Table 1: Mean Monthly Rainfall and Rainfall Concentration (P and RC are in mm)

	J	F	M	A	M	J	Jl	A	S	O	N	D
P	35.45	28.9	44.97	75.83	177.19	235.31	312.09	282.48	152.7	29.91	24.33	5.6
RC[1]	0.3	0.25	0.38	0.64	1.51	2.01	2.67	2.41	1.3	0.26	0.21	0.05
Desg.[2]	Dry[3]	Dry[3]	Dry[3]	Rainy[4]	BRM[5]	BRH[6]	BRH[6]	BRH[6]	BRM[5]	Dry[3]	Dry[3]	Dry[3]

Source: Computed from NMSA data; **NB:** RC[1]= Rainfall concentration; Desg.[2]= Designation of the rainfall concentration in the months; Dry[3]= RC<0.6; Rainy[4]= RC>0.6; BRM[5]= Big rains with moderate concentration where RC=1.0-1.9 ; BRH[6]= Big rains with high concentration with RC= 2.0-2.9 (Based on UNFAO, 1965 cited in Daniel 1977).

In general, the other half of the years (AMJJAS) are rainy periods for the RC >0.6. Five of these six months (AMJJAS) are designated as big rainy months as their RC values $\geq$ 1.0 and receive over the rainfall module (Table 2). The study area receives big rains with moderate concentration during May and September, with the RC of 1.51 and 1.3, respectively. The RC >2.0 during the summer season (JJA) and is known for its highest concentration of big rains.

3.3. Local Perception on CV

Local Perception on climatic variation is crucial to design appropriate adaptation and coping strategies especially to those poor countries that are highly vulnerable to the impacts of CV (Whitmarsh, 2009). It is important to have an insight of peoples view on temperature and rainfall variability to dig out locally available adaptation options. Over 87.9% of the SHHs were informed (from Radio, DAs and also NGO participating there). Almost half of the SHHs reported that the major information source on CV was radio while the role played by NGOs and GOs is accounted for relatively at/below one quarter. And about 83.6% of the SHHs perceived about CV. The translated view of key informants on CV is as under:

We lived here in Weliso Wired for about 70 and 65 years. The past temperature is different from the contemporary one.
Due to increased temperature, diseases such as malaria has expanded to the highland area. Moreover, maize and Guayas introduced to our environment. This is new for us in the
more highland areas. In the case of rainfall, during past time,
the spring rainfall was starting from March but at this time starting from May.

3.3.1. Local perception of temperature variability

According to 94% of the SHHs perceived that there is increase in the temperature pattern in the study area. This seems in accordance with the trend analysis of monthly temperatures discussed in section 3.2. The indicators of temperature variability perceived by the SHHs are drying up of rivers and streams, crop damage by pests, newly introduced human and animal disease, and species shift to upper altitude, and introduction of new plant and animal species (Table 2). During FGD and key informant interview, local community representative listed additional indicators of temperature increase in Weliso wired, namely increase in water consumption, loss of biodiversity and land degradation.

Table 2: Locally Perceived Indicators of Temperature Increase (N=180)

Locally Perceived Indicators	*Frequency*	*Percent*
Drying up of river and stream	173	96
Crop Damage by pests	137	76
New human and animal disease	110	61
Species shift to upper altitude	108	60
New crop pests and animal species	59	33

Source: Field Survey, 2013.

3.3.2. Local perception on rainfall variability

Most of the participants of semi-structured interview, key informant interview and FGDs recognized and perceived the prevalence of rainfall variability in duration, intensity and distribution. About 96% of SHHs indicated increased rainfall variability in the study area. The local community perceived the shift in the beginning of spring rainfall from March to May. For instance, in 2009 spring rain started too late on June and the 2011 in May it was characterized by high distribution and sufficient amount, what goes in line with the aforementioned RC value and its designation in Table 1.

The perceived impacts of such variability in rainfall include emergence of pests and disease, interruption in crop calendar of such spring crop production as root crops and vegetables, death of livestock, etc in 2009 and 2011. In general, it affected both agricultural activities and human wellbeing. This has adversely affected in the highlands of Weliso Wired failure of the spring rain led to failure of root crops and other green vegetables production in 2009 and 2011. The survey results revealed that about 94.5% of the SHHs perceived the prevalence of impacts of climate variability in recent time. They also stated that the 2012 rainfall of Weliso Wereda was almost twice of the other years within a decade that led for flooding and land degradation especially during the summer season that affected many farm land and crop production activities along hillsides and rugged relief areas in the study area.

3.4 Local Perception on Indicators and Impacts of CV

The indicators by perceived local community were increase in loss of livestock and plant species; shortening of growing period; high rainfall variability; rise prevalence of animal and human disease; decline in agricultural yield and in availability of water in Weliso Wereda over the past 10 years (Table 3). The most common crops/plants vulnerable for climate induced pests and diseases in were enset, wheat, barley, and teff (WARDO, 2013) while climate induced health disasters were malaria, diarrhoea and typhoid, which shifted from relatively lowland to midland and highland areas, become newly introduced in to the area. Furthermore,

enset (which is the most staple food and supports the livelihood of the people of the Weliso Wereda) has continually dried up as victim of newly prevalent enset disease.

Table 3: Local Perceived Indicators of Rainfall Variability

Indicators of Rainfall Variability	*Items*	*Frequency*	*Percent*
Loss of livestock and plant species	Increased	124	69
	Decreased	56	31
Shortening of growing period	Increased	175	94
	Decreased	5	3
Rainfall comes lately and goes early	Increased	175	97
	Decreased	5	3
Decline of agricultural yields	Increased	164	91
	Decreased	16	9
Availability of water	Increased	13	7
	Decreased	167	93
Expansions of human and animal disease	Increased	171	95
	Decreased	9	5

Source: Field Survey, 2013

Under CV, small increase in temperature and variability in precipitation can result in measurable impacts on pests and diseases (Aklilu and Alebachew, 2009). Likewise, rising temperatures are changing the geographical distribution of disease vectors, through migrating to new areas and higher altitudes (for example migration of the malaria mosquito) and thereby expose large numbers of previously unexposed people to infection in the densely populated East African highlands (Boko, 2007).

3.5 Livelihood Strategies

3.5.1 Adaptive Strategies by Local Community: About 86% of SHHs engaged in numerous adaptive measures towards CV and its impacts. The major adaptation strategies devised by them reforestation, afforestation, terracing, family planning, change in cropping pattern, and growing short-maturing crops (Table 6). Mostly, the community agreed to af/reforest and terrace hilly slopes and degraded land cover using enclosure from human and livestock interventions.

Recently, rainfall in the study area has shown variability. As a result, farmers could not be certain about rainfall duration and amount from the onset to offset. According to them, even after the onset, rainfall could be heavy or light or it may stop earlier than the expected time. The farmers are aware about the type of crops planted in accordance with the characteristic (pattern) of the rain. The crops grown in the area in their decreasing order of importance include teff, wheat, barley, maize, vetch, flax, nuge, chick bean and bean (WARDO, 2013).

Table 6: Household's responses to climate variability (N=180)

Responses to Climate Variability	*Yes*		*No*	
	Freq.	*Percent*	*Freq.*	*Percent*
Reforestation	165	91.4	15	27
Aforestation	159	88.6	21	11.4
Rainwater harvest	17	9.3	163	90.7
Terracing	170	94.3	10	5.7
Family planning	143	79.3	37	20.7
Change cropping pattern	139	77.1	41	22.9
Growing short maturing crops	132	73.6	48	26.4

Source: Field survey, 2013

According to FGD participants and key informant interview, early maturing crop are planted due to shortening of growing season in the study area. For instance, spring season is shortened from three to one month. Therefore, high yield varieties of wheat, barley, beans and potato become familiar to grow during this short season. Similarly, Guayas and maize were introduced and become among the dominant crops in the middle and highland areas of the study area in response to the effects of CV. Conversely, only 90.7% of SHHs have not practised rain water harvesting (Table 6). The reason hindering from the practice were erratic nature of rainfall, increase in evapotranspiration, and low level of awareness about rainwater harvest technology. Result of FGD, key informant interview and experts also showed involvement of farmers in non-farm activities to subsidize their agricultural income. These include wage labour, petty-trading, charcoal making, firewood selling, daily labour work and temporary on-farm work in flower/horticulture farms. Moreover, CV, population growth, land scarcity and degradation, low crop productivity and lack of grazing land enforces remarkable people to migrate to Tolay (Jimma), East Shewa (Meki), Alemgena and Addis Ababa for employment and earning income.

3.5.2 Strategies by GOs and NGOs

There were some NGOs continued to work in Weliso Wereda since 2010, though not directly targeted to CV. Some of these are Green Ethiopia Agro forestry (GEA), Sustainable Land Management (SLM), Agricultural Growth Program (AGP), UNICEF and PROGIANIST. Most of their activities focus on livelihood diversification, introduction of improved agricultural inputs including empowering cultural practices, improved high yielding and early maturing crop varieties and improved bee-hives with accessories, plantation of indigenous fodder trees, shrubs, herbs and grasses along selected watersheds, improvement of rural infrastructure through construction and maintenance of rural access road, health facilities, school classrooms and farmer training centres (FTCs) and formation of Self-Help-Groups (SHGs), building hand pump water, etc. The SHGs supported by the NGOs and provided with high yield varieties and technical training and access to capital through saving and credit ventures, The NGOs also participate in Integrated Watershed Management in collaboration with the government since 2009. Despite the higher level of perception, only 80% of the respondents took remedial actions. Out of these, about 62% reported that their adaptive measures not successful. The major hindrances of effective practice of adaptation measures identified by major respondents were poverty; scarcity of water, forage/feed and land; lack of meteorological information, agricultural inputs,

and access to health, social and political institutions, and capital.

4. Conclusion

Climate variability and its perception on causes, indicators, impacts and livelihood strategies by smallholding farmers is the topic of the day. The current study identified the relatively congruence between the meteorological data processed and perception by local community on issues of CV in Weliso Wereda. Various mechanisms are devised by numerous stakeholders to adapt/cope with such variability. Despite this fact, integrated and sustainable environmental, socio-economic, institutional and political oriented modifications and development programmes needs to be strengthened towards transformation into climate-resilient livelihood and rural development.

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