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Farmers and policy makers' perceptions of climate change in Ethiopia

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Abstract

Climate change is one of the most urgent and complex challenges for societies and economies. Left unaddressed it contains the potential to compromise the wellbeing of the current and future generations. Smallholder farmers who depend on rain-fed agriculture are heavily affected and it is important to understand what they think about the problem and its impacts so that the remedial measures can be tailored to address the same. Hence this study[1] explores how farmers and policy makers in Ethiopia conceived climate change, factors contributing to it and its impacts. The study is based on a field research conducted from January to May 2012 in Sidama's three agroecological zones (AEZs), namely, the highlands, midlands and lowlands. It deployed both qualitative and quantitative research method. Data collection involved a) semi-structured interviews with 15 farmers and 17 policy makers, b) focus group discussion with 30 farmers, and c) a survey of 120 farmers. The novelty of the study lies in exploring and comparing two sets of views (that of local people and the policy makers) on climate change.

Findings revealed that farmers clearly perceived climate risks based on their experience and knowledge of their local environment. The commonly cited indicators of change include high temperature, rainfall, seasonal shifts and incidence of certain diseases. Farmers also identified specific indicators such as change in wind direction, disappearance of plant (crop and tree) species, growing hitherto unfamiliar crops and emergence of new parasites and weeds. Their perceptions of causes of climate change are mixed: deforestation, God's wrath, human activities, and weakened indigenous practices and values. On the other hand, participants from policy-making community espoused views shared by scientific discourse such as deforestation, global warming and CO_2 emissions. The gap in understanding needs to be bridged by information and education of the local public with the policy makers paying attention to the importance of indigenous knowledge.

Key words: climate change, smallholder farmers, perceptions, vulnerability, adaptation, Sidama, Ethiopia

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[1] The study forms part of the broader research project into actual and perceived climate change that included climate data (see Hameso, 2015) and book chapter on farmers perceptions about climate change (Hameso, 2014) but this paper reports on and compares climate change as perceived by farmers and policy makers. I acknowledge comments from two anonymous reviewers.

Introduction

Climate change is one of the most urgent and complex challenge for societies and economies (Corner *et al*., 2012; Giddens, 2009; UNDP, 2007). For developing countries, it complicates existing challenges of poverty eradication (Hassan, 2010; Hope, 2009; Adger *et al*., 2003) and the realization of Millennium Development Goals (Sachs, 2007; Sumner and Tiwari, 2009). Left unaddressed climate change contains the potential to reverse progress on development and to compromise the wellbeing of the current and future generations (World Bank, 2010, p.37). For as long as climate change is occurring and more change is anticipated, gaining deeper understanding of the subject is timely and critical across communities, space, and disciplines.

The Sub-Saharan Africa region faces special vulnerabilities to climate change owing to poorly developed infrastructure and transport, energy, information, and communication systems (World Bank, 2009; Hassan & Nhemachena, 2008). Within the region, Ethiopia is one of the most affected by climate change due to its low level of economic development, heavy dependence on rain-fed agriculture and high population growth (Conway and Schipper, 2011; Eshetu *et al*., 2014). The problem is aggravated for Sidama's smallholder farmers'[1] who depend on rain-fed agriculture to produce coffee for global market and Enset for subsistence. Yet these farmers' understanding and responses to climate change have neither been seriously acknowledged nor empirically studied. Moreover, local perceptions and contexts that define quality of life and wellbeing are often ignored in climate vulnerability studies (O'Brien *et al*., 2004).

According to Intergovernmental Panel on Climate Change (IPCC), perception about climate change is about human behaviour -- one of the least understood components of the climate system (IPCC , 2007b, p.14). While abundant literature explored perceptions of climate change worldwide, the case of rain-fed agricultural livelihoods of Ethiopia is scarce (Deressa *et al*., 2010; Conway *et al*., 2007; Ching *et al*., 2011; Admassie *et al*., 2008). Recent studies from Western India into rural people's belief and understanding of climate change suggested that most respondents detected changes in the climate but they did not hear about the scientific concept of climate change (Moghariya and Smardon, 2012). Similarly, a study of East Tibetan villages found that people were not aware of the global phenomenon of climate change and assumed that the changes were local (Byg and Salick, 2009). Despite lack of clear reference to global warming, studies on Africa noted that farmers were acutely aware of warmer temperatures and decline in precipitation (Maddison, 2007; Juana et al., 2013).

Closer to the Sidama context, farmers from central Tigray, Northern Ethiopia, are reported to recognise untimely rain and frequent drought as manifestation of climate change (Mengistu, 2011). Another research on Ethiopia's Nile Basin reported differential perceptions among farmers living in the highlands and in the lowlands

[1] Smallholder farmers are understood as 'farmers using predominantly family labour and for whom the farm provides their main source of income and livelihood' (Johansen *et al*., 2012, p. 19). They are variously described as family farmers, subsistence farmers, poor farmers and peasant farmers. Smallholder farming is characterised by small farm size, low technology and low capitalization (Hameso, 2015).

(Deressa *et al*., 2010, p.28). This finding requires closer examination, as it appears counter-intuitive to expect temperature or precipitation variability to be felt more keenly at the higher rather than the lower altitudes known for water stress. Given these mixed findings, it is worthwhile to probe the local/indigenous understanding of smallholder farmers versus the global/scientific understanding of policy makers about perceptions of climate change (Hameso, 2014) by quizzing how differently situated communities perceive, interpret and act on climate change (Litre et al., 2014).

The objective of the research is to gain enhanced understanding of the perceptions of climate change. The paper addresses a specific research question relating to how smallholder farmers of Sidama and policy makers in Ethiopia conceived, climate change and the its impacts. Perceptions play an important role to understand how the affected people think about the problem and its impacts so that the remedial measures can be tailored to address the same. Tackling the above research question involves exploring the background to Sidama, the policy dimension of climate change in Ethiopia and the selection of suitable methods and analytical tools.

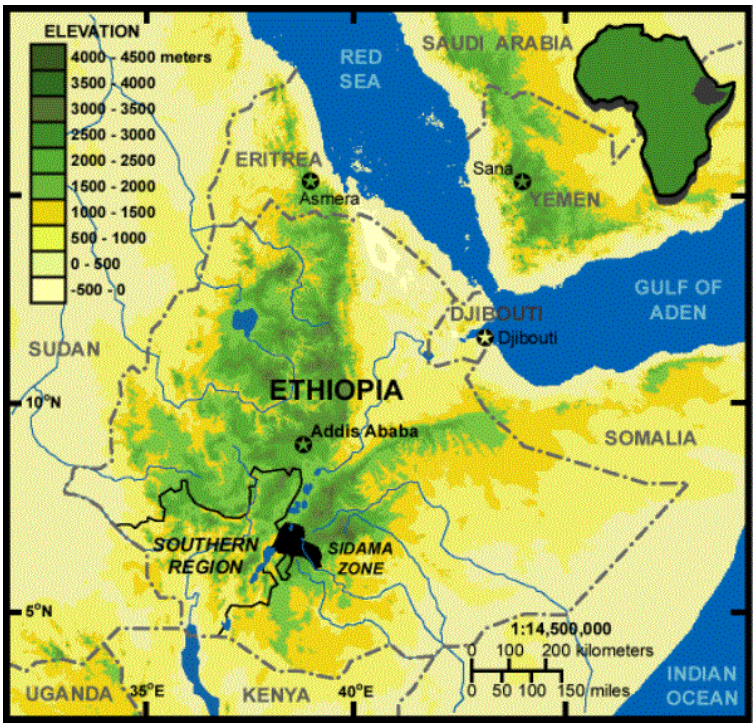
Background: Ethiopia and Sidama

Ethiopia is an East African country with immense geographical diversity and topographical variation. With the total population of 92 million, Ethiopia's economy is based on agriculture which contributes 42-45% of the country's GDP, 80% of employment, and 90% of foreign exchange earnings (Zenebe *et al*., 2011). Among important crops, coffee accounts for over 35% of export earnings and more than 25% of the population depend on coffee production and trade. Ethiopia is the third largest producer of coffee in Africa, and the tenth largest in the world (McCarthy, 2007). According to AfDB (2010), more than 95% of total coffee was produced by smallholder farmers.

Historical climate data show that the average temperature in Ethiopia has increased by 0.37 °C in every ten years for the last fifty years (1951-2006). The country's National Adaptation Programme of Action (NAPA) recognised that adaptive capacity varied between sectors and geographic locations within the country (NMA, 2007). So far, a number of climate change related analysis focused on the Nile Basin region of Ethiopia while other areas were neglected. In Ethiopia, like comparable cases around the world, climate change processes are altering not only the way smallholder farmers live, but also their strategies to secure basic living standards, including the opportunity to earn income and meet material needs, preserve health and basic education, and maintain a sense of social and cultural affiliation (Eriksen *et al*., 2007). This study focuses on Sidama, the least studied geographic area in Ethiopia (Hameso, 2015).

Sidama is located in Southern Ethiopia (Fig 1). It has a total population of over 3.6 million (CSA, 2007) and total land size of 6972 square kilometres. Its population density of 506 people per square km makes it one of the highly dense parts of the country with the average for Ethiopia being 83 persons (CSA, 2011).

Figure 1: Location of Sidama, Ethiopia



Sidama highlands (locally known as *Alichoo*) are characterised by rugged mountainous terrain. They lie at the altitude of over 2000 metres above sea level (masl) and comprise of 8% of Sidamaland. The average annual rainfall is 1800 mm and the mean annual temperature is 16°C. The midlands (*Gamoojje*) are characterised by temperate conditions found between 1600 to 2000 masl in elevation with average annual rainfall of about 1500 mm and 17°C average annual temperature. They cover 45% of Sidama. The lowlands (*Qolla*) are located in the Great Rift Valley system. They range between 500 and 1600 masl in altitude, with mean annual rainfall of 600 mm, and the mean annual temperature of 23°C. The lowlands cover 27% of Sidamaland (Hameso, 2015).

Sidama's rural livelihoods are at risk due to several factors, an important one being climate change. Weather conditions in the highlands are gradually converting to midland conditions while the lowlands tend to transform into semi-desert conditions (Hameso, 2015). Paradoxically, increased aridity and drought occur amid erratic rain and heavy flooding. Moreover, common to some other areas in Ethiopia (Kebede and Adane, 2011), Sidama experienced food insecurity, diminishing water resources, erratic and torrential rainfall causing floods and inundation of crop fields near riverbanks and lakesides and the spread of malaria. What makes the Sidama case unique is the constellation of marginality all worsened by climatic stress.

Methodology

The study used comparative case study research design to analyse climate change in three agroecological zones (AEZs). The selection of research sites is predicated on spatial difference, which links to the fact that vulnerability and impacts of climate

change vary from place to place. Altitude is the key influence on livelihood systems, farming practices, human settlement, temperature and rainfall distribution. Accordingly, three AEZs are selected representing semi-arid lowlands, sub-humid midlands and alpine highlands. The villages selected are Jara Galalcha in Hawassa Zuria district (representing lowland), Awaada in Dale district (representing midland) and Xexicha in Hula district (representing highland). Combined, these zones represent enset,[1] coffee,[2] and maize production alongside livestock livelihood systems.

The study deployed mixed methods (qualitative and quantitative) as complementary tools to provide different perspectives and help answer the research question of how do smallholder farmers and policy makers perceive climate change. Data on socio-economic shocks, climate shocks, trends and seasonality are collected via qualitative and quantitative methods. For qualitative data collection, 30 farmers were selected (10 households from each AEZs) while additional 15 farmers (5 heads of households from each AEZs) and 17 GO & NGO[3] participants were selected for interviews based on purposive sampling of participants with knowledge of the area and specific demographics (including female household heads). The choice of policy makers predicated on the positions held within their organisations and their relevance to climate change policy-making or implementation starting with Kebele*s*, districts, zonal administration, regional government, and sectoral federal government line ministries. At the regional, zonal, and district levels, interviewees include those involved in agriculture, natural resource management and environmental protection. Finally, participants for quantitative survey data were selected through systematic random sampling technique, which resulted in 120 heads of households (40 from each AEZ)

Discussion and findings

Socio-economic characteristics of survey

Survey respondents exhibit diverse demographic and socioeconomic characteristics (Table 1). The average age of survey household head is 46 years (SD 17.6). The minimum age is 20 and the maximum is 90 years. More than half of the survey respondents (54%) were relatively young (between 20 and 40 years of age). Middle to older age group accounted for the remaining 46%.

[1] Enset is a long maturity plant, taking about 4-6 years to fully mature; but it is often processed and consumed before full maturity. It requires longer rainy season to flourish.
[2] Coffee is a long maturity tree (3-4 years) and once planted and maintained, it can produce for decades. Depending on altitude, coffee beans are harvested between September and January. At lower elevations, harvesting takes place between October and December.

[3] Four Federal or Central government officials, namely from Ethiopian Environmental Protection Authority (EPA), National Metrological Agency (NMA), Ministry of Agriculture (MoA), and Ministry of Water and Energy (MoWE), 2 Regional Government officials, namely from the southern Regional Agriculture and Meteorology officials, 1 Sidama Zone official, 3 District officials, 2 Development workers, and 4 NGO officials from SOS Sahel, World Vision, Forum for Environment, and Sustainable Land Use Management.

Table 1: Socioeconomic summary of household survey (statistics)

Variable/Household characteristics	**Mean (SD)**		**Min – Max**	
Age of household head	46 (17.6)		20 - 90	
Family Size	7.13 (2.26)		1 - 14	
Variable/Household characteristics	**Frequency (%) N = 120**	**Survey sites**		
	All	Xexicha	Awaada	Jara
Age group				
Young (20-40)	61 (53.5)	29.7%	56.8%	72.5%
Middle (41-60)	25 (21.9)	29.7%	18.9%	17.5%
Old (61-80)	25 (21.9)	35.1%	21.6%	10.0%
Elderly (81-100)	3 (2.6)	5.4%	2.7%	0.0%
Family size (group)				
Small (1-5)	33 (27.7)	27.5%	20.5%	35.0%
Medium (6-8)	34 (28.6)	15.0%	38.5%	32.5%
Large (8-10)	42 (35.3)	40.0%	33.3%	32.5%
Very large (11-15)	10 (8.4)	17.5%	7.7%	0.0%
Gender				
Male	109 (90.8)	95.0%	85.0%	92.2%
Female	11 (9.2)	5.0%	15.0%	7.0%
Marital status				
Married	110 (91.7)	90.0%	90.0%	95.0%
Single	2 (1.7)	0.0%	5.0%	0.0%
Divorced	1 (0.8)	2.5%	0.0%	0.0%
Widow	7 (5.8)	7.5%	5.0%	5.0%
Ethnicity				
Sidama	117 (97.5)	97.5%	95.0%	100%
Amhara	1 (0.8)	2.5%	0.0%	0.0%
Other	2 (1.7)	0.0%	5.0%	0.0%
Religion				
Protestant Christian	92 (76.7)	52.5%	87.5%	90.0%
Orthodox Christian	4 (3.3)	2.5%	7.5%	0.0%
Catholic Christian	6 (5.0)	12.5%	2.5%	0.0%
Muslim	5 (4.2)	2.5%	0.0%	10.0%
Traditional beliefs	13 (10.8)	30.0%	2.5%	0.0%
Educational Level				
None	40 (33.3)	50.0%	12.5%	37.5%
Primary (grade 1-8)	71 (59.2)	47.5%	72.5%	57.5%
Secondary (grade 9-12)	9 (7.5)	2.5%	15.0%	5.0%
Occupation				
Smallholder farmer	115 (95.8)	90.0%	97.5%	100.0%
Teacher	1 (0.8)	0.0%	2.5%	0.0%
Artisan	1 (0.8)	2.5%	0.0%	0.0%
Driver/Mechanic	3 (2.5)	7.5%	0.0%	0.0%

[Source: Survey, 2012, Hameso, 2015]

Average family size of survey respondents is 7.13 persons (s.d = 2.26). Small family size (1-5 members) accounted for 28%, medium size (6-8 members) accounted for (29%) and large group size (8-10 members) accounted for 35%. Over 50% of households had over 8 members indicating the importance of extended family system. The use of family labour for economic activities is an attraction to have more family members whereas the absence of pension and insurance system in a rural society compels people to have more children as insurance against in old age. However, larger family size also increases vulnerability when combined with shortage of land

and food insecurity. In response to a related question of how much land respondents hold, 51% of respondents have between ¼ or ½ hectare (ha) while 75% have a hectare or less. Only about 8% have 2 ha of land. In most cases, landholding is small in size, and no one reported holding above 2 ha. The trend for most respondents is one of shrinking landholding with subdivisions of land amongst siblings (Hameso, 2015).

In terms of gender, most of survey members were male (91%) and an equivalent number reported being married. The latter is not surprising as it explains the dominant social expectations and survival challenges outside the norms set by society. Moreover, 97% of respondents were from the Sidama ethnicity, reflecting the population composition and ethnic homogeneity in rural Sidama. Protestant Christianity dominates survey sites (77%), followed by traditional belief systems (11%) – perhaps, a reflection of changing religious dynamism of recent decades where original belief systems were gradually replaced by monotheistic religions as was observed in the 1960s and 1970s (Hamer, 2002).

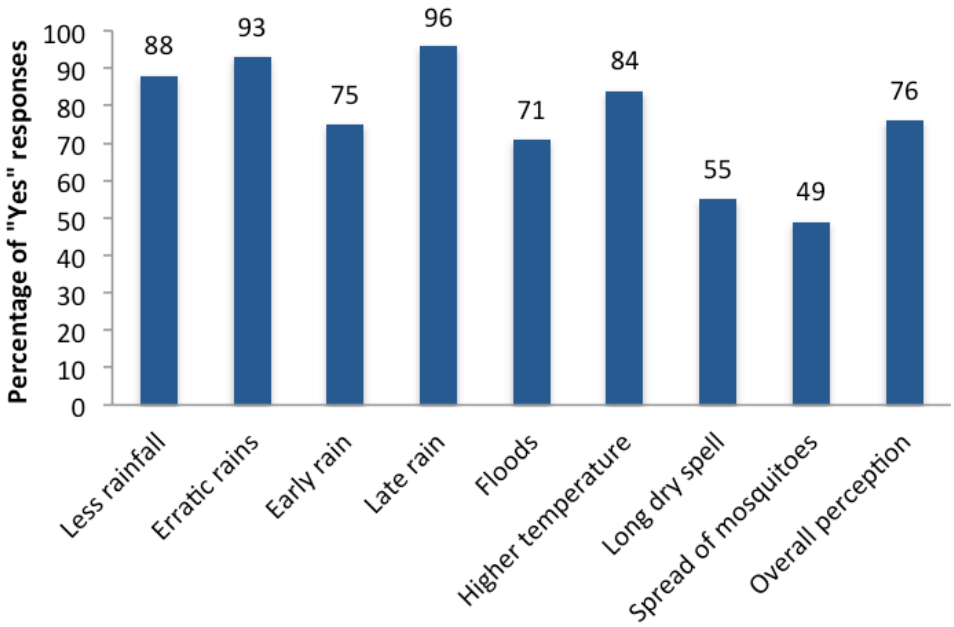
Households varied in their educational attainment. While 59% of respondents reported receiving primary education, a third reported being unable to read and write. The latter group indicated lack of scientific understanding of climate change supporting the notion that education would enable better understanding of climate change and adoption of new methods and farming practices. In terms of occupation, most household heads (96%) were smallholder farmers. Noting that wealth and status play an important role in rural livelihoods, the study asked households to rank their status as poor, medium and rich. The response is interesting as most respondents (83%) regarded themselves as medium, with 14% as poor and only 3% as rich. This finding is counter-checked with the type of house owned as indicator of one's status. The majority (71%) reported living in a traditional hut made of grass roof often the residence of the ordinary and poor people. Only 28% live in house with corrugated iron roof considered as status symbol in rural areas owned by relatively richer households. Wealth status ranking is spread equally across agroecological sites with higher frequency of households reporting rich in highland than the other two sites.

Apart from wealth status, monetary flows of income and expenditure indicated the context of vulnerability to shocks. Interestingly, there is a notable discrepancy between reported average income and expenditure. For example, reported annual income for 2011 (the year preceding the survey year) was 569,165 birr (about £18,972) but reported annual expenditure was 919,138 birr (about £30,637). Arguably, a large gap existed either due to memory lapse or intentional attempt to underestimate income or to overestimate expenditure. These and the above socio-economic characteristics have a bearing on perceptions of climate change, as analysed below.

Perceptions of climate change by farmers

According to the survey data, over two-third of respondents (76%) perceived climate change (Fig 2). Among specific risks and indicators of change, 96% of the respondents recognised late onset of rainfall, 93% recognised erratic rain and 88% recognised less rain. Floods from heavy rainfall is recognised by 71% of respondents. Higher temperature is perceived by 84% of respondents. The spread of mosquitoes (hence malaria) is recognised by nearly half (49%) of respondents.

Figure 2: Overall perception of climate change



[Source: Survey data, March 2012, Hameso, 2015]

The above results from survey data are supported by results from qualitative data. Table 2 indicates triangulation of results constructed on the basis of data derived from FGD and semi-structured interviews with farmers. The table encapsulates emerging themes on perceptions about climate change. The most common indicators are higher temperature, erratic rainfall patterns and higher incidence of diseases.

Table 2: Farmers' perceptions about climate change

Perception	Xexicha (highland)	Awaada (midland)	Jara Galalcha (lowland)
Perception of climate change	Climate change exists	Climate change exists	Climate change exists
Perception of indicators of climate change	Higher temperature, erratic rainfall pattern, emergence of diseases (malaria), disappearance of plant (crop and tree) species, growing new crops such as maize and coffee, change in wind direction, emergence of parasites/insects	Higher temperature, heat wave, erratic rainfall pattern, higher disease incidence	Higher temperature, drought, heat wave, erratic rainfall pattern, higher disease incidence
Perception of causes of climate change	Destruction of indigenous trees and expansion of eucalyptus trees, God's wrath, weakened indigenous practices and values	Deforestation, God's wrath, weakened indigenous practices and values	Deforestation, God's wrath, weakened indigenous practices and values

[Source: FGD; Hameso, 2014; 2015]

Given repeated reference to certain indicators of climate change in all study sites, the following section discusses perceptions of climate change in relation to high *temperature*, *rainfall* and *seasonal shifts* as well as incidence of certain *diseases*.

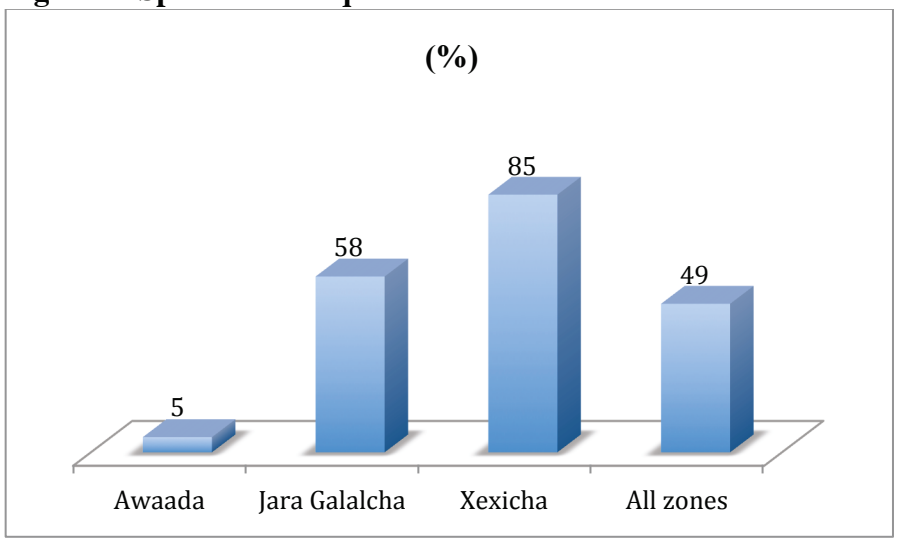
Farmers' perceptions about *temperature* differ among agroecological sites. Farmers at higher elevations noted an increase in temperature. For instance, FGD participants in the highland thought that their land was gradually drying: 'The sun has turned our highland to dry midland'. Similarly, farmers in the midlands reported not only drought conditions but also decline in river levels and underground water. They felt that drought got stronger and was sustained with significant impact on their livelihood including lost crops. More interestingly, while farmers in the midlands and lowlands had experienced higher temperature and declining moisture, those in the highlands were more articulate about perceived indicators of climate change than its causes and mitigation.

The perception of climate change as manifested in *seasonal variability* is common to all ecological zones. Participants reported that rain used to start in January or February in the past, but it moved to April-May in recent times. Indicating the late onset of rain and changes in cropping calendar, a farmer from the midland recalled: 'While we used to plant enset and maize in January and February in the past, today planting the same moved to April or June.'

Shifting cropping seasons is recognised by indigenous knowledge[1] in ways quite similar to findings from an Australian study (Leonard *et al*., 2013) whereby farmers ascertain regular seasons that separate the flowering of fruits or grass. Local experience and knowledge meant that farmers established seasonal calendars to predict times to prepare land, plant and harvest. Yet given the extent of changes in seasonal patterns, relying on past experience and indigenous knowledge alone cannot help fully predict changing seasonal scenarios. This problem is worsened by erosion of knowledge and interest on environmental concerns among young generations.

The third factor of climate change perceived by farmers is *high incidence of diseases*. The survey data shows that the highlanders are particularly alarmed by the incidence of mosquito spread (see Fig 3).

Figure 3: Spread of mosquitoes



[Source: Survey data, 2012, Hameso, 2015]

[1] Farmers are custodians of local knowledge having detailed understanding of soils, relief, vegetation and water movements.

These results correspond to predictions that highland areas formerly unsuitable for malaria will become epidemic (Ermert *et al*., 2012). Thus increased temperature creates conducive environment for the spread of Anopheles mosquitoes and Plasmodium parasites that cause malaria (Gage *et al*., 2008).[1]

While some indicators of climate change are commonly perceived in all agroecological sites, respondents in some areas reported facing distinctive climatic challenges. For example, participants from the highlands highlighted change in wind direction, disappearance of plant (crop and tree) species, growing new crops such as maize and coffee and emergence of new parasites and weeds. As the result, it is noted that some people started growing coffee (which has never been the case in the past). As far as the quality and quantity of coffee is concerned, the new possibility implies growing coffee under different soil conditions from coffee produced in the midlands. The change in wind direction and intensity is also reported. The immediate explanation for such change is decline in forest cover albeit in mountainous terrain. A participant summarised the wind condition as follows:

> In highly unknown ways, change happened in manners that harm our area (…) It does not wind the way it used to (...). It does not wind the way we knew. In the past, the wind was heavy…. But it was not harmful (...) It would not destroy anything. … Today's wind, however, causes damage to people. Its behaviour is not known. When rain appears on the horizon without signals, the wind disperses it across the land and we don't enjoy abundant rainfall. (Participant from highland)

Apart from erratic wind conditions and its effect to disperse rain which is consistent with other studies that identified long-term shifts in wind speed (e.g. Moghariya and Smardon (2012), respondents from the highlands reported another unique challenge in the form of disappearance of plant species. In the last twenty to thirty years, some trees known as Duwane in Sidamuafo (or Dokma in Amharic) whose fruits were used as food for birds and wild food for people are rendered extinct in many parts of Sidama. Another tree that disappeared included orange. Until the 1990s, orange trees used to grow in many parts of Sidama midlands, but .at the time of this research, they have virtually vanished. Decimation of orange trees is presumably linked to unidentified leaf and fruit disease, possibly caused by *phaeoramularia angolensis*. The disappearance of orange trees in Sidama needs scientific study to find out if it was linked to climate change or if other factors were at work.

While participants from the highlands cherished the possibility of growing crops new to them such as maize and coffee trees, this positive outcome is overshadowed by reported emergence and spread of new weeds affecting their farms. In the past, the highlands used to have fertile soil with lesser weeds and pests. The emergence of new weeds meant that farmers spend more time and effort to destroy the weeds. For example, a participant from the highland expressed frustration after spending considerable time to remove the weeds on his land. 'I do not know what to do; I don't know how to get rid of it. The weeds share soil nutrients and affecting crop growth'.

[1] *Plasmodium falciparum* transmission is limited by temperatures below 16° to 19°C, whereas *Plasmodium vivax* development can occur at temperatures as low as 14.5° to 15°C (Gage *et al*., 2008).

The above indicators of climate change are either commonly shared or uniquely felt by particular AEZs. In all cases, however, not only did participants held views and opinions about different indictors of change but also discussed what they believed were the causes of climate change.

Perception of causes of climate change

Scientific literature classifies the causes of climate change into two: natural and human induced conditions. Natural climatic variations emerge from processes internal to the Earth or driven by external forces whereas human-induced climate change or global warming is largely caused by GHGs emissions. The IPCC (2007a; 2013) determined that human activities have grown since pre-industrial times. For example, there has been 70% increase in greenhouse gas (GHG) emissions between 1970 and 2004. GHGs are generated from the burning of fossil fuels, land use changes and deforestation. And CO_2 contained in these processes is one of the main GHGs that contribute to global warming.

One would expect some components of scientific explanation to filter into discussions related to causes of climate change. Yet the connection between CO_2 concentration and climate change was not directly established during the FGDs. For instance, the burning of fossil fuels or even the use of chemical fertiliser or dung as contributors to GHGs was hardly mentioned as a cause of climate change. This is not surprising given the context of rural communities who do not use fossil fuel except kerosene. Firewood is commonly used for cooking food and for generating energy.

In general, farmers' explanations about the causes of climate change focused around cultural, religious and environmental causes. Only the latter explanations support the climate science view that climate change is man-made. The common explanations in all study sites were *weakened indigenous practices and values, God's wrath, human activities and deforestation,* which will be discussed below.

Weakened indigenous practices and values as the cause of climate change is an important dimension of farmers' perception of the causes of climate change. Participants repeatedly mentioned the erosion of respect for customary norms and values, protection of trees, paying sacrifice and praying for rain, use of indigenous crop seeds and strategies to cope with disasters and adjust to changed times. Others studies (for example Tauli-Corpuz *et al*., 2009) also noted the value of indigenous knowledge belonging to locales as the following statement testifies:

> We, indigenous peoples, have long observed and adapted to the climatic changes in our communities for tens of thousands of years. Because of our sustainable lifestyles and our struggles against deforestation and against oil and gas extraction, we have significantly contributed in keeping giga tonnes of carbon dioxide and other greenhouse gases under the ground and in the trees.

Unfortunately, the value attached to indigenous people, knowledge and practices seem to erode in different parts of the world with globalisation (see for example, Kipur, 2009; Nyong and Elasha, 2007) contrary to development paradigms which strongly promote importance of incorporating indigenous knowledge, local views and

priorities into programmes and policies (Chambers, 1983). In the case of Sidama, all focus group discussions magnified the erosion of respect for norms and values.

The perception of weakened indigenous practices as the cause of climate change has generational, gender and religious tone as evidenced in other parts of Africa. Farmers in Zimbabwe, for instance, attributed the decline of social and cultural practices to climate variability (Mubaya *et al*., 2012). Farmers in Sidama did not only indicate *decline* in cultural practices, but also identified the *termination* of indigenous practices that were once called upon to resolve natural disasters including drought.

These findings are in agreement with previous research that farmers make sense of the world around them by drawing from the local beliefs, values and moral responsibilities and cultural interactions with nature (Roncoli *et al*., 2002; Bulkeley, 2000; Moghariya and Smardon 2012). What is interesting in the context of this study relates to the strength of religious and cultural beliefs in opinion formation. The preponderance of religious rationalization and ever growing faith-based networks can be linked to what one may refer to as *spiritual capital* (which is part of assets' component of sustainable livelihoods framework (DFID, 1999). Study participants seem to invest in faith and religious beliefs to provide psychological buffer against the impacts of climate change.

Results also espoused generational dimension to perceptions of climate change. For instance, a participant from the midland remarked about the skills and knowledge of old generations. 'Our predecessors had astrologists who examine the arrangement of stars and predict the arrival of rain or otherwise. Today's generations abandoned age old traditions and follow gospel, both young and adults.' Another participant complemented the above view: 'They see the sky and cloud formations. They sacrifice on fateful dates. Then it rains. They also see the direction [and speed] of wind. But today, people are accustomed to modern religions and they abandoned all that' (Participant from the lowland).

The resilience of farmers in the face of adversity notwithstanding, certainty about continued validity of local knowledge is no longer guaranteed in the case of climate change. For one, climate change does not only challenge indigenous knowledge but also science and scientific practice. In recognition of the latter challenge, Schipper (2004, p.10) noted that scientific uncertainties exist regarding the characteristics and impacts of future climate change and especially questions about the magnitude, frequency and other characteristics of climatic processes. Hence, climate change challenges both forms of knowledge. Yet the challenge did not stop participants lamenting the abandonment of tradition and associated knowledge. A participant from lowland told a FGD meeting that people of his day 'do nothing' in apparent criticism of nihilism. Another participant expressed frustration that '[people] claim they are believers, they are not even good believers. They pray but it does not rain.' Modern religions, on their part, seem to make matters worse by excommunicating those practices. According to a participant from the lowland:

> Today's people claim they believe in God and they think God does not like the old practices (…) The old way are gone. The old ways are considered the work of Satan (devil). We quitted all as we were told it is the work of the devil. (Participant from lowland)

The abandonment of customary practices coincided with widespread conversion to different Christian denominations. While the conversion of the youth is understandable, it is not immediately clear why and how members of older generation resigned into submission. The answer, according to a participant from the midland, lies in the fear of social isolation resulting from religious enlisting of some members of a family:

> When you take calves away from the cows, what is left will be old [cows]. The old [people] became isolated and follow the rest for their own survival. They are frightened that there will be no one to burry them when they die.

Religious conversion went hand in hand with the abandonment of traditional practices. Abandoned in the process are not only cultural and religious practices but also some forms of livelihoods. According to a farmer: 'In the past, people use indigenous crop seeds but today people use hybrid seeds obtained through the ministry (MoA). As these seeds cannot be re-planted, they have to be consumed or sold. Every year, we have to buy hybrid seeds' (Participant from lowland).[1] Lost in the process, amid incompatibility between hybrid seeds and smallholder practices, is the habit of getting people to reflect about conservation. Time and again, participants felt that contemporary people are less concerned about long-term future or nature compared to the past generations. Participants appear to blame modern men and women for pursuing short-term benefits derived at the cost of long-term soil fertility. The common example is the choice of planting eucalyptus trees that are hazardous to soil fertility, yet adopted due to economic imperatives, increased population and urbanisation. The combined effect is observed in declining importance attached to indigenous knowledge and community forest resource management. Sacred places that were once filled with sycamore and other native trees have withered in the face of enormous pressure from environmental, economic, and socio-political changes. The attribution of weakened indigenous values and practices to climate change goes with the notion of God's wrath.

God's wrath as a cause of climate change: Reference to God appeared in all FGDs. According to a participant from the highland: 'This climate change, when we think about it, is an act of God.' Another participant added 'I am of the opinion that what is happening is due to the wrath of God'. These are widely held views but such perception is not exceptional to Sidama. For example, a study of rural Indian communities stated that people could have 'views about climate change causation that are different from scientific perspectives' (Moghariya and Smardon, 2012, p.14). This is partly due to limited extent of formal schooling among many rural people who often lack the capacity necessary to grasp detailed scientific views on climate change.

As there are participants who attribute the causes of climate change to weakened values and God's wrath, there were also others who equate it with their own actions.

Climate change is the result of human activity: A few participants held the view that climate change is the work of man. With reference to deforestation, one participant

[1] Study participants regularly conveyed the sense of dependency on seeds and fertiliser purchased from government or affiliated businesses.

from midlands admitted: '… the mistake is ours only. What God is supposed to do?' Explaining the fact that human action contributed towards climate change, a sense of responsibility is palpable as the following statement shows:

> It is wrong to blame God for lack of rain after planting trees in a wrong place. The land was fertile even when there were no rains. Planting wrong trees ruined it … Similarly, we plant eucalyptus tree where it should not be planted and we bring poverty upon ourselves. What I mean is, we dried up the rain by inappropriately cutting down indigenous trees, which were balancing our climate. (FGD participant from highland)

While admission of responsibility for misuse of natural resources is admissible, hence linking climate change to human activity, participants' knowledge seemed to be largely limited to the local world. For this reason, they did not seem to establish direct links to global warming, except remotely associating climate change with activities of 'wealthy people'. However, a few take proportional responsibility for their own actions, instead of putting blame entirely on others, especially God. This position corroborates the shift in thinking from the idea that 'humans were at the mercy of the environment' (Schipper, 2007) to the one that humans possess agency to impact the environment both detrimentally and positively.

Deforestation as a cause of climate change: Participants in all AEZs identified deforestation as a cause to climate change. A female FGD participant from the highland used the metaphor of 'umbrella' to amplify the problem.

> It is known that trees attract air. It is obvious to everyone that trees attract good, fresh air (...). Even if heavy sun exists, where there are forests, we get milder environment. People are not conserving the environment, forests and native trees. …. Trees are not handled with care (...) In the past, we had good trees that attract good air. Now our land is exposed, we are unable to get fresh air. We are now exposed. It is as if we are not holding umbrellas, hence we suffer from dry sun. The same applies to our land. Due to forest shortage, the area is warming. I think that is the reason for [climate] change.

Field visits showed that the highlands are home to native trees used for, among other things, medicinal purposes. An example is a *koso* tree whose leaves are used to treat tapeworm. This and other native species are threatened by combined pressure of climate change, agricultural land expansion, wood for construction, timber production, and firewood collection (Kewessa, *et al.,* 2015).

Participants from the lowland recall experience of deforestation and growing up in an area filled with forest but later cleared for cultivation. Deforestation in the scale mentioned by farmers does not only cause environmental degradation but also removes the socio-economic, cultural and ecological importance of forest resources. For communities that are highly reliant on natural resources, the loss of forest resources means loss of economic, cultural values and ecological benefits. It also means removal of benefits of forest resources in terms of soil and water conservation, watershed protection, nutrient recycling, nitrogen fixation, amenity and recreation, creation of microclimate, wildlife habitat, gene conservation and carbon sequestration from the atmosphere (Melaku *et al.,* 2014, p.215).

Sustained deforestation and land use changes led to the conversion of ecosystems. Participants clearly identified loss of trees and forest as contributing to climate

change. This perception is mediated by generational gap in attitudes towards trees and forest. For example, older generations are said to maintain conjugal bond with nature which is not common among younger generations. According to a participant in the highland, 'people in the past pray to God and pay sacrifice under a tree. Today's people hurriedly cut trees and devastate native forest'.

The idea of cutting trees is considered as one of the causes of climate change is equally spread across the agricultural zones. A participant from the midlands recalled: 'In the past, all what you see here was forest, and partly open fields. Today there is no space even to keep cattle.' In the words of a female participant from the highland, cutting trees is one of reasons for climate change: 'When observed deeply, one reason is the cutting down of trees. There are some trees left but not in large quantity as before.'

The perception of deforestation and land use change as causes of climate change is well established. Results from this research link well with findings from a study of Eastern Tibet where people strongly believed that human actions are the root cause of climate change, directly or indirectly by angering or weakening gods or deities (Byg and Salick, 2009).

In sum, the above are common perceptions by farmers about climate change. Based on their observation of natural phenomena of which they maintain shared and selected repertoire, lay people formulate opinions of climate change (Roncoli *et al*., 2002). Their understanding is based on their knowledge, values, and moral responsibilities and cultural interactions with nature (Bulkeley, 2000; Moghariya and Smardon, 2012). Thus in matters of perception, people's subjective thoughts and ideas proved as important as quantitative assessment of climate change knowledge.

Perceptions of climate change by policy makers

Qualitative data showed that participants at various levels of government structures held views shared by scientific community. However, depending on the position of participants in government structures, individual responses contained varied nuance. At the district level, participants made a link between deforestation and declining rainfall with subsequent impact on crops. For example, an extension worker from the lowland mentioned longer dry season, rising temperature, and erratic rainfall: 'The amount of rain is decreasing … last year, it started to rain on 24 April [2012].' This corresponds with farmers narrative that April used to be the time of good rain. The late onset of rain is consistent with shifting seasonal pattern and modification in the crop calendar. A district participant from the midland recognised erratic rain and seasonal shift explaining that rainfall distribution varies from place to place. 'It rained in Yirgalem yesterday, but in the nearby villages (Kebeles), people tell you it did not rain.' Another district participant compared and contrasted broad ecological change, including introduction of coffee production in some areas of the highlands:

> In the past, our district rarely lacks rain during the rainy and dry seasons. There is now a situation where rain is erratic or sporadic. It is not raining in the times it used to rain. …. The change is visible. We used to have areas covered by mist …. Now there is no

> mist …. We used to have continuous supply of water from above the ground wells. That changed and people have difficulty to get water for their cattle, especially during the dry season. We had three planting seasons: dry/winter, moderate rain (badhessa), and rainy/summer…. It used to rain heavily in mid-February, followed by greening of grass by March and April. But now [April], there is no rain, and people are using enset leaves to feed the cattle. [Moreover] over ten years ago, coffee planting was limited and it was confined to a few corners of the district. But with climate change, the practice [of growing coffee] is widening beyond these corners. There are now 11 Kebele*s* [in this district] who grow coffee. In the past, if you grow a coffee plant, it does not yield berries; it only grows leaves. That has changed, and farmers now get coffee berry (District official from highland).

Among the three areas surveyed, the intensity of deforestation is extensive in the lowlands. A participant from the lowland district compares past and current forest coverage as follows:

> In terms of natural ecosystems-system, this area was covered with forest. The existence of trees contributed to rain and crop cultivation was productive. But now, the forest cover in 14 of the Kebele*s* is depleted. This contributed to rain shortages (...) (Participant from lowland).

The comment of extension worker on forest cover decline in the area corresponds to what farmers reported in FGD and in interviews. Decline in forest cover in general and native trees in particular is associated with changing land use and the expansion of eucalyptus trees. From policy makers' perspective, it can be argued that the continued plantation of eucalyptus as a source of firewood may have postponed the urgency to seek alternative energy sources and eased the pressure to allocate resources on the latter.

The controversy surrounding eucalyptus trees notwithstanding, there is persistent perception among participants linking deforestation and environmental degradation. Moreover, most participants from policy making and implementing bodies share a view of *global warming* as a cause of climate change. And the fact that global warming is a global phenomenon with international dimensions is not lost to a participant from the midland who goes on to detail the problem in the context of a coffee growing area:

> Our district is a victim of the problem of climate change (…) This district is known to produce coffee. The only way production and productivity of coffee can be increased is by having stable weather conditions. Problems associated with global climate change affect our district (…) The source of global warming is man-made pollution … [which] results from gases released by factories of wealthy countries. CO_2 emissions are released by developed countries. Most vulnerable countries are victims especially African countries and developing countries. (Participant from midland district)

Another participant saw climate change as a complex condition that involves land use, ecosystem and weather conditions. 'There is definitely a (climate) change,' the participant noted, linking it to La Nina and El Nino phenomena that are now occurring frequently, every three years. 'Now their variability is a matter of seasons.

If it is La Nina now, it soon becomes normal and then starts to warm as El Niño.' (Participant from regional NMA)

At the federal level, perceptions of climate change is in line with broader scientific consensus evinced in IPCC (2007a) reporting, namely explaining climate change as man-made phenomena associated with global warming, resulting from CO_2 emissions and deforestation. In this study, participants attempted to link deforestation with increased CO_2 emissions and cutting trees has its impact on Oxygen and CO_2 interface. Native trees are expected to hold water and maintain soil moisture while their leaves maintain soil fertility. The loss of these trees has a bearing on the environment. A participant from regional NMA office agrees that decline in forest cover results in decline in soil fertility, imbalance in rainfall distribution or rain variability, environmental degradation, flooding, and increased temperature. And 'due to rise in temperature areas that were not known for having malaria are affected by malaria epidemics.' Policy makers further note that the majority of Ethiopia's carbon emission is caused by deforestation through changing land use to agriculture and degradation from cutting trees to provide wood for fuel (EPA, 2011). Such observations are aligned with scientific explanations of climate change.

Conclusions

This paper presented farmers' and policy makers' perceptions of climate change. Results showed that the majority of farmers perceived changes. In terms of AEZs, the higher percentage of respondents in the highland noted climate change compared to respondents from the midlands and lowlands.

Climate change is widely perceived by smallholder farmers but their perceptions of its causes are mixed and at times different from scientific explanation. Explanations centred on deforestation, God's wrath, human activities, and weakened indigenous practices and values. perceptions are the result of the farmers' experience with the local environment and their worldview are largely confined to the local world, often delinked from the global space. For instance, they hardly linked climate change with global warming or green house gas emissions, except stating river pollution caused by local coffee processing plants. Within the locally-bound perception, the most cited attribution of causes of climate change is either human-induced or the work of God.

Some farmers recognised that climate change is caused by land use changes, deforestation and overpopulation. Others reported abandonment of past traditions or practices, declining moral values, the collapse of customs and traditions as causes of climate change. Reference to God is ubiquitous among those who believed climate change has more to do with nature and the supernatural.

In terms of perception of *impacts* of climate change, farmers recognise that their challenge is not only the changed climate but also the unpredictable nature of the changes. Epitomizing the livelihoods of rural societies, smallholder farmers in Sidama face multiple stressors, climate change being an important one. They believe that climate change has impacted their livelihoods, and eventually their wellbeing and ecosystems. Since they depend heavily on rain-fed farming, unpredictable rain and increased temperature negatively affect their livestock and crops including coffee..

Apart from impact on coffee production, increased heat waves and spread of diseases is also reported to affect human, plant and animal health. These impacts directly translate to food insecurity and sometimes to hunger conditions.

At the macro level, policy makers displayed highly advanced perceptions about climate change indicators, causes and impacts and the ways of addressing the problem. They clearly linked climate change to CO_2 emissions and hence global warming. They are particularly aware that climate change poses a challenge through development-environment nexus. For them, what is at stake is how to address climate change without compromising development efforts for poverty reduction and economic growth. Depending on their positions of authority, they emphasised different indicators of change.. For national policy makers, the discourse on impacts of climate change is dominated by sectoral considerations. In the list and priorities of sectoral susceptibility to climate change, they cite agriculture, water resources, biodiversity and human health as the most vulnerable sectors. Apart from sectoral priorities, they tend to place emphasis on impacts of climate change on mega projects, which may result in reduced focus on smallholder farmers due to diversion of resources. Local government and NGO participants, on the other hand, prioritise the impacts of climate change on the livelihoods and communities.

Overall, there is divergence of views about the causes of climate change between farmers and policy makers. Bridging the gap at the micro and macro level requires learning on both sides through better information and education of the local public. In this endeavour, research and education establishments, the media and meteorology agencies play vital role. Policy makers may also draw on knowledge and experience from local communities (Altieri and Koohafkan, 2008; Admassie *et al*. 2008) whose knowledge of the environment passed down through generations offer invaluable information regarding adaptation to changing climatic conditions that would not likely be acquired through other means.

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