**Supplementary Material I: Is climate-smart agriculture a silver bullet solution? Challenges pertaining to local knowledge and upscaling in Africa**

**Protocol:** 01-14-2021

**Background**

Climate-smart agriculture (CSA) is endorsed as a strategy to achieve food security and sustainable development goals (SDGs) in the face of climate change by several national governments, and international non-profit organizations (INGOs) (Newell & Taylor, 2018; Taneja et al., 2014). CSA is designed to support developing countries in transforming agricultural and food systems to be more productive, sustainable, and climate-friendly (Lipper & Zilberman, 2017). Large INGOs such as the World Bank has committed to invest annually $8 billion to support CSA initiatives, and Africa is a major region to benefit from these investments (Shilomboleni, 2020).

Although there are large investments by INGOs and national governments, scaling up CSA in Africa has been challenging. For instance, many smallholder farmers are unable to adopt CSA as many practices and technologies are expansive. CSA scholarship is at an interesting crossroads: scholars and practitioners realize that a viable transition to CSA in Africa requires not only acknowledging the knowledge needs of farmers but also ensuring that new technology is sensitive to the values and culture of the locale. Indeed, the low levels of CSA adoption among African smallholder farmers is a stark reminder to the international development community and governments in Global South that there are very few organic complementarities between farmers' existing farming practices and 'new' and 'improved' CSA approaches.

The existing system of knowledge generation and dissemination for CSA is not conducive for upscaling these practices and technologies to millions of farm households in Africa. The knowledge system is independent of farmers' participation, and these hinder upscaling CSA. Against this backdrop, we used a systematic review of existing literature to interrogate how CSA literature addresses the following research questions: *(1) In the last decade, how has smallholder farmers' local knowledge been included or excluded in CSA practices and technologies in Africa;* and *(2) how are CSA practices and technology possibly upscaled in Africa?* This article uses an interpretive approach to analyze the CSA literature systematically, drawing meanings and interpretations from the reviewed literature.

In the following section, we have detailed the method that guides the search for CSA studies that explain inclusion and exclusion of farmers local knowledge and upscaling of CSA in Africa in the last decade.

**Methods**

To explore the questions this study poses, we conducted a systematic review of literature following the reporting standards for systematic evidence synthesis (ROSES) framework (Haddaway et al., 2018). ROSES provides a meticulous, transparent, and standard guideline to collect relevant literature on a topic related to the social-environment interactions. Based on this approach, search queries were developed and utilized to generate results from Scopus and Web of Science (WoS) search engines. Titles, abstracts, and keywords of all articles were examined in the next phase; we further examined the entire articles to ensure all articles fit the study criteria and are able to answer the questions these study poses. The last procedures are the critical appraisal and critical reviews where we checked for methodological and conceptual strength of each article included in the analysis. We followed Haddaway et al. (2018) ROSES Flow chart to structure and document our literature search, number of duplicate articles and articles included in the final analysis in Figure 1 below.

Potential studies identified from Scopus and Web of Science searches (n= 3594)

Duplicate excluded (n= 3155)

Studies remaining after excluding duplicates (n= 439)

Studies excluded during title/abstract/keyword screening (n= 389)

Studies remaining after screening title/abstract/keywords (n= 50)

Studies remaining after full text screening (n= 30)

Studies excluded during full text screening (n= 20)

Studies included for analysis (n= 30)

Critical review (n =0)

**Figure 1:** Identification and selection process for systematic review

**Definition of key concepts**

The study used the following key concepts relevant to the study. These concepts are explained below.

1. **Climate-Smart Agriculture (CSA):** defined by FAO, CSA are a series of practices and technologies that "contributes to the achievement of sustainable development goals. It integrates the three dimensions of sustainable development by jointly addressing food security and climate change challenges" (FAO, 2013). In this study, CSA encompasses innovative practices, technologies, and management services that are context-specific and adopted to address a broad range of climate change issues such as drought, rainfall, food productivity, among many others (Khatri-Chhetri et al. 2017).
2. **Adaptation**: In climate change context, adaptation refers to "adjustments in ecological-socio-economic systems in response to actual or expected climate stimuli, their effects or impact" (Pielke, 1998, P.158). The main objective of adaptation, for instance, can be to ensure that climate risk is maintained at the current level or to reduce risk and minimize exposure to potential risk (Doria, Boyd, Tompkins, & Adger, 2009). Adaptation, which is successful, weighs on reducing risk and vulnerabilities (Doria et al., 2009).
3. **Mitigation**: is counterposed to the concept of adaptation in the literature and policy arena. Mitigation is defined as a reduction in greenhouse gas emissions from agricultural activities, land-use change, fossil fuels, amongst many others (Lavell et al., 2012).
4. **Resilience**: Many definitions of resilience exist in the literature. For the purpose of this study, resilience refers to the "ability of systems and its component parts to anticipate, absorb, accommodate, or recover from the effects of a potentially hazardous event in a timely and efficient manner, ensuring the preservation, restoration or improvement of its essential basic structures and functions" (Lavell et al., 2012).

1. **Adaptive capacity**: refers to the capacity of a system to change, adjust its strategy to cope, and respond to potential risk (Brooks & Adger, 2005; Gallopín, 2006). An essential element is for societies, communities, and individuals to participate in the process of achieving change (Jones, Ludi, & Levine, 2010). Systems that possess adaptive capacity can promote innovation and support new practices (Smit & Wandel, 2006).
2. **Food Security**: implies “all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their food preferences and dietary needs for an active and healthy life" (FAO 2002).
3. **Large and Smallholder farmers:** Large scale farmers engage in the production of agricultural commodities on a commercial landscape on thousands of hectares. Smallholder farmers engage in farming on a subsistence level on less than five hectares per year (Gollin, 2014; Salami, Kamara, & Brixiova, 2010).
4. **Upscaling:** Upscaling is defined as the duplication, adaptation of techniques, technologies, practices to achieve increased scale coverage (Linn, 2012). These processes occur by reproducing practices and technologies proven to be effective with the objective of introducing them in a new geographic region or within groups of people. Therefore, the essence of upscaling is to ensure an increase from a pilot to a larger scale (World Bank, 2003).
5. **Local knowledge** This study defines local knowledge as a set of skills, technologies, and practices that have emerged from the experience of people and communities, attached to history, local culture, and environment, identified as norms embedded in community practices (Beckford & Barker, 2007).

**Description of Keywords**

We developed keywords based on our study questions. Keywords developed to search the databases are climate-smart agriculture, adaptation, mitigation, food security, governance, technology, equity, climate finance, adaptive capacity, and Africa (categorized into different regions). A combination of these keywords gives a vast expanse of CSA literature in Africa from Scopus and WoS. The search consists of unique sets of words to search the literature. Examples of these keywords are given below in table 1.

**Table 1:** Examples of Keywords and their descriptions

|  |  |
| --- | --- |
| **Keywords** | **Description** |
| "climate-smart" AND "agric\*" | Generally used parlance for climate-smart agriculture. |
| "Mitigat\*" OR "Adpat\*" OR "Food Secur\*" | The triple win pillars of CSA include climate change adaptation, mitigation, and food productivity |
| "Adapt\*" OR "Resilien\*" | Describes climate change adaptation |
| "Africa\*" | Covers various countries and regions in the African continent |
| "Smallholder" | Refers to farmers who cultivate on less than five hectares of land |
| "Upscal\*" | the duplication, adaptation of techniques, technologies, practices to achieve increased scale coverage |
| "local knowledge" | Farmers’ local farming knowledge |

**Search queries**

Table 2 provides some examples of search queries performed to retrieve relevant articles from the search engines. The search queries are a combination of keywords that generate an extensive database of literature constituting data for our analysis.

**Table 2:** Search queries

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| --- | --- | --- |
| **S/No.** | **SCOPUS - Number of retrieved articles** | **Web of Science-Number of retrieved articles** |
| 1 | (TITLE-ABS-KEY (“climate-smart” AND agric\*) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) ) – **358 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") – **320 articles** |
| 2 | (TITLE-ABS-KEY ("climate-smart" AND agric\*) AND TITLE-ABS-KEY ("Mitigat\*" OR "Adpat\*" ) ) – **235 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Adpat\*") – **192 articles** |
| 3 | (TITLE-ABS-KEY (“climate-smart” AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" ) ) – **355 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*") – **323 articles** |
| 4 | (TITLE-ABS-KEY (“climate-smart” AND agric\*) AND TITLE-ABS-KEY ( "Food Secur\*" OR "Adpat\*" ) ) – **221 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Food Secur\*” OR “Adpat\*") -**210 articles** |
| 5 | (TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Food Secur\*" OR "Adpat\*" OR "equity" ) AND TITLE-ABS-KEY ( "Africa" ) ) – **51 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Food Secur\*" OR "Adpat\*" OR "equity") AND TOPIC: (" Africa")-**83 articles** |
| 6 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Food Secur\*" OR "Adpat\*" OR "equity" ) AND TITLE-ABS-KEY ( "East Africa" ) ) – **2 articles** | (\*climate-smart and agric\*) AND TOPIC: ("Food Secur\*" OR "Adpat\*" OR "equity") AND TOPIC: (" East Africa") -**2 articles** |
| 7 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Food Secur\*" OR "Adpat\*" OR "equity" ) AND TITLE-ABS-KEY ( "West Africa" ) ) – **6 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Food Secur\*" OR "Adpat\*" OR "equity") AND TOPIC: (" West Africa") – **9 articles** |
| 8 | (TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "Africa" ) ) -**78 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" Africa") -**102 articles** |
| 9 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "West Africa" ) ) -**10 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" West Africa") -**10 articles** |
| 10 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "East Africa" ) ) -**5 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" East Africa") – **6 articles** |
| 11 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "Central Africa" ) ) -**0 article** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" Central Africa") -**1** **articles** |
| 12 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "Southern Africa" ) ) -**11 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" southern Africa") -**17 articles** |
| 13 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "North Africa" ) ) -**1 article** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" North Africa") -**0 article** |
| 14 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "Adaptive Capacity" ) ) – **20 articles** | (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" Adaptive Capacity") -**19 articles** |
| 15 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "governance" ) ) -**15** **articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" governance") – **16 articles** |
| 16 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( " techn\*" ) )-**153 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" techn\*")-**149 articles** |
| 17 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( " techn\*" ) AND TITLE-ABS-KEY ( "organic farming" ) ) -**2 articles** | (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" techn\*") AND TOPIC: ("organic farming") -**3 articles** |
| 18 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( " techn\*" ) AND TITLE-ABS-KEY ( "Resilien" ) )-**49 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" techn\*") AND TOPIC: ("Resilien\*") – **43 articles** |
| 19 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( " techn\*" ) AND TITLE-ABS-KEY ( "agronom\*" ) AND TITLE-ABS-KEY ( "Resilien\*" ) ) -**1 article** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: (" techn\*") AND TOPIC: ("Agronom\*") AND TOPIC: ("Resilien\*") **-1 article** |
| 20 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "product\*" ) ) -**231 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: ("product\*")-**218 articles** |
| 21 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "upscal\*" ) ) -**4 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: ("product\*") AND TOPIC: ("upscal\*") – **3 articles** |
| 22 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "Smallholder farmer" OR "Small scale" ) AND TITLE-ABS-KEY ( "Africa" ) )-**30 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: ("Smallholder farmer" OR "Small scale") AND TOPIC: ("Africa")-**9 articles** |
| 23 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "local knowledge" ) )-**4 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: ("local knowledge") -**3 articles** |
| 24 | ( TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "local knowledge" OR "indigenous Knowledge" ) ) -**7** **articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: ("local knowledge" OR "indigenous Knowledge") – **5 articles** |
| 25 | TITLE-ABS-KEY ( "climate-smart" AND agric\* ) AND TITLE-ABS-KEY ( "Mitigat\*" OR "Food Secur\*" OR "Adpat\*" ) AND TITLE-ABS-KEY ( "local knowledge" OR "indigenous Knowledge" ) AND TITLE-ABS-KEY ( "Africa" ) )- **4 articles** | TOPIC: (\*climate-smart and agric\*) AND TOPIC: ("Mitigat\*" OR "Food Secur\*" OR "Adpat\*") AND TOPIC: ("local knowledge" OR "indigenous Knowledge") AND TOPIC: ("Africa")-**3 articles** |

Table 3 details the criteria guiding the selection of studies included and excluded in the analysis.

**Table 3:** Study inclusion and exclusion criteria

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| --- | --- | --- |
| **S. No.** | **Inclusion criteria** | **Exclusion criteria** |
| 1 | Article written within the period 2010-2020 | Exclude studies not written within the time frame 2010-2020 |
| 2 | Include articles that discuss CSA practices and technology in Africa | Exclude articles not discussing CSA in Africa |
| 3 | Include articles discussing the interaction of different knowledge systems (local, indigenous, and expert knowledge) and upscaling. Upscaling is defined as a process that provides a path to introduce CSA practices and technologies | Exclude articles without a focus on local knowledge and upscaling |
| 4 | Include only English language peer-reviewed empirical and review articles | Exclude book chapters |
| **Critical appraisal step** | | |
| 1 | Study not adding value to the discourse of upscaling and local knowledge will be excluded. | |
| 2 | Articles with methodological and conceptual weakness will be excluded | |

**Critical Review**

The critical review was conducted to ensure that the literature included in the analysis covers a wide range of articles to answer the questions. During the critical review we check the quality of literature to be included in the analysis and to ascertain if there are articles that might have been omitted from the repository.

**Table 4: Extraction tables**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **S/No.** | **Title of the article** | **Journal** | **Author(s) name** | **Year** | **Abstract** | **Keywords** | **Local knowledge** | **Upscaling in Africa** |
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|  |  |  |  |  |  |  |  |  |
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**Reference included in the review**

1. Abegunde, V. O., Sibanda, M., & Obi, A. (2019). The dynamics of climate change adaptation in sub-Saharan Africa: A review of climate-smart agriculture among small-scale farmers. Climate. <https://doi.org/10.3390/cli7110132>
2. Aggarwal, P. K., Jarvis, A., Campbell, B. M., Zougmoré, R. B., Khatri-Chhetri, A., Vermeulen, S. J., Tan Yen, B. (2018). The climate-smart village approach: Framework of an integrative strategy for scaling up adaptation options in agriculture. Ecology and Society. <https://doi.org/10.5751/ES-09844-230114>
3. Akrofi-Atitianti, F., Ifejika Speranza, C., Bockel, L., & Asare, R. (2018). Assessing Climate Smart Agriculture and Its Determinants of Practice in Ghana: A Case of the Cocoa Production System. Land. <https://doi.org/10.3390/land7010030>
4. Alexander, S. (2019). What climate-smart agriculture means to members of the Global Alliance for climate-smart agriculture. Future of Food: Journal on Food, Agriculture and Society. <https://doi.org/10.17170/kobra-2018122073>
5. Cattaneo, A., & Lipper, L. (2016). Incorporating forest landscapes into climate-smart agricultural strategies. Unasylva.
6. Cavanagh, C. J., Chemarum, A. K., Vedeld, P. O., & Petursson, J. G. (2017). Old wine, new bottles? Investigating the differential adoption of 'climate-smart' agricultural practices in western Kenya. Journal of Rural Studies. <https://doi.org/10.1016/j.jrurstud.2017.09.010>
7. Chandra, A., McNamara, K. E., & Dargusch, P. (2017). The relevance of political ecology perspectives for smallholder Climate-Smart Agriculture: A review. Journal of Political Ecology. <https://doi.org/10.2458/v24i1.20969>
8. Duffy, C., Toth, G., Cullinan, J., Murray, U., & Spillane, C. (2020). Climate smart agriculture extension: gender disparities in agroforestry knowledge acquisition. Climate and Development. <https://doi.org/10.1080/17565529.2020.1715912>
9. Fentie, A., & Beyene, A. D. (2019). Climate-smart agricultural practices and welfare of rural smallholders in Ethiopia: Does planting method matter? Land Use Policy. <https://doi.org/10.1016/j.landusepol.2019.04.020>
10. Fuchs, L. E., Peters, B., & Neufeldt, H. (2019). Identities, interests, and preferences matter: Fostering sustainable community development by building assets and agency in western Kenya. Sustainable Development. <https://doi.org/10.1002/sd.1934>
11. Hellin, J., & Fisher, E. (2018). Building pathways out of poverty through climate smart agriculture and effective targeting. Development in Practice. <https://doi.org/10.1080/09614524.2018.1492516>
12. Kamara, A., Conteh, A., Rhodes, E. R., & Cooke, R. A. (2019). The relevance of smallholder farming to african agricultural growth and development. African Journal of Food, Agriculture, Nutrition and Development. <https://doi.org/10.18697/AJFAND.84.BLFB1010>
13. Kuntashula, E., Chibwe, T., & Chabala, L. M. (2017). Enabling Agricultural Transformation Through Climate Change Policy Engagement. In Smart Technologies for Sustainable Smallholder Agriculture: Upscaling in Developing Countries. <https://doi.org/10.1016/B978-0-12-810521-4.00012-8>
14. Kurgat, B. K., Lamanna, C., Kimaro, A., Namoi, N., Manda, L., & Rosenstock, T. S. (2020). Adoption of Climate-Smart Agriculture Technologies in Tanzania. Frontiers in Sustainable Food Systems. <https://doi.org/10.3389/fsufs.2020.00055>
15. Lee, J. (2017). Farmer participation in a climate-smart future: Evidence from the Kenya agricultural carbon market project. Land Use Policy. <https://doi.org/10.1016/j.landusepol.2017.07.020>
16. Maindi, N. C., Osuga, I. M., & Gicheha, M. G. (2020). Advancing climate smart agriculture: Adoption potential of multiple on-farm dairy production strategies among farmers in Murang' a County, Kenya. Livestock Research for Rural Development.
17. Makate, C. (2019a). Effective scaling of climate smart agriculture innovations in African smallholder agriculture: A review of approaches, policy and institutional strategy needs. Environmental Science and Policy. <https://doi.org/10.1016/j.envsci.2019.01.014>
18. Makate, C. (2019b). Local institutions and indigenous knowledge in adoption and scaling of climate-smart agricultural innovations among sub-Saharan smallholder farmers. International Journal of Climate Change Strategies and Management. <https://doi.org/10.1108/IJCCSM-07-2018-0055>
19. Martinez-Baron, D., Orjuela, G., Renzoni, G., Loboguerrero Rodríguez, A. M., & Prager, S. D. (2018). Small-scale farmers in a 1.5°C future: The importance of local social dynamics as an enabling factor for implementation and scaling of climate-smart agriculture. Current Opinion in Environmental Sustainability. <https://doi.org/10.1016/j.cosust.2018.02.013>
20. McKune, S., Poulsen, L., Russo, S., Devereux, T., Faas, S., McOmber, C., & Ryley, T. (2018). Reaching the end goal: Do interventions to improve climate information services lead to greater food security? Climate Risk Management. <https://doi.org/10.1016/j.crm.2018.08.002>
21. Murray, U., Gebremedhin, Z., Brychkova, G., & Spillane, C. (2016). Smallholder Farmers and Climate Smart Agriculture: Technology and Labor-productivity Constraints amongst Women Smallholders in Malawi. Gender, Technology and Development. <https://doi.org/10.1177/0971852416640639>
22. Notenbaert, A., Pfeifer, C., Silvestri, S., & Herrero, M. (2017). Targeting, out-scaling and prioritising climate-smart interventions in agricultural systems: Lessons from applying a generic framework to the livestock sector in sub-Saharan Africa. Agricultural Systems. <https://doi.org/10.1016/j.agsy.2016.05.017>
23. Nyahunda, L., & Tirivangasi, H. M. (2019). Challenges faced by rural people in mitigating the effects of climate change in the Mazungunye communal lands, Zimbabwe. Jàmbá Journal of Disaster Risk Studies. <https://doi.org/10.4102/jamba.v11i1.596>
24. Olorunfemi, T. O., Olorunfemi, O. D., & Oladele, O. I. (2020). Determinants of the involvement of extension agents in disseminating climate smart agricultural initiatives: Implication for scaling up. Journal of the Saudi Society of Agricultural Sciences. <https://doi.org/10.1016/j.jssas.2019.03.003>
25. Partey, S. T., Zougmoré, R. B., Ouédraogo, M., & Campbell, B. M. (2018). Developing climate-smart agriculture to face climate variability in West Africa: Challenges and lessons learnt. Journal of Cleaner Production. <https://doi.org/10.1016/j.jclepro.2018.03.199>
26. Scherr, S. J., Shames, S., & Friedman, R. (2012). From climate-smart agriculture to climate-smart landscapes. Agriculture and Food Security. <https://doi.org/10.1186/2048-7010-1-12>
27. Shames, S., Heiner, K., Kapukha, M., Kiguli, L., Masiga, M., Kalunda, P. N., … Wekesa, A. (2016). Building local institutional capacity to implement agricultural carbon projects: Participatory action research with Vi Agroforestry in Kenya and ECOTRUST in Uganda. Agriculture and Food Security. <https://doi.org/10.1186/s40066-016-0060-x>
28. Shilomboleni, H. (2020). Political economy challenges for climate smart agriculture in Africa. Agriculture and Human Values. <https://doi.org/10.1007/s10460-020-10126-5>
29. Totin, E., Segnon, A. C., Schut, M., Affognon, H., Zougmoré, R. B., Rosenstock, T., & Thornton, P. K. (2018). Institutional perspectives of climate-smart agriculture: A systematic literature review. Sustainability (Switzerland). <https://doi.org/10.3390/su10061990>
30. Westermann, O., Förch, W., Thornton, P., Körner, J., Cramer, L., & Campbell, B. (2018). Scaling up agricultural interventions: Case studies of climate-smart agriculture. Agricultural Systems. <https://doi.org/10.1016/j.agsy.2018.07.007>