Ethiopia

Ethiopia: The Case of the 2015–16 El Niño

Tsegay Wolde-Georgis, Amanuel A. Gebru, Yosef Welderufael Kinfe, and Kibret Mamo Bahiru

Abstract Ethiopian society has historically been vulnerable to climate-related hazards. The main hazard drivers are the ENSO extremes of El Niño and La Niña. The diversity of microclimates due to the topography of this tropical country paired with weak economic and institutional development, have made the impact of climate on society very complicated. Before the 1990s, there were no planned disaster risk management (DRM) strategies that strongly contributed to coping with the societal impacts of El Niño (impacts that were not only directly related to the strength of ENSO but also to weak social responses). The 2015–16 El Niño is now considered stronger than the 1982–83 event that was associated with the historic Ethiopian famine of the 1980s. Ethiopia's socioeconomic development was improving during the 2015–16 El Niño which prompted some stakeholders to conduct monitoring, early warning, and various preparations in response to the very strong event. Therefore, the impacts of El Niño's effects were minimal and were managed by the government and its partners. Political stability including the strengthening of DRM through the autonomous Disaster Prevention and Preparedness Commission (DPPC) had been important between 1991–2020. The disaster that could have taken place due to the 2015–16 El Nino was averted because of the lessons taken from previous El Niño impacts. The war that erupted in 2020 and the government-imposed embargo on its Tigray province has led to man-made famines in the region.

Keywords Ethiopia · El Nino · DRM · Famine

T. Wolde-Georgis (✉)
Consortium for Capacity Building (CCB), INSTAAR/The University of Colorado, Boulder, CO, USA

A. A. Gebru
Institute of Climate and Society, Mekelle University, Mekelle, Ethiopia

Y. W. Kinfe
General Manager, Yosef W/Rufael Water Works & Environmental Modelling Consulting Company (Y3WEM2C), Addis Ababa, Ethiopia

K. M. Bahiru
Climate Change Adaptation and Risk Reduction Advisor, World Vision, Addis Ababa, Ethiopia

M. H. Glantz (ed.), *El Niño Ready Nations and Disaster Risk Reduction*,
Disaster Studies and Management, https://doi.org/10.1007/978-3-030-86503-0_12

Fig. 1 Map of Africa highlighting Ethiopia

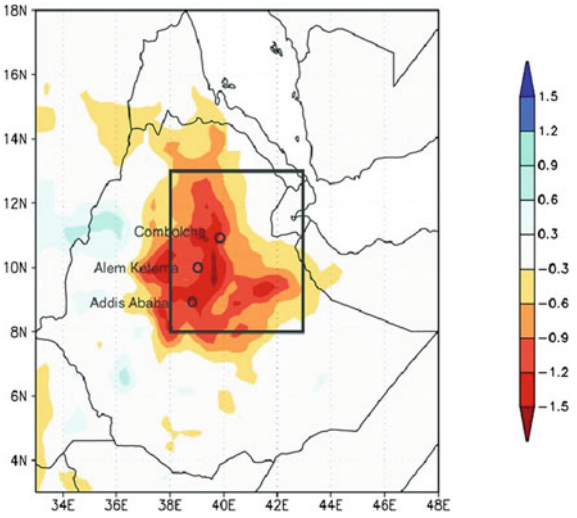

Fig. 2 Anomaly in precipitation (CHIRPS; precipitation minus 1981–2010 climatology) averaged over February-September 2015 (mm day-1). (Sjoukje 2018)

Note: From June 2015 until the end of 2016, Ethiopia (Fig. 1) experienced one of the worst droughts in decades, which had a devastating impact on people's lives and livelihood (Fig. 2). At the peak of the crisis in April 2016, 10.2 million people were aided with life-saving food assistance, and an additional 7.9 million people benefitted from the Productive Safety Net Programme (PSNP). The El Niño-induced drought was followed by extensive flooding that affected 480,000 people, of whom 190,000 were displaced. The severe drought combined with floods and disease outbreaks, such as Acute Watery Diarrhea, substantially eroded people's coping capacities, further increasing the level of need. The impact of the crisis on livelihoods people's nutritional and health status, and the provision of basic services has also been significant (OCHA 2016).

1 Introduction

In the last 60 years Ethiopia has been exposed to a wide range of climate-related hazards. This exposure has particularly been severe in northern and eastern parts of the country that are often vulnerable to droughts (Fig. 3), floods, vector-borne epidemics, and frosts (Degefu 1987). Other climate-related problems such as heat waves and climate-sensitive disease outbreaks have affected Ethiopia. These include rainfall-related landslides on mountain slopes that have been eroded due to deforestation and steep-slope plowing and flooding in lowland areas that often kill grazing animals as well as people. Climate-sensitive health hazards such as malaria, meningitis, and Rift Valley Fever (RVF) are prevalent in lowland areas.

The countries main climate-related hazards have, however, typically been driven by ENSO's extremes, El Niño and La Niña (Goitom and Assefa 2017). Drought has affected both agricultural and hydropower generation (Teshome 2015). The most notable droughts, dating back to the late nineteenth century, were all El Niño-related events (Kelem and Derbew 2017). Other notable El Niño drought events occurred in 1957–58, 1965–66, 1972–73, 1982–83, 1997–98, and 2015–16.

The leadership of Ethiopia's National Meteorology Agency (NMA) has long acknowledged the connection between El Niño and Ethiopian droughts (Haile 1988; Nicholls 1993). Significantly, however, one of its former directors admitted that NMA only mentioned El Niño in its forecasts for the first time in 1987 (Kassahun 1998). As Diriba Korecha (2015), a long-time scientist at NMA, stated, "Evidence has shown that there is strong lag and concurrent relationship between Ethiopian seasonal rainfall and ENSO parameters."

The impacts of El Niño on Ethiopia depend on the time of its formation in relation to the main onset of the seasons. When the onset, distribution, and cessation of rainfall mismatch with the seasonal agricultural calendar, crop failures often result. El Niño also leads to anomalous climate variability, which creates favorable environmental

Fig. 3 Drought conditions in Ethiopia during the 2015–16 El Niño (UNICEF 2016a)

conditions for these health hazards in the lowland areas. Global warming related to manmade climate change might also be driving the intensity of recent El Niño events (Wolde-Georgis et al. 2017).

El Niño events have led to crop failures and food insecurity in the country. It is now believed that the historic Wollo Famine of 1973–74 was caused by the 1972–73 El Niño (Wolde-Georgis 1997). El Niño also led to the notorious famine of 1983–85 that killed close to one million people in Ethiopia (Richman et al. 2016). Neither the monarchy that was deposed in 1974 nor the self-declared communist military government that replaced it (1974–1991) could handle the impacts of those two El Niño events. But the strong 1997–98 El Niño also caused severe droughts and floods, though the human impact was seriously minimized by the establishment in the intervening years of effective and institutionalized early warning, preparedness, and response systems.

The focus of the following chapter is the 2015–16 El Niño, its impacts on society, and the "readiness" of Ethiopia to contend with the event, both at the time and subsequent to it. When the arrival of an El Niño was forecast in 2014, many of the disaster management institutions in Ethiopia were mobilized to cope with the situation and to reduce the impact. In retrospect, the 2015–16 El Niño is now considered stronger than the 1982–83 El Niño in its intensity and almost as strong as the 1997–98 El Niño, with especially north and central Ethiopia suffering their worst drought in decades as a result (CDKN 2017). Some places in these areas recorded a rainfall deficit of 167 mm from long-term averages (Funk et al. 2015). Only one half to three quarters of expected rain fell from February to September of 2015, the period during which 90 percent of Ethiopia's food supply is typically produced.

2 Climate-Related Hazards and Disaster

Ethiopia's climate is characterized by three seasons, locally known as *bega* (October to January), *belg* (February to May), and the primary rainy season of *kremt* (June to September). Most of Ethiopia's agricultural production takes place during *kremt* (JGHP 2015b). Situated just north of the equator, seasonal classification in Ethiopia is mainly based on these rainfall patterns. The key to the primary rainy season of *kremt* is the Inter-Tropical Convergence Zone (ITCZ) (Gleixner et al. 2017; Haile 1987). Close to 80 percent of the rural population is dependent on *kremt* rains, and 20 percent is dependent on *belg* rains for food production (OCHA 2015a). Playing an important role in the onset, duration, and distribution of rainfall, the lifecycle of an El Niño event can dramatically influence the emergence of climate-related droughts and floods during either season.

There is not yet a complete understanding of the role of El Niño as a driving force of Ethiopia's seasonal rainfall variability. Gleixner et al. (2017), for example, note that "El Niño is known to cause failure of kremt (boreal summer) rainfall in Ethiopia, though the mechanisms are not fully understood." Other researchers have made similar observations. In fact, no single correlation between ENSO's warm

extreme (El Niño) and the whole country's seasonal rainfall variability has been identified, likely because some areas are more significantly correlated with El Niño than others. This complexity is due to the existence of various microclimates and a range of topography in Ethiopia.

Global warming may have made the 2015–16 El Niño more intense, which would likely have contributed to the decline in precipitation observed in Ethiopia at that time. The impacts of the 2015–16 El Niño continued into subsequent years, even though the physical event ended by May of 2016. This amplifying effect might explain why CDKN (2017) estimated that the 2015–16 El Niño drought affected nearly 10 million Ethiopians and that ~5.6 million people required emergency food assistance through June 2017 (FEWS NET 2017).

3 Different Governments, Different Levels of Preparedness

The imperial government that was deposed in 1974 did not have any established institutions for disaster preparedness or response. Anyone who died due to famine was considered either a police issue to verify or the victim of "an act of God." The military government that removed the emperor after the 1973–74 famine initiated the practice of food security preparedness, establishing the Relief and Rehabilitation Commission (RRC). The focus of RRC was on mobilizing resources to feed famine victims. The post-1991 Ethiopian People's Revolutionary Democratic Front (EPRDF) government, which replaced the military government, went beyond this start by creating a more robust disaster risk management (DRM) strategy. EPRDF, whose policies were rural-oriented, made disaster preparedness and prevention—including consideration of El Niño impacts—one of its key priorities. It strengthened disaster risk management institutions and designed and updated Ethiopia's DRM strategies, including for early warning and response. A national committee for disasters was created at the highest level of government, signaling the country's deliberate shift from a reactive to a proactive approach to disaster management.

In the 1990s the government strengthened disaster management by developing a new policy and introducing a disaster prevention and preparedness strategy. RRC was transformed into a comprehensive Disaster Prevention and Preparedness Commission (DPPC). It incorporated mechanisms to provide early warning for climate-related disasters as well as prevention mechanisms. DPPC was also tasked with undertaking needs assessments and resource mobilization. One of the institutional changes made to deal with climate impacts was the streamlining of DRM institutions.

A criticism of DDRC was that it was in constant fund-raising mode to respond to chronic non-disaster food insecurity. Another criticism was that donor fatigue tended to result whenever food production declined due to non-climate-related factors. In 2004, the Ethiopian government responded to this criticism by separating emergency demands from poverty-related food insecurity in the country, establishing the Food Security Bureau (FSB) under the Ministry of Agriculture. FSB was meant to deal

with chronic poverty and food insecurity during normal weather years in order to reduce the burden on DPPC so it could focus only on disaster-related issues.

DPPC remained focused on disaster until 2009 when it was put under the Ministry of Agriculture and into the Disaster Risk Management (DRM) and Food Security Sector (DRRFSS). The revised strategy was meant to enable affected populations to withstand the impacts of climate-related hazards and to "reduce damage caused by a disaster through establishing an effective, people centered, integrated, coordinated, accountable, and decentralized disaster risk management system... [and] measures that need to be taken before, during, and after the disaster period" (FDRE 2013a, 2013b). DRRFSS was run by a high ranking official at the Ministry of Agriculture (FDRE 2016a, 2016b). Though why exactly DPPC was incorporated into the Ministry of Agriculture is unclear, it was likely because crop failure is the leading cause of disaster in Ethiopia. The National Disaster Risk Management Commission was established in 2017.

By the end of the second decade of the twenty-first century, Ethiopia had seemed to have learned some of the previous lessons of drought-related disaster risk management. The introduction of various disaster preparedness and prevention policies were important milestones in this process. Even so, Ethiopia's capacity to respond to El Niño-related disasters, and its political commitment to doing so, were tested on several occasions in the intervening years, especially during the 1997–98 and again during the 2015–16 very strong El Niño events. In neither case did the famines that had characterized such events in Ethiopia prior to 1991 occur. What these successes suggest is that the investments in El Niño preparedness that Ethiopia had made since the early 1970s had reduced the impacts of the hazards produced by El Niño events, despite the likely climate-induced increase in those events' intensity.

A further constraint in dealing effectively with climate-related impacts such as famine in Ethiopia was the significant logistical issues of food delivery and distribution across the country's poorly connected regions. One of the main problems that contributed to famine in Ethiopia during the military government was the inability for surplus food in one part of Ethiopia to reach food-deficit communities elsewhere in the country in part because of basic communication and infrastructure problems, including a bureaucratically tangled food distribution system, unavailable or inadequate transportation infrastructure, and poor or nonexistent local storage facilities. In response to these problems, Ethiopia has worked to build up its strategic grain reserves, risk-financing mechanisms, logistical coordination procedures, and systems of community recovery (Rashid and Lemma 2011). Following the downfall of the military, free movement of food from one region to another by traders became an effective livelihood strategy, which had the effect of further diminishing the logistical challenges the country has faced in what were once disasters but are now merely challenging situations.

4 El Niño and the Ethiopian Economy

According to the World Bank, Ethiopia had a per capita income of USD$590.00 in 2015, making it one of the world's eleven poorest countries (IEG CLR 2017). According to most indicators, Ethiopia has also recently been one of the five fastest growing economies in the world (Carroll 2014). Nasdaq.com (Bajpai 2019), for example, notes that "Ethiopia is the fastest growing economy in Africa and the second fastest growing economy in the world... The country is projected to grow at 8.1 percent during the 2018–2021 [period]."

The leading sectors for investment in the country are service, infrastructure, manufacturing, and large-scale farming. There have been many foreign direct investments in the agricultural sector focused on exports of mainly nontraditional cash crops like rice, flowers, and biofuel production. For example, Ethiopia now competes with other flower export leaders, such as Kenya, in the region. Coffee, which has long been cultivated for both export and domestic consumption, is mainly grown by small holders but also still grows wild in the bush. It is extremely susceptible to climate variations, however, as was shown during the unseasonal El Niño-driven rainfall in October 1997–98 when coffee beans were reported to have sprouted before having been harvested.

Ethiopia has been commended in recent years for having reached most all of the Millennium Development Goals, including having lowered under-five mortality by two-thirds three years before 2015 and reducing the maternal mortality rate (Haileamlak 2015). The government has in recent years also taken upon itself to invest in infrastructure such as power, roads, railways, and even subways. It is focused on urban and rural development, industrial parks, and actively supporting foreign direct investment opportunities. The first five-year Growth and Transformation Plan (GTP1 2010–15) was unveiled in 2010 under the leadership of the late Prime Minister Meles Zenawi. In conjunction with GTP1, the country also declared its intention to build a climate-resilient green economy as its path to growth and transformation (FDRE 2011). When GPT2 (2015–20) was instituted, the government had plans to make Ethiopia a middle-income country by the end of the third plan, in 2025.

GPT has been described as an "ambitious five-year growth plan, with projected Gross Domestic Product (GDP) growth of 11–15 percent per year from 2010 through 2015" (FDRE 2010). Even though the Ethiopian economy grew faster than the sub-Saharan Africa average of 4 percent, however, a World Bank Review stated that its growth rate slowed to 6–7 percent in 2015–16 due to the El Niño-induced drought (IEG CLR 2017). Despite this setback, Ethiopia had until recently shown an excellent socioeconomic transformation, with an average annual growth of 11 percent.

Ethiopian leaders have long realized the potential adverse impacts of climate change. The main fear has been that climate-related disasters might roll back its social and economic gains. Deliberately shifting Ethiopia's climate risk management approach from one reactive to crises to one more proactive and sustainable should be understood, therefore, as a way to protect economic growth and socioeconomic stability (FDRE 2015). The government viewed El Niño as an obstacle to

the achievement of the goals of aggressive economic transformation that had to be dealt with accordingly. Therefore, a comprehensive DRM system was called for to "reduce the impacts of disasters on economic growth, and to protect development gains" (FDRE 2010). This approach was supported by diverse national policies across ministries (FDRE 2016a, 2016b). Ethiopia also took international disaster protocols and guidance into consideration in its DRM policy.

Ethiopia was in a different socioeconomic and political context during the 2015–16 El Niño then it was in during both the 1972–73 and 1982–83 events. For one, the size of the country's economy had doubled. There was also increasing confidence on the part of Ethiopia's international partners that the government would implement cooperative hydrometeorological risk management agreements effectively. Infrastructure developments such as roads that connect most parts of the country as well as the construction of food storage silos were important parts of an El Niño readiness strategy in Ethiopia.

The EPRDF governing coalition was dissolved on December 1, 2019 after many months of bickering among its member parties. It is now succeeded by a party that calls itself the Prosperity Party (PP). The Tigray Peoples Liberation Front (TPLF) refused to be incorporated into the new party. The Prosperity Party, under the leadership of Abiy Ahmed Ali, considers itself a successor of EPRDF and postponed the upcoming 2020 election due to the Covid-19 pandemic. It has been critical of its former iteration and implied that it wants to establish a liberal form of government, including plans to sell off some of the big government-owned companies. It is not clear, however, if it will introduce private ownership of land, which has been owned by the state ever since the rise of the military government in the mid-1970s.

[N.B. just prior to submitting this chapter for publication, the situation in the Tigray region in the north of the country had become quite fluid, with active military conflict having broken out between TPLF and the Ethiopian military. Uncertainty prevails as the country stands on the brink of civil war.]

5 Ethiopian Preparedness and the 2015–16 El Niño

The earliest warning of an impending El Niño for 2015 was actually in 2014. NMA announced in its seasonal early warning bulletin in December of that year that an El Niño could form within the following few weeks. This bulletin was based on a prediction of an impending event from IGAD's Climate Prediction and Application Center (ICPAC) in Nairobi. For its part, NMA noted in its *belg* 2015 outlook: "In the upcoming belg, the season is expected to be under the influence of the ENSO-Neutral SST episode of the central and eastern Pacific Ocean" (NMA 2015). It added that the onset of the rains would be erratic but that their cessation would be normal.

The 2015 El Niño was first detected by NOAA and the Australian Bureau of Meteorology (BOM). The formation of El Niño was officially announced in Ethiopia by NMA in March 2015 (Save the Children 2015). NMA incorporated El Niño in its early warning and planning process for the year. The NOAA advisory predicted

with approximately 90 percent certainty that the El Niño would continue through the Northern Hemisphere summer 2015 and with a greater than 80 percent certainty that it would last through 2015 (ICPAC 2015). NMA eventually concluded that the 2015–16 El Niño was one of the strongest in its overall impact on Ethiopia (Mengistu 2020; Thompson 2015).

The 2015 El Niño is now considered the strongest in the last 50 years (Thomson 2015). It was above the +0.8 °C three-month running mean of the Oceanic Niño Index (ONI) for more than 13 consecutive months starting in March 2015 (CPC 2020). This was above the +0.7 °C three-month running mean ONI value for an El Niño event to be considered "locked in" in a review of the ONI, as Glantz and Ramirez proposed (2020). At the end of 2015, FEWS NET Ethiopia (2015) noted that central/eastern Ethiopia received the lowest level of rain in 50 years at an average of 480 mm total between March and September. It also reported that in addition to the low rainfall, March to September temperatures were also the highest recorded since 1960.

Korecha (2015) reported that the 2015–16 event significantly affected *kremt* rainfall. According to NMA, there were several extreme weather conditions in many parts of the country in 2015, examples of which include extreme low temperatures in February in the towns of Adigrat (−5.0 °C), Debre Berhane (−4.5 °C), Mehal Mada, and Wegel Tiana (−2.8 °C) (FDRE 2015). Furthermore, the following towns received extreme rainfall: Debre Berhan (67 mm), Harar (50 mm), Dilla (47.5 mm), Gode (46 mm) and Kofele (36 mm) (Ethiopian Herald 2015).

In early 2015, NMA continuously monitored the extreme drought of the *belg* season that started in February (Teshome 2015). In June 2015, NMA announced that the *belg* rains had failed, even though May had had above normal rainfall. To be understood is that the announcement of the El Niño in March 2015 was issued while Ethiopia was in the middle of that ongoing *belg* drought. Therefore, the announcement was considered an extension of the ongoing *belg* drought monitoring and was, therefore, not considered a surprise by forecast users.

From January to June 2015, monthly situation updates on the weather and food security situation were released. ICPAC also warned that the summer months would likely reflect the onset phase of an El Niño event and that suppressed rainfall over the Northern Sector of Ethiopia should be expected from June to September (ICPAC 2015). This warning proved to be correct, as most regions of the *kremt* rainfall season in Ethiopia were characterized by below average 2015 rains.

An important component of disaster management in Ethiopia had been the continuous observation and management of precipitation, harvests, and food security. Reports were written with data not only from meteorological stations but also from observations by local governments.

The Productivity Safety Net Program (PSNP), for example, is important for El Niño/disaster preparedness related to food security (FDRE 2015). It protects household assets and provides farmers with inputs during normal seasons in order to reduce their vulnerability to drought. It is funded by the government with support from donors, including the World Food Program. Household members, unless they are disabled, must work on water and soil conservation and reforestation to benefit

from PSNP. This is an important program to help people prepare for El Niño. NGOs dealing with disaster have identified *woreda*-level (county) drought hotspots to provide special focus for the program (OCHA 2015b). These kinds of institutions have proven important for monitoring the emergence of hazards and their impacts and for preparing responses. There are also early warning departments from the local *woreda* to the national level. In sum, Ethiopia was prepared to face the 2015–16 El Niño.

6 Impacts of and Responses to the 2015–16 El Niño

Several pastoral and agropastoral areas of Ethiopia recorded significant rainfall deficits of up to 50 percent of normal (FAO 2016). According to FAO, the most extreme drought conditions in Ethiopia were in the northern states. In the village of Atebes near Adigrat (in Tigray), for example, farmers reported that there were only six rainy days in July 2015 (Haile-Mariam 2016). Neither *belg* nor *kremt* rains came in 2015 (Fig. 4), leading to the failure of crops and pastures (FAO 2016). In some areas, crops totally failed, and animals were allowed to graze the fields (Graham 2015). Because most of Ethiopia's agricultural production takes place during the *kremt* rainfall season (JGHP 2015a, 2015b), this crop failure led to food insecurity, malnutrition, and devastated livelihoods (UN News Service 2015). According to

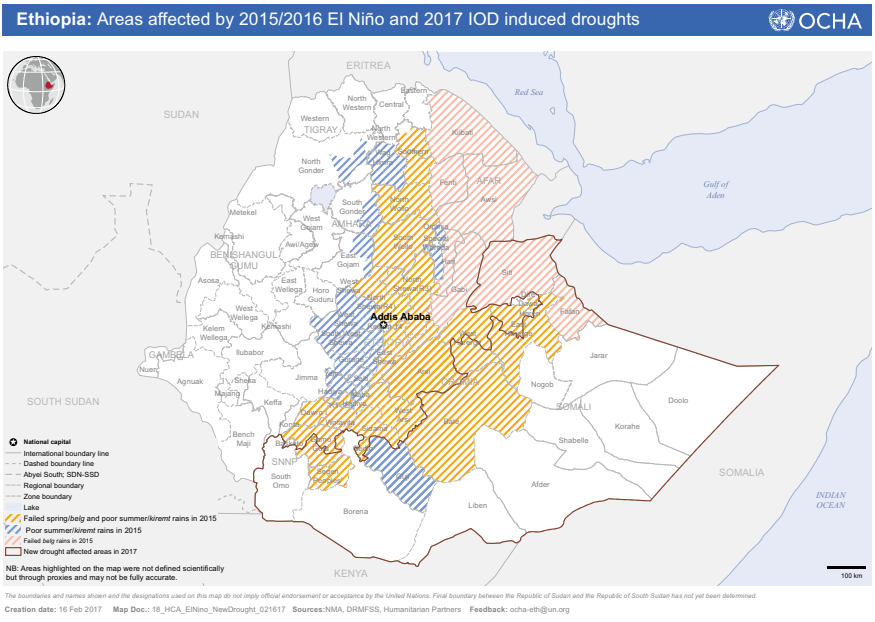

Fig. 4 Areas affected by 2015–16 El Niño and 2017 IOD-induced droughts (OCHA 2017)

EHCT/OCHA (2015), the failed *belg* rains added to food insecurity and malnutrition and wrought havoc on grain and livestock production in the country, even before the impact of the failed *kremt* rains. The El Niño severely affected "southern Tigray, eastern Amhara, Afar, and Siti zone of Somali region, eastern SNNP region, East and West Hararge, Arsi and West Arsi, and lower Bale zones of Oromia" (Solomon 2015).

The number of people in Ethiopia affected by the 2015–16 El Niño was estimated to be about 10.2 million, yet the country's mortality rate did not increase from previous years. In other words, Ethiopians were not starving to death as during earlier El Niño events (De Waal 2016). Food aid was being distributed to victims, with a standard ration per person having been 15 kg of wheat and a half liter of cooking oil per adult in the areas hit by drought (Meseret 2015). In pastoral areas there were interventions to protect the livelihood assets of pastoralists and agropastoralists alike and to revitalize the resilience of communities through a coordinated response (FAO 2016).

The arrival of the 2015–16 El Niño was communicated through the media as well as through email, fax, and hard copy documents. Once the arrival of the event and its impacts had been announced, a National Disaster Risk Management Task Force was established at the highest level under the leadership of the prime minister. The task force issued weekly appraisals and updates that were distributed to relevant offices. There were also continual situation updates. Activities such as the identification of affected populations, food distribution, and logistical arrangements were communicated to relevant stakeholders. The government developed communication plans for communities in flood-risk areas with messaging that included information about relocation, timely harvesting, and appropriate water catchment practices during the growing season.

7 Resource Mobilization

Ethiopia's traditional responses to disaster events had been early warning, assessment, resource mobilization, and response. The Ethiopian government and its partners/donors, including FAO, concluded that the 2015 El Niño would lead to food insecurity in the absence of early resource mobilization. Coordination of the agriculture and livelihood sectors during preparations was co-led by the Disaster Risk Management and Food Security Sector (DRMFSS) and FAO. FAO especially supported the Ethiopian government in coordinating initiatives to support agricultural livelihoods.

The overall coordination of resource mobilization was led by the government's National Disaster Risk Management Coordination Committee (NDRMCC), which managed the federal and regional level Disaster Risk Management Technical Working Groups (DRMTWGs) across Ethiopia and hosted a series of specialized task forces that worked in tandem with other clusters and sectors, including with food and agriculture (UNICEF 2016b). There was also multi-agency coordination at the strategy and technical levels led by NDRMCC and comprising representatives from

respective sector task forces. Humanitarian partners coordinated and provided guidance to facilitate effective responses at all levels. Other notable interactions included the informal climate partners meeting that worked to communicate and update one another.

The government and its partners produced situation analysis reports on the impacts of drought on people and property (Reuters 2016). Needs assessments were completed and estimates of the number of beneficiaries agreed upon by the stakeholders. There was also disagreement on the number of people affected, due to the fluid nature of the impacts, but the number was eventually settled at 10.2 million people. A coordination mechanism was also set up with the Ethiopia Humanitarian Country Team (HCT). The team prepared an action plan based on 2015 food production and projections of need for 2016 (NDRMCC 2015). The government and the HCT developed three strategies to develop their operational plans: (1) Save lives and reduce morbidity related to drought; (2) Protect and restore livelihoods; and (3) Prepare for and respond to other humanitarian shocks, including natural disasters, conflict, and population displacement (NDRMCC 2015).

The Disaster Risk Management and Food Security Sector (FDRE 2016) of the Ministry of Agriculture was responsible for overseeing and coordinating El Niño impact preparedness and response. The Secretary of the National Disaster Prevention and Preparedness Committee (NDPPC) directed DRMFSS and also coordinated the inter-agency group tasked with assessing needs (Solomon 2015).

With increased demand for food, the Ethiopian government allocated 700 million Birr (US$35 million) to purchase food and preempt the negative impact on production (Ethiopian Herald 2015). The government later allocated USD$381 million to purchase food (Joselow 2016). Donors including WFP, USAID, and the World Bank were also involved in funding preparedness, mainly for the purchase of relief food. The additional aid brought total U.S. humanitarian assistance to Ethiopia to over USD$435 million in 2015, including increased funding for nutrition, water, food, sanitation, and hygiene (USAID 2015).

Ethiopia had also created a contingency fund to cover shortfalls in food supplies. This disaster fund was called the National Disaster Prevention and Preparedness Fund (NDPPF). For 2015–16 El Niño preparations, the government had already secured USD$287,400 from donors (DRMFS 2016). Regions had fund withdrawal rights to support their relief efforts. According to *The New York Times* (De Waal 2016), Ethiopia was more prepared for the 2015–16 El Niño than for any previous event. This preparation included the development of safety net programs.

Some barriers to action did exist, however, as multiple other disasters were ongoing before and after the El Niño formed. For example, when El Niño was forecasted in 2015 other factors had already caused the *belg* rains to fail. Another issue was the number of people affected by El Niño-related impacts. Despite these obstacles, excellent coordination existed between the government and the donors in terms of needs estimation, resource mobilization, and distribution. To be sure, if not for the effective preparedness of the Ethiopian government and its excellent relationship with donors, 2015–16 could have been a famine year. It should be noted, however, that when less than 50 percent of the needed funds were raised from the government

and the donors, lack of funding also became an important constraint in implementing desired response protocols.

8 Hurdles and Obstacles

Until recently, very few researchers in Ethiopia had studied the basic science of El Niño, its teleconnections in the country, or its impacts. International collaboration and information exchanges through WMO, regional climate centers (such as ICPAC), and various weather and climate centers of the industrialized world, however, have provided information on and capacity for the use of El Niño information for seasonal climate forecasts in Ethiopia. The lack of local expertise on El Niño forecasts and the uncertainty associated with the information have been key obstacles to preparedness. Fortunately, a recent review of the ONI (Glantz and Ramirez 2020) shows that an ONI three-month running mean value of +0.7 °C indicates a "tipping point" in El Niño's locked in phase meaning that the event would continue for several months. This is an important finding for users because it could provide some months of extra lead time to prepare for foreseeable El Niño impacts.

"Constraints to action include but are not limited to the possible existence of different kinds of hazards and disaster events before as well as after an El Niño. As noted earlier, when the El Niño was forecasted in 2015 the *belg* rains had already failed due to other factors. The dependence of Ethiopian agriculture on millions of smallholders that depend solely on timely rainfall makes them vulnerable to even slight let alone significant seasonal variability" (Wolde-Georgis et al. 2017).

Another hurdle is the massive number of people affected by El Niño and the limited availability of local resources to respond. In fact, the Ethiopian government and donors combined were able to raise less than 50 percent of the funds needed at the local level to respond to the 2015–16 event.

An important issue related to the immediate use of forecasts has been that decision makers often consider forecasts from NMA lacking in desired specificity for their tactical policymaking needs. People tend to expect forecasts to be deterministic even though all forecasts are probabilistic, with an inherent amount of uncertainty. There were, for example, unsuccessful forecasts by both global and regional climate centers concerning the formation of an El Niño in both 2012 and 2014. Failed forecasts tend to erode policymakers' confidence in future forecasts.

9 Lessons Learned

The list below contains lessons from a previous study (Wolde-Georgis et al. 2017) in addition to uncovered lessons looking back at the event.

- In the last three decades, Ethiopia has been politically stable until November 2020. Political stability and the focus on economic development have been very helpful for effective disaster risk management. Political changes and recent social unrest, however, have begun to reverse these gains, which can only be improved with a return to relative stability.
- Since the early 1990s, a very effective in-country disaster risk management and food security system has been developed. DRM institutions have been strengthened at all levels of society.
- In Ethiopia, development of PSNP altered traditional responses of vulnerable communities during as well as between droughts.
- The Ethiopian diaspora's climate-related experts can be called upon to provide expertise that is not available or affordable solely in-country.
- People, including decision makers, expect forecasts to be deterministic, true–false statements, even though forecasts are always probabilistic, with an inherent degree of uncertainty. There has been very little discussion in Ethiopia about the certainties and uncertainties of El Niño information, including with regard to forecasts.
- El Niño readiness in Ethiopia has been effective because DRM institutions have been very active in responding to climate-related disasters during non-El Niño years.
- Ethiopia continues to accumulate lessons from previous El Niño events. For example, the 1982–83 El Niño proved a governmental turning point for heightened awareness in disaster preparedness and response for the country. The experience gained from the1997-98 event also added to the country's growing list of lessons learned.
- Local communities have their own coping mechanisms during El Niño-related events. They activate social mechanisms and wealth transfers among themselves as well as from those who transfer money from outside their villages.
- Communities with access to water and road infrastructure and a diversified income responded more easily to the impacts of El Niño-related disasters than those with no access. There is a need for developing infrastructure in all villages in climate-sensitive areas.
- Relevant research and teaching programs, such as the Department of Meteorology at Arba Mintch University and the graduate Institute for Climate and Society at Mekelle University, are expected to provide leadership in Ethiopia on El Niño-related research and preparedness in the future.
- Strategic preparedness efforts should be ongoing between El Niño events, not just when an event has been forecasted.
- Improved preparedness, including improving the capacity of NMA's infrastructure, should be prioritized.
- Weather communication via radio broadcasts, mobile phones, and TV must be improved.
- Non-climate scientists from a range of academic disciplines should be encouraged to learn about El Niño and other climate-related factors so that they can better communicate with civil society through various media channels.

10 Conclusions

Ethiopia has learned many lessons from previous El Niño events, with the 1982–83 event having proven a watershed in Ethiopia's disaster preparedness and response capacities. Most El Niños before 1982 led to famine, but those that have come after the 1990s have not. The 1997–98 El Niño, yet another very strong and surprising event that scientists have labeled "the El Niño of the Century," was the first test of the new EPRDF Government that came to power after the end of the military communist government (Wolde-Georgis et al. 2001). Designing a strategy to deal with climate-related disasters and building institutions to implement that strategy was important for overall El Niño preparedness. How societies respond to climate-related disasters in non-El Niño years, however, also needs to be considered in discussions about El Niño preparedness and response. According to WFP acting-Director Samir Wanmali, Ethiopia could cope with such problems because it had become a changed country with a capable disaster risk management system that could meet the needs of even its most vulnerable populations (Ethiopian Herald 2015).

NMA now routinely incorporates ENSO information in its long-term forecasts, and the expected recurrence of drought now has Ethiopia in a permanent state of preparedness for the impacts of ENSO's warm and cold extremes. The existence of a social welfare program (PSNP) for rural people also means that the most vulnerable populations in Ethiopia can be identified for what climate-related hazards are anticipated during each phase of the ENSO cycle. Although hydrometeorological hazards occur in many places in the country even outside of the ENSO extremes, drought is considered by Ethiopian policymakers as a constant hazard that constrains economic development. The political will for constant vigilance is now considered warranted.

Reasons for Ethiopia's El Niño readiness success have, until recently, been related to institutional readiness and an improved economy and infrastructure. One major achievement of the last few decades has been the development of transportation infrastructure like roads, rails, and airports that have more effectively linked different parts of the country. Food storage silos have also been constructed in several strategic regions. During the famine of the early 1980s, this infrastructure was not available, so timely food transfers could not be made even though there were surpluses in parts of the country that could have mitigated the impacts of the drought in other parts of the country.

In those former days, when the Ethiopian government imported food from overseas it was all shipped to Addis Ababa, making distribution to the people most in need in outlying areas difficult if not impossible. Today, El Niño readiness implies improved resiliency institutionally and materially to cope with national issues including droughts. DPPC was an experienced and strong DRM organization with a capacity to gather data from the field very fast and distribute it to users through email, fax, and its website. The new National Disaster Risk Management Commission (NDRMC) that replaced DPCC has also been effective, though it does not as of yet have its own website and remains quite invisible to those who could use its guidance most.

A major current concern about Ethiopia's readiness in the future with respect to El Niño is the ongoing erosion in political capital that helped the country progress in the last few decades. There are worrisome issues related to recent changes, including but not limited to the end of EPRDF and the creation of the Prosperity Party (PP) without the Tigray People's Liberation Front (TPLF). The current violence and disruption of peace in some parts of Oromia and Amhara are not encouraging signs for future El Niño readiness (Krippahl 2020; Amnesty International 2020). The political weapon of "highway closing" and the inaction of the federal government have weakened Ethiopia. Yet unknow is what the reaction of diverse political actors will be to the ruling party's cancellation of the 2020 national election. Rumors suggest that the current government and its allies (domestic and foreign, including Eritrea) are thinking of converting the federal constitution toward a more centralized state. Several autonomous states of the Ethiopian federation, including Tigray and Oromia, are anticipated to strongly oppose any changes that diminish state autonomy. Such political trends could have an adverse impact not only on Ethiopia's El Niño readiness but also on the future of the country's general well-being. The conflict that has broken out just prior to this manuscript's submission for publication will likely only reinforce this prediction on a near-future loss of readiness, which does not bode well for those who are most vulnerable to the known hazards a future El Niño will almost assuredly spawn.

References

Amnesty International (2020) Ethiopia: police must account for missing Oromo opposition Leader. News Break. https://www.amnesty.org/en/latest/news/2020/03/ethiopia-police-must-account-for-missing-oromo-opposition-leader/#:~:text=The%20police%20must%20account%20for,party%20members%20on%2029%20February. Accessed 21 Nov 2020

Bajpai P (2019) The 5 fastest growing economies in the world. Nasdaq. https://www.nasdaq.com/articles/the-5-fastest-growing-economies-in-the-world-2019-06-27. Accessed 21 Nov 2020

Carroll D (2014) The 5 fastest-growing countries in the world. Motley Fool. http://www.fool.com/investing/international/2014/11/24/the-5-fastest-growing-countries-in-the-world.aspx. Accessed 21 Nov 2020

CDKN (2017) Science summary: the drought in Ethiopia in 2015. Relief Web. https://reliefweb.int/report/ethiopia/science-summary-drought-ethiopia-2015. Accessed 21 Nov 2020

CPC (Climate Prediction Center) (2020) Cold and warm episodes by season. Origin. https://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php. Accessed 21 Nov 2020

Degefu W (1987) Some aspects of meteorological drought in Ethiopia. In: Glantz MH (ed) Drought and hunger in Africa. Cambridge, Cambridge University Press (pp. 23–36)

De Waal A (2016) Is the Era of great famines over? New York Times. https://www.nytimes.com/2016/05/09/opinion/is-the-era-of-great-famines-over.html. Accessed 21 Nov 2020

Ethiopian Herald (2015) Ethiopia: consolidating nation's response to drought impacts. All Africa. https://allafrica.com/stories/201511181579.html. Accessed 21 Nov 2020

FAO (2016) FAO in Ethiopia—El Niño response plan 2016. http://www.fao.org/emergencies/resources/documents/resources-detail/en/c/380012/

FDRE (Federal Democratic Republic of Ethiopia) (2016a) Growth and transformation plan (GTP-II), 2015–20. The second growth and transformation plan document of Federal Democratic Republic of Ethiopia. National Planning Committee, Addis Ababa, Ethiopia

FDRE (2016b) DRMFSS, disaster risk management strategic programme and investment framework (DRM SPIF)
FDRE (2015) Ministry of agriculture and rural development, productive safety net programme component document, 2010–2014
FDRE (2013a) Opening speech by H.E. Ato Mitiku Kassa, State Minster of Agriculture, on the occasion of the launch of humanitarian requirements document for July-December 2013. DRMFSS, Addis Ababa
FDRE (2013b) National policy and strategy on disaster risk management, Part 2. Addis Ababa, Ethiopia
FDRE (2011) Ethiopia's climate-resilient green economy green economy strategy. UNDP. https://www.undp.org/content/dam/ethiopia/docs/Ethiopia%20CRGE.pdf
FDRE (2010) Growth and transformation plan (GPT1), 2010–2014/15. Draft Ministry of Finance and Economic Development (MoFED), Addis Ababa
FDRE (2007a) DRMFSS, Report 6/2007, Miazia 15, 2007. (Ethiopian Calendar)
FDRE (2007b) DRMFSS, Wektawi YeAyerna ya Gibrina Sira Enkisikasie Hunate.b, No 4/07. Yekatit 12, 2007 (Ethiopian Calendar)
FDRE—Ethiopian government (2015) Government could shift development budget if drought persists. www.ebc.et//web/ennews/-/gov-t-could-shift-dev-t-budget-if-drought-persists-gcao. Accessed 4 Apr 2016
FEWS NET Ethiopia (2015) Ethiopia food security alert, food security emergency in central/eastern Ethiopia follows worst drought in more than 50 years. https://fews.net/sites/default/files/documents/reports/FEWS%20NET_WFP_Ethiopia%20Alert_20151204.pdf
FEWS NET (2017) Severe drought in southeastern areas leading to livestock deaths and reduced income. https://fews.net/east-africa/ethiopia/key-message-update/january-2017
Funk C, Peterson P, Landsfeld M, Pedreros D, Verdin J, Shukla S, Husak G, Rowland J, Harrison L, Hoell A, Michaelsen J (2015) The climate hazards infrared precipitation with stations—a new environmental record for monitoring extremes. Sci Data 2. https://doi.org/10.1038/sdata.2015.66
Glantz MH, Ramirez IJ (2020) Reviewing the Oceanic Niño Index (ONI) to enhance societal readiness for El Niño's impacts. Int J Disaster Risk Sci 11:394–403. https://doi.org/10.1007/s13753-020-00275-w
Gleixner S, Keenlyside N, Viste E, Korecha D (2017) The El Niño effect on Ethiopian summer rainfall. Clim Dyn 49:1865–1883. https://doi.org/10.1007/s00382-016-3421-zpage1865-1883
Graham J (2015) No ordinary year in Ethiopia: It's a 'code red' and must be treated like one. https://www.devex.com/news/no-ordinary-year-in-ethiopia-it-s-a-code-red-and-must-be-treated-like-one-87292. Accessed 21 Nov 2020
Haile T (1987) A case study of seasonal forecast in Ethiopia. WMO regional association I: Africa. Seminar on modern weather forecasting, Part II, 11/30 – 12/04 1987 in Geneva, Switzerland. Geneva: WMO, 53–65
Haile T (1988) Causes and characteristics of drought in Ethiopia. Ethiop J Agric Scie 10:85–97
Haile-Mariam GS (2016) Personal discussion, Atebes village, Ethiopia
Haileamlak A (2015) Ethiopia successfully attaining the millennium development goals. Ethiopia J Health Sci 2:109–110
IEG CLR (2017) Review independent evaluation group. Ethiopia, CLR period FY13-FY16, Date of review, Executive summary
ICPAC (2015) IGAD climate prediction and applications center climate watch for the period March-May 2015. REF: ICPAC/CW/No.30
JGHP (Joint Government and Humanitarian Partners) (2017) Ethiopia: humanitarian overview 2016. Document SYNOPSIS, National disaster risk management coordination commission and the Ethiopia humanitarian country team
JGHP (2015a) Joint government and humanitarian partners document, Humanitarian requirements. Addis Ababa
JGHP (2015b) Joint government—humanitarian parents national flood contingency plan for the 2015 bega season. Addis Ababa

Joselow G (2016) El Nino-linked drought is Ethiopia's worst in 50 years. NBC News. https://www.nbcnews.com/news/world/el-nino-linked-drought-ethiopia-s-worst-50-years-n520686. Accessed 21 Nov 2020

Kassahun B (1998) Former director general of the NMA, Interview, Addis Ababa

Kelem G, Derbew A (2017) The frequency of El-Niño and Ethiopian drought. Research Gate. https://doi.org/10.13140/RG.2.2.25826.73922

Korecha D (2015) El Niño/Southern Oscillation (ENSO) and its impacts. Meteorol News 20(2):30–34

Krippahl C (2020) Ethiopia's democratization at risk. DW (Deutsche Welle). https://www.dw.com/en/ethiopias-democratization-at-risk/a-54069213. Accessed 21 Nov 2020

Mengistu N (2020) National Meteorology Agency (NMA), forecast department of the NMA, personal interview, Addis Ababa, Ethiopia

Meseret E (2015) Ethiopia government starts distributing wheat, cooking oil to millions facing hunger. Associated Press, Ethiopia Today. https://ethiopian-today.blogspot.com/2015/11/ethiopia-government-starts-distributing.html. Accessed 21 Nov 2020

NDRMCC (National Disaster Risk Management Coordination Commission and the Ethiopia Humanitarian Country Team) (2015) Ethiopia: humanitarian overview 2016. Joint government and humanitarian partners' document. SYNOPSIS

Nicholls N (1993) What are the potential contributions of El Niño—Southern oscillation research to early warning of potential acute food-deficit situations? Workshop on usable science: food security, early warning and El Niño, 25–28 October, Budapest, Hungary. Organized by MH Glantz, Boulder, Colorado National Center for Atmospheric Research (NCAR), 169–177

NMA (2015) Belg seasonal outlook. http://www.ethiomet.gov.et/other_forecasts/seasonal_forecast. Accessed 21 Nov 2020

OCHA (2016) Retreat outcomes: Ethiopia lessons learned from the El-Niño drought, 2015–16. ALNAP. https://www.alnap.org/help-library/retreat-outcomes-ethiopia-lessons-learned-from-the-el-ni%C3%B1o-drought-2015-16

OCHA (2017) Ethiopia: areas affected by 2015/2016 El Niño and 2017 IOD induced droughts. https://www.humanitarianresponse.info/sites/www.humanitarianresponse.info/files/documents/files/18_hca_elnino_newdrought_021617.pdf

OCHA (UN Office for the Coordination of Humanitarian affairs) (2015a). Eastern Africa: El Niño snapshot as of October 2015. Addis Ababa

OCHA (2015b) Ethiopia slow onset natural disaster. United Nations office for the coordination of humanitarian affairs, Addis Ababa

Rashid S, Lemma S (2011) Strategic grain reserves in Ethiopia Institutional design and operational performance, IFPRI Discussion Paper 01054

Relief Web (2017) Science summary: the drought in Ethiopia, 2015. https://reliefweb.int/report/ethiopia/science-summary-drought-ethiopia-2015. Accessed 9 Oct 2020

Relief Web (2015) Ethiopia: hotspot priority woredas (as of 2 December 2015). https://reliefweb.int/map/ethiopia/ethiopia-hotspot-priority-woredas-2-december-2015. Accessed 9 Oct 2020

Reuters (2016) Ethiopia drought relief needs $500 million for support beyond April: WFP. https://www.reuters.com/article/us-africa-drought-ethiopia/ethiopia-drought-relief-needs-500-million-for-support-beyond-april-wfp-idUSKCN0V60PV. Accessed 21 Nov 2020

Richman M, Leslie M, Segele Z (2016) Classifying drought in Ethiopia using machine learning. Procedia Comput Sci

Save the Children (2015) More than 4.6 Million children in Ethiopia facing hunger from unprecedented El Niño Drought. https://www.savethechildren.org/us/about-us/media-and-news/2015-press-releases/more-than-4-6-million-children-in-ethiopia-facing-hunger-from-un. Accessed 21 Nov 2020

Sjoukje P, Kew SF, Oldenborgh GJ, Otto F, O'Keefe S, Haustein K, King A, Zegeye A, Eshetu Z, Singh KHR, Jjemba E, Funk C, Cullen H (2018) Attribution analysis of the Ethiopian drought of 2015. J Clim 31:2465–2486. https://journals.ametsoc.org/view/journals/clim/31/6/jcli-d-17-0274.1.xml

Solomon T (2015) Ethiopia braces for effects of El Niño, October. Afr Rep https://www.theafricareport.com/2466/ethiopia-braces-for-effects-of-el-nino/
Teshome F (2015) The shadow of drought. Interview
Teshome S (2015) Ethiopia hit by 'darkness': Addis Ababa battles with an opponent that has defeated Africa's big men. EthioThinkThank. https://ethiothinkthank.com/2015/12/17/ethiopia-hit-by-darkness-addis-ababa-battles-with-an-opponent-that-has-defeated-africas-big-men-mg-africa-mobile/. Accessed 21 Nov 2020
Thompson A (2015) El Niño could rank among strongest on record. Clim Cent https://www.climatecentral.org/news/el-Ni%C3%B1o-could-rank-among-strongest-19330. Accessed 21 Nov 2020
UN News Service (2015) Ethiopia experiencing 'worst drought in 30 years' due to El Niño conditions. UN News. https://news.un.org/en/story/2015/10/513782-ethiopia-experiencing-worst-drought-30-years-due-el-nino-conditions-un-report. Accessed 21 Nov 2020
UNICEF (2016a) Floods deal 'staggering' blow to pastoralists recovering from Ethiopia's long drought—UN. Afr Renewal https://www.un.org/africarenewal/news/floods-deal-%E2%80%98staggering%E2%80%99-blow-pastoralists-recovering-ethiopia%E2%80%99s-long-drought-%E2%80%93-un. Accessed 21 Nov 2020
UNICEF (2016b) Joint government and humanitarian partners' document. SCRIBD. https://www.scribd.com/document/343735167/ECO-Ethiopia-HRD-2016-pdf
USAID (2005) United States announces $88 Million in humanitarian aid for Ethiopia. USAID Press Office. https://2012-2017.usaid.gov/news-information/press-releases/dec-18-2015-united-states-announces-88-million-humanitarian-aid-ethiopia. Accessed 21 Nov 2020
Wolde-Georgis T, Gebru AA, Kinfe YW, Bahiru KM (2017) Ethiopia. In: Glantz MH (ed) El Niño ready nations and DRR—executive summary (pp 28). ISBN: 978–0–9988419–0–8. http://www.ccb-boulder.org/wp-content/uploads/2017/05/Final-El-Nino-ready-Nations-and-DRR-April-2017.pdf
Wolde-Georgis T, Aweke D, Hagos Y (2001) Reducing the impacts of environmental emergencies through early warning and preparedness: the case of the 1997–98 El Niño. In: Glantz MH (ed) Once burned twice shy. United Nations University, pp 88–100
Wolde-Georgis T (1997) El Niño and drought early warning in Ethiopia. Int J Afr Stud