Farmers’ perception of drought and its socioeconomic impact: the case of Tigray and Afar regions of Ethiopia

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ABSTRACT
A cross-sectional study was conducted from March 2016 to June 2016 to assess the perception of farmers on drought and its socio-economic impact, and their mitigation and adaptation strategies. A total of 240 respondents from three districts in Tigray and one district from Afar were considered. The study indicated a significant reduction in the farm income (from 21,882 to 6482 ETB) and income from the livestock sector (12,833 to 5659 ETB). The average market price of cattle has reduced from 8228 to 4096 ETB due to the 2015/2016 drought. The environmental impacts such as increase in average temperature, pasture-forest degradation and deteriorated water quality were perceived by farmers to a high extent. In spite of good perception of severity of drought impacts by farmers, their preparedness to deal with its impacts was found minimal. Therefore, it is recommended that policy-makers and government authorities should look for more appropriate and locally adaptable mitigation and adaptation strategies that ensure the participation of the local community.

Background
Climate change is real and it is taking place now. It will become worse in future with more impacts to rural poor communities of developing countries. Changes in climate and extreme weather events have received increased attention in the recent years (IPCC 2007). According to the Fourth Assessment Report of the IPCC (2007), climate change is a long-term shift in the statistics of the weather (including its averages). It could show up as a change in climate normal (expected average values for temperature and precipitation) for a given place and time of year, from one decade to the next. More recently, the IPCC report (IPCC 2013) indicated that the warming of the climate system is clear, and that many of the changes observed since the 1950s are unparalleled for periods that range from decades to millennia. By 2050, the projection of the average annual global surface air temperature is estimated to increase with the range of 1.1–6.4°C and the sea level will rise ranging from 18 to 59 cm (IPCC 2007) and these increases have been partially attributed to the accumulation of GHGs’ concentration in the atmosphere.

Projections over East African countries are presented with mixed uncertainty regarding the scope, timing and magnitude of climate variability and change (Thornton et al. 2009). According to the same author, projection results with rainfall will be increased by 10–20% and progression in temperature rise is anticipated with an increase in the margin of 0.7°C and 1.5°C in the short term (2020–2029) and between 1.5°C and 4.3°C by the 2080s.

Drought is an extreme and recurring climate event that affects the livelihoods of millions of people around the world and it is regarded as the most important natural disaster in economic, social and environmental terms (Mniki 2009). According to the Disaster Prevention Organization, approximately 410 major drought events were reported globally during 1980–2008, affecting 53.5 million people each year. Due to increasing temperature, water stress, frequency of El Nino events and decreasing number of rainy days, production of crops has declined in many parts of Asia and Africa and the incidence of diseases in humans and animals has increased (Debela et al. 2015).

The character of drought is distinctly regional, reflecting unique meteorological, hydrological, agricultural and socio-economic characteristics. The impacts of droughts are complex, in contrast to the impacts of floods, hurricanes and most other natural hazards. Its impacts are spread over a larger geographical area than are damages that result from other natural hazards. Drought severity is dependent not only on the duration, intensity and spatial extent of a specific drought episode, but also on the demands made by human activities and vegetation on a region’s water supply. The characteristics of drought, along with its far-reaching impacts, make its effects on society, economy and the environment difficult to identify and quantify (Willhite et al. 2000).

Of all the natural hazards, drought affects the maximum number of people globally causing devastating impacts. Drying of water resources, crop failure, increase in food prices, poor health, livestock production losses and mortality and a decline in prices of livestock were the most immediate impacts of drought perceived by farmers (Udmale et al. 2014). The cost of the measures implemented to mitigate, prevent
or alleviate the impacts of drought can also be attributable to the economic cost of the drought (Ya et al. 2011). The coupled effects of drought weaken the income of agrarian households, results in poor nutrition and decreasing risk absorptive capacity, thereby increasing the vulnerability of the community (Scoones 1992; Nguyen et al. 2009; Mwinjaka et al. 2010; Singh et al. 2014).

Much is known about the environmental impacts of drought. However, very little is known about the socio-economic impacts particularly on farm owners whose livelihood is mainly dependent on agricultural production. Existing information on economic impacts of drought are scarce, incomplete, unreliable and scattered. Addressing these challenges could play a paramount role in reducing the socio-economic impacts of drought, particularly in the least developed countries of Africa (Brida et al. 2013; Debela et al. 2015). Hence, information on earlier drought impacts is very important for planning future drought responses. By comparing the most severe impacts of drought, policy-makers can plan to minimize the most severe impacts. Furthermore, an understanding of the socio-economic impacts of drought is essential at different levels (country, regional, zonal, district, village/communities). Thus, the objectives of the present study were to assess the perception of farmers about drought in the selected districts of Afar and Tigray regions of Ethiopia and to determine the socio-economic impacts of the 2015/2016 drought on smallholder farmers in the selected study sites.

It is hoped that this study will promote drought awareness and encourage pro-active management of drought as opposed to reactive management by the farming communities. This study will also provide a guiding framework for devising action plans to improve capacity among vulnerable populations.

Materials and methods

Study area

A cross-sectional study was conducted in three selected districts of Tigray (Alamata, Ofla and Raya-azebo) and one district of Afar region (Aba’ala) from March 2016 to June 2016 (Figure 1). Tigray region which is located in northern and the hilly areas of Ethiopia and Afar region which is located in the northeastern part of Ethiopia are among drought-prone and desert regions.

The study districts were selected purposively based on their previous history and for comparison of the drought impacts in mid, highland and lowland areas. According to the National Population and Housing Census carried out in 2007, the population of Alamata, Ofla and Raya-azebo districts were 85,403, 126,889 and 135,870, respectively (CSA 2007).
Aba’ala district is located in the Northern part of the Afar National Regional State, Northeastern Ethiopia. The study area lies approximately between 13°15’ and 13°30’ latitude and 39°39’ and 39°55’ longitude. The average elevation of the area is approximately 1500 m.a.s.l. The temperature of the region varies from 25°C during the rainy season to 48°C during the dry season. According to the National Population and Housing Census carried out in 2007, the human population of the district is 37,963 (CSA 2007).

**Study population and sampling design**

From the four districts selected in the present study, one sub-district from each study area was considered as target population for the present study. To select the study sites, a purposive sampling approach was employed due to the accessibility of the study sites and previous experience of drought. A total of 240 respondents, 60 from each selected district, were considered for the present study for the questionnaire-based survey and the respondents were selected using probability sampling for which a simple random sampling (random walk) technique was employed.

**Questionnaire survey**

A structured questionnaire was prepared, pilot tested and administered to collect and generate primary data from the study participants (small holder farmers) from the study sites. The respondents

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**Figure 2.** Distribution of respondents in terms of HH size, age, farm income and non-farm income.
were selected using a simple random sampling approach. The objectives of the study were explained to the target respondents and those who volunteered to participate in the study were included. Any identification of the participants was not recorded and confidentiality was assured during data collection. The questionnaire survey was administered on the volunteer participants using local language translators (when necessary).

The questionnaire survey administered in the present study was structured into three parts: (i) household demographic and socio-economic characteristics, (ii) farmers’ perception of drought and its impacts, and (iii) adaptation strategy and mitigation measures.

Data analysis and interpretation

The data collected through the questionnaire survey were coded and stored in a Microsoft Excel spreadsheet and transformed to STATA version 12.0 statistical software package for analysis. Descriptive statistical tools such as percentages, tables and graphs were used to analyse and interpret the results (StataCorp 2011). The demographic variables were summarized using tables and percentages. Scatter plots, bar charts, pie-charts and line charts were used to summarize the perception of farmers on drought and impacts, and their adaptation strategies.

Results

Demographic data

In the present study, a total of 240 participants (60 each from Alamata, Ofa, Raya Azebo and Aba’ala) were interviewed. From these participants, the majority 87.5% (210/240) of them were males and married. The minimum and maximum ages of the participants were 22 and 86 years, and the mean age was 51.5 years. The minimum household size was 1 and the maximum was 13. Of the participants, the maximum annual farm and non-farm incomes were 125,000 and 54,000 ETB, respectively. Majority of the respondents were within the age ranges of 43–60 years, household size of 4–7, having a farm income ranging from 11,000 to 27,125 ETB and a non-farm income of 7950–16,000 ETB (Figure 2).

The major source of income was crop production (48.75%, 117/240) followed by crop-livestock production (41.25%, 99/240) (Figure 3). With regard to the educational status of the respondents, majority of them were found to be illiterate, 63.75% (153/240) and 30% (72/240) of them had attended elementary school.

Farming experience, land holding and household (HH) livestock size

About 83% of the respondents had farming experience of more than 15 years. However, more than 75% of these farmers had a farming area of less than one hectare (Figure 4).

The livestock owning of the participants from 2004 to 2015 was also investigated in the present study and the results revealed that mean cattle owning of 2004–2010, 2011–2014 and 2015 were 8.45, 6.3 and 4.64, respectively, while the maximum cattle ownership for the same period was 80, 52 and 45, respectively. The result indicated a decreasing trend for cattle ownership while the small ruminant ownership had increased from 2004 to 2015 (Figure 5).

Farmers’ perception of drought and its impacts

The participants of this survey were questioned to gauge their understanding on drought and 96.2% of them explained that drought is a natural disaster than manmade. Moreover, 77.5% of the respondents had experienced drought and around 78.8%, 17.5% and 15% of them had experienced the 1983, 1989 and 2003 drought years in addition to the recent drought (2015/
Moreover, the respondents indicated other drought years that they had experienced in addition to the above ones. About 67.5% of the study participants indicated that droughts occurred more frequently than expected and 56.25% of the respondents anticipated the onset of drought (Table 1).

The major impacts of drought indicated by the farmers included crop failure, drying of water resources, loss of livestock, famine, poor health of humans and animals, increase in food prices and decline in livestock prices. With regard to the extent of effect of the recent drought (2015/2016), except 2.5% of the farmers, 97.5% of them were affected either severely or moderately.

The farmers were also asked to rate the impacts of drought on various sectors and issues. Accordingly, more than 85% of the respondents rated the impacts of drought on household food security, choice in food preference, malnutrition, human and animal health, loss of livestock, unemployment and reduction in household income as moderate and above (Figure 6).

The highest loss of livestock associated with the recent drought (2015/2016) was recorded for cattle (41.25%) followed by poultry (40%) (Figure 7). On the other side, there was no loss of camels reported by the respondents due to the recent drought.

The average incomes in a normal year and drought year range from 10,000 to 50,000 ETB and 2000 to 20,000 ETB, respectively (Figure 8). For the majority of the farmers, the average income during a normal year is around 20,000 to 40,000 ETB; however, in the drought year, this income significantly reduces by 2000 to 10,000 ETB. The mean incomes were 21,882 ETB and 6482 ETB during the normal and drought years, respectively.

For the majority of the farmers, the income from livestock in a normal year ranges from 3000 to 20,000 ETB but in a drought year this income ranges from 1,000 to 10,000 ETB. The mean incomes from livestock were reported to be 12,833 and 5659 ETB (2016). Moreover, the respondents indicated other drought years that they had experienced in addition to the above ones. About 67.5% of the study participants indicated that droughts occurred more frequently than expected and 56.25% of the respondents anticipated the onset of drought (Table 1).

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ETB during normal and drought years, respectively. The prices of a cattle in normal and drought year range from 5000 to 12,000 ETB and 2500 to 5000 ETB where the average cattle price was 8228 and 4096 ETB in the respective years (Figure 9).

**Adaptation strategy and mitigation measures against drought**

The coping strategy followed by the majority of farmers to respond to drought is by storing crop harvest (71.25%), saving money (11.25%) and storing crop residues for livestock (7.5%) (Figure 10). During the 2015/2016 drought, majority of the farmers got support from the government (58.75%) and family (10%). However, a significant proportion of the farmers (30%) did not have any alternative source of income during the 2015/2016 drought (Figure 10).

The level of satisfaction of farmers with the government support to the livestock services during the 2015/2016 drought was less (40%) and very less (24%) (Figure 11).

**Discussion**

For millions of poor people in Sub-Saharan Africa (SSA), variability and unpredictability of climate is a major challenge and poses a risk that can critically restrict options and limit their development (Brida et al. 2013). In the present study, the perception of farmers on one of the extreme climate events, drought and its socio-economic impact was assessed.

The average HH size in the present study was five person/HH. Majority of the respondents in the present survey were within the age range of 43–60, which indicates the maturity level of the respondents to give reliable response to the questions raised. The majority of farmers involved in the present study had farming experience of above 15 years and this is directly correlated with age of the respondents. However, the average land holding of these farmers was very small and this could be linked with the increasing human population from time to time. The average annual household income from farming activities ranged from 11,000 to 27,125 ETB. In the present study, the major HH sources of income were crop farming and crop-livestock production. In most developing countries, the major source of income for smallholder farmers is crop production, crop-livestock production and/or livestock rearing (Udmale et al. 2014).

With regard to the livestock ownership, the present study evidenced that the mean cattle population decreased from 2004 to 2015/2016, while the mean small ruminant population increased. The decrease in cattle population and increase in the small ruminant population could be associated with the adaptation measures taken by the farmers (i.e. shifting from large ruminant to small ruminant which are better adapted to the changing climate and climate extremes). This could also be evidenced by the highest loss of cattle (41.25%) in the 2015/2016 drought compared to small ruminants. Research findings

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*Figure 7.* Death of livestock species due to the recent drought, 2015/2016.

*Figure 8.* Comparison of average income in normal and drought years.

*Figure 9.* Comparison of average income in normal and drought years.
indicate a shift from large ruminant production to small ruminant production as means of adaptation to climate change (Chiara et al. 2009; Philip et al. 2011).

Drought has different meaning to respondents based on their physical environment, type and degree of involvement in agricultural activities, and level of impact on their financial well-being (Dagel 1997; Ashraf and Routray 2013; Mmofa and David 2015). However, in the present study, almost all farmers defined drought as a natural disaster. It was found that about 77.5% of the farmers had experienced drought in the past years and around 78.75%, 17.5% and 15% of them had experienced the 1983, 1989 and 2003 drought years in addition to the 2015/2016 drought.

For designing effective technological and policy interventions for the successful mitigation and adaptation against drought, it is important to understand the socio-economic impacts of drought (Pandey and Bhandari 2009; Panda 2017). Droughts have significant economic impacts as they affect the main economic activities of residents in the area (Antonio et al. 2013). Droughts and floods alone account for 80% of the loss of life and 70% of the economic losses in SSA (Bhavnani et al. 2008). Frequent drought conditions have reduced the GDP growth of many African countries (Dube and Jury 2000; Brown et al. 2011; Howitt et al. 2014) and threatened their development gains (Hellmuth et al. 2009). Drought has both direct and indirect impacts. Drought directly affects production, lives, health, livelihoods, assets and infrastructure that contribute to food insecurity and poverty. However, the indirect effects of drought on environmental degradation and reduced household welfare through its impact on crop and livestock prices could be larger than its direct effects (Holden and Shiferaw 2004).

Figure 9. Comparison of average income from livestock in normal and drought years.
The majority of the farmers indicated crop failure, drying of water resources, loss of livestock, famine, poor health of humans and animals, increase in food prices and decline in livestock prices as the major impacts of drought. In addition, more than 85% of the farmers rated the impacts of drought on household food security, choice in food preference, malnutrition, human and animal health, loss of livestock, unemployment and reduction in household income as moderate and above. More than 97.5% of the respondents also indicated that they were affected either severely or moderately with the 2015/2016 drought. Furthermore, the present study showed a significant variation in the overall income of farmers and income from livestock during the normal and drought years. Besides it was shown that the average market price of cattle had reduced from 8228 ETB in a normal year to 4096 ETB during drought periods. Thus, the present study evidenced that drought has a socio-economic impact in the livelihood of the farmers. The socio-economic impacts of drought have also been evidenced by research findings from different parts of the world (Mniki 2009; Bryan et al. 2010; Karpisheh et al. 2010; Guha 2012; Kesha-varz et al. 2013; Udmale et al. 2014; Debela et al. 2015).

With regard to the preparedness of farmers to deal with and respond to the impacts of drought only 35% farmers believed that they were able to deal with drought but the remaining majority indicated they were not prepared to deal with the impacts of drought. This supports previous work that indicated low resilience and high vulnerability of farmers in the rural areas to deal with drought and its impacts (Singh et al. 2014; Udmale et al. 2014; Debela et al. 2015; Mmofa and David 2015). This is also evidenced by the dependence of farmers on government support during drought periods.

It has been evidenced that droughts have significant economic impacts as they affect the main economic activities of poor farmers in the study area. The present study indicated a significant decrease in the income of farmers from farming and livestock resources and also loss of their livestock during drought years. In addition, the preparedness of farmers to deal with the impacts of drought was found weak. Therefore, an integrated early warning and preparedness plan is important to deal with the impacts of drought. Promotion and advocacy to the public about the impacts of drought and possible mitigation and adaptation strategies should be considered. In addition, farmers should be advised about selling their livestock before the onset of drought to reduce the significant price reduction during drought periods.

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Disclosure statement

No potential conflict of interest was reported by the authors.
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