



## Review Article

# Review on Determinants of Farmers' Perception on Climate Change Adaptation Strategies in Ethiopia

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**Abstract:** Ethiopia is one of the drought affected areas which require huge community, government and NGOs participation. The past experience in the country shows the limited capacity of the government for climate change adaptation strategies. Therefore, the current direction is towards enhancing the capacity and creating awareness of the community and users could own, finance and manage their environment in order to minimize impact of climate change by establishing adaptation strategies. The objective of adaptation strategies is to promote farmers perception, improve service delivery, demand management and increase productivity. The main objectives of this study are to examine adaptation strategies, to identify the factors that determine farmers' perception on climate change adaptation strategies the study area. Apart from the descriptive analysis, binary logit model will be employed to identify the determinants of farmers' perception on climate change and adaptation strategies. The study will be used both primary and secondary data. The primary data will be obtained through questionnaire and interview; while secondary data will be collected from books, journals articles and different reports. The study site will be selected based the frequent occurrence of drought, topographic variation and other determinants of climate change and adaptation strategies. Accordingly four kebeles will be selected by systematic random sampling for the study.

**Keywords:** Farmers' Perception, Climate Change, Adaptation Strategies, Determinants, Ethiopia

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## 1. Introduction

### Background of the review

According to [16] suggestion Climate change is a long-term change in the average weather conditions of an area, such as its usual temperature, rainfall, and wind. The climate varies naturally from year to year and decade to decade. This is caused by natural processes linking the atmosphere, ocean and land, as well as variations in heat output from the sun. Climate change that experiencing now is being caused primarily by human factors.

According to [7] report, variations of unexpected temperature and rain fall distribution resulted from this climate change have greater impact on Agriculture and food-related industries. Even though, Agriculture is the greatest significant sector in Africa, it is expected to be negatively affected by climate change. It is perfect that climate

variation will carry out significant losses particularly for smallholders' farmers who are their livelihood depend up on agriculture. Consequently, there is a necessary to deactivate the potential opposing effects of climate change if damages to this exposed sector of the people are to be prevented [23].

Since Agriculture is the most dependent on weather events and rainfall patterns, it is very sensitive to climate change variation [12]. This Extreme weather and uncertainty in rainfall patterns are negatively affecting the agricultural productivity and the volumes as well as the quality of agricultural products are decline. These changes in weather and climate are likely to affect the food security of developing world including our country Ethiopia where a large fraction of ever-increasing population is already fronting hunger, insecure and unhealthy food [36].

In order to reduce the impact of weather and climate different scholars, researchers, government and stakeholders

suggest different mechanism or approach. One of the most important of this approach or system used to minimize the impact of climate change is Adaptation. Adaptation is discourses climate change influences that are experienced currently makes us for influences happening in the coming. It comprises activities to reduce opposing effects from climate change and dig out chances that might afford socioeconomic importance. According to [17] Adaptation practices can be independent, deliberate or usual. While independent activities are primarily carry out by isolated performers, caused by climate change convinced market alterations, deliberate activities can be carried out by both individual and community actors. These activities primarily comprise planned strategy decisions grounded on the consciousness that circumstances have altered. Usual activities perform within the environment as a response to climate change. A vast variety of adaptation measures is available. Though, the actions existing to policy makers and the wide community involve typically of deliberate adaptation actions. All most important sector of the economy has definite choices to adapt to climate change. Particularly, water resource sector, important approaches to implement adaptation actions such as rainwater harvesting is crucial one. And the expansion of drought resistance plant and improvement of drought resistance crop variety is a fundamental adaptation strategy in the agricultural sector [9].

According to [24] suggestion, the adaptation strategies have been practiced both at individual and group level. Community based adaptation is capable of reducing the vulnerability as well as improving the resilience of the local people to climatic variability and change. However survival farming has a long history of coping and adapting to some of these changes, effective adaptation strategies and actions should be intended at securing the well-being of the smallholder farmers in the face of climatic changes. However, most adaptation efforts have been top-down, and little attention has been paid to communities' experiences of climatic variability and their efforts to cope with their changing environments. However, the role of adaptation by smallholder farmers plays a great role [16]. Adaptation diminishes the contrary impact of climate change and enhance beneficial impacts, but will not prevent substantial costs that are produced by all damage. Some adaptation strategies at national level and local level and revise some cases of its implementation in several vulnerable areas.

The importance of understanding the influences of climate change will support direct area, time, and techniques of adaptation strategies. In Ethiopia, Some of the adaptation strategies implemented in different area in order to reduce or minimize the impact of climate changes are crop rotation, mixed farming, early planting, crop diversification and minimum tillage practices, expansion of irrigation, water harvesting expansion of selected seed variety [14]. Even though adaptation strategies are important to minimize the impact of climate change on agricultural productivity, there are several factors that can determine the adaptation strategies like income, age, farming experience, plot size, family size, education and other related factors has a great impact to adapt

or not to adapt this strategies [14].

Climate change, response to climate change and other related issues are still questions to the government, policy makers and for concerned experts. Still in Ethiopia there is many organized and documented research result, which can expose the determinants farmers' perception to Climate Change adaptation strategies in the study area. Of course, there are reports prepared by different governmental and non-governmental organizations based on short visit observations in different part of country. These report results, however, are not based on systematic analysis and even though they are sufficient to point out the determinants of farmers' perception on Climate Change Adaptation Strategies in the country.

Adaptation strategies is important in reducing the impact of climate change through implementing indigenous knowledge and adoption of new farm technology, however, many recent research have been done on farmers climate change adaptation strategies in different part of Ethiopia. Due to this fact, in view of the above statements the review is interested to focus the farmers' perception on climate change adaptation strategies in Ethiopia. Therefore, the objectives of this review paper are:

To review the perception and challenges of climate change adaptation strategies.

To highlight policy implication to focus on improve perception of Farmers on adaptation strategies.

## 2. Literature Review

### 2.1. Conceptual Framework on Climate Change

According to [33] climate change is the average variation of its features for long period. As per idea of wakjira climate change largely caused by human factor which comprise expansion of land use by human being activities and other causes climatic change is natural forces like volcanic eruption and continental drift [33]. The climate has been changing since the early 1900s, resulting in changes in precipitation, temperature, carbon dioxide (CO<sub>2</sub>), fertilization, climate variability and surface water runoff [5].

According to [12] suggestion Climate change refers to a model change in the climatic design of a place, area or planet which is connected with mean weather constituents, such as temperature, wind patterns and precipitations. Also as above scholars idea, natural processes such as variations in the intensity of the sun, eruptions from volcanoes, very slow changes in ocean circulations and land surfaces can cause this global climate change but human activities are by far the major causes through the continuous release of greenhouse gases and aerosols into the atmosphere, by altering land surfaces, and or depleting the ozone layer.

According to [29] the climate structure is a compound, collaborating system containing of the air, land surface and ice, hydrosphere, and biosphere elements. The climate system contains in period below the effect of its own internal changing aspects and due to changes in exogenic factors that are called forcing. Exogenic forcing comprises normal



However, the recent and accelerating warming of the earth's climate is largely attributable to human activity, and its impacts are mediated by psychological and social processes and can be limited primarily by human activity. Earth's temperature and climate have fluctuated over the course of millions of years. Over the past century or so, however, human activities have driven Earth's climate out of the temperature range within which human civilization developed during the past 10,000 years and further warming is inevitable because of the physical properties of the climate system. This climate change, recent in geological terms, is a result of several changes in human activities that accelerated with industrialization in the 19<sup>th</sup> century and increased exponentially since. These activities, sometimes called driving forces [22], have produced rapid increases in climate forcing factors, chiefly releases of greenhouse gases (GHG) and land cover changes that alter Earth's albedo, or reflectivity of energy coming from the sun.

## 2.2. Causes of Climate Change

The character of the Earth's climate system is formed by the universal movement of the air and waters (water bodies), the winds and tides that travel temperature and humidity all over the surface of the planet. The leading source of the energy that pushes these movements is the Sun. So, to classify the causes why climate changes, due to the Sun, change in the Sun's intensity varies in the extent of energy released by the Sun is a main candidate as a cause of climate changeability. And there is no uncertainty that on the longest timescales of Earth's geological history, trends in solar output have played a main role in determining the Earth's climate and will continue to do so in the future. Within our lifetime, though, of more concern are variations on the decade to century timescales. Despite many studies, the evidence is still controversial. Sunspot cycles have been found in climate parameters, but the fluctuations are weak and tend to appear and disappear without reason [9].

In the early 1600s, the sunspot series almost disappeared and this occurrence, the so-called Maunder Minimum, has been related with the height of the Slight Ice Age. It has also been claimed that the heating of the 20th century was basically due to trends in sunspot activity, for example, in the length of the sunspot cycle. Moreover, the variations in solar radiation that likely supplemented these sunspot conditions were not actually adequate to produce the practical climate changes, without some intensifying techniques. As the flow of solar energy hotness and brightness touches earth surface, the property of the Earth's circuit and its movement shows a key significant in affecting long lasting climate change [20]. However in order to describe the measure of the practical variations, it is required to raise other influences. One option is that the fundamentally influence is enlarged by the discharge and uptake of carbon dioxide as climate alters. As the stream of solar energy reaches the Earth's atmosphere, the components of the atmosphere gases and particles, clouds and contamination interfere with the energy flow, reflecting

certain heat and bright back to space, receiving then discharging a portion [22].

### 2.2.1. Volcanic Pollution

Explosive volcanic eruptions can introduce huge amounts of dust and the gas, SO<sub>2</sub> great into the atmosphere. Whereas volcanic debris in the lesser air falls out or is rained out within days, the veil of pollution in the upper atmosphere is above the weather and may remain for several years, gradually spreading to cover much of the globe. The volcanic pollution results in a substantial reduction in the stream of solar energy as it passes through the upper layers of the atmosphere, reflecting a significant amount back out to space [9].

Observational and modeling studies of the likely effect of recent volcanic eruptions suggest that an individual eruption may generate global cooling amounting to two or three tenths of a degree Celsius. The effect lasts for a year or two. Major eruptions have not been common this century, occurring once every ten to twenty years, so the long-term influence has been slight. The influence on climate has been on the year-to year time scale. Other forms of pollution can affect the passage of heat and light through the air – dust thrown up by windstorms or human activity, for example – but the most significant factor at this time is believed to be the rising amount of greenhouse gases, such as carbon dioxide and methane, in the atmosphere [9].

### 2.2.2. Greenhouse Effect

Greenhouse gases do not interfere to any great extent with the incoming solar energy. But once that energy reaches the Earth's surface, it is absorbed, warms the land and ocean surface of the planet, and then is re-emitted. The amount of heat re-emitted and eventually lost to space must equal the amount gained from the Sun if the temperature of the planet is to remain constant. But the so-called terrestrial energy stream is different in character it is longer in wavelength than the incoming solar energy as the Earth is cooler than the Sun and the greenhouse gases interfere with it strongly before it can escape to space [18]. The greenhouse gases absorb the outgoing terrestrial energy, trapping it near the Earth's surface, and causing even more warming. This is the greenhouse effect. Without it the planet would be too cold to support life as we know it.

Unfortunately, humanity, through energy generation, changing land use and other processes, has produced a substantial increase in the amount of greenhouse gases in the atmosphere, enhancing the natural greenhouse effect, and it is feared that this continuing change will lead to a major shift in global climate. Climate variability can also be generated by smaller-scale changes in the energy balance – the balance between heat received and heat lost. Many processes can lead to disruption of regional climate [25].

Current climate change is mainly caused by human activities that release greenhouse gases to the atmosphere. The sun's energy warms the Earth and the warmed Earth releases heat to the atmosphere. Certain gases in the atmosphere trap this heat and act like the glass of a greenhouse. Such gases are

called greenhouse gases. The main greenhouse gases are water vapor, carbon dioxide and methane. Greenhouse gases absorb heat and radiate some of it back to the Earth, raising surface temperatures. This process is often called the greenhouse effect. The greenhouse effect is a natural process, but it is being intensified by human activities that increase greenhouse gas levels in the atmosphere, especially carbon dioxide. Increasing greenhouse gas levels in the atmosphere makes it more effective at trapping heat, resulting in overall warming of the earth. Burning fossil fuels (coal, oil, gas) and some industrial processes are the main sources of carbon dioxide. Climate change caused by human activity is referred to as anthropogenic climate change [11].

### **2.3. Impact of Climate Change on Agriculture**

According to [37] described about impacts of climate change range from reduced productivity to outmigration of labor due to increased economic strain. The largest known economic impact of climate change is upon agriculture because of the size and sensitivity of the sector [3]. Warming causes the greatest harm to agriculture in developing countries primarily because many farms in the low latitudes already endure climates that are too hot. This paper reviews several studies that measure the size of the impact of warming on farms in developing countries. Even though adaptation will blunt some of the worst predicted outcomes, warming is expected to cause large damages to agriculture in developing countries over the next century.

There is increasing justification that greenhouse gases have before begun to heat earth the surface. If nothing is completed to curb emissions, the stock of greenhouse gases is expected to grow substantially over the next century largely from burning fossil fuels but also from land use change [25]. This in turn will cause future climates to warm and will likely cause changes in precipitation patterns. Although there are many impacts expected from global climate change, one of the largest impacts is expected to be on agriculture. Quantifying these impacts provides important insights into how much to spend on mitigation. Understanding the effects of climate change will also assist direct where, when, and how adaptation should progress [3].

An influence of climate change on agriculture has multifaceted effects on community and the environment. Climate variability and extreme events (drought and heavy rains) are causing significant damage to life, property, natural resources and economy making the country highly vulnerable to climatic vagaries [19]. Evidences suggest a different study implies that recurrent droughts and the associated food insecurity and famine in Ethiopia are mainly caused by climate, particularly rainfall variability. Drought and floods are catastrophic for the lowland pastoralists and mixed cropping systems areas of the country. Flood hazard is increasing in the highland areas due to changes in land use/land cover, rainfall pattern, and drainage. Empirical economic studies of agriculture in developing countries were rare because of the absence of suitable data [37].

One interesting technical question posed by studying

agriculture in developing countries is that existing climate can be hard to measure. Although weather stations take accurate recordings of weather over time (climate), the stations are often widely dispersed and concentrated in cities. Farms, because they are located in rural settings, can be quite distant from the closest weather station. The advantage of satellites is that they can take direct measurements of the entire earth, especially of temperature. One of the disadvantages of satellites is that they cannot measure everything of importance, especially precipitation. In order to obtain precipitation measures, it was necessary to interpolate between weather stations. This combination was found to provide the most reliable climate [29].

Additional theme that was examined in these studies was whether farms were more responsive to climate normal or climate variance. The climate normal is the mean weather over a 30 year period. The climate variance is the inter annual variation around that mean over that same period. Studies that have examined both normal and variance have found that both measures are important [29] Increased inter annual variance in spring and summers reduce land value. Increased inter annual variance in the winter, however, increases land value. Whereas farmers can adapt to observed changes in winter weather by planting different crops and changing the timing of the following growing season, there are fewer adjustments that can be made during the growing season to the weather that unfolds.

### **2.4. Climate Change Adaptation Strategies**

Adaptation means to perform the essential improvement for community to adapt to innovative climatic circumstances in order to minimize their exposure to climate change. Adaptive ability is the capacity of a approach to regulate to climate change (including climate inconsistency and extremes) and to moderate possible injuries, to take benefits of chances or face the consequences. Adaptation diminishes the adverse influences of climate change and improve helpful impact, but will not prevent considerable costs that are created by all damages. The performance necessitates adaptation activities. These are clear and realized at national, regional or local levels since several of influences and exposures depend on the certain economic, topographical and community condition of each country or region we will present some adaptation strategies at national and local level and revise cases of its implementation in several vulnerable areas [13].

Adaptation strategy of climate change effect is mostly relying upon the affecting causes related to smallholder farmers' perception about the occurrences and involvement of the guiding principle to implement properly. Adaptation strategy intended by seeing the understanding and perceptions of smallholder farmers can convey productive and maintainable adaptation response to effects of climate change [9]. Societies have a long record of adapting to the impacts of weather and climate through a range of practices that include crop diversification, irrigation, water management, disaster risk management, and insurance. But climate change poses novel risks often outside the range of experience, such as

impacts related to drought, heat waves, and accelerated glacier retreat and hurricane intensity [25].

Adaptation measures that also consider climate change are being implemented, on a limited basis, in both developed and developing countries. These measures are undertaken by a range of public and private actors through policies, investments in infrastructure and technologies, and behavioral change. A limited but growing set of adaptation measures also explicitly considers scenarios of future climate change [24].

Following [27], adaptation to climate change refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli or its effects, which moderates harm or exploits beneficial opportunities. Adaptation can be implemented by smallholder farmers themselves (autonomous adaptation) or by government policies aimed at promoting appropriate and effective adaptation measures (planned adaptation). However, in order to implement appropriate interventions, there is a need to understand location-specific opportunities, challenges, and the key drivers behind adaptation. Adaptation can also be effected at different scales: individual/farm-level, national level, or international level. Although there is some autonomous adaptation at farm-level, it is usually inadequate and requires the intervention of different institutions. Moreover, adaptation at national or international level entails an understanding of the process of location-specific autonomous adaptation at farm-level [23].

### **2.5. Determinants Farmers Perception on Climate Change Adaptation Strategies**

According to [25] that property right and shortage of insecure property from financial institutions controlling expectations because financial agricultural loans. Years of farming experience, soil conservation, of land decrease farmers' likelihood of having property right is likely to help farmers gain controlling for all other factors. This aspect of financial institutions often require land or a fixed asset a general decline in arable land available for potentially decrease farmers' access to credit conservation. Gain access to credit meets asset as collateral for production or an credit from banks or other financial institutions. Furthermore, the type of soil conservation mainly practiced by farmers in the district is basically allowing arable land to fallow for a few years.

According to [15] report, in Ethiopia collective indigenous people's perception because real climatic trends are often not equally perceived among small-scale farmers. As different studies confirmed farmers' perceptions of variations in temperature were similar with meteorological station data but different with meteorological rainfall trends in Ethiopia. Similarly, other studies reported that farmers' perceptions of increased temperature coincided with climatic data, but their perception of declined rainfall did not support with rainfall climatic data in other country. Opposite to these studies, exposed that the majority of farmers; perceived variations in temperature and rainfall score with meteorological data in in different part of Ethiopia. Hence, climate change system modeling and impacts may coincide with the perception of farmers in some cases but not in others. But the link between

the two is helpful for climate change adaptation by influencing farmers' risk perception behaviors [14].

Understanding local perceptions and adaptive behavior provides better insights and information relevant to a policy that helps to address the challenge of sustainable agricultural development in the face of variable and uncertain environments [29]. This study, therefore, will respond to a paucity of empirical information regarding the indicated gaps of knowledge addressing threefold purpose. According to [20] report, in response to the practical and perceived climate change, agrarians in a given agro-ecological and socio-economic activities might implement various site specific adaptation mechanisms. In different parts of Ethiopia, farmers practice approaches that help to adapt climate change. Various climate change adaptation strategies can have direct and indirect as well as temporal and persisting benefits. These benefits of trees on various land uses have been reported for different parts of the world 11-13. The soil and water conservation practices can contribute to the climate change adaptation through maintaining or increasing agricultural productivity [20].

## **3. Conclusion**

The climate varies naturally from year to year and decade to decade. This is caused by natural processes linking the atmosphere, ocean and land, as well as variations in heat output from the sun. Climate change that experiencing now is being caused primarily by human factors. Variations of unexpected temperature and rain fall distribution resulted from this climate change have greater impact on Agriculture and food-related industries. It is perfect that climate variation will carry out significant losses particularly for smallholders' farmers who are their livelihood depend up on agriculture. Since Agriculture is the most dependent on weather events and rainfall patterns, it is very sensitive to climate change variation. This Extreme weather and uncertainty in rainfall patterns are negatively affecting the agricultural productivity and the volumes as well as the quality of agricultural products are decline. These changes in weather and climate are likely to affect the food security of developing world including our country Ethiopia where a large fraction of ever-increasing population is already fronting hunger, insecure and unhealthy food.

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climate change on agricultural productivity, there are several factors that can determine the adaptation strategies like income, age, farming experience, plot size, family size, education and other related factors has a great impact to adapt or not to adapt this strategies.

## Personal Profile

Mr Haile Tamiru Urgessa was graduate by Masters of Science in Agricultural Economics from wollega University in 2016. And employed in Bule Hora University as a lecturer and still serving as instructor in department of Agricultural Economics.

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