

Adaptation to Climate Change Among Ethiopian Farmers: Determinants, Strategies and Programs

Ryan Mitchell

As its name suggests, Community-Based Adaptation (CBA) refers to any adaptation project or practice led by community members (as opposed to government organizations, for example). This thesis examines cases of Community-Based Adaptation from several developing countries, including Ethiopia. The Ethiopian section of this work focuses on the drivers, determinants and means of adaptation for Ethiopian farmers. Although the case of Ethiopia is unique, its examination may provide some useful insight into the drivers, determinants and means of adaptation for farmers elsewhere.

ETHIOPIA AND CLIMATE CHANGE

Before climate change started to intensify natural disasters in many countries, Ethiopia had a long history of catastrophic events. According to the World Bank, these events have reduced Ethiopia's economic growth by more than one third.¹ A large reason for this decrease is Ethiopia's dependence on agriculture, a sector that employs 85 percent of the population and accounts for 45 percent of the GDP.² Thus, Ethiopia is highly vulnerable to such events, regardless of climate change. As climate change leads to longer lasting, more intense and

more frequent droughts, Ethiopia will become even more vulnerable.

This vulnerability is not purely economic; since many Ethiopians are subsistence farmers, droughts can be deadly. A long drought that began in 1969 led to a famine which took the lives of 30 000 peasants by 1973. Hundreds of thousands died during a famine from 1984 to 1985 and another drought in 1987 also affected 5 million people.³ However, droughts and famine did not end with the 20th century; while ample rainfall caused crops to flourish in the western part of Ethiopia in 2008, severe droughts in the eastern part of the country left millions vulnerable to hunger.⁴ Both the 2008 and 2011 droughts indicate that droughts in general are intensifying. According to the Institute of Development Studies, droughts are becoming more frequent as well.⁵

Rainfall variability, a cause of many droughts and food security crises in Ethiopia, has increased over the past several decades.⁶ According to many climate models, it will continue to increase.⁷

Agriculture in Ethiopia is highly rain-fed, as opposed to irrigated, and only 1 percent of all cultivated land is currently irrigated.⁸ This will render Ethiopia even more vulnerable to climate change, which may reduce half of all yields of rain-fed agriculture in many African countries by 2020.⁹

Along with rainfall variability, droughts and other disasters, a rapidly rising temperature also threatens Ethiopia's food security and economy. The nation's temperature has risen approximately 0.36°C every ten years for the past 55 years.¹⁰ The International Panel on Climate Change (IPCC)

¹ World Bank, "Main report," Vol. 1 of *Ethiopia - Economics of adaptation to climate change*, Washington, DC: World Bank (2010), <http://documents.worldbank.org/curated/en/2010/01/16279299/economics-adaptation-climate-change-ethiopia>

² CIA, "The World Factbook: Ethiopia," CIA, <https://www.cia.gov/library/publications/the-world-factbook/geos/et.html>

³ Ibid.

⁴ "Earth Observatory: Drought in Eastern Ethiopia," NASA, <http://earthobservatory.nasa.gov/NaturalHazards/view.php?id=35787>

⁵ A. K. Sørhaug, "Climate Change Impacts and Adaptations Among Ethiopian Farmers: Case Studies of Hagere Selam, Tigray, and Kofele, Oromia," (master's thesis, University of Adger, 2011): 1-139.

⁶ W Bewket, "Rainfall variability and crop production in Ethiopia: Case study in the Amhara region," Proceedings of the 16th International Conference of Ethiopian Studies (2009): 823.

⁷ Sørhaug, "Climate Change Impacts and Adaptations Among Ethiopian Farmers," 1-139.

⁸ M. Worede, T. Tesemma, and R. Feyissa, "Keeping diversity alive: an Ethiopian perspective," *Genes in the Field* (Boca Raton, FL: Lewis Publishers, 2000): 38.

⁹ Intergovernmental Panel on Climate Change (IPCC), "Climate Change 2007: Working Group II: Impacts, Adaptation and Vulnerability: Africa," (2007): 13. http://www.ipcc.ch/publications_and_data/ar4/wg2/en/spmsspm-c-7-africa.html

¹⁰ Gov of Ethiopia, "Climate Change National Adaptation Programme of Action," Ministry of Water Resources, National Meteorological Agency. Ed. Abebe Tadege (2007): 1-84.

predicts that by 2030 Ethiopia's increases in average temperature will range from 0.9°C to 1.1°C by 2030, from 1.7°C to 2.1°C by 2050, and from 2.7°C to 3.4°C by 2080.¹¹ Additionally, many climate models predict that the Sahel region will become drier in this century.¹²

ETHIOPIAN AGRICULTURE

The Ethiopian Highlands are the most agriculturally productive region of the nation.¹³ Gebreegziabher et al. (2011) predict that climate change will cause yields to increase in the "moisture-sufficient" Highlands.¹⁴ This could be a result of extended growing seasons caused by changing rainfalls and rising temperatures.¹⁵ However, Gebreegziabher et al. (2011) predict that, after 2030, they will swiftly decline.¹⁶ They also predict that in the drought-prone Highlands, productivity is expected to decline rapidly until 2030 and then temporarily slow until 2050.¹⁷ The Lowlands are drier and even more drought prone.¹⁸

Many Ethiopians are aware of climatic and other environmental changes. Bryan et al. (2009)¹⁹ interviewed farmers from five regions about whether they had recently observed changes in temperature and rainfall. 64 percent had observed an increase in temperatures and 65 percent had observed a decrease in rainfall. In another study, Di Falco et al. (2011) found that 68 percent of farmers in the Nile basin noticed that the average temperature had been increasing over the past twenty years,²⁰ and 62 percent of these farmers observed a decline in average rainfall during those years.²¹ Although these studies examined different regions, the majority of farmers in both cases observed the same general trends. This indicates that climate change is having similar effects on

different parts of the country and that many farmers are aware of such trends. However, this does not mean that these farmers will necessarily adapt accordingly. The next section will examine some of the factors that determine whether or not farmers adapt.

ADAPTATION

In one of the studies described in the previous section, Di Falco et al. (2011), asked whether adaptation actually increases food productivity;²² Di Falco et al. do find that adaptation results in higher rates of productivity.²³

As stated earlier, the majority of farmers in this study were aware of increasing temperatures and decreasing rainfall. However, only 68 percent attempted to adapt to these changes. Some of the main reasons why the other 32 percent did not include labour shortages and a lack of land, money or information.²⁴ A lack of information was one of the most common reasons, being cited by almost half of the households. This reveals how important education and awareness raising activities can be for adaptation, in general, and CBA in particular. In many cases, it may be best for groups looking to promote adaption to invest in awareness raising campaigns.

95 percent of adaptation strategies that households adopted consisted of "changing crop varieties, adoption of soil and water conservation strategies, and tree planting."²⁵ These strategies were commonly used in several other cases examined in this paper, indicating that these may be among the most commonly used strategies for Ethiopian farmers.

¹¹ Intergovernmental Panel on Climate Change (IPCC), "Climate Change 2007. Synthesis Report," IPCC (2007).

¹² Sørhaug, "Climate Change Impacts and Adaptations Among Ethiopian Farmers," 1-139.

¹³ Zenebe Gebreegziabher et al., "Climate change and the Ethiopian economy: A computable general equilibrium analysis," Environment for Development Discussion Paper (2011): 11-09.

¹⁴ Ibid., 11.

¹⁵ See: Below, T., Artner, A., Siebert, R., and Sieber, S. "Micro-level practices to adapt to climate change for African small-scale farmers," *A Review of Selected Literature. Environment and Production Technology Division*, (2010): 4.

¹⁶ Gebreegziabher et al., "Climate change and the Ethiopian economy," 11.

¹⁷ Ibid.

¹⁸ T. Deressa, R. M. Hassan, and C. Ringler, "Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia," *The Journal of Agricultural Science*, 149.1 (2011): 23.

¹⁹ Elizabeth Bryan et al., "Adaptation to climate change in Ethiopia and South Africa: options and constraints," *Environmental Science & Policy* 12.4 (2009): 416.

²⁰ S. Di Falco, M. Veronesi, and M. Yesuf, "Does adaptation to climate change provide food security? A micro-perspective from Ethiopia," *American Journal of Agricultural Economics*, 93.3 (2011): 829-846.

²¹ Ibid., 828

²² Ibid.

²³ Ibid., 827

²⁴ Ibid., 828

²⁵ Ibid., 828.

In a later working paper, Di Falco and Veronesi (2012) focus on what adaptation strategies are most effective.²⁶ They found that although single adaptation strategies had no major effect on net revenue, “adaptation to climate change based upon a portfolio of strategies significantly increases farm households’ net revenues.”²⁷ For example, alternating crops while using a soil or water conservation strategy was found to be a highly effective means of increasing yields. The combination of crop alternation with water conservation was found to be only slightly more effective than with soil conservation. The study found that when all three strategies are used, the impact is actually less than when crop alternation and a conservation strategy are used. This may be largely due to the higher cost of implementing multiple strategies.²⁸

Bryan et al. (2009) compared climate change awareness and adaptation efforts of Ethiopian and South African Farmers.²⁹ The Ethiopian farmers they questioned used similar adaptation strategies to those in the Di Falco and Veronesi (2012) study,³⁰ such as changing crop types, tree planting and soil conservation strategies. They also found that “73 percent and 83 percent of farmers perceived changes in temperature or rainfall, respectively, but 56 percent and 41 percent of farmers, respectively, did not undertake any adaptation measures. Overall, 37 percent of farmers in Ethiopia did not adapt to either perceived changes in rainfall or temperature.”³¹ Ethiopian farmers stated that their biggest barriers to adaptation were a lack of access to land and information.³² Notably, lack of information was again found to be a major factor

that deterred farmers from adopting adaptation activities.

Deressa et al. (2008) focused on adaption decisions (and lack, thereof) in Ethiopia’s Nile Basin, which is home to 40 percent of the country’s population.³³ The correlation between education and access to information and adaptation is frequently emphasized.³⁴ Of course, lack of information is not the only reason that adaptation measures are not taken. The study found a strong correlation between education levels and the decision to adapt as well. Improving a country’s educational system, increasing enrolment and incorporating information on climate change and adaptation strategies into educational programs can lead to a more resilient agricultural sector.

“ ‘Adaptation to climate change based upon a portfolio of strategies significantly increases farm households’ net revenues.’ ”

The most commonly used strategy was tree planting,³⁵ a method that also secures land tenure.³⁶ Soil conservation and irrigation made up 15 percent and 4 percent of adopted strategies, respectively. Kato et

al. (2011) examined soil and water conservation technologies in that region.³⁷ They found that these technologies, which include grass strips, waterways, irrigation and soil and stone bunds, substantially reduced production risk.³⁸ These strategies can be used in many other countries, although they would need to be adapted to the area’s climate and physical layout.

A later study by Deressa et al. (2011) returns to the subjects of climate change perception and adaptation.³⁹ The study found that “education of the head of the household, the household size, whether the head of the household was male,

²⁶ S. Di Falco and M. Veronesi, “How African Agriculture Can Adapt to Climate Change?—A Counterfactual Analysis from Ethiopia,” (2012), Working Paper Series.

²⁷ Ibid., 4

²⁸ Ibid., 19–20

²⁹ Bryan et al. “Adaptation to climate change in Ethiopia and South Africa,” 416.

³⁰ S. Di Falco and M. Veronesi, “How African Agriculture Can Adapt to Climate Change?”

³¹ Bryan et al., “Adaptation to climate change in Ethiopia and South Africa,” 6.

³² Ibid., 7.

³³ T. Deressa, “Determinants of farmers’ choice of adaptation methods to climate change in the Nile Basin of Ethiopia,” IFPRI Discussion Paper (2008): 798. International Food Policy Research Institute (IFPRI), Washington, DC.: 4

³⁴ Ibid., 11.

³⁵ Ibid., 9.

³⁶ . Di Falco, M. Veronesi, and M. Yesuf, “Does adaptation to climate change provide food security?” 829–846.

³⁷ E. Kato et al., “Soil and water conservation technologies: a buffer against production risk in the face of climate change? Insights from the Nile basin in Ethiopia,” *Agricultural Economics*, 42, 5 (2011): 593–604.

³⁸ Ibid., 3, 17.

³⁹ , Deressa, R. M. Hassan, and C. Ringler , “Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia.” *The Journal of Agricultural Science*, 149, 1 (2011): 23,

livestock ownership, advice received on crop and livestock production and the availability of credit and temperature” were all positively correlated with implementation of adaptation strategies.⁴⁰ Interestingly, this study found large farm size to be negatively correlated with implementation. Lack of land has been also been a major limitation to adaptation.⁴¹ Furthermore, climate change may have proportionally less of an effect on the wealth or yields of farmers with a large amount land. They may be, therefore, less incentivized to adapt.

The study also found that farmers in the Highlands perceived climate change more than those in the Lowlands and Midlands.⁴² In a survey based in the Highlands region, Gebrehiwot and Van der Veen (2013) recorded the effects of various determinants on the type and quantity of adaptation methods used.⁴³ They also found that 78 percent of farmers had noticed an increase in temperature and that 69 percent observed a decrease in rainfall.⁴⁴ This matches up with Deressa et al.’s (2011) observation of Highland farmers’ high awareness of climate change.⁴⁵ In this article, as in several others discussed in this section, there is a significant disconnect between the number of farmers who perceive climatic changes and the much lower number of farmers who undertake adaptation practices. Deressa et al. (2011) found that only 53 percent of farmers undertook any adaptation practice.⁴⁶

Gebrehiwot and Van der Veen (2013) identified extension services and climate change education as important means of motivating farmers to undertake adaptation practices.⁴⁷ They recommend “Improving the knowledge and skills of extension service personnel about climate change and

adaptation strategies, and making the extension services more accessible to farmers.”⁴⁸ They found that for every year of education there was an increased likelihood of using crop diversification, soil conservation, changing planting dates or irrigation as adaptation strategies. Having access to information on climate change increased the likelihood of farmers adopting these practices even more: by 18.5 percent, 9.5 percent, 5.1 percent and 5.4 percent, respectively. Increased access to extension services increased the probability of farmers adopting crop diversification strategies and changing planting dates by 5.4 percent and 6.9 percent, respectively.⁴⁹ One way to make the agriculture sector more resilient is to increase and expand extension services, particularly in highly vulnerable areas.

While the above studies have examined adaptation efforts on broad scales, a thesis by Sørhaug (2011) focuses on adaptation efforts in the towns of Hagere Selam and Kofele (in the Tigray and Oromia regions, respectively).⁵⁰ Hagere Selam has 6,800 inhabitants and is in a dry-land environment, whereas, Kofele has 13,100 inhabitants and is located in a dry plateau region.⁵¹

Both towns were highly aware of climatic changes. In Hagere Salem, 95 percent of those surveyed said that they had observed climatic changes over the past 20 years. Furthermore, 91.7 percent identified these changes as negative. In Kofele, 98 percent said they had perceived negative climatic changes.⁵² 96% percent of respondents in Kofele and 58.3% of those in Hagere Selam said they had experienced negative impacts from these changes such as famine, water shortage or reduced yield. Reduced yield was by far the most common impact.

⁴⁰ Ibid., 28.

⁴¹ See: Bryan, Elizabeth, et al. "Adaptation to climate change in Ethiopia and South Africa: options and constraints," *Environmental Science & Policy* 12.4 (2009):

⁴² Ibid., 28.

⁴³ E. Kato, C. Ringler, M. Yesuf, and E. Bryan, "Soil and water conservation technologies: a buffer against production risk in the face of climate change? Insights from the Nile basin in Ethiopia," *Agricultural Economics*, 42, 5 (2011): 593-604,

⁴⁴ Ibid., 36-7.

⁴⁵ Deressa, Hassan, and Ringler, "Perception of and adaptation to climate change by farmers in the Nile basin of Ethiopia," 23.

⁴⁶ Ibid., 37.

⁴⁷ Gebrehiwot, T. and Van Der Veen, A, "Farm Level Adaptation to Climate Change: The Case of Farmers in The Ethiopian Highlands," *Environmental Management* 52 (2013): 29-44.

⁴⁸ Ibid., 42.

⁴⁹ Ibid., 42.

⁵⁰ Sørhaug, "Climate Change Impacts and Adaptations Among Ethiopian Farmers," 1-139.

⁵¹ Ibid., 10, 12.

⁵² Ibid., 65.

However, famine had occurred in both towns as well.⁵³ These cases show how common famine is nationwide and that climate change could conceivably lead to more.

Sørhaug found that factors such as farm size and level of education were positively correlated with the decision to adapt.⁵⁴ She also notes that distance from the market, a source of information and social capital are negatively correlated with the decision to adapt.⁵⁵ This is likely the case in many other parts of Ethiopia and in many other countries. Governments, NGOs and other organizations trying to promote adaptation should be aware of this negative correlation.

Unlike other case studies, the majority of respondents interviewed by Sørhaug adopted at least one adaptation strategy. An average of 2.8 strategies were adopted in Hagere Selam and 4.4 were adopted on average in Kofele.⁵⁶ Soil and water conservation strategies were found to be used by 73.3 percent of the population in Hagere Selam and 4 percent in Kofele.⁵⁷ Tree planting is used by 50% and 56% of the populations in Hagere Selam and Kofele, respectively.⁵⁸ The most commonly used strategy, however, is crop diversification, which was found to be used by 80 percent and 98 percent of the population in Hagere Selam and Kofele, respectively.⁵⁹

One strategy that was unique to Kofele, practiced by 72 percent of its inhabitants, is growing Enset, a drought resistant plant that grows between 2000-3000 meters in elevation. The plant is a

major food source for farmers after the cereal supply runs out.⁶⁰ Unlike many other adaptation strategies described in this section, this strategy cannot be reapplied in many other countries. This is simply because specific conditions are required to grow Enset. However, Enset may be an effective strategy for many communities in Ethiopia and eastern Africa.

In 2009, Oxfam America launched the Horn of Africa Risk Transfer for Adaptation Program (HARITA).⁶¹ In 2010, 65 extra villages took part in HARITA's community risk management and insurance education programs and seven hundred extra farmers were educated about insurance.⁶² According to that year's final quarterly report, for the past three years, a team from several organizations had conducted an annual Impact Monitoring Evaluation and Learning (IMEL). These IMELs formed the basis for the risk reduction strategies that farmers of each community later chose to undertake. The program's Disaster Risk Reduction (DRR) team then reviewed the feasibility of these strategies with each farmer.⁶³

Several of these adaptation strategies, such as agroforestry, have already been discussed in this section whereas, others have not. Seed cleaning, for example, may be a very effective strategy. Researchers at Mekelle University, a partner organization of Oxfam, found that "cleaning teff seeds before sowing can increase production by 50 percent."⁶⁴ Six million Ethiopian farmers grow teff.⁶⁵ The cleaning process, at least according to Oxfam America, is quick.⁶⁶ This may be a very effective means of facing food insecurity. Threshing, a similar process of removing chaff from around a seed, can reduce health risks.

⁵³ Ibid., 82-3.

⁵⁴ Ibid., 102-3.

⁵⁵ Ibid., 105.

⁵⁶ Ibid., 106-7.

⁵⁷ Ibid., 101.

⁵⁸ Ibid., 91-2.

⁵⁹ Ibid., 101.

⁶⁰ Ibid., 97.

⁶¹ "Horn of Africa Risk Transfer for Adaptation Program," UNFCCC (2012) http://unfccc.int/secretariat/momentum_for_change/items/6636txt.php

⁶² OxfamAmerica, "Horn of Africa Risk Transfer for Adaptation: Harita Quarterly report: October 2010-December 2010." Rural Resilience Series (2010).

⁶³ Ibid., 9-10., for list of strategies see: Ibid., 11.

⁶⁴ Ibid., 11.

⁶⁵ OxfamAmerica, "Horn of Africa Risk Transfer for Adaptation"

⁶⁶ OxfamAmerica, "Weather insurance offers Ethiopian farmers hope- despite drought," (2009) <http://www.oxfamamerica.org/articles/weather-insurance-offers-ethiopian-farmers-hope-despite-drought>

HARITA also has an insurance system, whereby farmers in five villages can buy crop insurance for barley, wheat and teff. Poorer farmers could purchase the insurance with their labor which is often used for risk reduction projects for their communities.⁶⁷

CONCLUSION

As section 3 indicates, there has been a significant amount of literature on the determinants of adaptation for Ethiopian farmers. Although the effects of these determinants vary between regions and case studies, there are some common trends among the case studies. For example, wealth, education, extension services and information on climate change are all positively related to the probability of adaption. Policy makers, NGOs and community organizations can all learn from these trends. As Gebrehiwot and Van der Veen (2013) recommend, policy makers could make extension services more accessible in order to indirectly promote climate change adaptation.⁶⁸ Similarly, NGOs may find that climate change educational campaigns are an effective way of doing the same thing.

These case studies may also provide NGOs with useful information about what adaptation strategies are generally used. In all of the case studies, the same adaptation strategies were used most often: soil and water conservation, tree planting and changing crop types. It is worth noting that these names refer to very broad categories. Tree planting and crop alternation are prime examples. The type of tree planted or crop alternated could vary significantly between regions or communities.

The cases of Hagere Selam and Kofele provide useful information on adaptation decisions on much smaller scales. Consequently, one could study how the villages' social and physical micro-environments affect a farmer's decision to adapt and the effectiveness of certain adaptation strategies. Sørhaug also points out another major determinant of the decision to adapt: access to a market. Policy makers and NGOs should consider this determinant.⁶⁹

In the HARITA program, other adaptation strategies were also used which were discussed in the last section. HARITA's insurance program is also worth noting. If an adaptation activity were to be unsuccessful, such a safety net could prevent financial or food security crises. Furthermore, the program allows poorer farmers to pay for their insurance by working on disaster risk reduction projects for the community.⁷⁰ NGOs planning on starting an insurance program should consider setting up a similar labor-for-insurance system.

Many of the adaptation strategies and means of promoting adaptation (e.g. awareness campaigns) discussed in this chapter can be very effective in other countries. Certain strategies, such as cleaning Teff seeds, could only be performed in certain countries. Teff, of course, only grows in certain parts of the world. Many other strategies and programs, such as HARITA's insurance program, could be replicated in many other countries. Similarly, many of the determinants of adaptation, such as access to extension services, may be the same or similar to those in other parts of the world. The studies examined in this paper, although specific to Ethiopia, may provide important lessons for those interested in promoting agriculturally adaptation elsewhere.

⁶⁷ Ibid., 5.

⁶⁸ T Gebrehiwot and A. Van Der Veen, "Farm Level Adaptation to Climate Change: The Case of Farmers in The Ethiopian Highlands". *Environmental Management* 52 (2013): 29-44.

⁶⁹ Sørhaug, "Climate Change Impacts and Adaptations Among Ethiopian Farmers," 1-139.

⁷⁰ OxfamAmerica. "Horn of Africa Risk Transfer for Adaptation,"