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Research Application Summary

Assessing local community perceptions on climate change and variability and its effects on crop production in Western Oromia, Ethiopia

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Abstract

Understanding of local people's perception on environmental conditions is crucial to designing and implementing appropriate adaptation strategies to climate change and variability. This study looked at communities' perception of climate change impacts, barriers and effective adaptation strategies in Western Oromia. Survey data were collected from 204 respondents using both qualitative and quantitative approaches through random sampling technique. Descriptive statistics such as percentage and frequency were used in data analysis. The results of the study showed that the respondents perceived the occurrence of climate change in terms of increase in temperatures, decrease in rainfall and change in timing of rain, change in the onset of rains, and erratic rainfall pattern. Weather related problems such as low rainfall, drought, flood, heat, cold, and strong winds were mentioned to have led to increased farming problems such as soil erosion, loss of soil fertility, reduction in crop yields and high rate of disease occurrence. The impacts of climate change on crop production were considered to have been affected by the start of farming season, including: rainfall coming early or late, decrease in rainfall, increase in temperature and increase in farming problems, in particular, increase in soil erosion, loss of soil fertility and reduction in crop yields. Respondents perceived the main cause of climate change as due to human action through intensified agriculture, deforestation, increased use of fossil fuel and use of chemical fertilizer on farms. The adaptation measures identified were soil and water conservation, crop rotation, changing crop varieties, changing planting dates, diversification of crop types, growing drought tolerent varieties, building water harvesting schemes and use of irrigation.Soil and water conservation was the method commonly used by the farmers to respond to climate change variability. Barriers to climate change adaptation included: lack of information, shortage of labor, lack of capital, lack of access to water and inability to use irrigation. There is a need to take into account these community perceptions when designing climate change adaptation measures.

Keywords: Adaptation, climate change, local community, perception, variability, western Oromia

Résumé

La compréhension de la perception qu'ont les populations locales des conditions environnementales est cruciale pour concevoir et mettre en œuvre des stratégies d'adaptation appropriées aux changements climatiques et à la variabilité. Cette étude a porté sur

la perception des communautés sur les impacts du changement climatique, les obstacles et les stratégies d'adaptation efficaces à l'Ouest de l'Oromia. Les données ont été recueillies auprès de 204 répondants à partir des approches qualitatives et quantitatives au moyen d'une technique d'échantillonnage aléatoire. Des statistiques descriptives telles que le pourcentage et la fréquence ont été utilisées pour l'analyse des données. Les résultats de l'étude ont montré que les répondants perçoivent l'occurrence des changements climatiques en termes d'augmentation de température, de diminution des précipitations et de changements dans les calendriers des saisons de pluie, de changement dans l'apparition des pluies et du régime irrégulier des précipitations. Les problèmes liés aux conditions météorologiques, comme la faible pluviométrie, la sécheresse, les inondations, la chaleur, le froid et les vents forts, ont entraîné des problèmes agricoles croissants tels que l'érosion des sols, la perte de fertilité des sols, la réduction des rendements et le taux élevé d'apparition de maladies. Les impacts du changement climatique sur la production végétale ont été considérés comme ayant été affectés par le début de la saison agricole, y compris: les précipitations qui arrivent tôt ou tard, la diminution des précipitations, l'augmentation de la température et l'augmentation des problèmes agricoles, la perte de fertilité du sol et la réduction des rendements des cultures. Les enquêtés ont estimé que la principale cause du changement climatique était l'action anthropique à travers l'intensification de l'agriculture, la déforestation, l'utilisation accrue de combustibles fossiles et l'utilisation d'engrais chimiques dans les fermes. Les mesures d'adaptation identifiées étaient la conservation des sols et de l'eau, la rotation des cultures, l'évolution des variétés de cultures, la modification des dates de plantation, la diversification des types de cultures avec l'adoption des variétés tolérantes à la sécheresse, la construction de systèmes de récolte d'eau et l'utilisation de l'irrigation. La conservation des sols et de l'eau était la méthode communément utilisée par les agriculteurs pour faire face à la variabilité du changement climatique. Parmi les obstacles à l'adaptation aux changements climatiques figurent le manque d'information, la pénurie de main-d'œuvre, le manque de capital, le manque d'accès à l'eau et l'incapacité d'utiliser l'irrigation. Il est nécessaire de tenir compte de ces perceptions communautaires lors de la conception de mesures d'adaptation face aux changements climatiques.

Mots clés: Adaptation, changement climatique, communauté locale, perception, variabilité, Oromia occidental

Introduction

Climate change imposes constraints to development especially among smallholder farmers whose livelihoods mostly depend on rain-fed agriculture (IPCC, 2007b). Negative impacts of extreme events such as floods and droughts are expected to be high in developing countries especially in rural areas (Adger *et al.,* 2003; IPCC, 2007a, 2007b). Indeed adverse effects of climate change continue to be a major threat to rural livelihoods (IPCC, 2007a, 2007b; Nhemachena, 2009; Pouliotte *et al.,* 2009). This poses a challenge of developing innovative technologies to improve rural livelihoods and environmental conservation and ensuring adoption of such technologies.

Sub-Sahara Africa is among the most vulnerable regions to climate change impacts, because the majority of the sub-Sahara African population live in abject poverty, and are heavily dependent on rain-fed agriculture for their economies and livelihood sustenance. Therefore, variations in rainfall patterns and temperature adversely impact their economic and social survival. Because the main long-term impacts include significant changes in rainfall patterns and temperature which affect agriculture, there is a projected significant reduction in food security; worsening water security; decrease in fish resources in large lakes due to rising temperature; increase in vector-borne diseases; rising sea level affecting low-lying coastal areas with large populations; and rising water stress (APF, 2007; Feleke, 2015; Menberu, 2016). Likewise, the livelihood vulnerability indices (LVIs) calculated for agricultural land and climatic exposure indicators revealed that households are increasingly vulnerable to climate change risks (Negash, 2016). The problem of climate change in Ethiopia has the potential of undermining sustainable development efforts if steps are not taken to respond to its adverse consequences. This study reviews existing and available literature on farmers' perceptions and adaptations to climate change in Western Oromia, Ethiopia. In addition, it specifically assesses local community experience of climate variability and climate change on crop production and responses made to overcome impacts of climate change.

Methodology

Study area description. The study area lies between 8^0 00' to 10^0 00' N and 36^0' to 37^0 50'E and an elevation range of 1200 to 3200m. The study was carried out in six (6) selected woreda of Western Oromia: Diga (Lalisa Dimtu and Demeksa), Jimma Arjo (Abote Didessa and Hindhee), Gida Ayana (Anger Gutin), Sibu-sire (Cari), Bako Tibe (Sedan Kite and Biqiltu Leku) and Cheliya (Jarso Dire and Tulu kosoru). The annual precipitation over western Oromia ranges from 1000 mm to 2100mm. The study area experiences annual temperature ranging from 10^0C to 30^0C, with mean annual temperature of 19^0C, where the highlands and mountainous areas in the region receive lowest mean annual temperature, while lowlands and valley bottoms get highest mean annual temperature records (BoFED, 2008; ORHB, 2010). Western Oromia wet season runs from May/June to August/September and this is also regarded as the main agricultural summer growing season. Most rainfall occurs in June, July and August. The least rainfall is in September when the summer agricultural crops are mostly at maturity stage.

Data sources. Two types of data were used in this study, primary and secondary data. The primary data were collected from the households Survey in January, 2015 through two complementary approaches, namely (i) Key informant interviews and (ii) farmer interviews using semi-structured household questionnaires. Respondents selected for interview were those individuals living in the sample (small adminstrative units in Ethiopia) kebeles, who were considered knowledgeable and elderly people who represented the opinion of the community. Purposive sampling techniques were used in the selection of study site and sample households.

Most of the people in the area are engaged in mixed agriculture, i.e., both crop cultivation and livestock production is practiced. Crop production is entirely rain-fed, except in very specific small areas where vegetables are cultivated based on traditional and small-scale irrigation.

For key informant interviews, 55 household heads (HHs) were selected (five HHs from each kebele). The purpose of the interview was to explore the perception of the community about climate change and its causes. To ascertain if farmers' perceptions of climate change and variability corresponded with actual long term climatic records, climatic data for Western Oromia were analyzed and compared with the survey results. Available historical climate data on precipitation and temperature of Western Oromia, covering the period from 1980 to 2014 were obtained from the National Meteorology Agency of Ethiopia.

The study integrated both qualitative and quantitative methods. Historical climate data covering the period 1980 to 2014 were also analysed. Data obtained from farmers were analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistical tools such as mean, percentages, frequencies and standard deviations were used to summarize and categorize data. Crosstabs, F-test, chi-square test and a one-way (ANOVA) tests were employed to compare group means.

In order to observe the trend of temperature and rainfall, a time series data for temperature and rainfall were subjected to trend analysis using the Mann-Kendell test (Bose *et al.,* 2014). This test detects monotonic increase or decrease in time series of climate components like teperature and rain.

Results

Characteristics of respondents. From a total of 204 respondents interviewed, 79.4% were male and 20.6% female. The age of household head respondents ranged from 30 to 75 years. Around 44.1% of the respondents were below 40 years old while about 55.9 % were above 50 years old. Marital statuses of respondents were: 91.7% married, 2.9% single, 2.4% widowed and 2% divorced from the sampled households. From the total respondents around 23% could read and write and 36.8% household heads respondents were illiterate with no formal education.

In the last 20 years, majority of the local communities (more than 80.4 %) have experienced change in climate varibles. They reported an increase in temperature and a decease in precipitation in all woreda of Western Oromia. Almost 49% and 39.2% respondents said that precipitation had decreased and that onset of rainfall had also changed (Fig 2).

Their responses revealed that communities gave several indicators of change in rainfall. These included decline of agricultural yields (26.5%), rainfall coming early or late

(26%), loss of some animals and plant species (20.1%), decrease in available water (11.3%), increased drought and flood frequency (9.8%) and shortened growing period (5.9%).

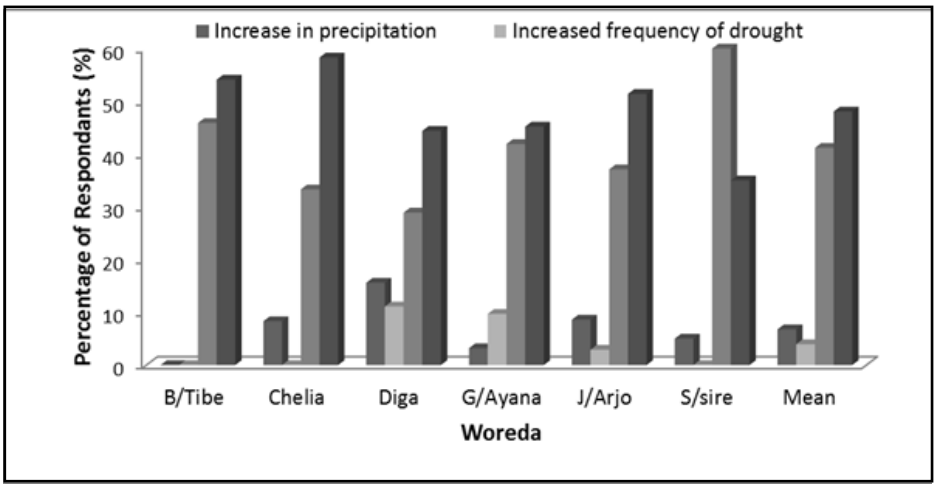

Figure 1: Communities response on rainfall variability in different woredas of western Oromia (N=204)

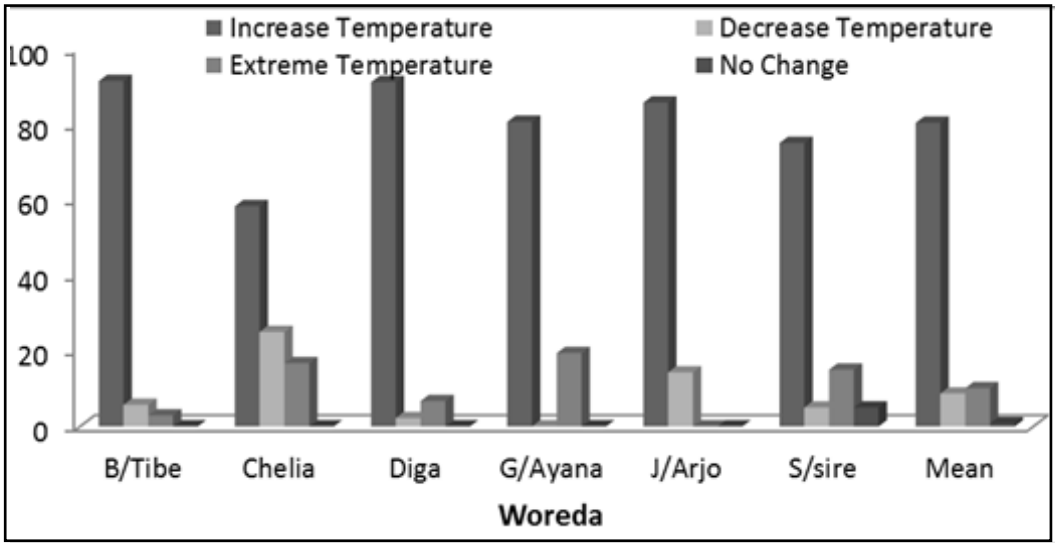

Figure 2: Communities response on temperature variability in different woredas of western Oromia (N=204)

Changes from historical climate data analysis

Climatology evidence: To ascertain if farmers' perceptions of climate change and variability corresponded to actual long term climatic records, climatic data for western Oromia were analyzed. The mean annual maximum and minimum temperature generally showed a warming trend ranging from 0.25 to 0.86^{0}C and 0.05 to 0.46 ^{0}C per decade respectively over the last 20 years (Fig. 3). The precipitation concentration index (PCI) value was more than 12% for most of the stations. This highlights the seasonality in rainfall distribution. Based on the results of the study, annual and seasonal rainfall variability for selected stations ranged between 12% to 25%. This shows high annual and seasonal rainfall variability (Fig. 4). Belg rainfall showed higher variability compared to annual and Kirmet. A plot of the three climate variables (precipitation, maximum temperature, and minimum temperature) shows that temperature has been increasing while average annual rainfall has been decreasing (Fig.5).

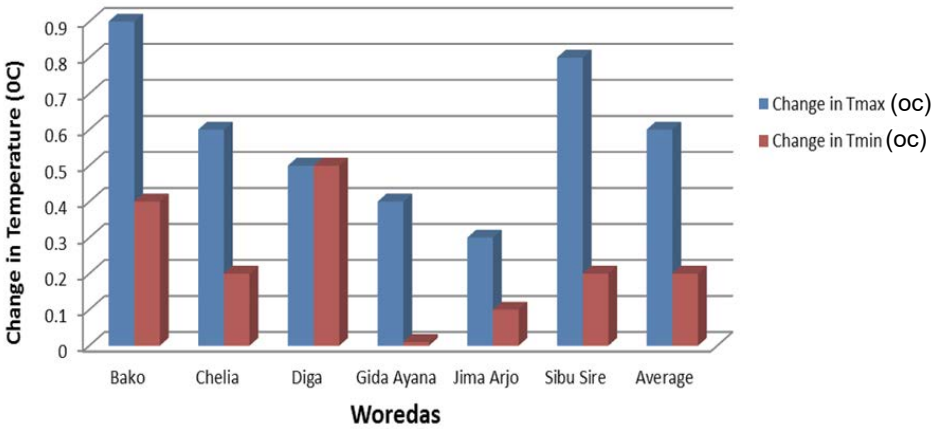

Figure 3: Change in observed temperature per decade over the last 20 years

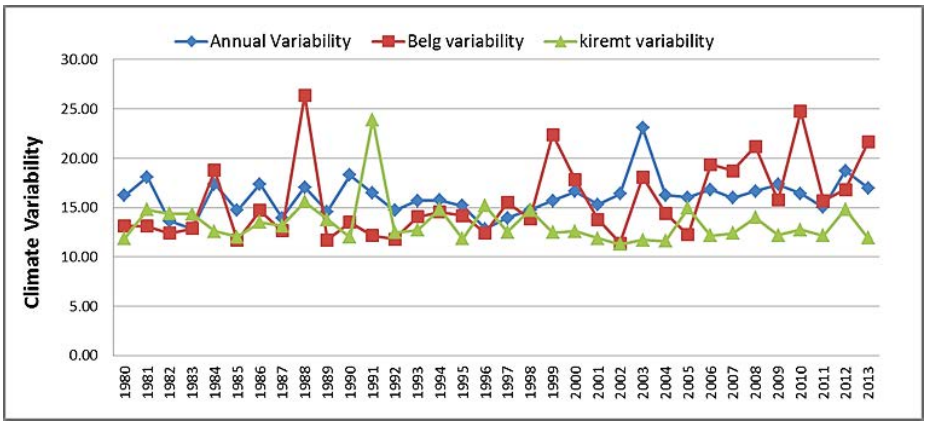

Figure 4: Annual, Belg and kiremt rainfall variabilty in western Oromia

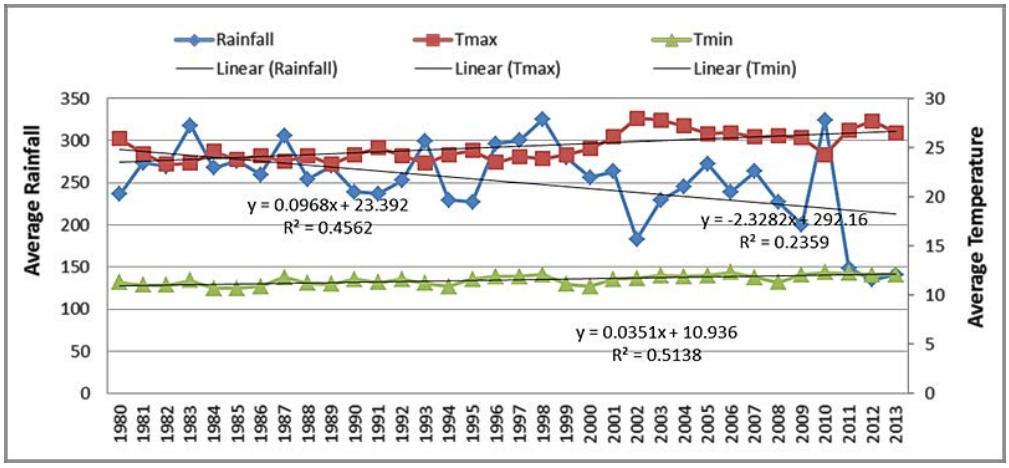

Figure 5: Time series and trends for precipitation, minimum and maximum temperatures in western Oromia

Perceived impacts of climate change on crop production. Results revealed that decline in crop yield was percieved as the biggest impact of climate change. Increase in pest and disease incidence, reduced seedling, delayed in seedling and delayed maturity of crops were the other percieved outcomes of climate change on crop production in Western Oromia. The dominant cash and subsistence crops in Western Oromia were maize, wheat, teff, barley, finger millet, sorghum beans, peas and potatoes. However, yields of all the crops in all areas were reported to be declining due to climate change, land degradation, pests and diseases, high cost of inputs, decreasing land size, etc. The findings suggest that climate change had a negative impact on crop production in each Woreda of Western Oromia and that climate adaptation and mitigation measures are required to reduce the long term vulnerability and food insecurity in the area (Fig. 6).

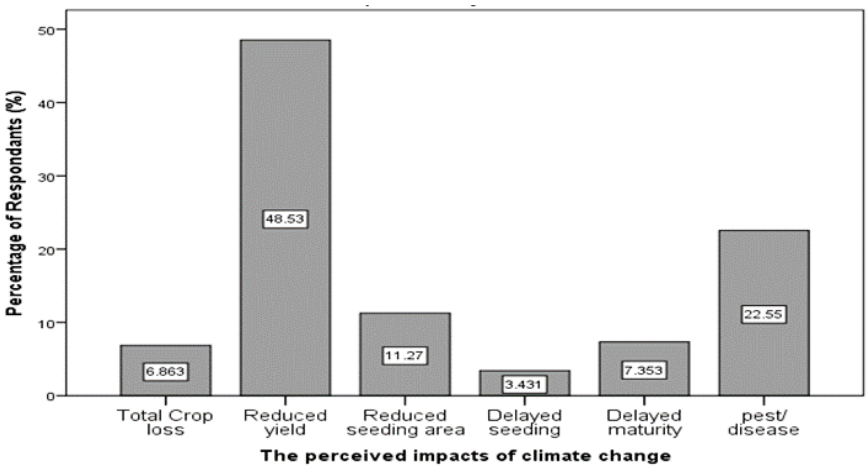

Figure 6: Perceived impacts of climate change in western Oromia

Coping and adaptation measure to climate change and variability. Most respondents (93%) in the study area reported having adjusted their farming practices due to climate change (Fig.7). The adaptation measures identified were soil and water conservation, crop rotation, change of crop varieties, and change in planting dates, late planting, diversification of crop types and varieties, growing drought resistant varieties, building water harvesting schemes and use of irrigation. The most adaptation measure reported was soil and water conservation (57%) (Fig. 8).

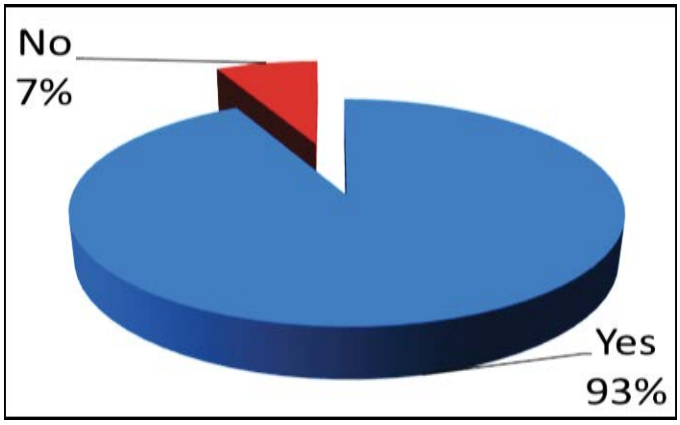

Figure 7: Adaptation measure to climate change and variability in western Oromia

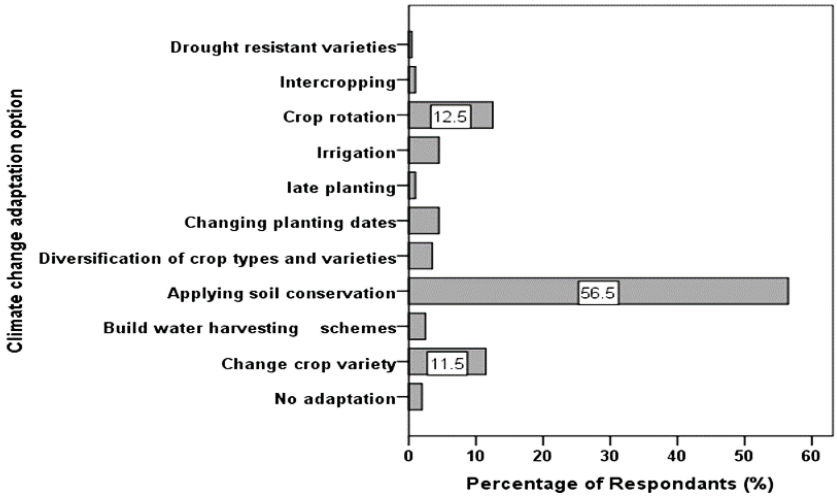

Figure 8: Distribution of households by coping and adaptation measures in western Oromia

Barriers to climate change adaptation. The study showed that communities were facing various barriers towads adaptation of strategies against climate change. The most inportant of these were lack of information (43.59%), shortage of labor (22.05%), and lack of capital (21.54%) (Fig. 9). These barriers acted interdependently to restrict communities to adapt to climate change and variability. Therefore, policy makers need to plan a holistic and coordinated approach in dealing with these barriers.

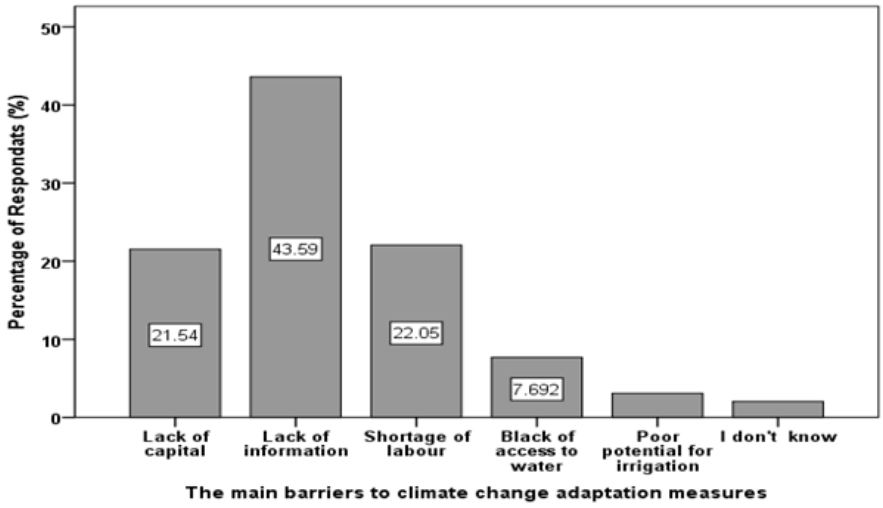

Figure 9: The main Barriers to climate change adaptation measures

Conclusions

The study revealed that most farmers perceive an increase in temperature and a decrease in precipitation in the study area as consquence of climate change and variability. Major impacts of climate change were perceived as decline in crop yield, increased flooding, drought, increased incidence of pests and diseases, reduced establishment of seedlings, delayed seedling emergence and delayed maturity. These findings indicate negative impact of climate change on crop production in Western Oromia and that climate adaptation and mitigation measures are required to reduce long term effects. The study identifified soil and water conservation, crop rotation, changing planting dates and crop varieties as the widely used adaptation measures in the study area. Lack of information, shortage of labor, lack of capital, lack of access to water, and limited irrigation are barriers to effective adaptation.

This study has provided empirical evidence and deepened our understanding of the barriers that challenge small-scale farmers in their attempt to implement appropriate adaptation strategies to manage the negative impacts of climate change and variability. Government and non-governmental organizations should therefore enact policies that support farmer adaptation to climate change and effectively address the barriers to adaptation.

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