability and major public sector budget variability, leading to reduced coverage and quality of public services and high debt levels.

To protect both people and assets from the adverse impacts of natural hazards and to reduce the impact of disasters on the public budget, governments can employ instruments to manage disaster risks. In particular, Disaster Risk Financing and Insurance (DRFI) instruments, such as contingent budget, contingent credit or disaster risk insurance, can help governments achieve greater financial resilience against disaster risks and increase their capacity to better plan and manage the financial impacts of natural disasters. DRFI instruments can also help governments in accessing finance in the immediate aftermaths of disaster events, thereby enabling the government to address financial needs associated with the provision of emergency assistance. An Operational Framework for Disaster Risk Financing and Insurance can be found in World Bank (2014c).

In classifying DRFI instruments, one can distinguish between those instruments that can be mobilized after a disaster strikes, such as budget reallocation or post-disaster credit, and instruments that need to be established before disasters strike, such as contingent credit or insurance. A further distinction can be made between risk retention instruments, which mobilize financial resources at the sovereign level, and risk transfer instruments, which transfer disaster risks to international markets. Risk retention instruments include, for instance, reserve funds or budget reallocation, and risk transfer instruments comprise catastrophe bonds, catastrophe swaps, and disaster risk insurance.

In managing financial risks associated with disasters, two key considerations are the costs of different financial instruments and the timing of the availability of funds. In particular, different financial instruments are associated with different costs of use, amounts of money made available when a disaster strikes, and speed of access. By combining different DRFI instruments as part of a risk layering approach, governments can structure their financial needs associated with disaster events such that the timing of the availability of funds matches needs, and such that sufficient funding is made available.

Figure 7 below illustrates the risk layering approach. Thereby, government reserves and contingency budgets can be made available in the immediate aftermaths of disaster events, allowing for a timely and efficient response to the disaster event. However, due to the high opportunity costs of holding contingency budgets, this instrument is best suited to meet financial needs associated with high frequency, low intensity events. Contingent credit lines may be used to address less frequent, more severe events, due to relatively higher costs of access to finance. However, the amount of funding made available under contingent credit lines is typically larger than that available through reserve funds, allowing for the coverage of relatively larger post-disaster needs. Finally, disaster risk insurance is often used to address very infrequent, high intensity events, as insurance is often associated with significant financial costs. On the other hand, insurance can represent an effective instrument that allows governments to spread potentially high costs associated with disaster risks over time, thereby reducing public sector budget variability.

FIGURE 7: THREE-TIERED RISK LAYERING STRATEGY FOR GOVERNMENTS (REPRODUCED FROM WORLD BANK, 2014C).

By combining DRFI instruments as part of a risk layering approach, governments can ensure that cheaper sources of finance are used first, and more expensive instruments are used only for very infrequent, high impact events. A sound financial protection strategy for the government generally combines both pre-and post-disaster financing instruments and links specific DRFI instruments to needs associated with disasters of different frequencies and severities.

Annex 3: Regional Breakdown of LEAP and LIAS Data

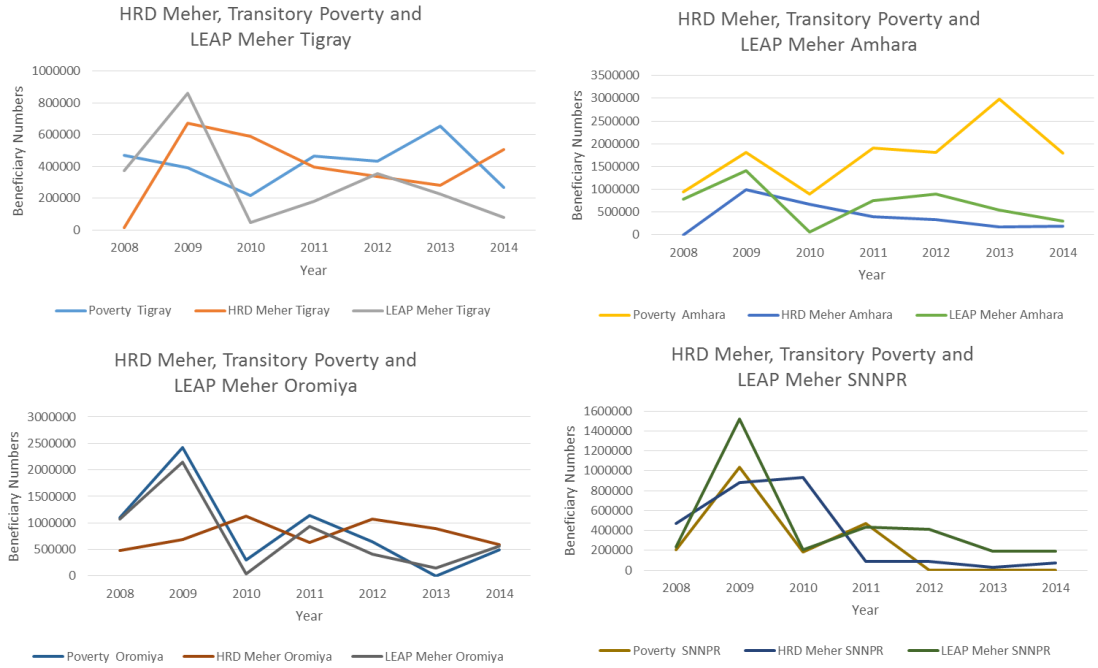

FIGURE 8: HRD, TRANSITORY POVERTY AND LEAP DATA FOR THE MEHER SEASON BY REGION

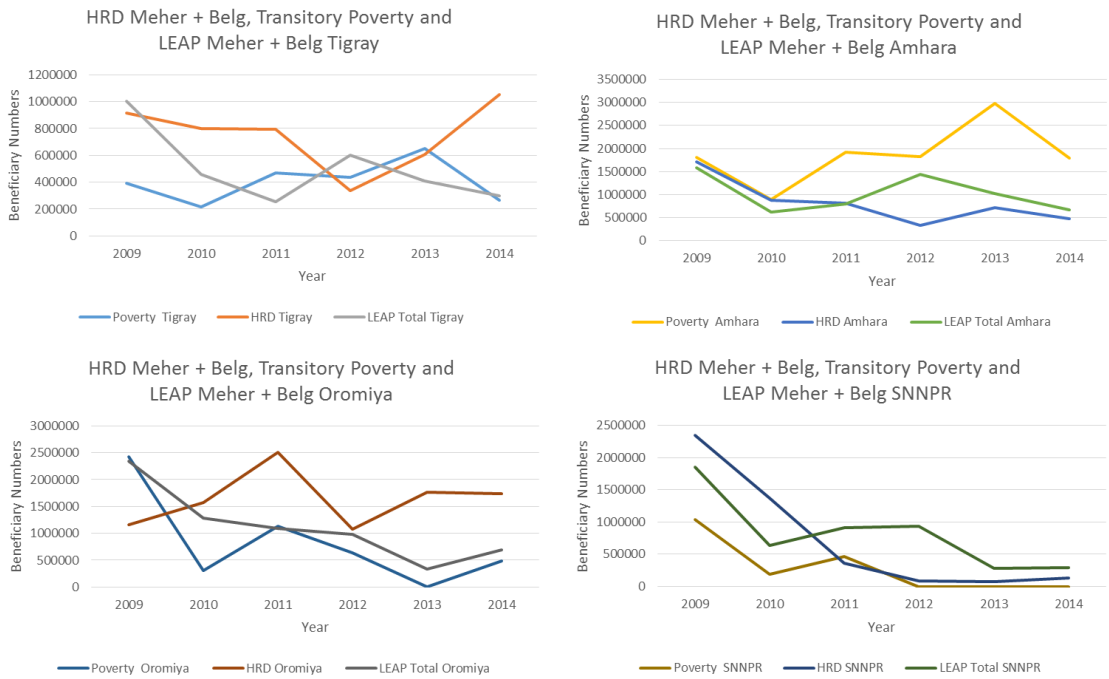

FIGURE 9: HRD, TRANSITORY POVERTY AND LEAP DATA FOR THE MEHER AND BELG SEASONS BY REGION

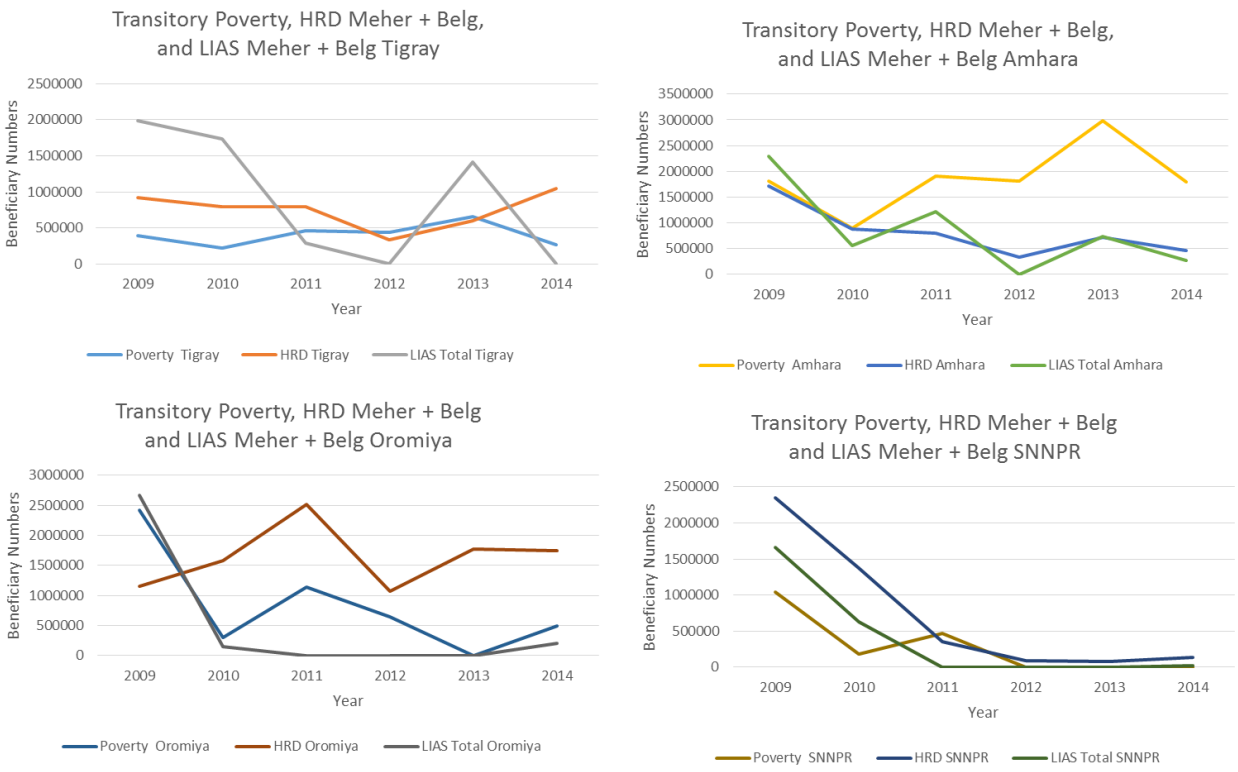

FIGURE 10: HRD, TRANSITORY POVERTY AND LIAS DATA FOR THE MEHER AND BELG SEASONS BY REGION