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Extension Agents’ Awareness of Climate Change in Ethiopia

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ABSTRACT Purpose: The fact that highly vulnerable countries like Ethiopia face far greater challenges from climate change makes agricultural adaptation a top priority. Even though the public agriculture extension system in Ethiopia plays a central role in facilitating and supporting adaptation, very limited information is available on how aware the actual extension agents (EAs) are regarding the issue. Therefore, this research attempts to provide a specific insight on the current level of awareness and understanding of EAs regarding climate change.

Methodology: Survey questionnaires and semi-structured key-informant interviews were used to collect primary data from extension agents and decision-makers.

Findings: Results indicated that generally EAs had a good perception of climate change as well as its impact on agriculture & natural resource use and availability. Also, there was a consensus among EAs regarding certain changes in weather patterns and the frequency of extreme events. Weaknesses and challenges concerning the level of priority given to climate change and adaptation, capacity-building efforts and access to resources were identified as well.

Practical implications: Identified challenges imply the need for a synchronized approach towards climate change adaptation and capacity-building to enhance EAs awareness on the issue. Also, the findings highlight the urgent necessity to prioritize climate change as an extension programming issue and to develop clear mitigation and adaptation approaches.

Originality/value: This research is original and highly valuable to identify weaknesses and strengths regarding EAs’ awareness of climate change adaptation.

KEY WORDS: Climate change, Adaptation, Agricultural extension, Climate change awareness, Ethiopia, Climate change response
Introduction

Although numerous controversies surround the issue of climate change, it can generally be defined as ‘a change in the climate which is attributed directly or indirectly to human activities that alter the composition of the global atmosphere in addition to natural variability observed over comparable time periods’ (IPCC 2007). Studies have shown that atmospheric concentrations of greenhouse gases (GHGs) are increasing as a result of human activity, and such emissions are probably responsible for climatic changes (Boykoff 2008; Hope 2009; Nelson et al. 2009). It is also accepted that global climate change will likely continue over the following decades (IPCC 2007; Nelson et al. 2009; Simpson and Burpee 2014).

The relationship between climate change and agriculture is quite complex and diverse. Bosello and Zhang (2005) state that climate change and agriculture interdependencies evolve dynamically over time, they often cover a large spatial and temporal scale, and are still surrounded by large uncertainties. However, scholars agree that climate has obvious and direct effects on agricultural production (Lybbert and Sumner 2012; Simpson and Burpee 2014; Nederlof, Wennink, and Heemskerk 2010). For instance, climate change can affect crop yields both positively and negatively, as well as the types of crops that can be grown in certain regions (Dhaka, Chayal, and Poonia 2010). Even though some prediction models imply that there will be positive sides (Nelson et al. 2009), the overall impacts of climate change on agriculture are expected to be negative, ultimately threatening national and global food security. This is particularly true for developing regions (Deressa, Hassan, and Ringler 2011; Bryan, Deressa, and Gbetibouo 2009; Nederlof, Wennink, and Heemskerk 2010).

The Need for Adaptation

According to Nelson et al. (2009) on-going social and economic challenges will likely build up, mainly for those societies which are already vulnerable and highly dependent on climate-sensitive resources. That is to say developing countries, where the majority of population as well as the national economy is agriculture-based, are expected to be most vulnerable to climate change. Cairns et al. (2013), Bryan, Deressa, and Gbetibouo (2009) and Nederlof, Wennink, and Heemskerk (2010) also argue that climate change will have a significant impact on agriculture as well as livelihood of the populations of the developing world, particularly in Sub-Saharan Africa.

Adaptation to climate change should be a top priority in Ethiopia, as agriculture remains by far the most important sector. Agriculture contributes some 44% to the country’s GDP and about 84% of the national population is rural, deriving livelihoods from agriculture and natural resources (Adem and Bewket 2011). Climate related hazards in Ethiopia include drought, floods, heavy rains, strong winds, frost and heat waves (NMA 2007). Most rural communities are already highly vulnerable to weather variability. For instance, in 2008 around 12.6 million people were affected by drought and in 2011 an estimated 3.2 million people were affected by drought-induced food shortages and food insecurity (Adem and Bewket 2011). Also, mapping reports confirm Ethiopia’s high vulnerability to climate change with the least capacity to respond to possible consequences (McSweeney, New, and Lizcano 2008; Falco, Veronesi, and Yesuf 2011). NMA (2007) and Georgis (2010) list high dependency on rainfall,
under-development of water resources, high population growth rate, low adaptive capacity, weak institutions and lack of awareness as reasons for the high vulnerability of Ethiopia. According to Funk et al. (2012) fast population growth and the expansion of farming and pastoralism under a drier, warmer climate could considerably increase the number of at-risk people in Ethiopia.

It is generally agreed that adapting to climate change is the best option at hand to minimize impacts and risks, and possibly harness new opportunities. The definition of adaptation best suited for this study is given by Pielke (1998, 159) as ‘the adjustment in individual, group and institutional behaviour in order to reduce society’s vulnerabilities to climate’. Agrawal (2008) stresses that how people respond to the impacts of climate change and variability often determines their prospects for growth, equity, and sustainability. According to Bryan, Deressa, and Gbetibouo (2009) adaptation of the agricultural sector to the adverse effects of climate change is imperative to protect the livelihoods of the poor and to ensure food security. Akponikpè, Johnston, and Agbossou (2010) also underline that adequate and relevant agricultural adaptation strategies are the only solution for poor populations. However, adapting agriculture to climate change has proven to be a complex process. Hope (2009) and Bryan, Deressa, and Gbetibouo (2009) also stress that a successful adaptation in agriculture is usually multi-dimensional and requires a well coordinated action by relevant stakeholders.

**Observed Trends and Policy Responses**

According to Georgis (2010), Nelson et al. (2009) and Hulme et al. (2001) Africa is warming at a faster pace and is likely to continue to do so. Boko et al. (2007) noted that there have been decadal warming rates of 0.29° Celsius in African tropical forests and 0.10–0.3° Celsius in Ethiopia and South Africa. Also, Barrios, Bertinelli, and Strobl (2006) state that generally there has been a decline in rainfall on the African continent since the 1960s.

Agrawal (2008), Adem and Bewket (2011) and Simpson and Burpee (2014) describe changes in mean temperatures and precipitation, greater range in seasonal and inter-annual variation, change in frequency and intensity of extreme events, and destructive transformations of ecosystems as the main manifestations of climate change. Georgis (2010) confirms weather variability and the frequencies of extreme events have increased over recent times in Ethiopia. Previous research shows an overall decline for rainfall in most major dry land areas of Ethiopia and interviews with farmers across the nation also confirmed the same experience (Deressa et al. 2009). There were observed changes in mean annual temperature (0.28° Celsius increase per decade) between 1960 and 2006 (McSweeney, New, and Lizcano 2008) and changes in precipitation and rainfall are expected to show changes in the coming decades (NMA 2006).

Summarized data (adapted from Keller 2009) of past-observed trends, as well as future projections (from 1920–2040) of rainfall and precipitation show similar results (Figure 1).

It is globally accepted that strategies to control probable causes of climate change and mitigate its impacts are best coordinated and implemented at national level. Accordingly, the Ethiopian government launched its own National Adaptation Programmes of Action (NAPA) and Nationally Appropriate Mitigation Action (NAMA) in 2007 and 2010 respectively and recently completed Ethiopian Program of Adaptation to Climate Change (EPACC). Capacity-building, improving natural resource management, enhancing irrigation
and water harvesting, strengthening early warning systems and awareness creation were identified as priority projects to address adaptation needs of the country (NMA 2007).

**Role of Extension Service**

Institutions play an important role in adaptation at multiple scales – from inception to transfer of technologies, and access to agricultural innovations by vulnerable smallholders (Lybbert and Sumner 2012). Agrawal (2008) highlights the influence of institutions in adaptation and climate vulnerability in the following critical ways: first, they shape impacts and vulnerability in social and ecological contexts; second, institutions mediate between individual and collective responses to climate impacts and thereby influence the outcomes of adaptation; finally they act as the means of delivery of external resources to facilitate adaptation, and thus govern access to resources such as information, technology, funds, and leadership. However, there needs to be changes in knowledge, attitudes, resilience capacities, and skills of the relevant service providers and institutions (Ozor and Cynthia 2011).

Agricultural extension, according to Leeuwis (2006, 26), is ‘a series of embedded communicative interventions that are meant, among other things, to develop and/or induce innovations which help to resolve (usually multi-actor) challenges’. The public agricultural extension service under the Ministry of Agriculture and Rural Development (MoARD) is primarily responsible for providing such services to the agricultural sector in Ethiopia as well. The extension system has federal and regional dimensions, with the Woreda (district) Offices of Agriculture and Rural Development (OoARD) being the lowest in the hierarchy (Gebremedhin 2006). Here, the core institutions are the Agriculture Technical and Vocational Education and Training (ATVET) centers and the Farmer Training Centers (FTCs), which are currently producing, as well as using, extension agents (EAs) (MoARD 2010). The ATVET centers provide education to the majority of EAs in five disciplines (i.e., animal science, animal health, agricultural cooperatives development, natural resources, and plant science) using a curriculum introduced by MoARD (Davis et al. 2010).

It is known that extension services have the potential to influence farmers’ decision to change their farming practices in response to climate change (Nhemachena and Hassan 2010).

![Figure 1](image-url) Observed precipitation and temperature changes in Ethiopia with simulated changes by 22/23 GCMs* (the light colored lines show observations likely flawed by network density changes and measurement errors in the first half of 20th century). *Source: Keller 2009.
2007; Maddison 2007; Falco, Veronesi, and Yesuf 2011). A study on EAs in southern Ethiopia states that effectiveness of extension work highly depends on the availability of extension professionals who are qualified, motivated, committed and responsive (Belay and Abebaw 2004). Research conducted in some African countries show many front-line extension staff in Africa lack competences such as knowledge, skills and attitude that they need in order to be effective in their work (Lindley 2000). This underlines the necessity for EAs to be equipped with the right knowledge and information required to provide advisory service that can successfully show alternatives and initiate attitudinal change. Simpson and Burpee (2014) also confirm that EAs will need to programmatically prepare in order to help farmers undertake a succession of adaptive responses to emerging challenges of climate change.

Research Objectives

Adaptiveness presupposes adaptive capacity and those affected by climate change expect relevant entities to facilitate processes and enabling conditions on adaptation to climate change (Speranza, Kiteme, and Opondo 2009). However, not much is known about current awareness and preparedness of the Ethiopian agriculture extension system and extension agents (EAs).

This information gap can be a major constraint when it comes to evaluating the adaptation process and devising efficient agricultural adaptation and mitigation approaches required to face impacts of climate change.

Therefore, the objective of this paper is to provide a micro-level analysis on:

- the level of priority given to climate change and adaptation in the extension service and investigate capacity-building efforts
- EAs’ overall perception of certain issues regarding climate change and adaptation, and to develop a general reflection on how the extension system is responding to the challenge

Methodology

Study Area

The research was carried out around Addis Ababa, the economic and political capital of Ethiopia. The research area was selected on the basis of socio-economic and agro-ecological characteristics, i.e. farming population density, involvement in agricultural activities, as well as availability and accessibility of EAs. Timeframe and budget allocated for data collection were also considered.

Addis Ababa is located 2,408 meters above sea level with average daily temperature of about 16° Celsius, having a mean annual precipitation of about 1180 millimeters and a uni-modal rainfall regime starting from June to September (CSA 2002).

The region includes urban and peri-urban areas. There are ten administrative districts in and around Addis Ababa, seven of these are peri-urban and have agriculture offices that provide various extension services. The peri-urban areas where data were collected are widely involved in various agricultural activities and are typical of rural areas of Ethiopia.
Investigative Techniques

Both qualitative and quantitative approaches were employed for primary data collection (i.e., a mixed method approach) which is advised to better explore and explain the research aims and objectives (Hall and Howard 2008), and also to provide multiple approaches in answering research questions, rather than restricting or constraining researchers’ choices (Johnson and Onwuegbuzie 2004). Similar studies on climate change perceptions show that conducting surveys and then comparing the responses with available data is among the most common approaches (Thomas et al. 2007; Deressa, Hassan, and Ringler 2011).

Accordingly, semi-structured key-informant interviews consisting of four fundamental themes to investigate the level of priority given to climate change, the responses of the extension system, capacity-building efforts and farm-level interventions were designed. Survey questionnaires (consisting of 24 questions, both closed and open ended) were also designed with the following main sections:

- social background of extension agents
- opinions on climate change
- training opportunities, access to resources on climate change and adaptation, and sources of information
- climate change risk perceptions and observed changes in weather patterns

Sampling, Data Collection and Analysis

Samples were used to select respondents as it is common to systematically select a sample of the population under study when complete coverage is impractical or unnecessary (Sarantakos 2005). Resources available, analysis (type and number of comparisons), and sample homogeneity were considered in deciding the sample size.

Four districts (i.e., Akaki, Nefasilk Lafto, Gulele and Yeka) were selected out of the seven in and around Addis Ababa based on their involvement in agriculture, number and availability of active EAs (minimum of 15) and accessibility for transport. Afterwards, agents who had two years or more work experience as EAs were selected and survey questionnaires were administrated to a total of 60 EAs (15 from each of the four districts) from July to September 2012 following pre-test.

Detailed semi-structured interviews were also conducted with three key informants at management positions (i.e., the Head of Akaki District Agricultural Office, the Head of Socioeconomics and Research Extension at Ethiopian Institute of Agricultural Research (EIAR), and the Head of Agricultural Extension of Addis Ababa Agricultural Bureau) to get a general reflection on how the extension system is responding. The three key informants were selected by the researcher using purposive sampling, based on the high level of responsibilities of these individuals.

The quantitative data was analyzed using statistical software (PASW 18.0: Chicago SPSS Inc.)

Descriptive statistics (frequency distribution, percentages, measures of central tendency and variability) were used to describe the data. Cross-tabulations and T-tests were used to examine relationships between variables.
Results

Priority Given to Climate Change

Each of the three key informants was questioned on the level of priority given to climate change and adaptation in the extension system. The Head of Akaki District Agricultural Office and the Head of Agricultural Extension at Addis Ababa Agricultural Bureau reported that there was no clear policy or strategy currently in place giving the issue special priority. However, the Head of Socioeconomics and Research Extension at EIAR said mainstreaming climate change in agricultural research (together with household food security and technology dissemination) was one of the three pillar projects being undertaken at national level, and that efforts are being made to make sure generated technologies are climate change sensitive.

Dissemination of climate change-sensitive agricultural technologies, promoting sustainable land use and rehabilitating degraded areas, promoting soil and water conservation methods, farm diversification, and agro-forestry were mentioned by all three interviewees as the main actions with regard to how the extension system is responding to climate change. In addition to the above, according to the Head of Socioeconomics and Research Extension at EIAR, integrated farming and conservation agriculture are getting more attention in extension messages, and research is being done to determine the adoption of improved technologies, to characterize adaptive strategies, and to investigate determinants of adaptive capacity with respect to climate change. The output of such research is expected to provide estimates of vulnerability of farming communities, and provide a means of enhancing their adaptive capacity. Also, the Socioeconomics and Research Extension department at EIAR is involved in preparing promotional materials, training manuals and production guidelines for extension workers and producers with regard to technologies useful in adapting agriculture to climate change.

Concerning capacity-building efforts (current and planned) to enhance the knowledge of extension staff and/or capacity of the extension service on climate change and adaptation, two of the interviewees responded that there were short-term training, workshops or seminars in recent years, the exception was the Head of Akaki District Agricultural Office, who claimed that there were no such opportunities so far. However, the two interviewees who indicated that they had exposure to such capacity-building opportunities mentioned that these events were not an integral part of their work-plan and almost all were initiated and carried out by external institutions. This can explain the different perceptions about the access to capacity-building opportunities. More importantly, all the key informants said they are not aware of any current or future strategy aimed at enhancing the knowledge and capacity of extension staff on the issue.

On what is being done at field level to support farmers and facilitate adaptation, all three key informants mentioned training, on-farm research trials and demonstration of climate change sensitive agricultural technologies as the main means of support and facilitation. The head of Socioeconomics and Research Extension at EIAR additionally mentioned creating and strengthening of Farmer Research and Extension Groups (FREGs) also formerly known as Farmer Research Groups (FRGs) at local agricultural research centers, and using them for provision of different resources and training materials to Farmer Training Centers (FTCs) to facilitate scaling up/out of climate change sensitive technologies and alternative farming systems.
Social Background of Extension Agents

Out of the 60 respondents 25% were female and 75% were male, and their ages ranged between 22 and 58 years with mean age of 31. The survey also revealed the majority of EAs (58%) were 30 years old or under, and had a working experience in the extension system ranging from a minimum of two years to 37 years with an arithmetic mean of 8.8 years. About half of the respondents had experience of six years or less, and similar proportion graduated in the last eight years.

The survey data showed 46.7% of respondents had a diploma qualification, followed by first degree (35%); certificate (11.7%); second degree (5%); secondary school graduates (1.7%). The highest proportion of respondents worked on crop production (38.3%), followed by animal production and health (26.7%). Natural resource, forestry, energy and soil conservation sector take up 10%. The sectors of agricultural input, irrigation, land management and development, and agricultural produce marketing sectors together made up the remaining 25%.

Opinions on Climate Change

Some 71.7% of EAs agreed climate change is indeed taking place, 18.3% said they did not know and six respondents (10%) said climate is not changing.

The various levels of qualifications were grouped into two (that is, respondents with a degree and those without a degree) to examine association between the levels of education of EAs and their response on whether or not climate change is taking place. The result showed a higher proportion of respondents without degree (75%) believed that climate is changing compared to those with degrees (66.7%). Interestingly, higher number of EAs with degrees responded that they did not know whether or not climate is changing (25%), while only 13.9% of those without degree gave same response. However, statistical significance and strength of this relationship cannot be commented on due to limitation of samples for chi square test.

Additional analysis was executed to examine the relationship between the respondents’ age and their attitude on whether or not climate is changing, and the association between the two was found to be highly insignificant (t = 0.259; df = 47; Sig = 0.85), as the mean age of those who said climate is changing was 31.2 years while that of respondents who said climate is not changing was 30.3 years.

Responses on whether or not climate is changing at global or national level differed across gender. A much higher proportion of women (86.7%) believed climate change is taking place, while 66.7% of male respondents believed so. Some 11.1% of male EAs believed that climate is not changing which is slightly higher than percentage of women with the same opinion (6.7%). Even though significance of the relationship between responses given and gender cannot be statistically proved, the results suggest a higher proportion of women tend to believe climate is changing.

Training Opportunities, Access to Resources and Sources of Information

When asked if the respondents believe they have adequate access to resources about climate change and adaptation (such as policies and strategies, up to date information, easily available and user-friendly data, scientific publications, reading materials and
manuals, etc.), the highest proportion (56.9%) said they did not know, only 20.7% believed they have adequate access and 22.4% did not think so.

Extension Agents were then asked to select from a list of possible information sources that they have (or they would) used regarding climate change and adaptation. Mass media (including local radio, television and newspapers) were the most frequently mentioned sources of information ($n = 29$) followed by training, workshops and seminars ($n = 23$). Scientific reports and experts in the extension system were each mentioned 16 times, and Internet 13 times. Local agriculture research centers and/or researchers were the least mentioned source of information ($n = 6$).

Analysis carried out to find out what proportion of EAs had previous chance to build and update their knowledge particularly on climate change and adaptation showed that the majority of EAs (56.7%) have not received any type of training or attended any seminar, workshop or similar event. However, the remaining 43.3% had some kind of exposure to the matter at least once. The data also revealed all of the respondents who had exposure did so in the last five years (from 2007 to 2012).

Analysis executed to examine the association between previous training exposure and belief on whether or not climate change is taking place indicated there is hardly a difference in response between those with previous training exposure and those without the opportunity. Chi square test also confirmed that the difference between the groups is not statistically significant ($\chi^2 = 0.277; df = 2; \text{Sig} = 0.871$).

With regards to awareness of any changes in the messages of extension system in response to climate change, 50.9% of respondents said they were aware of such changes and 49.1% responded they did not know.

### Risk Perceptions and Observed Changes in Weather Patterns

The overwhelming majority of respondents (91.5%) agreed that climate change has/will have impact on the agricultural sector.

To further investigate EAs’ understanding of the extent of risk posed by climate change on agricultural sectors and availability and use of natural resources, the respondents were asked to give their opinions. As the summary shows (Table 1) the majority of EAs believed that climate change affects (or it will affect in the near future) crop production, animal production and husbandry, and natural resource management to a very high or high degree.

With regard to whether or not human activities (such as urbanization, industrialization, agriculture etc.) affect climate change in anyway, 72.4% of EAs agreed human actions affect climate; 17.2% did not believe so; 10.3% stated they didn’t know.

Regarding the level of priority given to climate change and adaptation by the extension system, only about a quarter of respondents said climate change and adaptation are one of the top priorities, while 59.6% believed the extension system should give more attention to the matter.

Individual observations of weather patterns and frequency of extreme events were included in the survey questionnaire as supplementary indicators of EAs awareness. This was on the basis of their personal experience as EAs and/or if they have agrarian social background over their lifetime. According to the results (summarized in Table 2) the majority of respondents stated they have witnessed a decrease in rainfall amount, an
increase in temperature and drought frequency, as well as changes in rainfall predictability, distribution and timing.

**Climate Change Awareness Index**

An index was developed to get a somewhat general depiction of how aware the respondents are after selected variables were first re-coded on right/wrong basis and then given points. Here it is important to state that the awareness index is not meant to be a definitive and comprehensive evaluation, but rather a preliminary check to assess whether EAs are conscious of certain basic issues (that climate change is taking place and human activities have a part, that it has impact on agriculture, and whether they have made correct observations on weather variability).

**Table 1. Summary of responses on the extent of climate change impacts**

<table>
<thead>
<tr>
<th>Sector</th>
<th>Scale</th>
<th>N°</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop production</td>
<td>Very high degree of impact</td>
<td>34</td>
<td>58.6</td>
<td>58.6</td>
</tr>
<tr>
<td></td>
<td>High degree of impact</td>
<td>20</td>
<td>34.5</td>
<td>93.1</td>
</tr>
<tr>
<td></td>
<td>Small degree of impact</td>
<td>4</td>
<td>6.9</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>No influence</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I don’t know</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Animal production and husbandry</td>
<td>Very high degree of impact</td>
<td>23</td>
<td>39.7</td>
<td>39.7</td>
</tr>
<tr>
<td></td>
<td>High degree of impact</td>
<td>21</td>
<td>36.2</td>
<td>75.9</td>
</tr>
<tr>
<td></td>
<td>Small degree of impact</td>
<td>10</td>
<td>17.2</td>
<td>93.1</td>
</tr>
<tr>
<td></td>
<td>No influence</td>
<td>1</td>
<td>1.7</td>
<td>94.8</td>
</tr>
<tr>
<td></td>
<td>I don’t know</td>
<td>3</td>
<td>5.2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**Table 2. Summary of responses regarding changes in weather patterns**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>No change</th>
<th>Increased</th>
<th>Decreased</th>
<th>I don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall (amount) n = 59</td>
<td>6</td>
<td>10.2</td>
<td>4</td>
<td>6.8</td>
</tr>
<tr>
<td>Temperature n = 59</td>
<td>2</td>
<td>3.4</td>
<td>55</td>
<td>93.2</td>
</tr>
<tr>
<td>Drought (frequency) n = 59</td>
<td>6</td>
<td>10.2</td>
<td>35</td>
<td>59.3</td>
</tr>
<tr>
<td>Flood (frequency) n = 59</td>
<td>13</td>
<td>22</td>
<td>28</td>
<td>47.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicator</th>
<th>No change</th>
<th>There is change</th>
<th>I don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rainfall (predictability) n = 59</td>
<td>2</td>
<td>3.4</td>
<td>55</td>
</tr>
<tr>
<td>Rainfall (distribution) n = 58</td>
<td>5</td>
<td>8.6</td>
<td>40</td>
</tr>
</tbody>
</table>
For this purpose, each response on the following variables was cross-checked with widely accepted literature findings and available recorded climate data (both national and international):

- responses on whether climate is changing at global or national level
- responses on whether various human activities affect climate in anyway
- observed changes in temperature at national level
- observed changes in rainfall amount at national level
- responses on whether or not climate change has an impact on the agricultural sector

Various literature confirm that climate is changing at national and global levels (IPCC 2007; Hope 2009; UNDP 2007; Georgis 2010; IPCC 2014; Nelson et al. 2009). Also it is accepted that different human activities affect climate in various ways (IPCC 2007; Adem and Bewket 2011; Ozor and Cynthia 2011).

The fact that climate change already has, and will continue to impact on agriculture directly and indirectly is well documented (Lybbert and Sumner 2012; Dhaka, Chyal, and Poonia 2010; Nelson et al. 2009; Ozor and Cynthia 2011; Nederlof, Wennink, and Heemskerk 2010).

Data regarding weather variability in Ethiopia including temperature and rainfall amount changes are given in Georgis (2010), Keller (2009), Funk et al. (2012), Deressa et al. (2009) and McSweeney, New, and Lizcano (2008).

Then the points were added yielding scores on a 0–5 scale, with a score of 5 meaning all five responses were correct, and a score of 0 meaning all given responses were incorrect (according to the above literature). Frequency analysis is summarized in Figure 2.

For the purpose of running analysis and categorizing responses, the sum of scores for climate change awareness index were grouped into two categories, that is, respondents who scored between 0 and 3 were labeled as the ‘Less Aware’ group; and respondents

![Figure 2. Climate change awareness index scores and their respective percentage.](image-url)
who scored between 4 and 5 were labeled as the ‘More Aware’ group. Some 38.3% of total respondents fell into the ‘Less Aware’ group while 61.7% belonged to the ‘More Aware’ group, getting only one or two responses wrong. Further analysis was executed to investigate if climate change awareness index scores differed across gender, and the result showed that a higher proportion of females fell in the ‘More aware’ group (80%) compared to males (55.6%).

The means of scores in climate change awareness index were compared with previous exposure to training opportunities to check possible association between the two, and the results revealed that the means of scores between the two groups were not statistically significantly different ($t = 0.150; \text{Sig} = 0.980; \text{df} = 58$), suggesting that climate change awareness was not influenced by previous exposure to training.

Also, analysis on EAs’ work experience and scores in climate change awareness index revealed that the correlation between the two variables is very weak and not statistically significant (Pearson Correlation $-0.179; \text{Sig} = 0.172$).

Finally, analysis to find out if scores in climate change awareness index differed across the two groups of educational qualifications (i.e., respondents with a degree and those without) showed there was no statistically significant difference between means of scores among the two groups ($t = 0.056; \text{df} = 58; \text{Sig} = 0.822$).

**Discussion**

Both the literature reviewed and the primary data presented in this paper indicate that the government of Ethiopia has given increased attention to the agricultural extension system in recent years. The fact that nearly half of the EAs had work experience of six years or less and that all EAs who had previous exposure to training opportunities particularly on climate change and adaptation did so in the last five years is possibly an outcome of this. According to Davis et al. (2010) the number of Agriculture Technical & Vocational Education and Training (ATVET) colleges and graduating EAs has increased dramatically.

However, the evidence from both the literature and the results presented in the present paper indicate that there is no clear sign of mainstreaming climate change in ATVET curriculums. This should be investigated and reconsidered as pre-service climate change and adaptation education is vital to prepare EAs to face rising technical and methodological challenges (Simpson and Burpee 2014). Furthermore, IPCC (2014) describe adaptation itself as a social learning process and highlights educational programs on climate change and adaptation as critical factors in building social resilience from individual to institutional levels.

Regarding the level of priority given to climate change and adaptation in the extension system, the key informant responses reported in this paper imply lack of common understanding among decision-makers at different positions. The survey analysis also reveals that only about a quarter of EAs believe climate change and adaptation is one of the top priorities, while half of the EAs are not aware of any changes in extension messages and priorities as a response to climate change. Integration in adaptation planning and decision-making process is crucial in embedding climate sensitive thinking in existing and new institutions (IPCC 2014). Moreover, lack of a synchronized strategy and common understanding on climate change can undermine adaptation efforts significantly. Aaheim et al. (2008) and Reid, Huq, and Murray (2003) stress such unorganized approaches tend to
make efforts autonomous and unconscious (also known as spontaneous adaptation),
triggered by ecological and other stress; while planned adaptation is a long-term solution
rooted in awareness, deliberate policies and action needed to moderate the situation.

The information gathered on capacity-building efforts is somewhat concerning. The
majority of the EAs in the survey responded that they don’t know if they have access to
relevant resources and similar proportion of EAs claimed they never had any type of
exposure or training on climate change and adaptation. The key informants also indicated
that there are no current (or future) coordinated and planned strategies to build staff
awareness on the issue. Moreover, the effectiveness of previous training is questionable
as quantitative analysis showed previous efforts had little effect when it came to
influencing EAs’ attitudes. More coherent work needs to be done on this as adaptation
requires adequate information on risks and vulnerabilities in order to identify needs and
appropriate adaptation options to reduce risks and build resilience (IPCC 2014).

Measures specified by the key informants as responses to climate change being
undertaken by the extension system are indeed ideal to support adaptation and build
resilience via diversification of incomes, stable yields and long-term ecological benefits.
Farming systems such as agro-forestry have been found to be promising in parts of Africa
(WB 2008; Simpson and Burpee 2014). Making use of biodiversity in crops and wild
plants, and integration of livestock into farming systems have been documented as
adaptive strategies in Nigeria (Morton 2007). At the same time, increasing implementa-
tions of soil and water conservation techniques have also been observed in several
African countries as adaption measures (Wit 2006; Simpson and Burpee 2014). According to IPCC (2014) the above measures and climate change-sensitive technology
disseminations (via Farmer Research Groups/Training Centers) fall under physical
(technological and ecosystem based) and social (educational, behavioral and informa-
tional) categories of adaptation options. Nevertheless, various socioeconomic and other
challenges remain when it comes to large scale adoption of such technologies (WB 2008;
Bryan et al. 2009).

When it comes to EAs’ opinions regarding basic issues on climate change and its
possible impact on the agricultural sector it can be said the majority of respondents are on
the right track. That is, numerous research findings confirm that climate is changing
Also, literature shows that climate change already has, and will continue to impact
on agriculture directly and indirectly (Lybbert and Sumner 2012; Dhaka, Chayal, and
Poonia 2010; Nelson et al. 2009; Ozor and Cynthia 2011; Nederlof, Wennink, and
Heemskerk 2010).

The majority of respondents also agreed on decreased rainfall, increased temperature,
increased drought frequency, and changes in rainfall predictability and distribution.
Literature also confirms weather variability has increased in Ethiopia over recent decades
and generally supports the above observations (Deressa et al. 2009; McSweeney, New,
and Lizcano 2008; Georgis 2010; Funk et al. 2012).

Local agricultural research centers were among the least mentioned sources of
information for EAs when it came to climate change and adaptation, implying that
cooperation and linkage between research centers and the extension system/EAs are
weak. IPCC (2014) underline the importance of shared learning on adaptation and that
research partnerships and networks are vital in knowledge exchange and awareness-
raising from individual to institutional levels. The most frequently mentioned source of
supplementary information by EAs (i.e., mass media) should be further exploited in a careful manner. According to Boykoff (2008) media have the potential to effectively communicate as well as the potential to misrepresent, misunderstand, distort and misinform the climate science they cover.

No statistically significant relationship was observed between climate change awareness and work experience, awareness and levels of education, or between awareness and previous exposure to training opportunities. A more comprehensive measure for awareness (with additional indicators and larger sample size) should be developed to investigate the relationship between awareness and relevant independent variables in depth.

Conclusions

The evidence from primary and secondary data as well as consecutive analysis indicate that there are gaps when it comes to climate change and adaptation particularly in capacity-building efforts, mainstreaming climate change education in ATVET curriculums, linkage between EAs and relevant stakeholders, and access to relevant resources.

Approaches and measures mentioned by the three key informants as responses to climate change are indeed ideal options at hand to support adaptation and reduce the vulnerability of rural communities. Moreover, involvements of the extension system (at the Ethiopian Institute of Agricultural Research) in research concerning adaptive strategies and capacities, as well as vulnerability estimations provide the basis for the development of appropriate adaptation policies and strategies.

The consensus among EAs regarding possible impact of climate change on the agricultural sector, changes in weather patterns and frequency of extreme events, together with EAs’ scores in climate change awareness, imply that the majority of EAs are conscious and aware that climate is indeed changing and that it poses certain new risks.

Overall, the outcomes of this research point out the need to clearly set the level of priority towards climate change and adaptation and establish a solid strategy in the extension system. Also, more should be done to improve EAs’ access to relevant and updated scientific resources. It is imperative that capacity-building efforts focusing on climate change and adaptation should be planned for the future in a coordinated and effective manner. Finally, knowledge and information exchange between relevant stakeholders (especially agricultural research centers) and EAs should be improved and exploited to enhance extension services.

References


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