JOURNAL OF DEGRADED AND MINING LANDS MANAGEMENT
ISSN: 2339-076X (p); 2502-2458 (e)**,** Volume 5, Number 3 (April 2018): 1181-1190
DOI:10.15243/jdmlm.2018.053.1181

Research Article

Perceived impacts of climate change and disaster risk management by rural communities in Ethiopia

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Received 9 January 2018, Accepted 28 February 2018

Abstract: In developing countries including Ethiopia changing pattern of rainfall, increasing temperature, recurrent drought, massive land degradation, and poor performance of agricultural sector contribute for failure to meet the growing demands for food for the rural communities and left dependent on foreign food aid and seasonal migration. This study aims at examining the perceived impacts of climate change and disaster risk management by rural communities in Ethiopia. Cross-sectional socio-economic data were used. Dejen district was purposively selected as it is highly susceptible to climate related problems. Stratified and snowball sampling techniques were employed to select a sample of 398 households. Household survey was employed to collect data on climate change impacts perceived by local communities. Focus group discussions were carried out using guiding questions and seasonal calendar. Key informant interviews were used to triangulate households' perceived climate change impacts. Field observations were used to observe biophysical, economic, social, and institutional features of the district. The results indicate that crop pests, soil erosion, crop disease, frost, drought, flood, hailstorm, and erratic rainfall were the major contributing factor for the loss of 50,555 quintals of agricultural cops over the period 2009-2016. The community seasonal calendar indicate that erratic rainfall, hailstorm, dry period, flood, landslide, livestock disease, crop disease and pests, and human diseases were the major climatic events in the study areas of rural communities. The lowland households were more susceptible to climate change impacts. Policy priority should be given based on the agro-ecology and households livelihood assets vulnerability levels.

Keywords: *climate change impacts, community seasonal calendar, Ethiopia, land degradation*

To cite this article: Amare, Z.Y. 2018. Perceived impacts of climate change and disaster risk management by rural communities in Ethiopia. J. Degrade. Min. Land Manage. 5(3): 1181-1190, DOI: 10.15243/jdmlm. 2018.053.1181.

Introduction

The changing climate impacts society and ecosystems in a broad variety ways. Climate change can alter rainfall, reduce crop yields, affect human health, and impacts the energy supply. According to Kyoto protocol (UNFCC, 2007), the rural communities in the developing countries are expected to be affected more due to their dependence on climate sensitive livelihood options, and limited adaptive capacity to adapt to the changes. Ethiopia, with its fragile geography, predominantly agriculture based livelihoods and low level of adaptive capacity due to higher incidence of poverty, is placed among the most vulnerable country to climate change. In Africa by 2020, between 75 and 250 million people are projected to be exposed to increased water stress; yields from rain-fed agriculture could be reduced by up to 50% in some regions by 2020; agricultural production, including access to food, may be severely compromised (Marchal et al., 2011). In 2016, Ethiopia has been faced its worst drought in decades, with over 10.2 million people in need of food aid. The failure of two consecutive rainy seasons, including the Kiremt rains, which normally feed 80 to 85 percent of the country between June and September, has

devastated livelihoods and greatly increased malnutrition rates across the country (DRMFS, 2016). In Amhara region, where the study district is located, a flash flood is common in *Bugna*, *Gidan*, *Guba Lafto* and *Meke*t district in North Wollo zone. Flooding in *Fogera*, *Dembia*, *Libo Kemkem* and Bahir Dar Zuria is induced by backflow of Lake Tana and overflow of *Rib* and *Gumera* rivers at times of heavy rainfall. It is also likely that heavy belg rain (between February and May) induce flooding in belg benefiting areas of the region.

A hazard is a geophysical, hydrological, biological, and human- made an event that has the potential to cause harm or loss and force people to dispose of assets to cope with it. There are different types of shocks. These are; crop damage, deaths, and illness of productive household member and livestock because of different hazards such as floods, storms, droughts, fire accidence, outbreaks of infectious diseases and pests, conflict and instability, and theft (Benson et al., 2007). Currently climate change is an added stress to already threatened habitats, ecosystems and species in Africa, and is likely to trigger species migration and lead to habitat reduction. Up to 50 percent of Africa's species total biodiversity is at risk due to reduced habitat and other human-induced pressures (Boko et al., 2007). In the study area some of the human-induced pressures were land-use conversion due to mining activities and agricultural expansion and subsequent destruction of habitat. Planning for climate change must involve consideration of climate related risks including those which have a slow onset, such as changes in precipitation and temperature leading to agricultural losses and drought and biodiversity losses ((UNFCC, 2007).

Like any other developing countries Africa is one of the most vulnerable to the impacts of climate change (IPCC, 2014). Higher food prices leading to currency depreciation and conflict and emergency security threats have been identified as a key risk to economic growth in the region (World Bank, 2013; Serdeczny et al., 2017). For example in East Africa, Kenya suffered annual damages of 10-165 of Gross domestic product (GDP), not accounting for indirect losses, because of flooding associated with El Nino in 1997-1998 and La Nino drought in 1998-2000 (Serdeczny et al., 2017). In sub-Saharan Africa where Ethiopia is located, agriculture is the mainstay of the rural communities with dependence on precipitation in combination with observed crop sensitivities to maximum temperatures during the growing season Schlenker and Roberts, 2009; Asseng et al., 2011; Lobell et al., 2011; Serdeczny et al., 2017), indicate significant risks to the sector from climate change (Serdeczny et al., 2017). Climate change adaptation is an important part of societal responses to climate change impacts. Thus, to propose appropriate adaptation options to the specific localities, understanding the levels of perception of communities to climate change impacts is a prerequisite. Thus, assessing the current climate change impacts perceived by rural communities and understanding their disaster risk management skills is crucial.

Materials and Methods

The study area

The study was conducted in Ethiopia. It is located at a road distance of 335km south of the regional state capital, Bahir Dar city, and 230 km northwest of the capital city of Ethiopia, Addis Ababa in the East Gojjam zone of the Amhara Regional State at the edge of the canyon of the Blue Nile. The District lies between longitude 38^o 6' E and 38^o 10' E, and between latitude 10^o 7' N 10^o 11' N, with an elevation of 1071 and 3000 meters above sea level (m.a.s.l). The annual average temperature and total annual rainfall of the District range between 20^oC and 24^oC and 800 mm and 1200 mm, respectively. Dejen district is located in the valley of the Blue Nile with highly undulated topography and frequent susceptibility to climate-related problems such as erratic rainfall, crop pests, livestock diseases, and malaria outbreaks. The study district is categorised into three traditional climatic zones, 41% *Dega* (highland), 31 % *Woinadega* (midland) and 28 % *Kolla* (lowland) (DDARDO, 2016, DDEPO, 2016). The study was conducted in these three agro-ecological zones of the district Nile Basin of Ethiopia.

Data collection

This study used a multi-stage sampling technique to select the agro-ecology, *Kebeles* (the lower administrative unit next to district), and households. At the first stage, Dejen district of the Nile Basin was selected purposely due to its highly undulated topography and frequent susceptibility to extreme events and representativeness of the three agro-ecological zones such as highland, midland, and lowland. In the second stage, six *Kebeles* (two from each agro-ecological zone) were selected purposely based on the above-listed district selection criteria. Climate change affects the rural communities differently in different agro-ecological zones. As a result, communities' knowledge and skill to adapt to the climate

change impacts varies from place to place or agro-ecological settings. In the third stage, stratified sampling was employed to select households. Under the stratified sampling, the population was divided into male and female-headed households, and then the sample was selected from each male and female-headed household to constitute a representative sample. The sample size was determined proportionately. In Ethiopia context, female-headed households are those who do not have husband due to either being divorced, widowed, or separated. In Ethiopia, in some of the rural communities, disclosing of the marital status of older females is culturally not allowed or not feeling comfort them (Zehirun, 2017). Thus, to get female-headed households, snowball sampling was employed as used by Zehirun (2017). Based on the formula provided by Yemane (1967) at the 95 % confidence interval and 5%, level of precision. 398 households were selected at the six *Kebeles* of the district. Household survey was the main sources of data triangulated with key informant interviews, focus group discussion, and field observation. Focus group discussions were carried out using guiding questions and seasonal calendar.In the household survey, the open-ended questions participants were answering questions in their own words. These types of questions are used to elicit respondent feelings and to provide depth to an issue. On the other hand, closed questions provide the respondent with a defined set of answers. Prior to the actual interview of the sampled households, 10% of the sampled households from the three agro-ecological zones were pretested. Pretested K*ebeles* and participants were not involved in the actual survey. After pretest, ambiguity words were rephrased, inappropriate questions was replaced. Data collectors were trained with respect to the survey techniques and confidentiality protocol.

Results and Discussion

According to the key informants' interview, rural communities understand their locality more than the district officials on climatic impacts. This is because, in the district, only extreme climate change impacts were recorded and documented. Whereas, the local communities more or less remembered what happened in the past ten years or so in their locality. Based on household survey, and key informants' interview, crop pest was happened at least on average; crop 7times followed by soil erosion (6times), food supply constraints, crop disease, crop weeds, human disease, and animal disease in the past 10 years (Table1). Like any other developing countries, Agriculture is the mainstay of the rural communities of Ethiopia and the study area too. The agricultural production is highly dependent on weather, climate and water availability. This could have the possibility to adversely affect by weather and climate related disasters.

Table 1. Reported climate change impacts (in frequency) in the past 10 years

Events	Key informants	Households (average)	Average of KII&HHs
Drought	2	4	3
Flood problem	2	3	3
Water supply constraints	3	4	4
Crop failure	2	4	3
Crop pest	10	4	7
Crop disease	3	5	4
Crop weeds	4	4	4
Human disease	2	4	3
Animal disease	2	4	3
Soil erosion	7	4	6
Food supply constraints	4	4	4

Source: Household Survey (HHs), and key informants interview (KII), March-October (2016)

According to Ballingall et al. (2013), crop pests, weeds, and diseases are very resilient and will adapt to new climatic niches. Currently, it is estimated that between 10% and 16% of the world's crops are lost to diseases outbreaks (Bebber et al., 2013). Therefore, the rise in the temperature could make the problem worsen globally and specifically in the study area which this study confirmed. When there is an increase in temperature and decrease in rainfall, there is likely to an increase in many weeds, pest and diseases problems. For example Ballingall et al. (2013), noted that drought stressed crops will be more at risk from weeds, pests, and diseases except for

some crops which grown well i.e., a change in climate may also allow different crop species to be grown and this may increase the probability of the sowing of crops which are more susceptible hosts. For example growing maize in the rotation will increase the chance more maize being grown (Ballingall et al., 2013). Maize is the major crop in the lowland of the study district. A small number or below half of the surveyed households complain about an increase in crop failure (41.8%) and food supply constraints (39.2%). This is because the lowlands produce more maize which has a chance to resist the climate change and the midland and highland parts of the district grow more *Teff*, *Wheat*, and *Barley* which probably affected by the climate change extremes like crop pest and diseases. The majority of the surveyed households reported there is an increase in drought (84.4%) and crop weeds (78.4%) followed by an increase in water supply constraints, crop pests, crop disease, and food supply constraints. Whereas, the surveyed households report there is a decrease in food supply constraints (57%), soil erosion (49.7%), animal disease (57%), flood (49.7%), and human disease (66.3%) in the past ten years in their locality (Figure 1). In addition, the results was confirmed by the key informants interview as the major hazards were found frequent crop pest and soil erosion in the district with an average frequency of seven and six times respectively in the past ten years. Crop pest happened in all the past ten years in the study area (Table 1). Due to an increase in climate change events, the study district has lost 50,555 quintals of crops from 2009-2016 (Table 2).

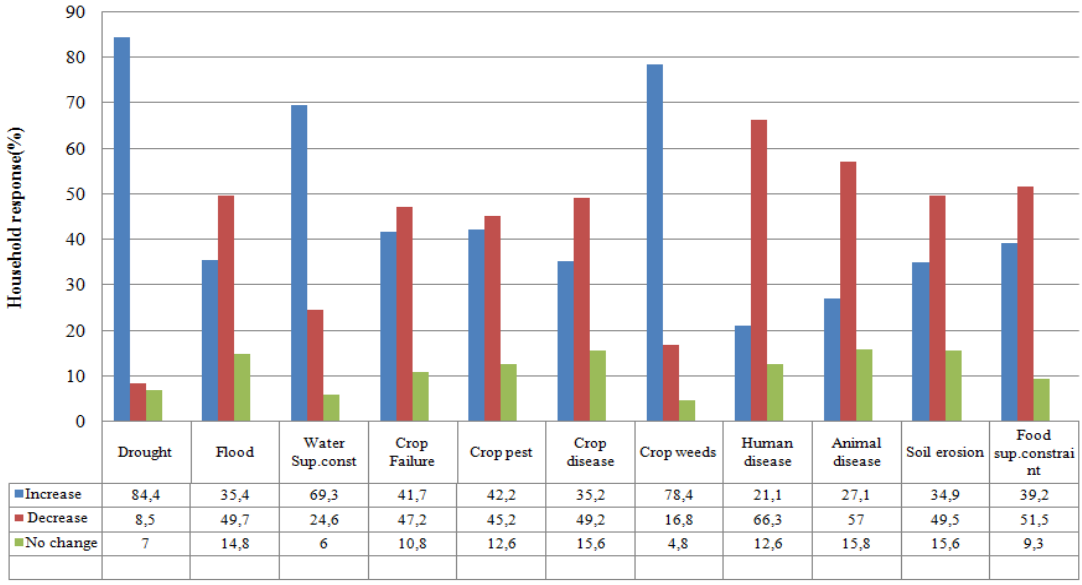

Figure 1. Climate change events reported by households in the past 10 years
Source: Household Survey data, March-October (2016)

Table 2. Crop loss (in quintal) from major climate extremes (2009-2016)

Climate change events	**2016**	**2015**	**2014**	**2013**	**2012**	**2011**	**2010**	**2009**	**Total loss**
Crop pest	300	62	1230	251	3670	601	285	4018	10417
Soil erosion	----	54	2916	1364	605	373	419	1340	7071
Crop disease	----	95	----	----	2903	9030	--	--	12028
Frost (wirch)	----	----	----	----	----	----	----	8487	8487
Drought	11,777								11777
Flood	----	50	----	----	----	----	----	----	50
hailstorm	54	553	----	----	----	----	----		607
Erratic rainfall	118	----	----	----	----	----	----	----	118
Total loss in ql.	12249	814	4146	1615	7178	10004	704	13845	50,555

Source: Key informants interviews data, March-October (2016)

Drought is the strong determinant of agricultural performance as well as general economic development in Ethiopia (NMA, 2001). The surveyed households and focus group participants also reported an increase in rainfall intensity (mostly July and August) has exacerbated the problems of flooding and soil erosion, particularly in the lowlands of the district which the topography of the land is a steep hill slope. In all study sites and social groups, impacts of climate change and variability were defined. Based on the focus groups discussions, there is a water problem and consequently, it burdens to females in search of water by traveling to distance places. Crop failure, crop pest, and diseases, decreasing of forest coverage, human and animal health problems, and expansion of crop weeds were also explained by the groups as climate change impacts in their locality (Table 3). In addition, other non-climatic factors like inadequate extension services (example weather information by development agents was insufficient) and poor/inefficient access to agricultural inputs also stated by focus group discussion participants. In this regard, synthesis report by African Climate Change Resilience Alliance (ACRA, 2011) noted that the impact of climate change is more pronounced when there is interaction with other non-climatic stresses.

Table 3. The impacts of climate change in their own words

	Responses		**Agro-ecology**
Discussed issue	**Female FGDs**	**Male FGDs**	
Impacts of climate change in your locality?	Water wells are drying up, mothers are forced to walk for hours to find water, crops fail from the lack of rain, animal disease, crop pests are increased, crop failure and peoples displacement in other places	Water wells are drying up, expansion of crop weeds	Highland
	Drying of water sources Decrement of forest coverage Crop failure	Drying of water sources There is decrement of forest coverage Human &animal health problem	Midland
	Water wells are drying up, crop pests and diseases are increased crop failure	Due to unexpected rainfall season, we are Unable to implement based on development agents education to manage our farming activities Drying of water sources There is decrement of forest coverage, No rainfall in June for the past 15 years	Lowland

Source: Focus group discussions data, August (2016)

Rural communities' disaster risk management using Community seasonal calendar

Every community of the study area faces the risk of being struck by a disaster of one type or another (covariate risk), including natural disasters such as erratic rainfall, hailstorm, dry period, floods, land slide, livestock disease, crop pest/ disease, food shortage, water shortage, and human diseases. In this subsection, community seasonal calendar was a tool to track the hazard severity in each month. Seasonal calendar tracks seasonal change, climate related hazards and other activities related to a specific month. It uses in documenting regular cyclical periods and significant events that occur during a year and influence the life of a community. In the agriculture sector, this tool used primarily to plot seasonal farm activities and can serve as the basis

for developing strategies for reducing the risks from disasters. Before starting exercise, the facilitator was asked participants when in their perception, the year starts then after the seasonal calendar was set up accordingly and in their local language. After identifying the major environmental periods and hazards using seasonal calendar (Table 4). The matrix was drawn on a flip chart then the facilitator asks the FGDs participants to identify the hazards that have the greatest impact on their lives and livelihoods in each twelve months of the year. This was done through a simple ranking exercise 1 stands for has a negligible impact or low intensity, 2 stands high and 3 stands for has a severe impact or very high intensity. The seasonal calendar was done in three target *Kebeles* with one male and one female group. In order to get the district level hazard events, all the responses were averaged (Table 4). In the seasonal calendar, the average focus group discussion responses of the climatic factors in the three agro-ecology zones were computed. However, there is no significant difference in the agro-ecologies of the study area. As a result, this study used the district level of the seasonal calendar for discussion.

Erratic rainfall: In Ethiopia, June to September is supposed to be the main rainy season. Untimely rainfall occurred in the month of October. As it is seen from the seasonal calendar (Table 4) in June there is low rainfall. As a result, participants claimed late onset delayed planting of slow maturing crops like maize and sorghum and other early cessation of rainfall has led to greater yield decline. This event damages matured crops and spoils gathered crops of the farmer's crop land but this October rainfall has advantageous in some crops such as chicken-peas in the study area.

Table 4. Seasonal calendar of major climatic events intensity in the past ten years

Climatic	**Kiremt/Rainy season**				**Bega /Dry season**				**Belg/Small rain seaso n**			
factors	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dece**	**Jan**	**Feb**	**Mar**	**April**	**May**
Rainfall	1	2	3	1	1	0	0	0	0	1	1	2
Hailstorm	1	1	2	1	0	0	0	0	0	0	0	0
Dry period	1	0	0	1	1	2	3	3	3	1	0	1
Flood	1	2	3	1	0	0	0	0	0	0	0	0
Land slide	0	1	3	2	0	0	0	0	0	0	0	0
Livestock disease	1	0	2	2	2	0	0	0	0	0	0	1
Crop disease/pests	1	1	1	2	2	2	0	0	0	0	0	0
Food shortage	0	1	2	3	2	0	0	0	0	0	0	0
Water shortage	2	0	0	0	0	0	0	1	2	1	2	1
Human disease	0	0	0	2	2	1	0	1	1	1	1	1
Other												

Description: 1: indicates low; 2: high and 3: very high intensity; Source: Focus group discussion seasonal calendar, August (2016)

Hailstorm: It is a storm in which a lot of small balls of ice fall like rain. In the study area, there is a hailstorm event in between June and October of the Kiremt (main rain) season and March to April of the Belg (small rain) season. August is the highest or severe hail storm event in the twelve months. The first season the so called Kiremt (main rain) season is the growing period of crops and the Belg (small rain) season is the growing season of some other crops and maturity periods of the major crops. As a result, the participants during the group discussion explained hailstorm occurs both in the growing and maturity stages of crops. Participants remembered two hail storm events (in 2015 and 2016) in the past ten years. This hail storm event was documented at the District Agricultural and Rural Development Office and accessed during key informant interviews. These two years hail storm events have loss of 607 quintals of crops in the district (Table 2). Studies in Asia and Pacific regions also asserted the effect of the hail storm on amplifying drought incidences and society's sensitivity by livelihood assets (Liu, 2007).

Dry period: Dry period could lead to dry lands. In the study area, seasonal calendar shows

except for July and August, the majority (83%) of months are characterized by slightly (June, September, October, March, and May) to severe dry (November to February) periods. Based on field observation, dry lands of the lowland study area show clear evidence of environmental degradation. Drought and unreliable and variable rains are recurrent problems in the study District. Even without climate change, the dry land faces a daunting array of threats including population pressure, social changes such as the settlement of traditionally nomadic peoples, and exploitive agricultural and grazing practices that increase deforestation, soil erosion, salinization, and water depletion (Abdi et al., 2013).

The problem was expressed by residents during field observation and household survey informal discussions. For example during field observation, one mother response about the degraded and bare lands of their surrounding:

> "I do not have to complain about nature rather, my complaint is on the people who changed the natural settings by exploiting the land (Plate1). Before, the mining investors came; there was dense vegetation in our surroundings. After mining investors start, the vegetation becomes bare and the land lacks moisture. Even the malaria outbreaks increased".

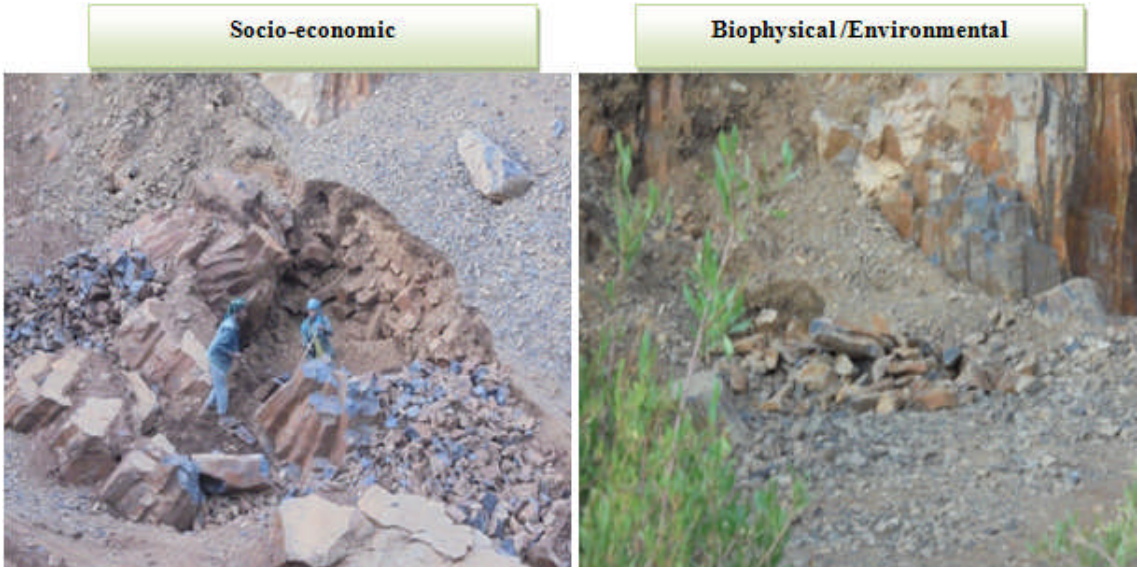

Plate 1. Land degradation due to socio-economic and biophysical influence.
Source: Field observation, March-October (2016)

The focus group participants complain about the degradation of their farmland and living environment. They explained that the area is degraded due to investment and lack of rainfall. Therefore, land degradation due to dryness is not a matter of only long dry periods rather it is the result of the biophysical and socio-economic result.

Flood: In Ethiopia, the flood is high in the main rainy season (in June and August). However, in the study area flood happened in June and September in low intensity. Flood is the major climate- related extreme event reported by the farmers of the study area. As per their explanation, when the rain comes, it falls hard followed by intense flooding without recharging underground water, removing away soils are devastating agricultural production, and beating down the cultivated crops.

Land slide: Based on the seasonal calendar and participants' discussion, land slide occurs during the main rain season (August). The land slide is severing in the lowlands of the district due to the instability of slopes. The participants reported that land slide of their farmland and their surrounding is due to farming practice, exploitation of minerals, and deforestation. The land slide damages the residents surrounding, loss of natural resources, blocking rivers and increase the risk of flood especially in the lowlands it affects farmers' livelihoods as they can prevent access to land for years, destroy seed and food stocks. The damage to crop production is caused by a reduction in cultivated land. Rural communities believe that the rain during August has penetration power and a large mass of snow and ice sliding swiftly down a mountain side and reduce their farmland size (Plate 2).

Plate 2. Land slide in the lowlands of the district.
Source: Field observation, March-October (2016)

Livestock disease: in the study area climate-induced disease has created health shocks. The seasonal calendar shows that August, September, and October months are high in disease outbreaks, whereas, the month of June and May are low disease occurrence. In the district, animal diseases are; the Black leg, Anthrax, Foot and mouth disease (FMD). Besides, the key constraint to improved livestock productivity remained inadequate feed resources, especially in the dry season. According to the FGDs, when livestock diseases occurred, the threat to the farmers' livestock production is found much severe in all agro-ecology zones of the district. There are a decreasing pasture availability and quality as well as increasing water stress.

Livestock keeping and farming practice has become a serious problem from time to time. In this regard, Yirgu et al. (2013) noted that in recent years a complex set of factors such as increased rainfall variability, rising temperature, invasive species, resource conflict and over grazing are forcing huge changes within farming community in Ethiopia.

Crop disease and pests: Participants of the focus group discussions in their seasonal calendar reported that, their major livelihood activities/crops were also affected by weeds, pests, and insects. In the study area, the crop diseases and pests occur highly in the month between September and November when the relative humidity increase. On the other hand, there are low disease and pest outbreaks between June and August. This implies the changing temperature regimes will affect not only growing seasons but also the prevalence of pests and disease that attack the cultivated crops. These impacts are anticipated to have very significant implications for the livelihood bases of the poorest farmers.

Locust/tropical grasshopper is one of an insect found in low and mid lands of the district. This insect has a strong power of flight and usually solitary, but from time to time there is a population explosion and it migrates in vast swarms which cause extensive damage to crops and vegetation (see Plate 3).

Food shortage: a devastating drought in Ethiopia is causing worst food crisis that the country has faced in three decades. In Ethiopia, Meher is the main crop season. It encompasses crops harvested between September, and February. Crops harvested between March and August is considered as Belg (small rain) season crops. In the study area due to less Belg (small rain), the rural communities start to harvest their crop at the end of October and they do not have Belg (small rain) season crops. Based on the seasonal calendar of the focus group discussion participants, between July and October are the food shortage months of the year. Among these August and October months are high and the month of September is very high scores on the seasonal calendar at the community level. Based on the surveyed households the average number of months households faced food shortage in a year is at least one month on average. The minimum is zero and the maximum annual food shortage gap is up to nine months.

Water shortage: The seasonal calendar shows the month of June, February, and April months are characterized by high water shortage.

Whereas the month of January, March, and May months are a low shortage of water problem. The average distance to fetch water in the study area is 18 minutes during summer (Ethiopian rain season) and 21 minutes during winter (Ethiopian dry period/Bega). During drought years the surveyed households lack water at least for three months and less than one month during normal years.

Plate 3. Outbreaks of Locust in the lowlands of the study area.
Source: Field Observation by assistants, March-October (2016)

Human health: The seasonal calendar shows, there is high human disease outbreaks in the month of September and October, where as for November to May except December, there is a low incidence of climate related human diseases. As water resources become scarcer and competition for water increases, polluted water may be an option for drinking and this spreads infectious diseases such as typhoid and cholera among others. This result is consistent with key informant interviews, recorded information at the district level and aspects of the literature.

Conclusion

Identified Climate change impacts in this study were; drought, flood, water supply constraints, crop failure, crop pests, crop disease, crop weeds, human diseases, animal diseases, soil erosion, and soil supply constraints affect the population of Dejen district and other places having similar agro-ecology and livelihood activities. In the study area, like the majority of Ethiopia, poor climatic conditions such as changing pattern of rainfall, increasing temperature, recurrent drought, massive land degradation, and poor performance of the agricultural sector contribute for failure to meet the growing demands for food for the rural community and left the people dependent on foreign food aid and seasonal migration. In the agricultural sector, seasonal calendar is used primarily to plot farm activities and it can serve as the basis for developing strategies for reducing the risks from disasters. This study finds the need for farmers to adopt disease resistant varieties and water harvesting technologies in order to deal with the incidence of dry spells during the production season.

Acknowledgments

This study was sponsored by the Pan African University (PAU) a continental initiative of the African Union Commission, Addis Ababa, Ethiopia. The author would like to thank the data collectors and field assistants for their effective coordination, support, and time spent in organizing and conducting successful households' interviews and facilitates focus group discussions.

References

Abdi, O.A., Glover, E.K. and Luukkanen, O. 2013. Causes and impacts of land degradation and desertification: case study of the Sudan.

International Journal of Agriculture and Forestry 3: 40-51.

ACRA. 2011. African Climate Change Resilience Alliance (ACCRA). Understanding the Influence of Development Interventions on Adaptive Capacity at Local Level in Ethiopia, Africa Climate Change Resilience Alliance Ethiopia. Synthesis Report. Addis Ababa. .

Asseng, S., Foster, I. and Turner, N.C. 2011. The impact of temperature variability on wheat yields. *Global Change Biology* 17: 997-1012.

Bebber, D.P., Ramotowski, M.A. and Gurr, S.J. 2013. Crop pests and pathogens move polewards in a warming world. *Nature Climate Change* 3: 985-988.

Benson, C., Twigg, J. and Rossetto, T. 2007. Tools for mainstreaming disaster risk reduction: guidance notes for development organisations. Provention Consortium.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R. and Yanda, P. 2007. Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, eds. ML Parry, OF Canziani, JP Palutikof, PJ van der Linden and CE Hanson, 433-467. Cambridge University Press, Cambridge UK.

DDARDO, 2016. Dejen District Agricultural and Rural Development Office (DDRDO), Annual Report, East Gojjam zone, Dejen, Ethiopia.

DDEPO. 2016. Dejen District Environmental Protection Office (DDEPO),East Gojjam zone, Dejen, Ethiopia.

RMFS. 2016). Disaster risk management and food security Sector (DRMFS). National contingency plan, Joint Government - Humanitarian Partners' National Flood Contingency Plan (Unpublished), Addis Ababa, Ethiopia.

IPCC. 2014. Intergovernmental Panel on Climate Change, Climate Change -Impacts, Adaptation and Vulnerability: Regional Aspects, Cambridge University Press.

Liu, L. 2007. Back Ground Paper on Drought-An Assessment of Asian and Pacific Progress. Regional Implementation Meeting for Asia and the Pacific for the sixteenth session of the Commission on Sustainable Development (CSD-16), UN-ESCAP.

Lobell, D.B., Schlenker, W. and Costa-Roberts, J. 2011. Climate trends and global crop production since 1980. *Science* 333: 616-620.

Ballingall, M., Evans, A. and Burnett, F. 2013. Climate Change and Crop Pests, Weeds and Disease: A Concern for Today and Tomorrow? Factsheets October 2013, Farming Connect, Cyswlt Ffrermio Wales, United Kingdom.

NMA. 2001. National Meteorological Agency (NMA). Initial National Communication of Ethiopia to the United Nations Framework Convention on Climate Change (UNFCCC). Addis Ababa, Ethiopia: National Meteorological Services Agency under the GEF supported.

Schlenker, W. and Roberts, M.J. 2009. Nonlinear temperature effects indicate severe damages to US crop yields nder climate change. *Proceedings of the National Academy of Sciences* 106:, 15594-15598.

Serdeczny, O., Adams, S., Baarsch, F., Coumou, D., Robinson, A., Hare, W., Schaeffer, M., Perrette, M. and Reinhardt, J. 2017. Climate change impacts in Sub-Saharan Africa: from physical changes to their social repercussions. *Regional Environmental Change* 17: 1585-1600.

UNFCC. 2007. Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries. Bonn: UNFCCC.

Marchal, V., Dellink, R., van Vuuren, D., Clapp, C., Château, J., Lanzi, E., Magné, B. and van Vliet, J. 2011. OECD Environmental Outlook to 2050 Climate Change Chapter Pre-Release Version. The OECD Environment Directorate (ENV) and the PBL Netherlands Environmental Assessment Agency (PBL).

World Bank. 2013. The World Bank and agriculture in Africa. http://go.worldbank.org/GUJ8RVMRL0. Accessed 30 December 2017.

Yemane, T. 1967. Statistics: An introductory Analysis, 2nd Ed., Harper and Row. New York.

Yirgu, L., Nicol, A. and Srinivasan, S. 2013. Warming to Change? Climate Policy and Agricultural Development in Ethiopia,Working paper 071. Future Agricultures consortium, Addis Ababa, Ethiopia.

Zerihun, Y.A. 2017. Barriers to and determinants of the choice of agricultural land management strategies to combat climate change in Dejen district, Nile basin of Ethiopia. *International Journal of Current Research* 9(12): 62095-62102.