Arabian J Bus Manag Review
Volume 11:2, 2021

Arabian journal of business and management review

Research Article

Open Access

# Effects of Climate Change and Variability on Coffee Production and Adaptation Mechanisms; The Case of Small-Holder Farmers at Dara Woreda, South Ethiopia

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## Abstract

This study was carried out with the objective of examining the extent of climate variability and its effect on coffee production and identifying determinants for farmers' decisions to undertake adaptation measures in Dara woreda. A multistage sampling technique was employed to select peasant association. Qualitative data were gathered through focus group discussion, key informant's interviews and quantitative data were also collected from 145 sample households. Logit model was used to identify the determinants for farmer's decisions on adaptation measures, while linear regression and Pearson's correlation were used to identify relationships and effects of climatic variables on coffee production. The results of this study reviled that, 93% of the respondents perceives the existence of reduction in rainfall, while 85% believes an increase in temperature over the last 20 years. The analysis of linear trend also show not only inter-annual and seasonal variability, but also a decreasing trend of rainfall in the area. The meteorological data also confirmed the increase in both maximum and minimum temperatures. Similarly, the annual yield of coffee productivity showed a decreasing tendency in the area for the period 1995-2014. Besides, the results of linear regression showed that, the amount of rainfall received and increased temperature significantly affected coffee production. Similarly Pearson's correlations indicated negative relationship between temperature and coffee yield, and strong correlation between rainfall and coffee yield. On the other hand, results of the logit regression model illustrated that; education level, farm size, access to credit service and family size being the major determinants for the farmers' decisions on adaptation measures in the area. Thus it would be vital to acknowledge the impacts of climate variability on coffee production in Dara woreda and considere the determinant factors to implement appropriate adaptation measures in order to address the impacts of climate change and variability in the area. Keywords:

adaptation • climate variability •climate change •Dara woreda •logit model

**Keywords:** Yarns • Taper • Waste Yarn • Product Development • Beeswax

## Introduction

Agriculture is the foundation for the Ethiopian economy, and the overall economic growth of the country is highly correlated to the success of the agriculture sector. Agriculture accounts for about 43% of the country's Gross Domestic Product (GDP), 90% of exports, and 85% of employment (ATA, 2016). However the impact of impact of climate variability on agriculture is quite significant [1-5].

They stressed that agriculture has already suffered from the negative economic and ecological consequences of climate variability. Accordingly, the effect is expected to continue and rural communities are increasingly becoming vulnerable to climate induced hazards, especially in developing countries [6]. Moreover, (IPCC, 2007) projected that yields of crops in some countries could be reduced by as much as 50% by 2020, with smallholders being the most affected. This prediction and expectation coupled with the current situation worries all citizens especially in developing countries.

Consequently, the government considers agriculture as the major source of overall economic growth in its different growth strategies including the Growth and Transformation Plan (GTP). In the GTP, for example, the ambitious overall economic growth objective bases itself on agricultural sector, since the sector is believed to carry the overall socioeconomic burden of the country [7-9].

The principal development programme of GTP was therefore focusing on maintaining rapid and broad-based growth to eventually reduce poverty through the overall growth of agricultural sector [10]. The issue of climate variability thus stands at the center of this transformation agenda, as climate is the major environmental factor that affects nearly all agriculture related human activities (ATA, 2016).

The climate change as rise in temperatures and erratic rain fall on wide spread infection of coffee berry disease may already be affecting coffee production in Ethiopian. Rising temperatures and erratic rain fall are threatening sustainable coffee production by enabling outbreak of diseases and infestations of insect pests that decrease the quality and yield of coffee berries [11]. Therefore, this study was prepared to assess the effects of climate change and variability and adaptation mechanisms of the study area.

## Methodology

### Description of the study area

Dara is one of the administrative woreda of Sidama, Sothern Nations Nationalities and Peoples' Region of Ethiopia. The woreda administration Kebado which is located at 87 km southeast of the regional capital Hawassa and at 355 km South of Addis Ababa. Geographically located at 60 30'N latitude, 380 25' E longitudes. The Woreda receive a mean annual rainfall varying from 1000mm-2800mm and mean maximum and minimum temperature of 26 $^0$C and 10 $^0$C. The altitude ranges from 1554 - 2149 masl. It has a total population of 155,265, of whom 76,475 are men and 78,790 women.

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**Received:** January 20, 2021; **Accepted:** February 03, 2021 ; **Published:** February 10, 2021

### Methods of data collection

Both quantitative and qualitative data were gathered from primary and secondary sources. Quantitative data were generated through randomly selected household by employing structured interviews in two PAs namely Setamo and Kumato. Relevant secondary data such as: population of the study kebeles, metrological data of the last two decades and coffee yields for a period of 1995-2014 were collected from records, reports and other published and unpublished documents from the concerned offices. Qualitative data were also gathered through focus group discussion, key informant's interviews, informal discussions with farmers, and personal observations.

### Sampling procedures and sample size

A multi-stage sampling technique was employed to select peasant associations (PAs) and sample respondents. In the first stage, Dara woreda was purposively selected because of its coffee production potential.

In the second stage, categorization of selected kebeles was done in consultation with woreda agricultural office, NGO staffs working in the area and available documents which provide information about coffee production practice of the area. Furthermore, numerous rules-of-thumb have been suggested for determining the minimum number of subjects required to conduct regression analyses. These rules-of-thumb are evaluated by comparing their results against those based on power analyses for tests of hypotheses of multiple and partial correlations. Accordingly, in this study sample size selection is based on the rule of thumb $N \geq 50+8m$, where, N, is sample size and `m` is the number of explanatory variables (Xi) where i=1, 2…8. Based on this rule the researcher took a total sample of 145 respondents from the selected two PAs. The sample of respective households is also selected random from the two strata i.e. 101 households from high potential area and 44 households from medium potential area.

## Conclusion

Based on the findings of this study, the following conclusions could be drawn regarding the effects of climate change and variability on coffee production and determinants of adaptation mechanisms. The study area has experienced a decrease in rainfall, increase in temperature and a decline trend in coffee yield during the past twenty years. The correlation between minimum temperature and yield was negative and also the correlation between rainfall and yield was positive. The minimum temperature in was increasing significantly and affected coffee production. The farmers in the target area are well aware about the changes in rainfall and temperature, consequently practicing adaptation strategies; however adaptation strategies such as off-farm employment and planting trees have been exercised only by limited farmers. Some farmers are still reluctant to take adaptation measures due to lack of knowledge, shortage of farming land, lack of capital and lack of information, inadequate support from the government. The perception about climate variability, educational level of the household head, farm size owned by the household, access to credit service, and total family size of the household are among the factors which are contributing to the farmers' decision to take climate change and variability adaptation strategies. Therefore, concerned institutions and individuals should use drought and disease resistant coffee varieties and increase farmers' level of perception and awareness.

## Results and Discussion

The average annual rainfall of Dara Kebado woreda ranges between 1000 and 2800 mm. However, the rainfall has experienced inter-annual variability over the past 20 years (1995-2014). The Analysis of linear trend of annual rainfall indicates decreasing trend with about 47.7 mm every year especially between 1995 and 2015, in which the inter-annual patterns and rainfall distribution also showed annual amounts below the average since 2010 (Figure 1).

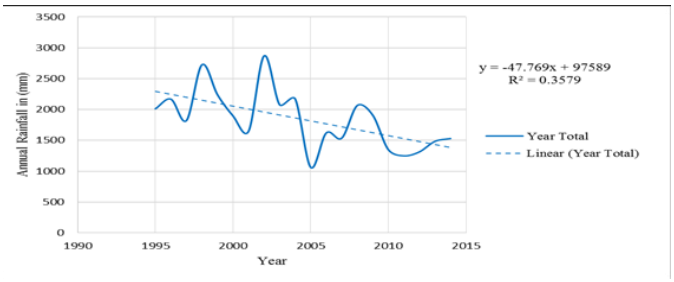


**Figure 1.** Inter-annual Rainfall Trends at Dara woreda.

In this study, the rainfall data was disaggregated into two growing seasons belg (February to May) and meher (June to September), in which both exhibited variations in seasonal amount of rainfall and monthly spread.

According to the analysis result of this study, both belg and meher rains showed declining trend by about 7mm and 31mm every year respectively during the past two decades (Figure 2), while year to year variability (CV%) of rainfall of meher and belg seasons were 37% and 35% respectively, which indicates highly variability of rainfall.

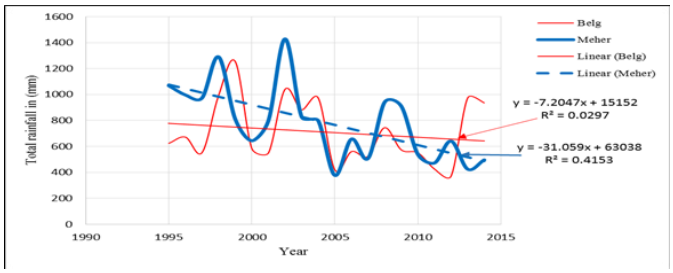


**Figure 2.** Belg and Meher Rainfall Trends at Dara woreda

## Conflict of Interest

None

## Funding and Sponsorship

Nil

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**How to cite this article:** Shiferaw, Aneteneh and Kefale Demelash. "Effects of Climate Change And Variability On Coffee Production And Adaptation Mechanisms; The Case Of Small-Holder Farmers at Dara Woreda, South Ethiopia." *Arabian J Bus Manag Review* 12 (2021):221