Barriers, incentive mechanisms, and roles of institutions in scaling climate-smart agriculture (CSA) interventions in rice growing environments in Mali

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Contents

Abstract

Climate change has many facets, including changes in long-term trends in temperature and rainfall regimes, increased year-to-year variability, and frequency of extreme events. Agriculture is the most affected, particularly in Sahelian countries, due to a scarcity of productive resources. Transitioning towards more resilient food systems requires the adoption of climate-smart agriculture (CSA) interventions. This study uses a participatory framework that provides ample space for local stakeholders to integrate their knowledge and experience in the assessment of the barriers, incentives mechanisms, and roles of institutions for scaling out locally relevant CSA interventions. The framework was applied to the four rice-growing environments in Mali, a Sahelian landlocked country, that provides 11% of the rice production of the West African region. The results showed that the adoption levels of the CSA interventions were low. The barriers to large-scale adoption of CSA interventions were specific to the rice growing environments and interventions, but overall included the lack of funding, equipment, capacity, and cost for implementation, insufficient fertilizer, quality seeds, and low farmers' awareness of the benefits of the interventions. Stakeholders emphasized the importance of subsidies, capacity building, and access to extension services as essential incentive mechanisms, and governments, farmers' organizations, women's organizations, youth organizations, and research and academic institutions as key players for scaling CSA interventions at the local level. The framework provides a decision-making tool for investment in CSA intervention scaling.

Keywords. Adoption, CSA, funding, investment, scaling, stakeholders

1. Introduction

Rice is one of the significant staple foods in SSA. Due to the triple effects of rising per capita consumption, urbanization, and demographic growth, rice consumption has increased significantly since the 1960s (Balasubramanian et al., 2007). The annual per capita consumption of rice exceeds 100 kg in some nations, including Guinea, Guinea-Bissau, Liberia, Madagascar, Mali, and Sierra Leone. The per capita consumption increased steadily from 10 kg in 1961 to 54 kg in 2017 (FAOSTAT, 2022). Despite rising rice consumption, domestic production can only meet 56% of the demand; the remainder is filled by imports, mostly from Asia (FAOSTAT, 2022). Due to the small rice cultivated area and low yield, there is insufficient rice production in SSA (van Oort et al., 2015). In comparison to the global average (4.6 t/ha in 2019), agricultural yields are low (on average 2.2 t/ha in 2017) (FAOSTAT, 2022) due to ineffective crop management practices, and biotic and biotic stresses (Niang et al., 2017; Tanaka et al., 2013, 2015, 2017; Dossou-Yovo et al., 2020, 2021, 2022a; Ibrahim et al., 2021; Diagne et al., 2013). Climate change has made the problems faced by the rice industry in the region worse (van Oort and Zwart, 2018). Making decisions in rice farming has become difficult because of the variability of the inter-annual and seasonal rainfall (Nyadzi et al., 2018). In addition to temperature increases, climate change in the region is predicted to cause changes in rainfall patterns, a rise in the frequency of extreme weather events (droughts and floods), desertification, and changes in disease vectors, all of which will have an impact on the spatial and temporal transmission of infectious diseases, as well as crop yield (Zougmore et al., 2016).

To adjust and reorient agricultural systems to support food and nutrition security in the face of climate change, climate-smart agriculture (CSA) has been proposed. Technologies (innovations, techniques, or services) that raise productivity or sustain it over time, improve farmers' climate resilience, and lower greenhouse gas emissions are referred to as CSA (Andrieu et al., 2017). Drought and submergence-tolerant rice varieties, alternate wetting and drying, mulching, land development for improved water control, site-specific crop calendar construction, fertilizer application, conservation tillage, crop diversification options, and improved processing and storage facilities are examples of CSA interventions (Dossou-Yovo et al., 2022a; Ibrahim et al., 2021; Ndindeng et al., 2015).

Despite the evidenced benefits of CSA interventions, farmers are only slowly adopting them (Makate, 2019). Previous studies showed that the adoption of CSA interventions is affected by the potential adaptation benefits, the viability of implementation, the barriers, and the incentive programs offered by the government and other agencies to farmers and farming communities (Khatri-Chhetri et al., 2019). These factors heavily influenced the decision-making of local farmers, resource managers, and policy-makers, particularly on the resource allocations required for adopting CSA interventions. Although there is ample evidence of the advantages of CSA interventions, less research has been done on the barriers and incentives that must be overcome by farmers, and other value chain actors. The objectives of this study were to assess the current adoption levels of CSA interventions in the rice-growing environments in Mali, the barriers and appropriate incentive mechanisms, and the roles of institutions to ensure large-scale adoption.

2. Material and methods

2.1 Study sites

This study used a participatory approach that integrated the knowledge, and experience of stakeholders in the assessment of CSA interventions at the local level. Stakeholder consultation workshops were organized to evaluate a range of CSA interventions in the four major rice production systems in Mali: irrigated lowland, rainfed lowland, rainfed upland, and submergence system. The region of Mopti was selected for submergence rice; Niono, Segou, Baguineda, and Selingue were selected for irrigated lowland; and Sikasso was selected for rainfed lowland and rainfed upland. These regions were identified by the National Agricultural Research and Extension Systems (NARES) as priority intervention regions for rice research and development and are characterized by different climatic conditions (Fig. 1). For further information about the methodology and the results from the prioritization, please, refer to Dossou-Yovo et al. (2022b).

2.2 Data, method, and analysis

The stakeholders evaluated 17 CSA interventions in the irrigated lowland, 16 in the rainfed lowland, 12 in the rainfed upland, and 9 in the submergence system, although some technologies, like the digital application for site-specific fertilizer recommendations, can fit multiple rice growing environments. A total of 144 stakeholders participated in the consultation workshops, of which 63% were from farmer organizations, 14% from the private sector, 11% from development organizations, 8% from agricultural research organizations, and 4% from extension offices. The farmers' representatives were chosen at random but in a way that guaranteed there are 40% female farmers. The workshop included participation from women's and youth organizations from the selected locations.

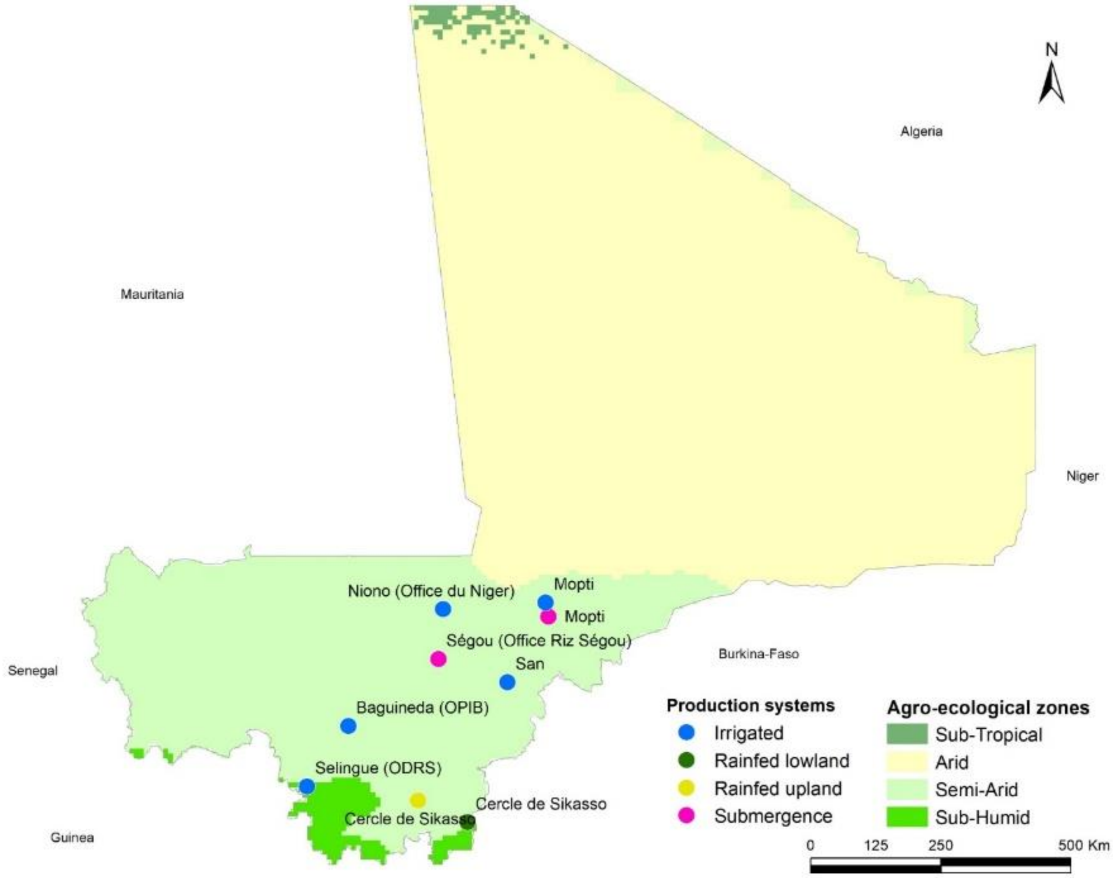

Fig. 1. Location of study sites per rice production system overlaid in the agro-ecological zones map.

All stakeholders evaluated the current level of adoption of each CSA intervention by men and women farmers by using a 0–5 Likert scale, where 0=no adoption, 1=very low adoption, 2=low adoption, 3=medium adoption, 4=high adoption, and 5=very high adoption. The study also assessed the adoption barriers of each CSA intervention by using a 0–5 Likert scale, where 0= not a barrier, 1= a very low barrier, 2= a low barrier, 3= a medium barrier, 4= a high barrier, and 5= a very high barrier. The adoption barriers considered in the study were: finance (farmers' investment capacity), machinery (level of farm mechanization), availability of labor resources, availability of seed, availability of fertilizer, availability of pesticide, availability of land, poor land tenure, reliability of irrigation water supply, lack of information on climate risks, lack of information on the technology, the inexistence of market to sell the product, price of the product, and lack of capacity or skill to implement the intervention.

The key incentives to scale out the CSA interventions at the local level were assessed by the stakeholders. The incentives considered in the study included access to subsidies, crop insurance, access credit, access to extension services, capacity building, and access to the market. The assessment of the key incentives was made by using a 0–5 Likert scale, where 0= not a requirement, 1= a very low requirement, 2= a low requirement, 3= a medium requirement, 4= a high requirement, and 5= a very high requirement.

Several institutions at various levels support farmers and farming communities, each with its own set of roles and responsibilities. Governments, the private sector, and development organizations can play critical roles in scaling out a variety of CSA interventions that are appropriate for a specific location and farm. Similarly, farmer organizations, women's organizations, youth organizations, and water user associations can contribute to the promotion of CSA interventions in a variety of locations. The stakeholders assessed the role of the following institutions in promoting the adoption of each of the CSA interventions at the local level: government, farmers organization, women farmers organization, youth farmers organization, custom hiring services, innovation platform, water user association, Non-Governmental Organization, private sector and research and academic institutions. The assessment was made by using 0–5 Likert scale, where 0= no role, 1= a very small role, 2= a small role, 3= a medium role, 4= a big role and 5= a very big role.

3. Results

In the irrigated lowland, rainfed lowland, rainfed upland, and submergence systems, respectively, the average levels of CSA intervention adoption were 19, 14, 13, and 7%, and they were 14% across all rice-growing environments. Drought-tolerant rice varieties and rice-vegetable rotation were the most widely adopted interventions in irrigated lowlands, while rice-tuber rotation was the most adopted intervention in rainfed lowlands. In the rainfed upland, rice-tree was the most adopted. Submergence-tolerant rice varieties were the most adopted interventions in the submergence system.

The major adoption barriers to the adoption of CSA interventions in irrigated lowlands were the lack of funding, equipment, capacity for implementation, and cost of technology. In the rainfed lowland, the major adoption barriers were lack of funding, insufficient fertilizer, and high implementation costs. High barriers to the adoption of CSA interventions in rainfed uplands include a lack of funding, equipment, high-quality seeds, fertilizers, the ability to implement interventions, and the cost of interventions. In the submergence system, the lack of funding, equipment, fertilizer, low awareness, cost, and a lack of capacity for implementation were cited as major obstacles to the adoption of CSA interventions.

When asked about the key incentives to scale out CSA interventions, stakeholders emphasized the importance of subsidies in the irrigated lowland. In the rainfed lowland, stakeholders highlighted capacity building and access to extension services as essential incentive mechanisms. In the rainfed upland, extension services, access to subsidies, and capacity building were cited by stakeholders as key incentive mechanisms. In the submergence system, access to extension services was mentioned as a key requirement in scaling out CSA interventions.

The stakeholders evaluated the key institutions for ensuring large scaling of the CSA interventions in the rice growing environments. In the irrigated lowlands, governments, farmers' organizations, women's organizations, youth organizations, and research and academic institutions were mentioned by stakeholders as key players in promoting CSA interventions at the local level. In the rainfed lowland, governments, farmer organizations, youth organizations, and women's organizations were acknowledged as essential players in scaling interventions. In the rainfed upland, stakeholders mentioned governments, farmers' organizations, youth organizations, women's organizations, and research and academic institutions as key players in scaling out CSA interventions. In the submergence system, stakeholders acknowledged the crucial role that governments, farmers' organizations, women's organizations, research and academic institutions, and others played in scaling out CSA interventions.

4. Conclusion

This study uses a framework that provides ample space for local stakeholders to integrate their knowledge and experience in the assessment of the barriers, incentives mechanisms, and roles of institutions for scaling out locally relevant CSA interventions in the four rice-growing environments in Mali. The study found that the adoption levels of many CSA interventions have been low. The barriers to large-scale adoption of CSA interventions were specific to the rice growing environments and interventions, but overall included the lack of funding, equipment, capacity for implementation, cost of technology, insufficient fertilizer, quality seeds, and low awareness of farmers of the benefits of the interventions. Stakeholders emphasized the importance of subsidies, capacity building, and access to extension services as essential incentive mechanisms, and governments, farmers' organizations, women's organizations, youth organizations, and research and academic institutions as key players for scaling CSA interventions at the local level.

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