



## Smallholder Farmers Agriculture Risk and Mitigation Strategy evidence from Ethiopia: A Literature Review

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### Abstract

Ethiopia's agricultural sector is primarily driven by smallholder farmers, who are vulnerable to numerous risks, including climate variability, market instability, and institutional gaps. The aim of these reviews was to explore a source of agricultural risks faced by smallholder farmers and adoption strategies in Ethiopia context. Smallholder farmers in developing nations are susceptible to climatic hazards due to their lack of access to institutional risk management tools like crop insurance, and the majority of them adopt conventional techniques to lessen the detrimental effects of these risks on agricultural productivity. Ethiopian farmers have skill at recognizing risk factors and may develop risk management strategies through practical knowledge. Farmers' risk management techniques are less successful in Ethiopia due to the lack of strong institutions including the banking, market information, and extension consulting services. Finally, different empirical findings show that market network, financial management, variety, and disease prevention are considered to be the most effective risk management strategies in agriculture. The paper recommends targeted government interventions and policies to enhance smallholder resilience in Ethiopia, through designing a policy that addresses farmers' risk management strategies for pre-existence stage and ex post measures of agricultural risks.

**Keywords:** smallholders' farmers, agricultural risk, risk management strategies.

## 1. INTRODUCTION

### Background

Ethiopia is essentially an agrarian nation. Despite being the largest economic sector, the majority of agricultural production is for subsistence. Agriculture is essential to many other economic endeavors, such as exports and industrial processing. Small farmers who grow cash crops supply a significant portion of the exported goods. In Ethiopia, subsistence smallholder farmers produce over 95% of the country's mostly rain-fed crops. Most Ethiopians people are eating coarse grains including sorghum, *teff*, and maize as part of their regular diet. Each household owns an average of less than one hectare of land. While 29% of cereal growers cultivated less than 0.5 hectares of land per household in 2006–2007, the majority of households cultivated their plots using family labour (Tigre and Heshmati, 2023).

A wide range of risks confront agricultural production were due to the high degree of system variability in weather, soil susceptibility, agricultural practices, price and yield fluctuations, and, not to mention, policy changes. Numerous dangers are highly particular to agriculture and have the potential to negatively impact agricultural output efficiency (Hübner *et al.*, 2017). The primary sources of low farm productivity, food and nutrition insecurity, and ongoing poverty in developing nations is farmers' frequent exposure to climatic threats (Duong *et al.* 2019 and Hansen *et al.* 2019). According to current figures, developing nations are disproportionately more negatively impacted by climate change than wealthy nations in terms of agricultural growth. The climate change has slowed global agricultural production growth by 21% since 1961, but more quickly in developing nations situated in warmer climates (Ortiz-Bobea *et al.*, 2021).

The rain-fed agriculture is a primary basis of food production, jobs, and income for the enormous vast majority of Ethiopia's rural poor, as it is in other sub-Saharan African nations. Ethiopia's rain-fed agriculture frequently has an unpredictable

character. Agricultural Food production is therefore extremely susceptible to the effects of unfavorable weather patterns, including drought. Food shortages and family food insecurity have been primarily affected by Ethiopia's strong reliance on rain-fed agriculture and the country's ongoing drought (Gebrehiwot and Anne, 2015). A number of natural factors, such as the introduction of new crops or technologies, the changing economic environment, and uncertainties surrounding public institutions and the implementation of their policies, can all put farmers at risk for a variety of production, institutional, price, human, and financial issues. The majority of smallholder farmers in sub-Saharan Africa are impacted by this risk scenario (Ajuruchukwu and Maggie, 2012).

Global warming and food security are two other hazards associated with agricultural production that have an impact on both the environment and human life (Hübner *et al.*, 2017). The widely of empirical research on small holder farmers' perceptions of risk and management strategies had either concentrated on aquaculture or livestock producers. Rainfall-dependent smallholder crop growers in poor nations have not received much attention in research (Richard Asravor, 2018). It has been demonstrated that a number of issues, such as a lack of money, institutional support, and transparent information, hinder the ability of farmers to implement management plans and effectively manage risks (Duong *et al.*, 2019).

Ethiopian farmers have experience recognizing the sources of risk and can use experiential learning to create risk management plans. However, given the severity and frequency of risk persistence, such techniques are less successful and cannot prevent or minimize risk over the long run. Farmers' risk management techniques are less successful in Ethiopia due to the lack of strong institutions including the financial, market information, and extension consulting services (Wondim *et al.* 2020). Relevant information regarding their production and marketing activities is not provided to smallholder farmers. This dearth of trustworthy information prevents farmers from making wise choices that could lower the hazards associated with their farming operations (Kahan 2008; Girma *et al.*, 2023).

The studies in the risk perception and its management strategies in developing nations' agriculture has concentrated on particular agricultural production sectors, like chicken production (Adeyonu *et al.*, 2021) and dairy farming (Hayran & Gül, 2015). But foreign academics in developing nations have given some thought to how farmers view risk factors and mitigation strategies (Ahmad *et al.*, 2019). Due to the lack of empirical research in Ethiopia, little is known about how wheat farmers perceive risk and how they manage it. The objective review was determine Ethiopian smallholder farmers perceive risk and what factors affect their beliefs. Therefore, this review built on previous research by evaluating the risk perceptions of farmers in an evolving economy, the origin of risk and management measures, and their relationship to specific farmer attributes. The purpose of this review was to randomly quantify causes of agricultural risks that smallholder farmers perceive to exist and to identify barriers to agricultural risk management and identify the coping and adaptive strategies used by farming communities.

## Materials and Methods

Approaches to review article assessment were widely based on a rigorous literature review of a published paper that was accessed through online internet based from Google scholars: journal articles, review papers, reports and books. The topics of interest was focused on literature local and international accessed on the source of smallholder farmers agriculture risk and their management strategies and constraints faces to adopt risk managements strategies. The scope of this reviews a focused-on Ethiopia and developing countries smallholder farmers.

### 2.1. Literature review and conceptual framework

#### 2.1.1. Risk and adaptation concept

Risk has no universally accepted definition, yet being an inherent aspect of existence. Risk is defined in the current research as "uncertainty about and severity of the consequences of an occurrence with respect to something that human's value". The term "risk" will be used to describe the uncertainty that faces us in the future, while "shocks" will be used to describe the incidence and the effects of uncertain earlier occurrences [19]. According to the UNFCCC and IPCC (2007), adaptation is the method by which societies enhance their ability to manage an uncertain future through policies that mitigate the negative impacts of climate change or leverage its benefits. In contrast, coping refers to the capacity to handle adverse situations or crises. The IPCC also noted that focusing solely on mitigation will not address the unavoidable effects of current climate change. Thus, adaptation—changes that reduce harm or capitalize on opportunities—is crucial in response to actual or anticipated climate-related challenges [7].

#### 2.1. Risk and risk perception within agriculture

Many people consider agriculture to be a dangerous profession. It is challenging to forecast the outcomes of farmers' operations and production decisions due to the physical and economic complexity of agricultural systems. There are differences in opinion regarding what constitutes risk. The authors define risk as unpredictable events that have an impact on the decision maker's well-being (Hübner *et al.*, 2017). Several authors explain a risk as imperfect knowledge where the probabilities of the possible outcomes are known, while uncertainty is the insecurity surrounding outcomes that involve

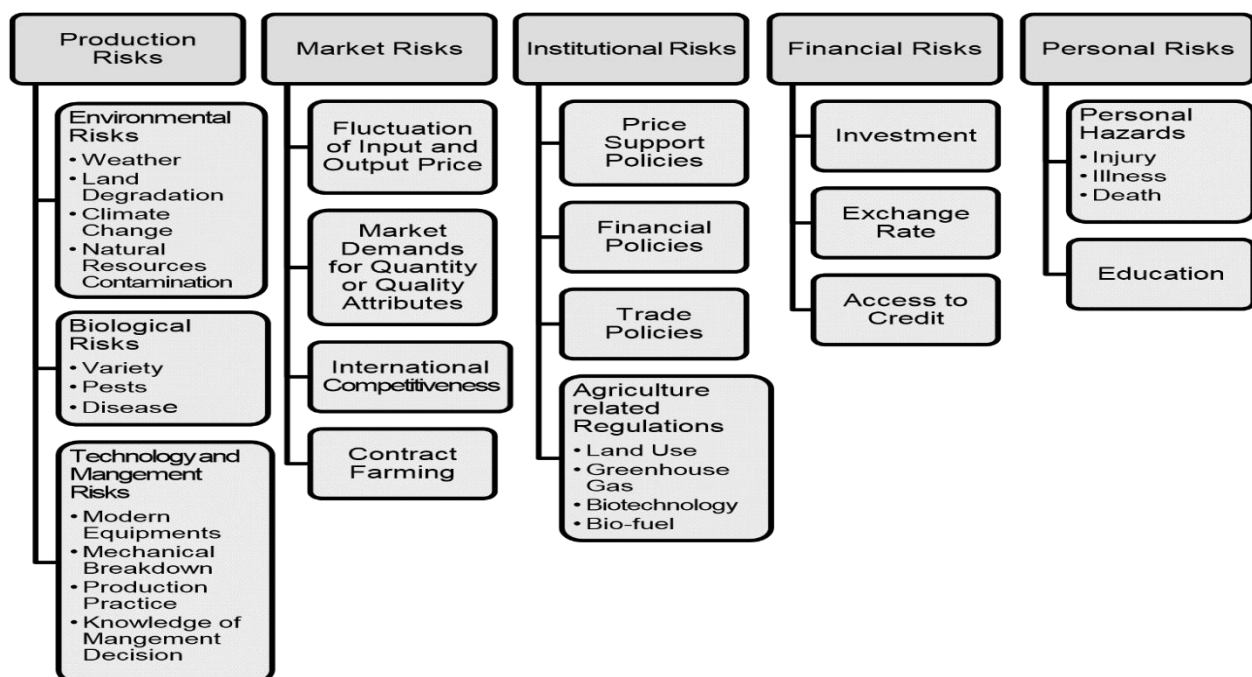
some loss or adversity that negatively impacts an individual's well-being when the probabilities are still unclear (OECD, 2009).

## 2.2 The main sources of risk in agricultural production

There are five common categories of risk in agriculture elaborated as follows:

1. Production risks are occurred a result of the unpredictable natural growth processes of crops and livestock. Typically, these risks are caused by pests and diseases, as well as weather and climate aspects like temperature and precipitation. Production hazards also include other factors that limit or reduce yield, such as excessive levels of heavy metals in soils or salinity in the soil.
2. Market risks is uncertainty surrounding prices, costs, and market access is the main emphasis of market hazards. Weather shocks and their impact on yields, energy price shocks, and inadequate access to information are some of the factors that cause volatility in the prices of agricultural commodities. Due to their ability to alter market access at various spatial scales, international trade, liberalization, and protectionism are additional drivers of market risk. Multiple risks, like weather fluctuations, price spikes, or limited market access, influence farmers' decision-making (Harvey *et al.*, 2014 and Lazzaroni and Wagner, 2016).
3. Institutional risks are associated with unforeseen modifications to agricultural policies and regulations that are produced by formal or informal institutions (Harwood *et al.*, 1999). Farmers have little control over the erratic changes in laws and rules that the government, a formal organization, may impose. Informal institutions can also be sources of institutional risk, such as shifting social norms that disturb agriculture or erratic changes in the behavior of rural producer organizations or informal trade partners. Institutions are supporting and connecting farmers more and more, particularly as agricultural production becomes more market-oriented.
4. Personal risks are unique to each person and are associated with health issues or interpersonal interfaces that have an impact on the farm or farm household. Personal risk factors include injuries from farm machinery, family members passing away ill from diseases, and the negative health impacts of pesticide use (Masuku and Sithole, 2009; Arana *et al.*, 2010; Tukana and Gummow, 2017). For farmers, health risks are a significant cause of income volatility and worry (Dercon *et al.*, 2005). Farmers frequently deal with the interdependence of institutional and personal risks; for instance, institutional risks brought about by customary laws may result in the takeover of land or animals in the event of a husband's death or divorce (Meinzen-Dick *et al.*, 2014).
5. Financial risk is a term used to define the hazards related to the financing of the farm and is characterized as the added variability of the farm's operating cash flow brought on by the fixed financial commitments that come with using credit (de Mey *et al.*, 2016). Changes in interest rates, loan availability, or credit conditions are a few examples of financial risk sources. To identify specific causes of risk, each category is subdivided into smaller themes (OECD, 2009 and A.M. Komarek, *et al.* 2020).

**Figure\_1: An overview of risk within agriculture production**



Source: Rico Hübner and Jie Lu, 2017

### 3. Constraint Agricultural Risks Management

Farmers absence of knowledge about available adaptation options, financial and labour constraints, land and fertilizer shortages, insecure land tenure, imperfect market accessibility, and limited irrigation potential are the most commonly cited obstacles to implementing adaptation strategies in other parts of Ethiopia (Deressa et al. 2009, Amdu 2010, Gebrehiwot and van der Veen 2013, Tessema et al. 2013).

Research on risk management obstacles in agriculture predominantly highlights case studies from small-scale farms in developing countries and large operations in developed nations (Ilbery et al., 2013). The absence of institutional assistance from the government is a major barrier to addressing agricultural hazards in both situations. For instance, Baruwa, Masuku, and Alimi, plantain growers in Nigeria, observed a lack of government support and marketing education (Baruwa et al., 2015). Similarly, when Indian farmers tried to switch to organic farming, they faced institutional obstacles and a lack of government assistance in implementing new methods for managing pests and diseases and breaking into new markets. Developed countries clearly need to improve their institutional support (Duong et al., 2019).

Smallholder and impoverished farmers are especially susceptible to agricultural hazards. They also struggle to embrace new crop varieties and technologies because of their production technology limits, lack of funding, and insufficient technical expertise. Technical and financial assistance from trustworthy sources is frequently insufficient. Smallholder farmers in Pakistan, Madagascar, and Ethiopia, for example, have complained about not being able to obtain official financial services (Legesse and Drake, L., 2005).

#### 3.1 Risk management process

Any action that assists in identifying and controlling hazards that endanger a farm or business is considered risk management (Wolke, 2007). Finding, measuring, managing, and controlling possible loss causes is its main objective. This helps a farm or business continue to exist and succeed. General and special risk management are distinguished in the literature (Mikus 2001). While exceptional risk management concentrates only on dangers that an insurance company can insure, such as fire or hail risks, general risk management handles all kinds of risks.

The risk management method consists of four primary phases, as illustrated in Figure 2. Risk identification: Which hazards affect a specific farm? For instance, livestock farmers face different risks than arable farmers, and wheat producers encounter distinct challenges compared to sugar beet growers, with further differences between conventional and organic farms.

**Risk assessment:** How much attention should be given to the identified dangers? Two evaluation criteria are relevant from a risk management perspective:

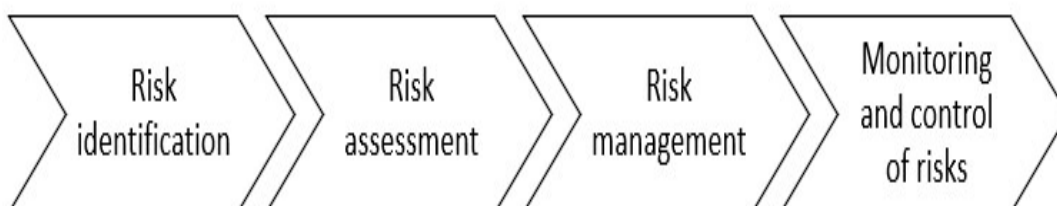
(a) **Incident rate:** How likely is a specific danger to occur? In some cases, we have data that can help us calculate risk occurrence rates, such as with weather hazards that have long-term records. In other situations, farmers need to rely on their own judgment to estimate these rates, taking into account past experiences with similar risks.

(b) **Potential loss:** What is the possible financial loss if a risk, such as an animal disease or a hailstorm, happens?

**Risk management:** Farmers must choose how to address pertinent concerns when they have been recognized and evaluated. Generally speaking, farmers can manage a risk in four ways: (a) Avoiding risks, such as those that could have disastrous outcomes. For instance, Horse farms frequently shift from risky breeding to more stable horse boarding They also transfer risks to insurance companies or futures market investors, reduce risk through long-term agreements or diversification, and accept some risks when incidents and potential losses are low (Näther and Theuvsen 2012).

Risk control encompasses the internal structure of the risk management process (responsibilities, deadlines, etc.); providing decision-makers with pertinent information on a regular basis regarding issues like new risks or evolving incident rates and loss potentials; and critically assessing the efficacy of the implemented risk management strategy, i.e., its capacity to lower risks to a manageable level. The entire risk management procedure must be redone if a farm's risk management plan needs to critically reviewed.

**Figure 2. Risk management process**





#### 4. Farmers Perceptions and Management of Agricultural Risk

A variety of risk variables, such as natural disasters, water scarcity, loan availability, debt payback, shaky land ownership, and animal illnesses and mortality, felt equally present for commercial and subsistence farmers. Compared to subsistence farmers, commercial farmers viewed poor crop prices, crop diseases and pests, and the inability to employ labour as the main sources of risk. The likelihood of a family member becoming ill was reported to have a higher impact on agricultural performance for subsistence farmers. Commercialized farmers viewed risk as more significant than subsistence farmers for the whole of risk sources (Suthathip *et al.*, 2017).

Farmers employ various strategies to manage risk factors, with remarkable correlation between a percentage of those utilizing these methods and their level of commercialization. To mitigate risk, many subsistence farmers choose debt avoidance, storage facilities, and crop diversification. In contrast, these strategies are less favored by commercial farmers, who more frequently opt for pesticides, monitor market prices, engage in contract farming, diversify sales channels, save money, and select successful crops (Suthathip *et al.*, 2017).

#### 5. Different Risk Management Strategies

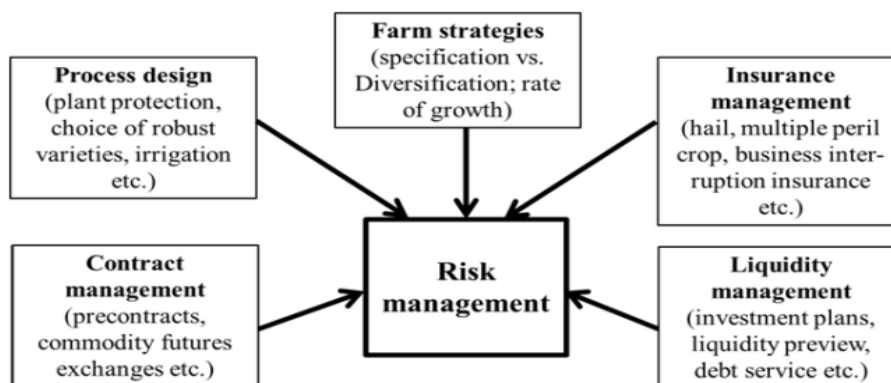
In developing nations, smallholders utilize both formal and informal risk management techniques. Informal strategies are typically defined by arrangements among individuals, households, communities, or villages, whereas formal strategies involve market-based activities and publicly provided methods. To reflect the diverse mechanisms in developing countries, the OECD framework has been expanded to include these informal tactics. A common *ex ante* activity is social reciprocity, noted in the community/informal category, along with other practices such as sharecropping, risk management, and common property resource administration. These practices have also been integrated into the framework of informal household-level procedures (OECD, 2009).

Six distinct risk strategies were identified through exploratory and confirmatory factor analysis: diversify, externalize, optimize, cope, off-farm, and buffer.

The "Diversify" factor includes two items that assess the tendency to diversify income and production sources, reflecting a willingness to adopt diversification as a way to reduce risk. Three items focus on the use of price contracts, futures, and insurance for managing risk. The "Externalize" factor pertains to the use of external risk management measures. "Optimize" refers to techniques that enhance the production process, consisting of two items that assess the farm's inclination to modernize and increase its scale. Coping is a technique that involves accepting risk and managing its consequences. It comprises two key factors: the willingness to work harder and to reduce personal spending during financially challenging times. The first factor, "off-farm," refers to the ability to earn income outside of farming or having a household member who does so. The second factor, "buffer," indicates the practice of maintaining a financial cushion for unexpected expenses (F. van Winsen *et al.*, 2016).

The examination in Ethiopia by Porter (2012) found that households' alternate sources of earned money could be used as coping mechanisms. She discovered that following a shock, off-farm income served as a safety net or insurance. Non-farm income (from wage labour or self-employment) increased while agricultural shocks had a negative and considerable impact on revenue from agricultural activities. A shock's detrimental effects on farm revenue were offset by increases in non-farm income. It is crucial to remember that land—more specifically, statutory land entitlements—may serve as a safety net for farmers seeking non-farm sources of income. Both individual and community entitlements may serve as a safety net, enabling farmers to meet their needs in the event that non-farm employment was terminated or unavailable. In the case of Vietnam, where there is some evidence of this involvement, this is especially true.

**Figure 2 Agricultural risk management strategies**



Source: adopted from Theuvsen, L., 2013.

The risks that agricultural producers encounter and the degree to which they permeate the agricultural system are broadly described by the [40] classification in Table 1. The degree of system city of a risk has a major impact on its management (Tangermann, 2011). Furthermore, Holzmann and Jorgensen (2001) divide risk management techniques into three groups: coping, mitigation, and reduction. *Risk reduction* is the process of lessening the possibility that an unforeseen circumstance may occur that might have a detrimental impact on wellbeing. The goal of *risk mitigation* is to lessen the potential harm that an incident

could do to people's quality of life after it happens. *Risk coping* entails handling an incident after it has happened, which typically entails reducing down on consumption (therefore having a detrimental impact on welfare) (OECD,2009).

**Table 1: Risk management approaches across institutions**

Strategies	Farm/household/ community	Government	market
<b>Risk Reduction</b>	Technological Choice	Macroeconomic policies	Technological choice
		Disaster prevention (flood control...)	
		Prevention of animal diseases	
<b>Risk Mitigation</b>	Diversification in production Crop sharing	Tax system income smoothing	Futures and options Insurance
		Counter-cyclical programs	Vertical Integration
		Border and other measures in the case of contagious disease outbreak	Production/marketing
			Contracts Spread sales
			Diversified financial investment
<b>Risk Coping</b>	Borrowing from neighbors/family Intra-community charity	Disaster relief social assistance	Selling financial assets
			Saving/borrowing from banks
		All agricultural support programs	Off-farm income

Source: OECD, 2009

### 5.1 Smallholder farmers Agricultural risk management in developing countries

Risk management is the systematic application of management methods, policies, and procedures to the activities of risk identification, analysis, assessment, treatment, and monitoring. Cervantes-Godoyet *al.* (2013) categorized RMS into ex-ante and ex-post approaches. While ex-post RMS are used by farmers to help them deal with losses after the risk has occurred and are primarily for short-term survival, ex-ante RMS are used by farmers before the risk occurs, lowering the potential loss and having a long-term nature (Waweru et al., 2019). Some common ex-ante adaptation options include using short-duration crops, raising adaptable livestock, storing crop wastes as animal feed, mixed cropping, and adopting soil and water conservation techniques. The sale of assets and reliance on consumer loans and informal network support are examples of ex-post coping mechanisms used to mitigate the effects of drought. Furthermore, members of the household move temporarily in pursuit of job opportunities (Conrad et al., 2011).

The choice of risk management strategies and resources is greatly affected by various risks related to production, finance, market conditions, and the farmer's own views on risk. Risks can lead to problems such as poor crop yields, fluctuating prices, and production challenges. As a result, farm income may decline or face difficulties due to any combination of these risks. Farmers can adopt various strategies to reduce the risks their farms encounter. These strategies can be categorized into two types: modern and traditional risk management tools. Modern tools include futures contracts, forward contracts, and crop insurance. For smallholder farmers in remote areas, who may not have access to modern risk management options, traditional methods can be particularly beneficial (Maggie and Ajuruchukwu, 2012).

The most important traditional risk management strategies used by farmers include crop diversity, careful saving, and participation in social networks. One common strategy is diversification, which involves engaging in various activities. The rationale behind diversification is that the returns from different ventures do not always move in the same direction. This means that when one activity is not performing well, others might be doing better, helping to balance overall returns. To measure how much a farmer utilizes on-farm diversification as a risk management strategy, the Enterprise Diversification Index (EDI), also known as the Herfindahl Index (DH), is used. Enterprise diversification is a self-insuring strategy used by farmers to protect against risk (Maggie and Ajuruchukwu, 2012).

Smallholder farmers employed various coping mechanisms to generate income, often selling small animals (goats, sheep, and fowl), household items (televisions, radios, and furniture), farm equipment (ploughs and sickles), and forestry products (wood, lumber, and charcoal). Despite these efforts, most households had to reduce their food intake during the drought (Conrad et al., 2011). Farmers utilized different strategies to manage risk and uncertainty. According to F. van Winsen et al. (2016), some well-known tactics include avoiding financial difficulties (such as avoiding excessive reliance on credit or maintaining contingency funds for difficult times), earning an income off the farm, employing external risk management techniques (such as forward contracts or crop insurance), diversifying production or revenue streams, and reducing private spending.

There are seven primary ways that people in the South African and Ethiopian Nile Basin are adapting to climate change, selling livestock, borrowing money from family or the bank, receiving food assistance, participating in food-for-work programs, moving, seeking off-farm employment, and reducing consumption. According to Bryan et al. (2009). Furthermore, the primary coping strategies in Ethiopia's Nile Basin include selling agricultural products, livestock, and productive assets; reducing consumption; temporarily or permanently moving; mortgaging land; and utilizing loans and inter-household transfers (Deressa et al. 2010). Amdu (2010) also ranked the various coping mechanisms in the Ethiopian Nile Basin, specifically in the Choke Mountain range, as reduced socialization for saving, grain storage, consumption reduction, livestock sales, inter-household transfers and loans, forest product sales, wage labor, credit from moneylenders or traders, migration in pursuit of work, and selling household assets. In other parts of Africa, these coping mechanisms have also been documented (Bangura et al. 2013, Berman et al. 2013, and Rakotobe et al. 2016).

In Ethiopia, agricultural diversification, soil conservation, tree planting, crop planting dates, and irrigation are the adaptation measures that are most frequently recorded. According to a 2009 study by Deressa et al., there are five distinct adaptation tactics in the Ethiopian Nile Basin: planting trees, varying crop varieties, conserving soil, planting early and late, and irrigation. Bewket (2012) found that the central highlands of Ethiopia have a variety of adaptation techniques that centre on changes in the management of natural resources and the production of crops and animals. In Ethiopia's eastern region, the East Hararghe Zone, common adaptation techniques included water harvesting, irrigation, terracing, early planting, and tree planting (Tessema et al. 2013). In northern Ethiopia's Tigray, adaptation measures included agricultural diversification, soil conservation, tree planting, adjusting planting dates, and irrigation (Gebrehiwot and van der Veen 2013). However, these studies lack a detailed analysis of the tactics used. Most of the research has focused on regional or national levels, which makes it difficult to understand the local context. Unlike previous studies, we used data from the smallest administrative level in the country to assess how farmers are implementing adaptation techniques and whether these techniques vary across different agro-ecological zones (AEZs). Additionally, Arragaw and Woldeamlak (2017) differentiated between coping and adaptation, defining coping as short-term responses to immediate shocks and adaptation as long-term strategies to address ongoing stressors.

Research on agricultural risk management in developing countries is gaining importance due to the challenges it addresses. Ahsan (2011) found that effective risk management strategies for shrimp farming in Bangladesh include disease prevention, farm management training, eliminating middlemen from the supply chain, and timely delivery of shrimp seeds. In Uasin Gishu, Kenya, agricultural households considered off-farm investments as effective risk management techniques (Korir, 2011). In Brazil, reducing crop diseases and building credit reserves were identified as key risk management strategies (Borges and Machado, 2012), while in Thailand, financial and production strategies were viewed as the most crucial responses to risk (Aditto et al., 2014). The three most significant traditional risk management techniques in South Africa were determined to be social network participation, crop diversification, and precautionary savings (Waithira et al, 2017).

## 6. 1 Recommendations

This review recommends following important policy option for smallholders' farmers risk management

- Designing Appropriate policies are required to improve farmers' ability to deal with and adapt to drought.
- Enhancing farmers' access to climate-related data, particularly drought projections, may facilitate the prompt implementation of efficient adoption strategies.
- As water conservation measures seem to be a major policy choice, smallholder farmers should receive the proper training in the production and preservation of animal feed.

- Formal financial institutions should be established to help farmers adjust to future hazardous weather circumstances and to help smooth consumption during dry spells.
- Creating a crop insurance plan to reimburse farmers in the event of crop failure.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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