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ORIGINAL ARTICLE

Why "formal" climate adaptation strategies fail in sub-Saharan Africa: Ignoring adapters' agency in the case of smallholding agriculture farming practices in Bono East Region of Ghana

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Abstract

This paper reviewed a body of literature on climate adaptation options in sub-Saharan Africa's (SSA) smallholding agriculture and complemented it with a case study involving experts interviews, focus group discussions, large-scale household surveys, and farmer practices observation while drawing insight from the concept of "everyday adaptation and interrupted agency" and agency theory to assess farmer perceived limitations with climate-smart agriculture (CSA) and climate-wise food systems (CWFS) practices for climate adaptation in the SSA. The study noted that the narrow focus on CSA and/or CWFS as a silver bullet for climate change adaptation suitable for smallholding agriculture ignores food producers' agency to undermine sustainable and inclusive adaptation solutions. Moreover, smallholder farmers' everyday climate adaptation practices could be grouped into three categories; on-farm adaptation, off-farm adaptation, and Indigenous agroecological adaptation options. The on-farm adaptation options are usually agriculture intensification and extensification. The off-farm adaptation options include livelihood diversification activities, petty trading, seasonal labor jobs, and migration. The Indigenous agroecological adaptation strategy uses observing nature and weather elements to predict the onset of

the rainy season. The study noted that smallholders' adaptation options, which is an expression of their agency, are motivated by smallholders' desire to be resilient to changing climate, increase productivity and income, and social network influence but not necessarily because the strategy is being promoted by the government or Non-Governmental Organizations (NGOs). Therefore, we propose a sustainable food agency (SFA)—a multifaceted blended constellation of climate adaptation and mitigation strategies, as the best approach to addressing the climate crises in the SSA. The SFA allows individuals or groups to decide what climate change adaptation options best work for them to adapt to changing climate and produce and distribute their food without undermining the economic, social, and environmental bases that generate food security and nutrition for present and future generations.

KEYWORDS
agency, climate adaptation, climate-smart agriculture, climate-wise food systems, smallholder farmers, sub-Saharan Africa, sustainable food agency

1 | INTRODUCTION

The Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (2022) re-echoed the need for rethinking transformative adaptation strategies and innovation expansion to usher in a more progressive, radical, and instrumental outcome that will minimize foundational causes of vulnerability to climate change among sub-Saharan Africa's (SSA) smallholder farmers (Trisos et al., 2022; see also Fedele et al., 2019; Few et al., 2017), notably climate adaptation strategies and tools that best serve the interest of smallholder farmers while also reducing smallholding agriculture's footprint on the environment (Antwi-Agyei et al., 2018; Asare-Nuamah et al., 2021). To achieve this task, policy-decision makers, donors, and the scientific and academic community continue to propose two main opposing viewpoints, that is, climate-smart agriculture (CSA), which is touted to have triple-win benefits of (i) food security and livelihood improvement, (ii) increased farmers' adaptation, and (iii) mitigation against greenhouse gases (GHGs) emissions (FAO, 2013; Lipper et al., 2014, 2018; Wassmann et al., 2019), and climate-wise food systems (CWFS), which embodied Indigenous agroecological knowledge (Altieri & Nicholls, 2012; Holt Giménez & Shattuck, 2011; Taylor, 2018a, 2018b), as the sine qua non for smallholders to tackle rapidly changing climatic conditions, address food insecurity, rural poverty, and reduce agriculture footprint on the environment.[1]

Through the efforts of the United Nations (UN) Climate Change Conference of the Parties (COP26), momentum to galvanize a multi-scaler and multi-institutional effort to usher in "formal" climate adaptation practices through financing and research across the globe is on the rise (UNFCCC, 2021). Though the flow of climate adaptation financing is insufficient, they have increased significantly over the past few years (Oxfam, 2020; Savvidou et al., 2021). Similarly, policy and research attention to adaptation has grown considerably (Savvidou et al., 2021). However, these sets of multi-scaler- and multi-institutional-driven formal climate adaptation strategies contribute substantially to adaptors' vulnerability to ecological stress (Eriksen et al., 2021). They also lead to maladaptation through agency disruption among local actors, increasing their vulnerability to multiple livelihood stressors (Funder et al., 2018, Mersha & van Laerhoven, 2018; Rahman & Hickey, 2019). This situation has prompted climate adaptation researchers to call for recognition of local actors' agency in "adaptation-related policy, practice, and decision-making, underlining the importance of attention to participation, representation, and influence" (Lindegaard & Sen, 2022, p. 1).

Agency refers to the capacity of individuals or groups to exercise control and make life decisions. Amartya Sen defined agency as an assessment of what a person can do in line with their conception of the good (Sen, A. 1985). People who enjoy high levels of agency are engaged in actions compatible with their values (Alkire, 2008) or interests (Narayan & Petesch, 2007). Climate adaptation practices, just like any other food system practices, are essentially social, cultural, and biological (Beck et al., 2013; Vivero-Pol, 2017). The instrumentality of the agency of local actors in agriculture and food production systems is echoed by development and food systems sustainability experts (UN-FAO HLPE, 2020a, 2020b; Toledo-Hernández et al., 2021). The Food and Agriculture Organization

(FAO) High-Level Panel of Experts on Global Food and Nutrition Security, in their 2020 report, made a call for recognition of the *agency* as an additional pillar of *food security*[2] (Clapp et al., 2021; UN-FAO HLPE, 2020a, 2020b; Neufeld et al., 2021). The report suggested that agency of all food systems actors is essential to address widening inequities within food systems, including imbalances of power among actors within those systems, and promote sustainable and equitable food systems (UN-FAO HLPE, 2020a, 2020b; Toledo-Hernández et al., 2021). Similarly, recognizing the agency of local actors in climate adaptation practices avoids maladaptation while also allowing local actors to express their intentionality, political will, and self-determination in their choices of everyday climate adaptation practices (Lindegaard & Sen, 2022; Rahman & Hickey, 2019).

Therefore, this research paper draws insight from the concept of "everyday adaptation and interrupted agency" and agency theory using a mixture of participatory learning methods, including key informant interviews, focus group discussions (FGDs), and a large-scale survey involving 1219 farmer households, which allow local people the opportunity to participate by sharing their experiences and knowledge on climate adaptation to assess perceived challenges with CSA and CWFS practices for climate adaptation in SSA. Specifically, the researchers used the case study approach to answer the following questions; *(1) what are the everyday climate adaptation practices of smallholder farmers?; (2) what are the smallholder farmers' motivations for adopting these strategies; and (3) what are the farmers' perceived challenges of CSA and CWFS practices for climate adaptation?*

Theoretically, we add to the already existing literature on agency and food production (e.g., Alkire, 2008; Moragues-Faus, 2017; Narayan & Petesch, 2007; Patel, 2009; Vivero-Pol, 2017) by expounding on agency: theory and practices to capture the nuances of the ability of individuals and organizations to exert some influence over their circumstances and provide meaningful input into governance processes, particularly regarding climate change adaptation in food systems. The engagement and application of these broad themes of agency theory and practices for this research also consolidate efforts to understand the politics of climate adaptation (Dolšak & Prakash, 2018; Eriksen et al., 2015; Nightingale, 2017) within the context of Africa's smallholding agriculture. Contextually, we add to the existing literature by consolidating the fact that smallholder farmers' adaptation options to climate change are three-fold: either on-farm adaptation options, which includes agriculture intensification and or extensification; off-farm adaptation options, which include livelihood diversification activities and migration; and third, Indigenous agroecological adaptation options such as observing nature and its element to predict the weather. The off-farm and Indigenous adaptation options complement the on-farm adaptation options of smallholder farmers to aid them in adapting to changing climate. Finally, we argue that instead of focusing on a narrow or single approach to adapting to climate change, a multifaceted blended constellation of climate adaptation and mitigation strategies borne out of an inclusive and participatory location-specific decision-making process to decide on specific policies, technologies, or management practices are essential to adapt to changing climate and address food security, livelihoods, and environmental needs of food producers. In what follows, we first provide a background to CSA and CWFS by exploring the debates surrounding these two widely proposed climate adaptation options for smallholding agriculture in Africa and the theoretical underpinning of this research.

2 | BACKGROUND CONTEXT

The term climate-smart agricultural development was initially used in 2009 by the UN-FAO to describe optimizing the tensions between global agricultural productivity, boosting agricultural system resilience in the face of climate change, and decreasing GHG emissions from agriculture (FAO, 2009a, 2009b). In 2010, to set a global development agenda through agriculture research and innovation investment, the CSA framing was presented and defined at the first Global Conference on Agriculture, Food Security and Climate Change at The Hague as "*agriculture that sustainably increases productivity, enhances resilience, reduces/removes greenhouse gas emissions, and enhances achievement of national food security and development goals*" (Neufeldt et al., 2013, p. 3). This move brought agriculture, development, and climate change societies under a single umbrella. Since then, the CSA concept has drawn on this initial thinking to include diverse agriculture and food production practices spanning the field production practices to distribution and supply chains across the entire food system (Whitfield et al., 2018). Again, some researchers argue that CSA, "as described and advocated by the FAO and the Consultative Group for International Agricultural Research (CGIAR), represents an agenda that is not limited to agricultural technologies but includes climate services, cooperative governance structures, data processing, and information/education" (Whitfield et al., 2018. p. 3). Broad constellations of institutions, policies, finance, safety nets, capacity-building, and assessment have been highlighted to facilitate CSA beyond agricultural methods and food production outcomes. The second Global Conference on Agriculture, Food Security and Climate Change in 2012 cemented the CSA ideology by further arguing that this

practice is a sine qua non to unleash the full potential of smallholding agriculture to achieve the duo food security and rural household economic wellbeing in developing nations.

In the SSA and other developing nations, the proponent of CSA argues that the CSA framework is the best approach to transform food systems, produce more food to meet growing consumer demands, address environmental degradation, enhance economic growth, and reduce poverty among rural households amidst rapidly growing population projected to reach nine billion by 2050 (FAO, 2013). For instance, "rapid transformation of food systems in Africa can be possible, …climate-smart agriculture can play a key role in driving the change through innovative actions that mainstream the three pillars (productivity/adaptation/mitigation) in an effective way" (Zougmoré et al., 2021. pp. 14–15). The literature noted that CSA approaches embody a wide range of technologies and practices, from conservation agriculture to high-tech, high-input agricultural practices that are location and context-specific (FAO, 2013; Grainger-Jones, 2012; Mwongera et al., 2017). Subsequently, the CSA literature suggests that its triple-win benefits align with the four dimensions of sustainable food systems outcomes (Aggarwal et al., 2019; FAO, 2013; Totin et al., 2018; Wassmann et al., 2019; Zougmoré et al., 2021). The CSA does so via effective climate adaptation and GHGs mitigation to enhance food security, rural household economic wellbeing, social equity, and environmental stewardship while at the same time recognizing the synergies and trade-offs that emerge over time due to the dynamic nature, multifaceted, and interconnectedness of the food systems dimensions (Aggarwal et al., 2019; FAO, 2013; Jagustović et al., 2021; Totin et al., 2018; Wassmann et al., 2019). Some studies suggest crop yields for areas using CSA are found to increase than as projected by climate impact simulations for the same period (Aggarwal et al., 2019), giving resource-poor farmers the liberty to use agricultural resources efficiently, enjoy high crop yields, be financially sound, have easy access to credit, and adapt well with rapidly changing climatic condition (Imran et al., 2019; Mutenje et al., 2019).

Despite these assertions on the role of CSA in smallholding agriculture, some critics argue it is just a "corporate greenwashing" and undermines the effort to achieve sustainable food systems. For instance, it is claimed to promote technology plus market, which only consolidates the powers of incumbent actors of the global food regime (Clapp et al., 2018; Newell et al., 2018; Taylor, 2018a, 2018b). Critics further argue that CSA does not provide clear principles for dealing with the trade-offs arising from achieving the three pillars of CSA, that is, food security and increasing income, adaptation, and mitigation (Neufeldt et al., 2013; Taylor, 2018a). Many technologies and practices, such as Genetically Modified Organisms (GMOs), biochar, and no-tillage, which embraces high-input agriculture, are rebranded as CSA to open new commodity market frontiers and make smallholder farmers input-dependent (Clapp et al., 2018; Pimbert, 2015). Additionally, CSA leads to data grabbing and control over new technologies and precision modes of food production (Newell et al., 2018), thereby sidelining the question of inequality. Issues of land reforms, changes to subsidy regimes for wealthier farmers, anti-dumping provisions, and so forth, which are issues of concern to farmers in the Global South, are often ignored. This situation, they claim, is the "business-as-usual" approach to food production in which the same agricultural practices that are destroying our environment are repackaged, rebranded, and re-introduced to us (Neufeldt et al., 2013; Taylor, 2018a, 2018b).

In addition, some critics argue that there are farmers whose agricultural-based livelihoods are so precarious that even "climate-proofing" their agricultural systems will not contribute to poverty reduction, let alone significant improvements in food security in rain-fed agriculture, which is particularly vulnerable to climate change (Hellin & Fisher, 2019). Therefore, farmers who are likely to benefit from CSA are those who can expand farm size and/or have access to markets in order can capitalize on these new agricultural technologies and practices (Harris & Orr, 2014). Likewise, the current framing and thinking in CSA, as it is now designed and executed, ignores the complexities of many actors, incentives, and interactions between various (but linked) provisioning demands for food, water, energy, materials, and ecosystem services (Neufeldt et al., 2013). The CSA idea does not consider complexities such as agriculture's potential influence on other ecosystem services, biodiversity protection, and larger social, political, and cultural dynamics (Clapp et al., 2018; Pimbert, 2015; Taylor, 2018a). Hence, the need for alternative agriculture and food production systems—CWFS for the total transformation of our current food systems (Taylor, 2018a, 2018b).

While the call for alternative agriculture beyond CSA has been made across many pieces of literature, the terminology CWFS was created by Marcus Taylor (2018a), who argued that CWFS would transform our food system by focusing on critical issues such as access to and distribution of food, a shift in consumption patterns as input-intensive, and mass production of soy and corn for sustaining factory meat production (Taylor, 2018a, 2018b). The climate-wise food system claims to embrace food production approaches such as agroecology[3] (see Altieri & Nicholls, 2012; Holt Giménez & Shattuck, 2011; Taylor, 2018b). Unlike CSA, agroecology reduces smallholders' dependence on the commodity market for inputs and enhances farmers' autonomy and control over food

production (Altieri & Nicholls, 2012; Clapp et al., 2018; Pimbert, 2015). The practice recognizes the four sustainability parameters: production output, economic output, social equity, and environmental stewardship (e.g., Nyong et al., 2007; Ricciardi et al., 2021). Also, agroecology is celebrated for achieving the triple benefits of food security, climate change adaptation, and GHGs mitigation (ibid). Ultimately, a CWSF that embraces agroecology is claimed to transform our food system by promoting food sovereignty, energy sovereignty, and technology sovereignty, which are essential for a robust local food system (Altieri & Nicholls, 2012; Taylor, 2018b).

Despite the literature's contentious nature on these two opposing viewpoints as suitable climate adaptation and mitigation practices for smallholding agriculture in the SSA. Evidence from the literature shows that each proponent of these pathways, that is, CSA or CWFS, argues this from their own philosophical standpoint, making the debate about appropriate solutions acrimonious and policy stalemate (e.g., Fraser et al., 2016). Moreover, these proposed climate adaptation options ignore the agency of smallholders (food producers) in their choice to take on their preferred climate adaptation and mitigation practices. They also ignore the agency of food consumers, which usually influences the type of climate adaptation options nations and smallholders, in particular, will adopt. This situation confirms that "formal adaptation interventions interrupt everyday adaptation strategies—and agency—of local actors, potentially leading to maladaptation" (Lindegaard & Sen, 2022, p. 1).

2.1 | Theoretical underpinning: Concept of everyday adaptation and interrupted agency and agency theory in climate adaptation practices of smallholder farmers

Lindegaard and Sen proposed the concepts of "everyday adaptation" and "interrupted agency" to investigate the connection between formal and everyday climate adaptation practices (Lindegaard & Sen, 2022). They drew inspiration from James Scott's (1985, 1989) research on everyday resistance to formal interventions and aggregate micro-practices in response to ongoing socio-ecological transformation. According to them, "everyday adaptation refers to the aggregate micro-practices articulated in response to ongoing social-ecological transformations including climate change … and the interrupted agency is where externally driven formal interventions interrupt existing adaptation strategies—and agency—of local actors, potentially leading to maladaptation" (Lindegaard & Sen, 2022, pp. 1). The interrupted agency concept focuses on how targeted formal adaptation interventions disrupt individuals' everyday adaptations. Most importantly, individual adapters' micro-actions that make up everyday adaptations are not permanently stopped but are rearranged (e.g., Lindegaad & Sen, 2022; Rahman & Hickey, 2019) to produce a maladaptive outcome in climate adaptation practices among local actors, thereby increasing their vulnerability to multiple livelihood stressors (Eriksen et al., 2021; Funder et al., 2019; Mersha & van Laerhoven, 2018). The concept of everyday adaptation and the interrupted agency is gaining momentum in emerging climate adaptation practices literature because everyday resistance and the aggregate micro-practices enunciated in response to ongoing socio-ecological transformations, including changing climate, are the political expressions of vulnerable groups (Scott, 1985, 1989), their intentionality, and agency (Lindegaard & Sen, 2022).

Clapp et al. (2021), in consonance with Sen A. (1985) and Alkire (2008), theorize agency as individual's or group's capacity to exercise a degree of control over their own circumstances and provide meaningful input into governance processes. Agency is also "widely seen today as an important aspect of addressing widening inequities within food systems, including imbalances of power among actors within those systems" (Clapp et al., 2021, p. 3). In a sustainable food system, *agency* is featured as a crucial component of advancing equitable livelihoods according to the Action Track 4 of the 2021 United Nations Food Systems Summit (UNFSS) (Clapp et al., 2021; Neufeld et al., 2021). Likewise, efforts to address food systems "inequality and power imbalances must build agency, change relations, and transform the structures that underpin this imbalance of power and result in inequalities" (Neufeld et al., 2021, p. 4). Furthermore, promoting agency at individual and community levels is vital to addressing the widening inequality gap in climate risk adaptation and mitigation among smallholder farmers (e.g., Lindegaard & Sen, 2022). Similarly, global food system transitions cannot be undertaken or entirely understood without addressing the agency issues of individual food system actors (Vivero-Pol, 2017).

Elsewhere in other social science sub-fields, the agency theory, in simplicity, recognizes that individuals and groups within a company have varying risk tolerance, and as a result, their actions differ (Mitnick, 1975; 2011; 2019; Panda & Leepsa, 2017; Ross, 1973). These individuals are made up of the principal, or the owner, who invests capital and takes economic risks, and the agents, who manage the firm and are risk-averse and concerned with maximizing their own private gains (Mitnick, 1975; Panda & Leepsa, 2017; Ross, 1973). A major part of the theory emphasizes reducing the problems that emerge from the separation of managers (agents) and owners (principals). Both the principal and agent have opposing risk preferences, resulting

in a conflict of interest in risk sharing. This theory's major question is whether these managers are performing for the owners or themselves since they may use the firm's assets for their own ends, resulting in tension between the principals and agents. In their respective works, Ross (1973) and Mitnick (1975; 2011; 2019) developed theories of agency and offered two different approaches. In Ross' view, the agency problem arises from incentives, whereas in Mitnick's opinion, it occurs because of the institutional structure, but their underlying ideas are similar.

Agency theory's narrow context focus on egocentric agents seeking only to maximize wealth at the expense of the principal highlights the gap in its application to broader socially diverse situations (Wiseman et al., 2012). To close the understanding gap between agency: theory and practices within a broader social context, Wiseman et al. (2012) argue for the need to capitalize on the flexibility of the agency theory to extend to more socially diverse settings and contexts where the critical elements such as self-interest, information asymmetry, and the mechanisms used to control agency costs are the major themes of the theory. In light of this assertion, we draw insight from these broad themes of agency theory and practices for our research. We recognize that smallholder farmers are both the principal and agent of their livelihoods. They take the risk to invest, manage those investments for their gains, or face the brunt of agency costs due to misalignment of self-interest as the principal and agent of their livelihood (e.g., Mitnick, 2019; Panda & Leepsa, 2017; Ross, 1973). Their choices of everyday climate adaptation practices express their agency and political resistance to formal-driven adaptation practices (e.g., Lindegaard & Sen, 2022). The adoption of this theoretical underpinning for this research is essential and unique because of the growing concerns of food sovereignty, and food movement advocates criticizing the negligence of the agency of food producers in climate change adaptation, leading to interrupted agency and undermining efforts to promote sustainable food systems (Clapp et al., 2021; Lindegaad & Sen, 2022; Neufeld et al., 2021; Vitolla et al., 2020). The engagement and application of agency: theory and practices, for this research, also consolidate efforts in understanding the politics of climate adaptation (Dolšak & Prakash, 2018; Eriksen et al., 2015; Nightingale, 2017) within the context of Africa's smallholding agriculture.

3 | RESEARCH SETTINGS, DESIGN, AND METHODS

3.1 | Study design

A two-way mixed methodology approach was used in this investigation. In phase one, the researchers conducted a literature review to learn more about the types of climate adaptation tactics used by smallholder farmers in SSA and debates around these adaptation practices. Using the following search terms: "Climate-smart agriculture + Africa and/or sub-Sahara Africa," "climate adaptation + Africa and/or sub-Sahara Africa," and "smallholding agriculture + climate adaptation + Africa and/or sub-Sahara Africa," the information was obtained from Google and Google Scholar in several processes (see Figure 1). The search process was focused on research and review articles published within the last decade. Out of the 115 documents retrieved online for analysis, only 23 papers met the inclusion criteria being (1) published in the last decade, (2) address CSA and CWFS, and (3) specifically or partly speak to SSA. These 23 articles were further retrieved to explore the controversies around the scientific and academic community's proposed CSA and CWFS as climate adaptation methods and practices for the SSA region and the drawbacks of the proposed adaptation practices and strategies within the SSA context.

In the second phase of this research, we conducted a case study in Ghana between May 2022 and August 2022. The process involved farmer FGDs, experts and key informant interviews, farmer-practices observation, and a large-scale farmer household survey involving 1219 households to understand the extent of the perceived limitations of CSA and CWFS as proposed climate adaptation strategies. Random sampling was employed using an open-ended questionnaire for the farmer FGD with participants drawn from farming communities due to the availability on the meeting day. Also, closed and open-ended questions were deployed in the household survey with randomly selected participants. The experts' interview ($n = 10$) was done using an open-ended questionnaire with participants drawn across the country from various ministries, departments, and institutions, including Ghana's Ministry of Food and Agriculture, Ghana Forest Commission, Ministry of Environment, Science, Technology and Innovation, Civil Society Organizations, Private Sector Organization, National Development Planning Commission, Environmental Protection Agency, NGOs, and the Academic and Research Institutions. These institutions were purposively selected given their roles in Ghana's climate change adaptation and local development issues. The expert interviews, conducted from June to July 2022, were done through the purposive sampling technique, with the criteria being the expert's level of understanding and lived experience on climate change adaptation issues in Ghana (Creswell & Plano Clark, 2017).

3.2 | Study area

Ghana was chosen as the target country because of the nation's rising temperatures and unpredictable

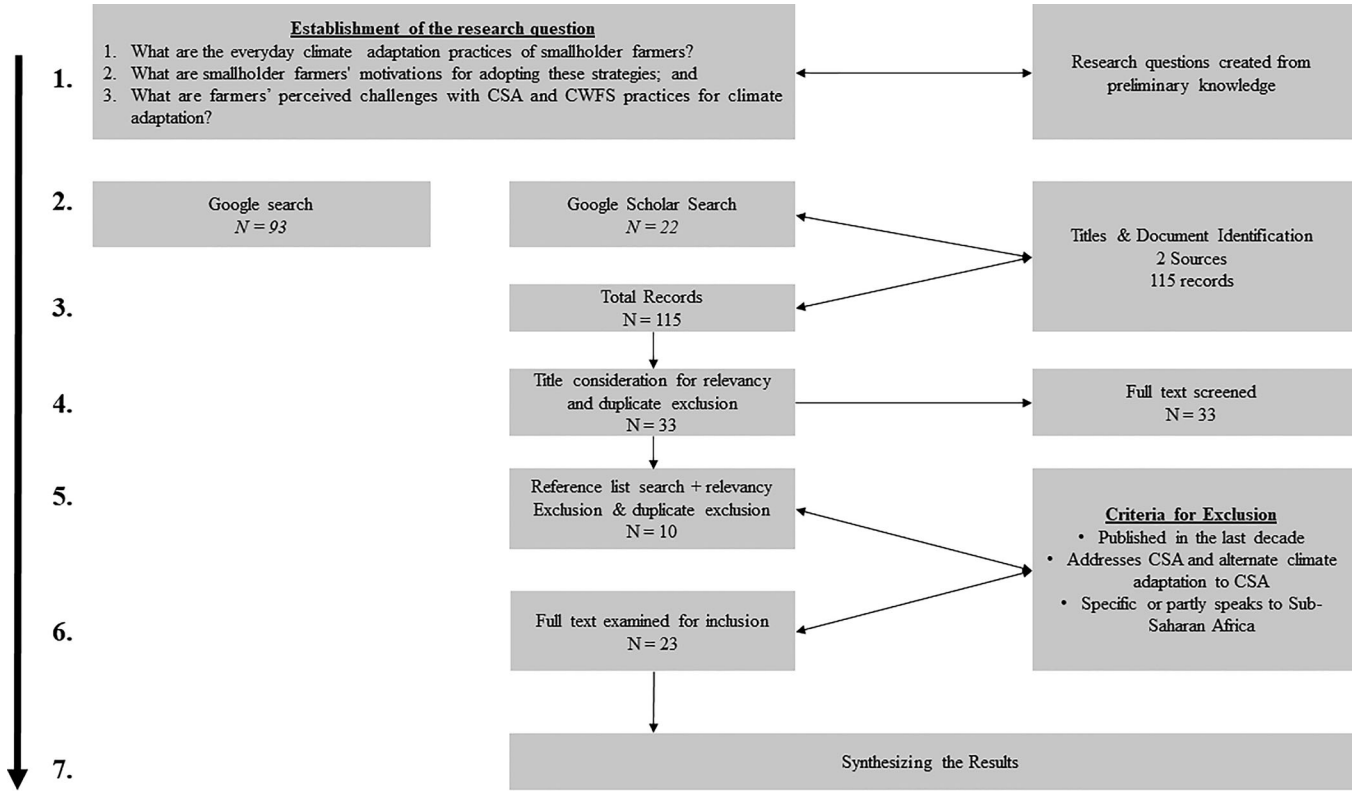

FIGURE 1 Literature review process. CSA, climate-smart agriculture; CWFS, climate-wise food systems.

rainfall variations (Asante & Amuakwa-Mensah, 2015; see Figure 2). Additionally, all agroecological zones in the nation are anticipated to suffer an increase in mean annual temperature of 0.8°C by 2020 and 5.4°C by 2080 (Minia & Agyemang-Bonsu 2008). More so, Ghana Government alludes that climate variations such as incremental droughts, floods, and torrential storms threaten crop production and growth, leading to livelihood crises for vulnerable groups such as smallholder farmers (Government of Ghana (GoG), 2013). As far back as 2007, Ghana's smallholder farmers make up about 95% of the active labor force of the nation (Chamberlin, 2007). Many of the nation's policy frameworks, including the UN Framework Convention on Climate Change, mention the country's susceptibility to changing climate and attest that climate change is a menace to agriculture productivity and socioeconomic development (Antwi-Agyei et al., 2021; Quarshie et al., 2023).

Some other reasons why Ghana was selected as the focus country are because, over the past 24 years, Ghana and other Western Saharan countries have accounted for more than 60% of SSA's agricultural output, despite obstacles such as soil degradation and climate change (Antwi-Agyei et al., 2017; Barbier et al., 2018; Mechiche-Alami et al., 2020). Also, Ghana as a nation has shown leadership in addressing climate-related threats in the West African region by being among the first to treat climate change as a national crisis and among the first to promote climate change policy at the national level[4] (Antwi-Agyei et al., 2017; Government of Ghana—NCCP, 2014; MoFA, 2021), and, finally, Ghana recognizes that effective climate adaptation by smallholders to increase agriculture productivity is a sine qua non to reducing Ghana's food import bills, which stand at US$2 billion and is projected to increase in the following decades (Bloomberg Market, 2017; Ghana National Daily Graphic, 2018; MoFA, 2021). Therefore, as a focus country, Ghana helps us understand climate adaptation issues and African agriculture. Further, the case study was situated within three district assemblies in Bono East Region. These study locations in the Bono East Region of Ghana are also considered part of Ghana's "bread basket" zones and have extreme climate perturbation tendencies (Klutse et al., 2020). Ghana's national statistics data indicate that apart from the region's rainfall fluctuation characteristics, it also has high poverty, illiteracy, and inadequate infrastructure development (GSS, 2015; Klutse et al., 2020). The mean annual rainfall of the Bono East Region is between 1400 and 1800 mm, and its yearly mean temperature ranges from 24°C in August to 30°C in March. This region is distinguished by its twofold rainfall pattern, with about 88% of the population engaging in agriculture as a livelihood (GSS, 2014).

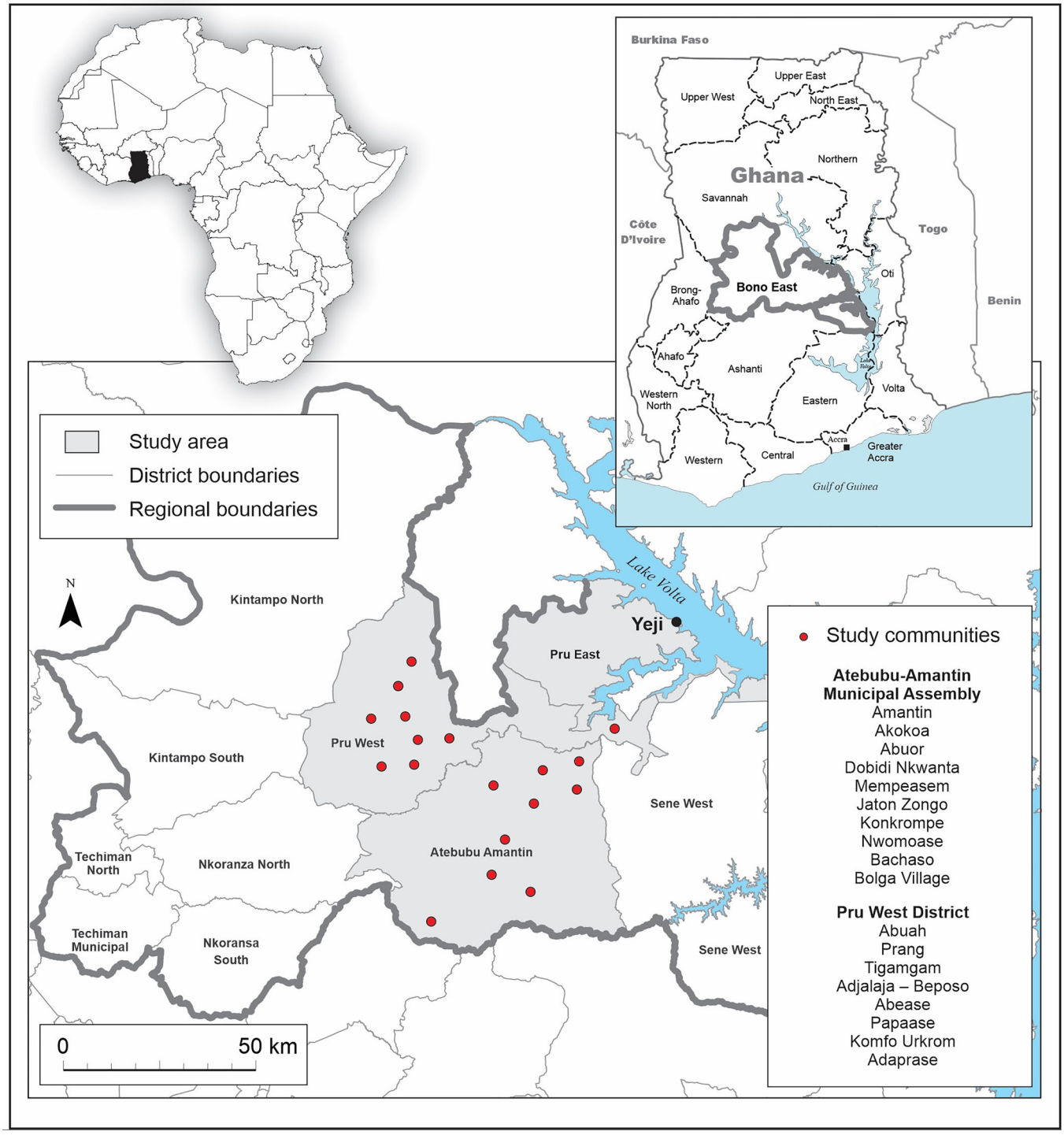

FIGURE 2 Map of study area.

The choice of these study locations was primarily informed by the centrality of these regions' agriculture and food production activities and expert interview recommendations. Likewise, these districts and their communities are climate-sensitive areas (GMet, 2022) and have benefited immensely from both NGO-supported agroecology scaling up for climate adaptation and the World Bank West Africa Agriculture Productivity Program (MoFA, 2022), which aims to scale up effective extension through e-agriculture and digital technologies to smallholders to enhance their adaptive capacity and increase agriculture productivity). Four FGDs meetings were held in Amantin (in June 2022; $n = 10$), Atebubu (in June 2022; $n = 10$; Atebubu-Amantin Municipal Assembly), Prang (in June 2022; $n = 10$; Pru West District), and Yeji (in June; $n = 10$; Pru East District), all in the Bono East Region of Ghana.

The large-scale farmer household survey ($n = 1219$) was conducted in 18 farming communities within hamlets of Amantin, Kokronpe, Nwomoasi, Janton-Zongo, Abuah, and Adjalaja-Beposo located at Atebubu-Amantin, Pru East, and Pru West Districts of the Bono East Region of Ghana.

3.3 | Data analysis and empirical framework

The responses from the FDGs and expert interviews were recorded with the interviewees' consent. Inductive coding was used to analyze qualitative data by enabling the identification of prevailing narratives and themes from interview responses (Creswell, 2017). The coding supplied the data required to extract sections and lines from the interviews corresponding to distinct themes that echo particular discourses about smallholder farmers' response to climate change. Also, this method allowed the findings to be generalized across scales per the intersectional generalizability approach proposed for community-based research that follows repression patterns across space and resistance movement (Fine et al., 2008; Schinke and Blodgett, 2016; Smith, 2018). The qualitative data dominate analysis in this body of work.

The quantitative data were entered into a Microsoft Excel sheet and later transported RStudio Connect 2021.09 application for analysis. Responses from the field investigation were analyzed by computing descriptive statistics, including frequency distributions, percentages, and cross-tabulations as appropriate. This study employed a multivariate probit (MVP) model (e.g., Ashford & Sowden, 1970) to analyze smallholders' motivation to adopt adaptation strategies, that is, agricultural intensification, agriculture extensification, traditional agroecological practices, livelihood diversification, and personal experience. The MVP estimation is appropriate since it allows to evaluate different strategies by assessing their correlations (Yu et al., 2008). However, we also estimated the UVP model for a robustness check of our results and also to know the estimate for each adaption strategy (e.g., Kassie et al., 2013).

The MVP model is specified as follows:

$$Y_{ij}^{*} = \beta_j X_i + \varepsilon_i \tag{1}$$

where X_i denotes a vector of independent variables (Resilient to Climate, Productivity, Income, Friends and Family, and NGO/Government Supported), β_j is vector coefficient, and ε_i is the error term. The outcome of expert interviews and farmer-focused group discussions informed the inclusion of these variables for computation. Moreover, these variables such as being resilient to climate, social network (family and friends) influence, increased productivity, and income are all documented raison d'etre for preferences of climate adaptation practices among Africa's rural farmers (e.g., Abegunde et al., 2020; Fagariba et al., 2018; Quarshie et al., 2023; Rahut et al., 2021).

The MVP model extends Equation (1) by adding equations to account for more than two outcome variables. Therefore, the motivation of smallholders to adopt each adaptation strategy can be expressed as the observable dichotomous outcome of each option (agricultural intensification, agricultural expansion, traditional agroecological practices, livelihood diversification, and personal experience). This is expressed in Equation (2) below.

$$Y_{ij} = 1 \text{ if } Y_{ij}^{*} \text{ \& } 0 \text{ if otherwise,} \tag{2}$$

where Y_{ij} represents the binary observable variable for which the (ith) farmer adopts the adaptation strategy (jth).

For each farmer using multiple adaptation strategies, the random error terms are assumed to jointly follow a multivariate normal distribution, with a conditional mean of zero and variance normalized to unity.

The marginal effects of independent variables on motivation influencing farmers to utilize adaptation strategies were calculated using Equation (3).

$$(\partial M_i) / (\partial x_i) = \alpha \left(x'\beta\right) \beta_i, \text{ where } i = 1, 2, 3, 4 \ldots .. n, \tag{3}$$

where M_i represents the likelihood of event i, which enhances farmers' adoption of adaptation strategies, and α denotes a standardized multivariate normal distribution function.

4 | RESEARCH RESULT

4.1 | Smallholder farmers' everyday climate adaptation practices in SSA

About 33% of the respondents are female, suggesting that male household heads highly represented the sample. Nearly 44.9% of the respondents have no formal education, and 49.7% are between the ages of 25 and 40. Also, 58% and 80.7% of these farmers engage in monocropping farming systems and cultivate for their family and partly, respectively. The mean age of the respondents is 38 years. See supplementary sheet (a) for Table S1, which has details of all variables used in the study.

In our literature review, the study identified smallholder farmers' climate adaptation practices and "current agricultural practices are neither smart nor dumb"

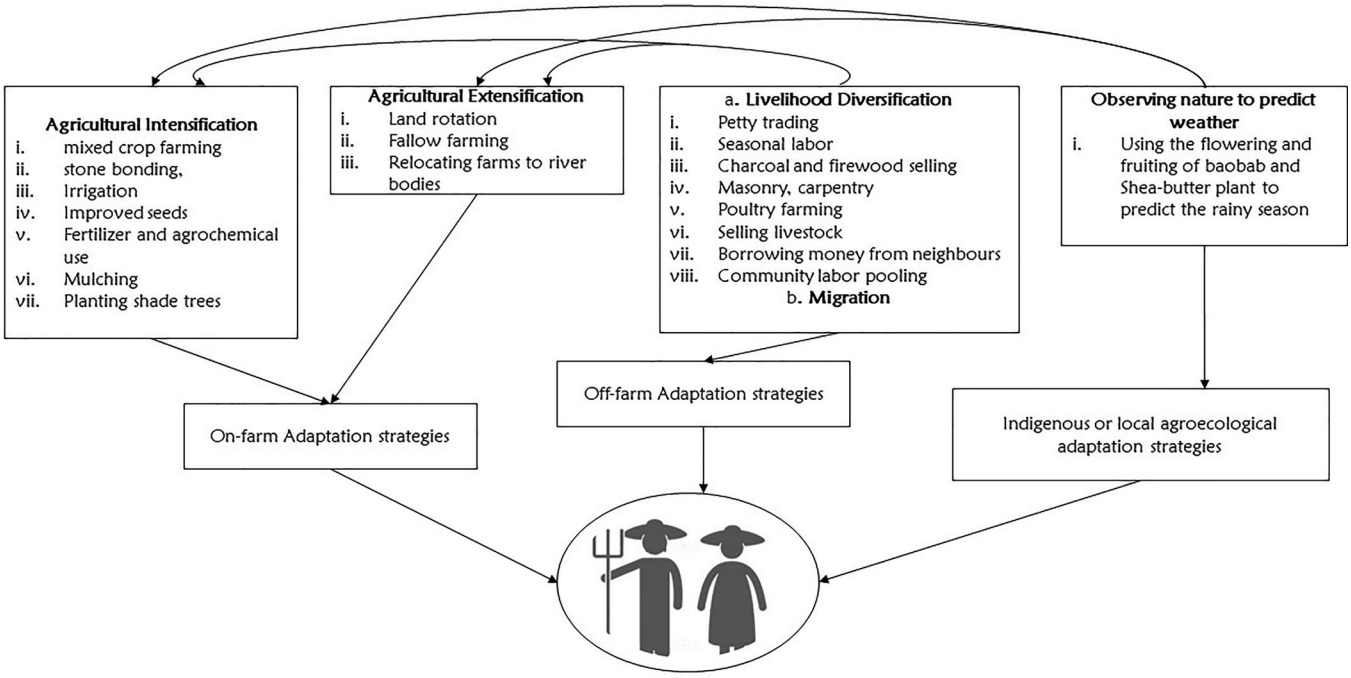

FIGURE 3 Everyday climate adaptation practices of smallholder farmers.

(Neufeldt et al., 2013. p. 3). These adaptation and agriculture practices can be classified under on-farm climate adaptation practices (including agriculture intensification and extensification), off-farm climate adaptation practices (livelihood diversification activities and migration), and Indigenous or local agroecological knowledge such as observing nature characteristics to predict the weather in climate adaptation practices (e.g., Antwi-Agyei et al., 2018; Quarshie, 2021; see Figure 3). From Figure 3, the study noted that both off-farm adaptation strategies, which include livelihood diversification activities such as petty trading, poultry farming, seasonal labor, migration, auto and motor repairs, fitting, and so forth and Indigenous or local agroecological adaptation strategies are used to complement farmers' on-farm adaptation options such as agriculture intensification or extensification.

The case study's result also suggests 87.8% of these farmers engage in agriculture intensification, and 37.5% engage in agriculture extensification. Participants using off-farm adaptation strategies such as livelihood diversification and migration are 4.9%. Moreover, those who rely on observing nature characteristics to predict the weather were 36.8%. Furthermore, the case study also identified that 70% of smallholders claim to rely on personal experience as an adaptation strategy to select specific or diverse and multi-complementary suitable climate adaptation practices from these broad ranges of on-farm, off-farm adaptation, and Indigenous climate adaptation options per time to adapt to climate change.

4.2 | Smallholder farmers' motivation for choices of climate adaptation strategies

To address objective two of this study, we attempt to assess the motivation behind farmers' choices of climate adaptation practices different from the traditional multi-scaler and multi-institutional-driven climate adaptation practices. The result is presented in Tables 1 and 2.

From Tables 1 and 2, we present estimates of marginal effects affecting farmers' motivation to use adaptation strategies (see supplementary sheet (a) for Table S2 showing the UVP estimate to check the robustness of the result). The estimated model fits the data well as indicated by the value of McFadden Pseudo R2 (0.74-0.88). Estimated parameters of agricultural intensification were statistically significant for climate resilience, income, and productivity gains but not for friend and family influence, government, and NGO-supported programs. These results suggest that when income, climate resiliency, and productivity increase by one unit, it enhances the probability that farmers will highly adopt adaptation strategies by 18%, 20%, and 24%, respectively. Regarding agricultural extensification and personal experience, the results suggest that resilience to changing climate, increase in income, productivity gains, and friend and family influence are significant in conditioning the farmers' decisions to adopt this adaptation strategy. Likewise, our estimated model reveals that high income, productivity, and the influence of family and friends all have a considerable positive bearing on the

TABLE 1 Farmers' motivation behind choices of climate adaptation strategies (Univariate Probit (UVP) model -estimated result)

Variables	Agriculture intensification	Agriculture extensification	Traditional agroecological practices	Livelihood diversification	Personal experience
(Intercept)	−0.61 ***	−1.5 ***	−1.52 ***	−2.63 ***	−1.48 ***
	(0.1)	(0.08)	(0.07)	(0.15)	(0.1)
NGO/Gov't-Supported Programs	6.19	6.32	6.56	4.75	6.69
	(435.36)	(146.95)	(143.35)	(1568.51)	(188.38)
Resilient to Climate	2.64 ***	2.14 ***	3.08 ***	2.81 ***	2.41 ***
	(0.42)	(0.29)	(0.49)	(0.5)	(0.27)
Increase in Productivity	3.5 ***	3.74 ***	3.78 ***	3.63 ***	3.57 ***
	(0.33)	(0.21)	(0.28)	(0.38)	(0.19)
Increase in Income	2.86 ***	3.77 ***	4.04 ***	8.38	4.05 ***
	(0.20)	(0.23)	(0.36)	(281.71)	(0.26)
Friends and Family Influence	6.15	3.27 ***	3.44 ***	3.3 ***	3.73 ***
	(129.71)	(0.46)	(0.43)	(0.70)	(0.40)
N	1219	1219	1219	1217	1218
AIC	318.77	409.27	455.37	107.04	328.43
BIC	349.41	439.91	486	137.66	359.06
McFadden Pseudo R^2	0.74	0.87	0.84	0.83	0.88

***$p < 0.0$;
**$p < 0.01$;
*$p < 0.05$, and (-) represent standard error.

TABLE 2 Coefficient estimate of the multivariate probit model

Variables	Probit model Motivation for choice of adaptation strategy	Marginal effects Motivation for choice of adaptation strategy
(Intercept)	−1.6 ***	
	(0.04)	
NGO/Government-Supported Programs	6.75	0.48
	(88.42)	(6.23)
Resilient to Climate	2.62 ***	0.18 ***
	(0.13)	(0.01)
Increase in Productivity	3.81 ***	0.27 ***
	(0.10)	(0.01)
Increase in Income	4.0 ***	0.28 ***
	(0.11)	(0.01)
Friends and Family Influence	3.72 ***	0.26 ***
	(0.20)	(0.02)
N	1219	1219
AIC	1679.56	1679.56
BIC	1719.84	1719.84
McFadden Pseudo R^2	0.89	

***$p < 0.0$;
**$p < 0.01$;
*$p < 0.05$, and (-) represent standard error.

adaption strategy of livelihood diversification. The MVP model shows that the probability of farmers adopting an adaptation strategy is highly significant when they are more resilient to climate change, increase productivity and income, and are influenced by their friends and family. However, NGOs and government-backed programs did not play a significant role in motivating farmers to adapt to these strategies (Table 2).

4.3 | Smallholder farmers' perceived challenges with CSA and/or CWFS practices

In addressing objective 3 of our study, we noted from a conceptual standpoint that CSA and CWFS, as proposed for smallholders and supported by some donors and other development agencies, interrupt the agency of rural farmers, thereby undermining the willingness to express interest, which is also their political will (e.g., Lindegaard & Sen, 2022; Rahman & Hickey, 2019). Similarly, in our case study, we identified that both CSA and CWFS had ignored the everyday adaptation practices of smallholder farmers by insisting on practices contrary to what these groups are comfortable or compatible with in their everyday adaptation practices, thereby leading to interrupted agency. For instance, a comment from a FGD suggests:

> We always choose climate adaptation practices that we are comfortable with per time. Sometimes we become confused when we go for training programs and are told to use certain practices incompatible with our normal farm practices. We are peasants and smallholder farmers with a special attachment to our farms and want to care for our farms in a way that makes us comfortable. However, these so-called (government/iNGOs) supported climate adaptation practices do not allow us to care for our farms how we want. (FGD Amantin)

Moreover, the study identified that CSA technologies and practices such as improved seeds, legume intercropping to control weeds, and mechanization are rejected by some farmers citing problems as the non-compatibility of these technologies and practices to existing farming systems and eroding farmers' agency to handle day-to-day food production challenges such as choice of planting materials for cultivation, weed controlling, and fertilizer application (Kansanga et al., 2018; Nyantakyi-Frimpong & Bezner Kerr, 2015). Likewise, the study noted that CWFS interventions, such as organic fertilizer, are incompatible with some smallholders' food production practices, such as seeds and fertilizer application, usually done through broadcasting. A female farmer said:

> Our losses are great anytime we want to adapt to climate change using some of the CSA or organic farming techniques and practices incompatible with how we farm in this community.

5 | DISCUSSION

5.1 | Agency of smallholder farmer and climate adaptation options

The study noted that smallholder farmers' adaptation strategies to climate change could be grouped into three sets: on-farm adaptation options, off-farm adaptation options, and Indigenous agroecological adaptation options. These are usually complementary to each other simultaneously. The on-farm adaptation options are classified under two categories: agriculture intensification involving mixed cropping, stone bonding, irrigation, improved seeds, inorganic fertilizer, agrochemicals, mulching, and planting shade trees. The extensification involves land rotation, farm relocation to water bodies, fallow farming, and so forth. The off-farm adaptation options include livelihood diversification activities, such as petty trading, seasonal labor jobs, other agribusinesses such as mushroom farming and apiculture, and migration. The Indigenous agroecological adaptation strategy uses observing nature and weather elements to predict the onset of the rainy season. The study noted that the choice of diverse and complementary adaptation strategies among smallholder farmers is the expression of their everyday adaptation practices, which is a function of their *agency*, and their intentionality, suggested to be central to promoting sustainable local food systems within the context of climate change adaptation (e.g., Lindegaard & Sen, 2022). Also, the use of multiple and diverse climate adaptation choices by these smallholder farmers in SSA points to the fact that these farmers have the agency to choose and practice adaptation options suitable per time. Across the scale, farmers adopt multiple adaptation options, with each adaptation option complementing the other to increase their efficiency and effectiveness in dealing with global climate change's impact on farm livelihoods. A respondent echoed this during the FGD when they argued that *"the climate is varying every season, so we need to adopt multiple strategies alongside our personal farming experience to increase our ability to adapt to climate perturbations on farming."*

In our study, we noted that the concept of CSA and CWFS, as proposed for smallholders and supported by some donors and other development agencies in the study area, has ignored the agency of food producers by insisting on practices that are contrary to what these groups are comfortable with. For instance, in the Amantin community of Bono East Region in Ghana, farmers' seed and fertilizer broadcasting and crop cultivation practices (see

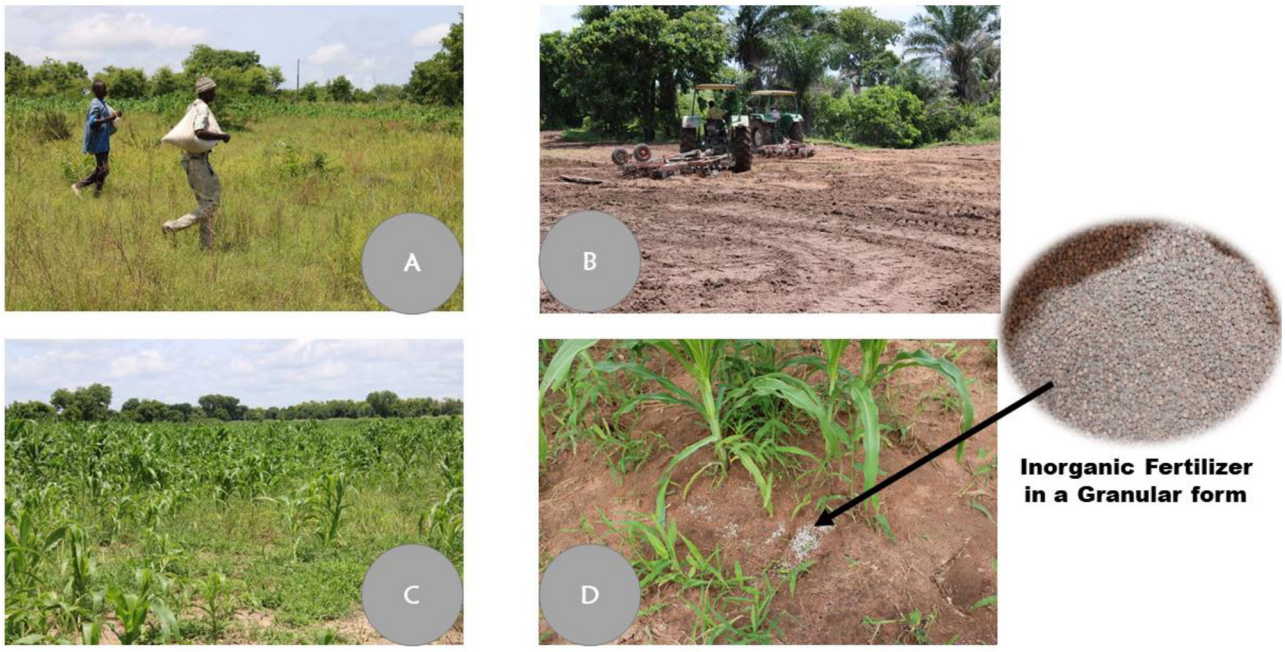

FIGURE 4 Farm process of smallholder farmers.
Description: (A) Farmers broadcasting their seeds/fertilizer (B) Tractor ploughing seeds and fertilizer broadcasted field (C) How the field looks like when crop grows (D) Inorganic fertilizer broadcasted at plant growth stage.

FIGURE 5 Nature and form of the Powdery organic fertilizer compound packed in sacks.

Figure 4) are incompatible with organic fertilizer application, which usually comes in powdery form (see Figure 5). Despite the effort to transition these smallholders to organic smallholding agriculture by German NGOs working in this region, these farmers prefer the inorganic fertilizer (granular in nature; see Figure 6) because it can easily be broadcasted. The choice for granular inorganic fertilizer is because these farmers can easily broadcast the seeds and the fertilizer together, which is their way of farming. Broadcasting NGO-promoted powdery organic fertilizers will lead to maladaptation and significant loss since the wind could blow them away (e.g., Eriksen et al., 2021; Funder et al., 2019; Mersha & van Laerhoven, 2018). Even though a German NGO is vigorously promoting organic farming in these communities, and the price of a 50 kg bag of organic fertilizer is GHc200.00, compared

FIGURE 6 Some granular Inorganic compound fertilizers used by smallholder farmers.
Description: Images A and F are photographs of inorganic fertilizer packages. Images B, C, D, and E are photographs of different inorganic fertilizers compound in different shapes and sizes.

to inorganic, which is GHc350.00, these farmers still prefer the inorganic fertilizer. Some farmers even suggest the returns on investment in organic farming, which is CWFS practices are not compelling enough to motivate them into such farm production practices. In the farmer FGDs, a farmer lamented, "*we can plant organic crops, but how many people can afford it; only a few economic wealthier can buy our products, and those people are in the city and not this rural community*" (FGDs, Amantin). The study noted that those farmers who prefer organic farming only cultivate vegetables on an out-grower scheme. The outgrower scheme allows risk-sharing since the contractor or buyer pays upfront for farm produce and off-takes them as soon as they are harvested from the field.

Figures 4–6 represent how farmers' agency interplay in their climate adaptation practices. Likewise, CSA technologies and practices such as improved seeds, legume intercropping to control weeds, and mechanization are rejected by some farmers, citing problems as the non-compatibility of these technologies and practices to existing farming systems and eroding farmers' *agency* to handle day-to-day food production challenges such as legume intercropping, inability to choose the type of seeds variety to plant (see also Kansanga et al., 2018; Nyantakyi-Frimpong & Bezner Kerr, 2015). For instance, farmers suggested CSA practices such as "*hybrid seeds cultivation are labor and time-intensive. There is a strict time to plant and apply fertilizer and pesticides. If you miss out on any of this, the crop productivity will be low, and you will lose a lot of money*" (FGDs, Nwomoasi). Others also testify concerning their reason for rejecting hybrid seeds promoted through the Ghana Government agriculture flagship program—Planting for Food and Jobs (e.g., Quarshie et al., 2022), saying "*even our own (traditional or farmer saved) seeds do much better than the hybrid seeds when planted, and they do not require much fertilizer and insecticides compared to the hybrid seeds*" (FGDs, Adjalaja-Beposo).

Scrutinizing this evidence, the study identified that smallholder farmers' choices and the degree of freedom to adopt or reject specific place-based climate adaptation strategies express their agency and self-determination irrespective of whatever global force impacts their livelihoods. Farmers prefer practices that guarantee increased yields and productivity since a strong correlation exists between productivity and rural household income and wellbeing (Onyeneke et al., 2018; UNDP, 2017). *However, agroecological practices such as organic farming, a climate-wise food systems strategy, have lower yields than conventional farms* (e.g., KC et al., 2016). Although this place-based adaptation practice nurtures a sense of place and ecological place meaning among smallholders (e.g., Quarshie, 2021), it is widely recognized as tedious and knowledge-intensive. All these references illustrate the challenges around formal adaptation practices and why farmers perceive they are incompatible with farmers' everyday adaptation practices leading to an interrupted agency of local actors.

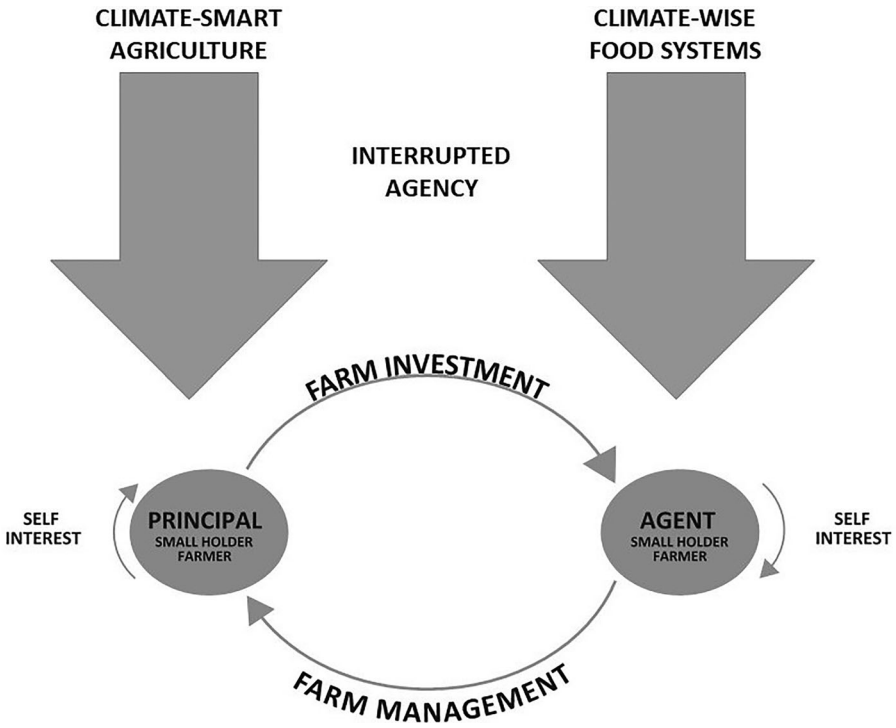

FIGURE 7 Interrupted agency of smallholder farmers—Agent and principal of their livelihood investment.

5.2 | Everyday adaptation choices and interrupted agency of smallholder farmers: The principals and agents in climate adaptation decision-making

Drawing lessons from the concept of everyday adaptation and interrupted agency and the agency theory to understand how and why the promotion of CSA and CWFS for smallholding agriculture has ignored the *agency* of local actors. The study identified that smallholder farmers' choices of diverse and complementary on-farm, off-farm, and Indigenous knowledge in climate adaptation practices instead of CSA and/or CWFS practices are the expression of agency, their intentionality, and political expression in the face of socio-ecological transformation including climate change (Lindegaard & Sen, 2022). Moreover, these farmers have a duo role as agents and principals who invest and manage their farm investments to their self-interest (e.g., Mitnick, 2019; Panda & Leepsa, 2017; Ross, 1973; Wiseman et al., 2012; see Figure 7). The motivations to adopt agricultural intensification, extensification, livelihood diversification, migration, traditional agroecological knowledge, and/or personal experience for climate adaptation depend on the strategy's ability to enhance climate resilience, increase productivity, increase income, and/or be suggested by family and friends as suggested by Quarshie et al. (2023).

From Figure 7, smallholder farmers perceive both CSA and CWFS as asymmetric information and interrupted agency, which is a maladaptation and a problem that arises due to misalignment between both formal climate adaptation interventions and the everyday climate adaptation practices of smallholder farmers as suggested by Lindegaard and Sen (2022) in their concepts of everyday adaptation and interrupted agency. Moreover, these farmers understand their needs and interest much better and in unique ways than the proponents of CSA and CWFS. Also, farmers' choices and preferences for different adaptation practices in defiance of the government and International NGOs-driven interventions confirm the longstanding argument that people who enjoy high levels of *agency* are engaged in actions compatible with their values (Alkire, 2008) or their own interests (Narayan & Petesch, 2007).

Furthermore, drawing on farmer practices observation in the Bono East Region of Ghana, the study noted that both CSA and CWFS have been unable to address tropical deforestation and methane emissions from livestock, rice cultivation, and post-harvest food waste. For instance, post-harvest waste was seen on both CSA and CWFS farmlands. Moreover, the study also noted that smallholder farmers have difficulty telling the differences and similarities between some CSA practices and CWFS food production practices because everyday adaptation practices and CSA and/or CWFS practices, in some instances, are used complementarily. For example, intercropping, minimum or zero tillage, conservation agriculture, composting, and integrated crop and livestock management practices

are well-known CSA practices deeply rooted in agroecology. Therefore, promoting effective climate adaptation practices among rural farmers will mean decolonizing the single mentality approach, that is, CSA or CWFS primarily promoted and driven by external entities, as the silver bullet to enhance climate adaptation among rural farmers and to recognize the multiplicity, interconnectivity, diversity, and synergies of local adapters' adaptation strategies, which highlight the reflexivity of adapters' agency, their self-interest, intentionality and political will (e.g., Lindegaard & Sen, 2022; Scott, 1989).

5.3 | Toward a sustainable food agency (SFA)for climate adaptation and mitigation

To address this complex challenge of climate adaptation while recognizing the agency of those directly involved in climate adaptation, we argue for a shift from the narrow focus on one particular climate adaptation strategy, that is, CSA or CWFS, as suitable climate adaptation options for SSA. We further argue for a more comprehensive approach that embraces constellations of diverse strategies while also recognizing food producers' agency in climate adaptation and mitigation thinking. In addition, the *agency* of food producers should be recognized within the context of sustainability, that is, "the long-term ability of food systems to provide food security and nutrition in a way that does not compromise the economic, social and environmental bases that generate food security and nutrition for future generations." (HLPE 2020a. p. xv). The sustainability context is crucial to reducing maladaptive outcomes from diverse adaptation options among smallholders (e.g., Antwi-Agyei et al., 2018; Asare-Nuamah et al., 2021). Therefore, instead of narrowly focusing on either CSA or CWFS as a silver bullet for smallholder farmers' adoption to adapt to climate change, smallholder farmers and nations in SSA should decide for themselves suitable climate adaptation interventions within the context of sustainability to enhance farmers' resilience to changing climate while also producing adequate nutritious food to feed their rapidly growing population. This new climate adaptation thinking ushers in what the study describes as the SFA.

The SFA is a multifaceted blended constellation of strategies and options ranging from local to global supply chains and aimed at various individuals and organizations. These strategies are borne out of an inclusive and participatory decision-making process by local actors to decide which specific policies, technologies, or management practices are essential to promote climate adaptation and mitigation while also producing adequate food to feed the growing population. Moreover, smallholders' specific SFA choices must recognize the economic, social, and environmental bases that generate food security and nutrition for present and future generations. By enhancing SFA for climate change adaptation and food production systems at the individual level, people are empowered to make decisions over their participation in food systems so that they can access foods and livelihoods within food systems that are culturally acceptable, promote the agency of local actors, uphold human dignity, reduce fear of food insecurity, and promote better environmental stewardship. In what follows, the study will expound on specific examples of the SFA approach to climate adaptation and mitigation while also addressing food needs for nations in SSA.

5.4 | Insight into some specific examples of SFA practices

SFA could mean different things within diverse contexts. For instance, extrapolating from the work of Amartya Sen (2000) on "Development as Freedom" that suggests "what people can positively achieve (in any endeavour) is influenced by economic opportunities, political liberties, social powers, enabling conditions of good health, basic education and encouragement and cultivation initiatives" (Sen, 2000, p. 5). The SFA, in some context, could mean expanding the "development freedoms" vulnerable groups such as smallholder farmers can access. The expansion of development freedoms in this context means addressing poverty, income redistribution, gender equality, and education challenges to enhance farmers' assets and capabilities, which are critical to building their adaptive capacity to climate and non-climatic shocks, while also positioning smallholder agriculture as a tool for food security and rural poverty reduction in Africa (Sen, 2000; Scoones, 2009, 2015). For instance, Scoones (2009, 2015) noted that when smallholder farmers' assets and capabilities are enhanced, they can adapt well to external stressors to build a more vibrant, sustainable livelihood. Again, strengthening the assets and capabilities of smallholder farmers could also mean expanding rural non-farm economic opportunities for farmers (e.g., Haggblade et al., 2010) who are barely surviving in agriculture (e.g., Harris & Orr, 2014) to step-up their livelihood operational activities (Gassner et al., 2019) and adapt well to changing climate. This was confirmed during a FGD that climate adaptation for some groups of farmers could mean "*creating more off-farm jobs opportunities to cater for the needs of farmers and rural population who are affected by climate change.*"

In another context, SFA could mean strengthening climate tolerance seeds and improved planting materials delivery systems (Quarshie et al., 2021; Teye & Quarshie, 2021) while also providing context-specific-targeted

extension delivery services for different demographic groups of smallholders to increase the widespread uptake of improved planting technologies essential to enhance climate adaptation, catalyze agriculture productivity, and transformation (Quarshie et al., 2022). Access to climate-tolerance seeds and extension services is considered central in enhancing farmers' adaptive capacity to changing climate in SSA (ibid).

Furthermore, an SFA approach for some nations in the SSA could mean strengthening trade policies and security guarantees to improve food importation to address climate-induced food production shortages. Moreover, emphasis should be placed on regional and territorial markets to ensure a continuous food supply to consumers. This was confirmed by a high-profile government appointee who said, *"climate adaptation that ensures food security and livelihoods must include food importation to offset the local production deficit and meet the dietary preference of all groups of persons. Food trade is essential to maintain food security and adapt well to changing climate as a nation."* As suggested in a large body of literature (e.g., Anderson, 2010; Fader et al., 2013; see HLPE, 2020b), this adaptation arrangement is more appropriate for addressing food security needs since growing evidence suggests water and land constraints (a direct impact of climate and environmental changes) will limit most nations in North Africa, Andean regions, and the Middle East's capacity to produce their food. Therefore, food trade is paramount to addressing food security in those regions (Anderson, 2010; Fader et al., 2013; see HLPE, 2020b). Already, the food of almost 1 billion people, who are located in 66 countries, mainly situated in Africa, comes from outside these countries because they were found to be unable to produce all the crops products they currently consume due to water and land scarcity (Fader et al., 2013).

Likewise, the SFA for some developing nations and emerging economies will mean market-led large-scale investment in agricultural infrastructure, technological skills and knowledge, storage, transport, and distribution as the key to improving food security and climate change adaptation. Such investment is central to closing the yield gaps for most of the region's staple food crops, considered food security crops. Further, SFA, in some contexts, could also mean enhancing access to digital agriculture technologies, which will help farmers be precise with input applications and adapt well to both climate and non-climatic stressors while drastically reducing agriculture's contribution to global GHGs emissions (e.g., Abdulai, 2022a, 2022b; Abdulai et al., 2023; Duncan et al., 2021; Green et al., 2021). Where possible, novel food production frontiers, such as aquaculture, seaweed, and so forth, could be expanded to address food security and climate adaptation needs (Glaros et al., 2021). The expansion of these technologies instead of a narrow focus on CSA or CWFS is critical to enhancing the regions' climate adaptive and food production capacity to promote food security, especially in this age where regional evidence suggests addressing SSA's food security crises will require a 335% increase in cereal production over the next 40 years (Dzanku et al., 2015; see also Nyiawung et al., 2019). These diverse place-based, context-specific, inclusive and participatory climate adaptation, and food systems transformation strategies are essential to address the impact of SSA's changing climate, rural and urban population growth, dwindling land resources, economic transformation, rise in more affluent people with increased demand for more nutritious food, health crises, civil conflict, and accelerated pace of agriculture digitalization, all of these which constitute major demographic, economic, environmental, and social megatrends that are (re)shaping Africa's food systems (e.g., AGRA, 2022).

The decision to rely on any specific SFA strategies to promote climate adaptation and mitigation among smallholder farmers and the region should be based on the availability of local and context-specific empirical evidence that will inspire confidence in formulating social policies to address climate vulnerabilities and food insecurities. Implementing any SFA strategy will require changes in governance and resource usage, supported by enabling political, social, and economic conditions beyond incremental changes. To generate the public demand and political will required to inspire profound transformations to SFA, "Glocal" efforts are required to establish scientifically valid indicators and long-term measures for what is considered SFS within the context of a changing climate and mounting social-ecological issues. The transition to SFA may require setting and testing hypotheses continuously to answer the question of what adaptation practices constitute SFA (e.g., Nuefeldt et al., 2012). Therefore, the need to develop and promote inclusive and participatory decision-making processes to decide which specific policies, technologies, or management practices are essential for sustainable climate adaptation and food production needs instead of narrowly focusing on a particular solution to tackling climate change impact on smallholding agriculture. Notably, the involvement of women smallholders in agriculture production and climate adaptation decision-making process is critical at a time when there is an increased feminization of agriculture as a result of climate change (Agarwal, 2013, 2018) and local-level evidence suggesting child survival, nutrition, and health for the rural household is better when women have enhanced assets and capabilities, compared to men (ibid).

In summary, instead of narrowly focusing on one specific approach, such as CSA and/or CWFS as climate change adaptation and mitigation options for nations in

SSA to produce more food and improve rural household economic wellbeing, countries in the region, and particularly smallholder farmers, should be supported to willfully choose how they want to adapt to climate change impact to produce what they eat, while also recognizing the interlinkages between food production and environmental stewardship. This is important to ensure smallholder farmers' choice of adaptation interventions does not push ecosystems to their planetary boundaries. These agency-inclined climate adaptation interventions must also enhance the ability of Africa's food systems to offer food security and nutrition without jeopardizing the economic, social, and environmental foundations that guarantee the now and future generations' food security and nutrition.

6 | CONCLUSION

Climate change continuously threatens the efficiency and sustainability of food systems across the globe, with a significant impact on smallholding agriculture in regions such as SSA. The narrow focus on CSA and/or CWFS as a silver bullet for climate change adaptation suitable for smallholding agriculture ignores food producers' agency—which is central to promoting sustainable and inclusive adaptation solutions. Furthermore, smallholder farmers' adaptation strategies to climate change could be grouped into three categories: on-farm adaptation, off-farm adaptation, and Indigenous agroecological adaptation options. The on-farm adaptation options are usually agriculture intensification and extensification. The off-farm adaptation options include livelihood diversification activities, petty trading, seasonal labor jobs, and migration. The Indigenous agroecological adaptation strategy uses observing nature and weather elements to predict the onset of the rainy season. The study noted that smallholders' decision to choose adaptation options, which is an expression of their agency, is motivated by smallholders' desire to be resilience to changing climate, increase productivity and income, and influence of family and friends and not necessarily because the strategy is being promoted by government or NGOs.

Therefore, a more effective and efficient way of climate adaptation and mitigation in the region is a SFA. The SFA allows individuals or groups to decide what climate change adaptation options best work for them to produce and distribute their food without undermining the economic, social, and environmental bases that generate food security and nutrition for present and future generations. The SFA recognizes that a multifaceted blended portfolio of climate adaptation and food production strategies is critical to enhancing farmers' adaptive capacity to climate change while ensuring sustainable food production systems. The decision to rely on any SFA strategies to promote climate risk adaptation and mitigation among smallholder farmers should be based on the availability of local and context-specific empirical evidence that will inspire confidence in formulating social policies to address issues such as food insecurities. The SFA should also be implemented through an inclusive and participatory location-specific decision-making process to decide on specific policies, technologies, or management practices essential to produce their food while also promoting climate adaptation and mitigation among food producers in the SSA. The significance of this study is that it provides policymakers, agriculture sector stakeholders, and development practitioners with crucial information to recognize the agency of local actors in climate adaptation framework design and implementation in rural Ghana and Africa to avoid maladaptation as a result of multi-scaler and multi-institutional-driven climate adaptation interventions in the region.

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CONFLICT OF INTEREST STATEMENT

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

DATA AVAILABILITY STATEMENT

The qualitative datasets [GENERATED/ANALYZED] for this study can be found in part or whole in this body of work. The quantitative dataset is available upon request to the lead author, Philip Tetteh Quarshie.

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NOTES

[1]The IPCC suggest, agriculture is noted to be responsible for 21%-–37% of global GHG emissions (IPCC, 2020), largely from tropical deforestation, methane emissions from livestock and rice cultivation, and nitrous oxide emissions from fertilized soils (Foley et al., 2011).

[2]Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and

healthy life. This definition features four essential dimensions that have been seen as central to the concept over the previous decades—including not just availability and access, as outlined above, but also utilization (referring to nutritional uptake) and stability (referring to the constancy of the other three dimensions). These four dimensions have also been highlighted consistently in the academic literature on food security and nutrition (Barrett, 2010; Webb et al., 2006). In 2006, FAO published a policy brief to capture and reinforce these four critical dimensions of food security as necessary for identifying policy pathways to improve food security (HLPE, 2020a, p . 7).

[3] Agroecology uses ecological concepts and principles to design and manage sustainable agroecosystems where external inputs are replaced by natural processes such as natural soil fertility and biological control like using wasps to control aphid population. Agroecological approaches promote diversification of farming systems and a mixture of crop varieties, intercropping systems, agroforestry systems, integrated crop-livestock's system, and not intensive use of chemical, labor, and input; Altieri & Nicholls, 2012; Holt Giménez & Shattuck, 2011; Taylor, 2018b).

[4] Ghana National Climate Change Policy was launched in July 2014 after it was approved by the Country's executive governance body in May 2013. The vision for the launch was "*to ensure a climate-resilient and climate compatible economy while achieving sustainable development through equitable low carbon economic growth for Ghana*" (Government of Ghana National Climate Change Policy, 2014).

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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