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Review

Developing climate-smart agriculture to face climate variability in West Africa: Challenges and lessons learnt

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ABSTRACT

This paper reviewed the prospects for climate-smart agriculture (CSA) development and promotion in West Africa as well as lessons learnt and challenges with a focus on climate change and variability. It was evident from the literature that West Africa is vulnerable to climate change and variability, on account of its socio-economic and physical characteristics. As climate change and variability persists, the region's quest to use agriculture as the mainstream opportunity to deliver on set targets of the sustainable development goals will be strongly challenged without appropriate interventions. Adopting CSA seems to be a suitable strategy to achieving food security while also mitigating and adapting to climate-related risks. Among numerous CSA technologies, the review found (1) agroforestry (farmer-managed natural regenerations), soil and water conservation technologies (zai, half-moon, tie/contour ridges, conservation agriculture) and (3) climate information services as highly valued promising options for climate change adaptation and risk management in West Africa. In addition, institutional settings at the community, national and regional levels such as the establishment of multi-stakeholder innovation platforms, national science policy dialogue platforms on CSA in parts of West Africa and the formulation of the West Africa CSA Alliance were found to be crucial in promoting capacity development and awareness of CSA technologies and innovations in the region. The review found that CSA still faces a number of challenges, including: lack of clear conceptual understanding, limited enabling policy and financing. The prospects of CSA in West Africa hinge on the capacities of farming households and the region's national institutions to understand the environmental, economic and social challenges in the context of climate change, and consequently self-mobilize to develop and implement responsive policies at appropriate scales.

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1. Introduction

With climate change already compounding the socioeconomic and biophysical constraints to development in West Africa, the adoption of climate-smart agriculture (CSA) is one mainstream opportunity to improving food and livelihood security in the region. As an innovative approach, CSA may effectively achieve the development goals of vulnerable populations highly dependent on agriculture although this will depend on effective management of the synergies and trade-offs between the mitigation, adaptation and productivity goals of CSA. While CSA may be a new term for a set of agricultural innovations, tools and policies, the concept is already embedded in many indigenous practices, tools and approaches that have helped farmers produce food in the face of changing and varying climatic conditions. For instance, traditional fallow systems, crop rotation and water harvesting practices such as *Zai* in the Sahel allow for sustainable conservation of water and soils for improved crop productivity and livelihoods (Lahmar et al., 2012). Meanwhile, advances in CSA research has also led to the development and dissemination of relatively new approaches, tools and policies such as solar-powered drip irrigation systems, integrated tree-crop-livestock systems, high yielding and drought resistant seeds, agriculture insurance, climate information systems, development of national and regional climate change action plans and policies which open new vistas of opportunities for farmers and production systems to adapt and/or mitigate climate-related risks. With the concept of CSA still developing and the complexity of the socioeconomic, political, cultural and ecological environment of West Africa, getting farmers to adopt and practice CSA technologies may likely encounter challenges despite the tremendous benefits attached to its adoption. While greater emphasis in the literature has been placed on climate change and variability effects and projections for West Africa (e.g. Jalloh et al., 2013; Zougmoré et al., 2016; Roudier et al., 2011), there is limited attention to lessons learnt and challenges that confront the development and adoption of agricultural practices that counter climate change (Neumann et al., 2010). As policy makers and development experts attempt to help poor and marginal farmers adapt to climate change as an opportunity to deliver on the food security targets defined by the sustainable development goals, knowledge on agricultural innovations that deliver on the principles of CSA will be crucial for bringing CSA to scale in the region. In this paper, we discussed (1) the need for CSA in West Africa, (2) some notable agricultural innovations that deliver on CSA principles in the region, (3) institutional settings that could help scale up CSA, and (4) some challenges that must be addressed to improve understanding on CSA concepts and speed up its scaling up in the region. We used evidence from the literature to discuss the aforementioned areas to draw implications on the prospects for CSA development and promotion in West Africa.

2. Methodology

Earlier, we had carried out a participatory selection of CSA options for testing in 5 locations within 5 countries (Ghana, Mali, Niger, Senegal and Burkina Faso) with participants being the local farmers who would trial the options, researchers from national and international agencies, and policy makers. The selected options have then been under testing for 7 years. Initial results suggest that of the initial options, six have been prioritised for further development and testing – these are the six that informed the focus of this paper discussed in section 4. These include: (1) conservation agriculture, (2) climate information services, (3) agroforestry – farmer managed natural regeneration, (4) planting pits – zai and half-moon, (5) drip irrigation and (6) erosion control techniques – tie/contour ridges and stone bunds. For each of the six, we have searched for the appropriate literature relevant to West Africa. The review employed Scopus for literature identification. The compound field TITLE-ABS-KEY that searches abstracts, keywords, and article titles was used to identify CSA literature that were specific to West Africa. The search was narrowed to peer-reviewed and grey literature published in English and French on and after 2000. Search keys for each practice in relation to climate change are enumerated in Table 1. In order to review papers based on the 3 pillars of CSA (productivity, mitigation and productivity), search keywords for productivity, mitigation and adaptation were also included where applicable (Table 2). Search results were subjected to filtering by reading through abstracts and titles and removing duplicates. In Table 3, we provide a list of literature found to be most relevant to this paper and catalogued into the 3 pillars of CSA. Moreover, we established national science-policy learning platforms in the above-mentioned countries and these have been operating for 5 years. These multi-stakeholder platforms consisting of academics, the media, researchers, NGOs, policy makers, farmer-based organizations, traditional leaders, etc. are settings through which scientists and policy makers interact, and challenge each other's opinions to come up with jointly developed knowledge aiming at informing policy decision processes. From the discussions in such fora, we have distilled institutional options that would foster uptake of CSA and the on-going challenges to CSA in Sections 5 And 6 respectively.

3. Why promote climate-smart agriculture in West Africa?

The literature attests to West Africa as being vulnerable to climate change and variability, on account of socio-economic and physical characteristics (Baptista et al., 2013). Farmers have to cope with highly variable, short and unpredictable rainfalls. Yet, agriculture in this region is essentially rain fed. With increasing variability of climate change, water resources for agriculture may become more unpredictable. In addition, increased run-off frequency and soil erosion has rendered many agricultural lands degraded (Zougmoré et al., 2014). This therefore necessitates adopting agricultural innovations that improve the efficient use of green water (rain water available in soil for plant use) and offer the opportunity to improve soil productivity and mitigate climate-related risks.

Climate change impacts are already known to West African