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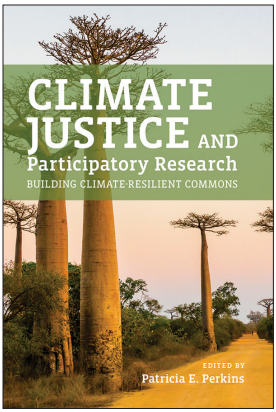

CLIMATE JUSTICE AND PARTICIPATORY RESEARCH: BUILDING CLIMATE-RESILIENT COMMONS

Edited by Patricia E. Perkins

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Enhancing Local Sensitivities to Climate Change Impacts and Adaptation Capacities of Smallholder Farmers: Community-Based Participatory Research

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Introduction: The Importance of Local Responses to Climate Change

Climate change and extreme weather events have led to multi-vulnerabilities worldwide, particularly in many African countries where recent severe droughts, floods, and intra-seasonal dry spells have impacted smallholder farming productivity. This chapter examines crop and livestock smallholder farmers' sensitivities to climate change and their adaptive strategies at the local level in southwestern Nigeria. Using participatory research methods, we investigated local indicators of climate change impacts and adaptation options being adopted by hundreds of rural farmers. We carried out our three-month study with the support of farmers' organizations in two major farm

communities. We found that nearly 97 per cent of farmers have experienced delays in rainy-season onset and changes in times for the ending of the rains during the growing seasons, and have noticed low yields of some crops in recent years compared to the average over the past thirty years. We were able to derive locally relevant climate change assessment indicators in the study sites, which included such factors as rural farmers' awareness of climate change, its impacts, and specific adaptation measures. This research has improved our understanding of how climate change affects smallholder farmers and their socio-economic systems through the documentation and analysis of local knowledge and perceived effects of climate change. The participatory research process has also raised awareness, understanding, and agency in the local communities.

Climate change is a global crisis which, out of necessity, is being addressed in diverse and innovative ways at local levels worldwide. While there is vast general evidence of climate change, its impacts, and the many ways in which it affects agriculture, sensitive local adjustments are a vital means of adaptation in African countries. Continent-based climate assessments show that Africa is positioned to experience significant climatic changes, as extreme drying and warming occur in most African regions, with regional variations (Ayanlade et al., 2020b; Boko et al., 2007; Dunning et al., 2018). But "bottom-up" assessments from the perspective of local people, focused on understanding the interactions among multiple types of climate change risks and impacts, the sensitivities of different agrarian rural communities, and particularly gender impacts, have been relatively scarce and limited. Multi-hazards resulting from extreme weather events due to climate change have affected nearly six billion people (due mainly to water scarcity) and caused over eighty million casualties globally; most affected people are seniors, children, and women who live in rural agrarian communities (Lal, 2004; Rippke et al., 2016; Woolf et al., 2010). In Africa, extreme weather events have led to recent severe droughts (Ayanlade et al., 2018b; Ogunrinde et al., 2019), floods (Adelekan & Asiyanbi, 2016; Ahmadalipour et al., 2019; Lamond et al., 2019), and intra-seasonal dry spells (Fall et al., 2019; Han et al., 2019) which have great impacts on agricultural productivity, putting stresses on food security (Ayanlade et al., 2017; Lipper et al., 2014), water scarcity resources (Schilling et al., 2020; Shiru et al., 2019), and human health (Ayanlade et al., 2020a; Ayanlade & Radeny, 2020; Ayanlade et al., 2020b; Sergi et al., 2019). Some studies have shown that climate change represents the major challenge for

future development, particularly in the drier parts of the continent, due to its increasing impact on crops and pastoral farming, ecosystem services, human health, and livelihoods (Adger et al., 2009; Ayanlade et al., 2018b; Mbow et al., 2014).

Year-to-year climate change impacts on crop production have resulted in severe agricultural losses in many African countries, which in some cases have led to unprecedented famines (Adejuwon, 2004; Kang et al., 2009). For example, a study by Adejuwon (2004) has reported inter-annual rainfall variability as a major factor affecting crop yields in Nigeria. Local farmers often do not have sufficient scientific information relating to the full range of causes and implications of climate change, and as such, their actions and adaptation strategies sometimes fall short of the desired result. The Intergovernmental Panel on Climate Change 6th Assessment Report (IPCC, 2021) shows that for adaptation to be effective, local knowledge is needed in conjunction with other forms of knowledge. The report further notes that economic poverty, political instability, and low productivity, which constitute important challenges in Africa, worsen and interact with the impacts of climate change. It is obvious that adaptation planning and implementation at the local level in Africa are essential for developing robust responses to climate change.

As an exploration of how this can be done, we set out to assess smallholder farmers' sensitivities to climate change and their adaptive approaches and rationales at the local level. Smallholder farmers, in this study, include small-scale farmers who own or control the land they farm but do not use mechanised equipment. They are typically operating under a small-scale agriculture system where they grow and commercialize their products alone or in local groups of neighbouring farmers. An important motivation of the study was to compare the perceptions of rural crop and livestock farmers to meteorological analyses in order to assess weather variability/changes and how rural farmers understand and view these changes. The study focused on two major research questions: the sensitivity of smallholder farmers to climate change and their adaptive capacity. As noted in the literature, adaptation and mitigation of anthropogenic climate change are significantly dependent on human sensitivity to its impacts and risks (Cox et al., 2018; Pecl et al., 2014; Trisos et al., 2022). We therefore tried to document the farmers' awareness of climate change, its impacts and specific adaptation measures, as a locally driven way of appraising the impacts of changes in rainfall and temperature during the rainy and dry seasons. The farmers' own assessments

provide information about how their strategies help protect their livelihoods, minimize risk, and shape interactions among variables that (unlike weather fluctuations) are within the farmers' control. This, in turn, indicates considerations that policy-makers, extension agents, education institutions, and community organizers should consider to support adaptation and socio-economic welfare in regions affected by climate change.

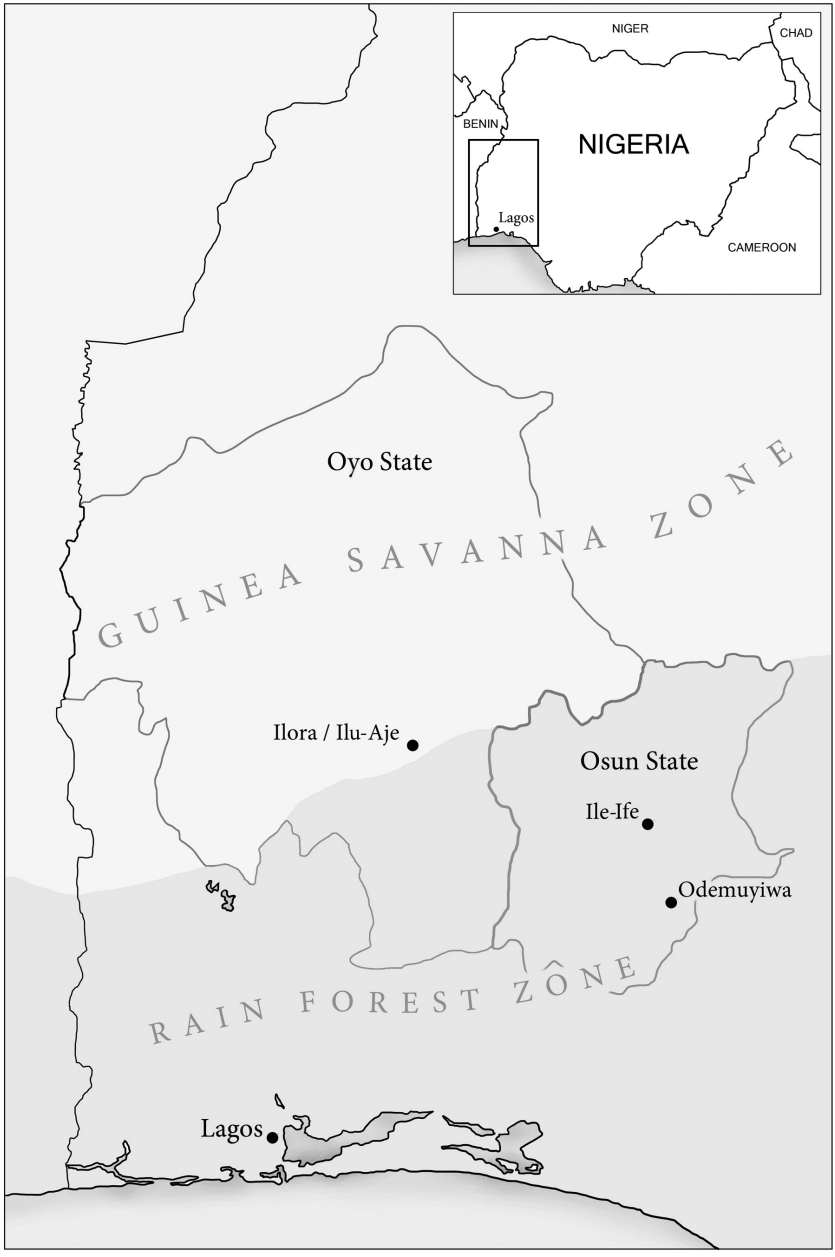
This chapter describes our study's context, methodology, and outcomes. In the conclusion, we comment also on the relationship between methodology and results: how our study's relatively attentive, community-based, participatory approach made possible some of our nuanced findings.

Study Area, Goals, Research Partners, and Methods

We carried out our research in the southwestern part of Nigeria (Map 3), with local farmers' organizations located in the rural communities of Odemuyiwa and Ilora/Ilu-Aje, which are among the most populous smallholder farming communities in southwestern Nigeria.[1] Yoruba is spoken in the study area, and the population also includes some Hausa farmers and Fulani livestock farmers. Crops include cocoa, maize, cassava, vegetables, and other farm produce.

We had several reasons for selecting these two communities. Besides the fact that they are the major smallholder farming communities in the region and are accessible from our university's location in Ile-Ife, they are located in the two main agro-climatic zones of Nigeria: Ilora is located in the Guinea Savanna; Odemuyiwa is located in the Rain Forest agro-climatic zone. The Guinea Savanna zone is known for cereals and tuber crop farming while the Rain Forest zone is known for cash crops and tree crops such as cocoa, coffee and kola nut. Thus, working with smallholder farmers in these two communities allowed us to sample perceptions of climate change impacts and adaptation across different agro-climatic zones and different kinds of farming practices. The soils across the study area are rich and appropriate for the kinds of cultivation undertaken.

We explored climate change impacts and multi-risks using mixed methods and multi-disciplinary approaches to develop what we call a multiplying vulnerability index. This relied on both quantitative and qualitative information from questionnaires and in-depth focus group discussions (FGDs) with farmers. A set of semi-structured questions was used for in-depth interviews.



Map 3 Nigeria—Osun and Oyo States

Care was taken to purposely interview individuals who had been farming for periods longer than ten years, and who thus had experience with farm and weather conditions in the area over time. The questions were related to impacts of climate change, perceptions and responses to climate change impacts, adaptive capacity, and vulnerability. The FGDs facilitated information exchange on the farmers' perceptions, local indicators of climate change, its impacts, and their adaptation strategies. We also gathered information on the demographic characteristics of the farmers, their agricultural practices, means of climate change awareness, and other details. This was to understand the determinants of farmers' choices of adaptation methods and adaptive capacity through climate-smart agriculture or other initiatives.[2] As a way to increase our work's relevance, applicability, and potential usefulness for local people, we developed our research questions and approach in conjunction with the local farmers' organizations that were our partners in this research process: the Odemuyiwa Farmers' Association, Agbeloba Farmers Society of Ilu-Aje (Agbeloba means that as providers of food for the community, "farmers are the kings"), the Ilora Women's Farm Association, and the Ilora Smallholder Farmers Cooperative. The lead researcher, while introducing the project and requesting leaders' support and participation, also carried out "key informant" interviews with local chiefs, elders, and leaders. The farmers' organizations kindly introduced the lead researcher at their regular meetings, provided him with lists of member farmers, and appointed a liaison member to help him make appointments, accompany him, and introduce him to farmers to be interviewed each day. Interviews were mostly carried out in the fields, during the farmers' breaks. Women farmers were mostly interviewed on market days in their market stalls, in between their attending to customers.

Through collaborations with the farmers' organizations, we organized training workshops for farmers in each of the communities (Odemuyiwa and Ilora/Ilu-Aje) to discuss concepts, policies, and mechanisms relating to climate change impacts and adaption on agriculture and food security, linked to the livelihoods of smallholder farmers in the study sites (Figure 3.1). The invited participants included both livestock and crop farmers, representatives from local government authorities, and rural community leaders in the settlements where their primary occupations are farming. The workshops, FGDs, and interviews were led by a team of twelve researchers (six men, six women) made up of lecturers, graduate and undergraduate students from

Fig. 3.1 Workshop/training on climate change impacts held in Odemuyiwa village, Osun State, Nigeria.

the Department of Geography, Crop Production and Protection, and the African Institute for Science Policy and Innovation, Information Technology, of Obafemi Awolowo University in Ile-Ife, Nigeria. More than two hundred and fifty smallholder farmers and other guests participated in each workshop, roughly one-third of whom were women. The individual interviews with elders, leaders, and farmers numbered about forty-five in Odemuwiya (about fifteen of whom were women farmers) and about twenty-five in Ilora (ten of them women and four of them Hausa-speaking pastoralists from northern Nigeria who had moved to the area in recent years). The participants' ages ranged from thirty-five years to over sixty years. Many of the participants had at least fifteen years of farming experience and had been living in the communities over a long period of time; many were native to the communities.

The FGDs (Figure 3.2) were held either outside or in large churches in each community, and besides farmers, local youths were invited, along with a group of more than ninety undergraduate students from Obafemi Awolowo University

Fig. 3.2 Focus Group Discussion on climate change impacts, held in Ilu-Aje/ Ilora, Oyo State, Nigeria.

Fig. 3.3 University undergraduates visit Odemuyiwa and learn how climate variability affects agricultural productivity in the rural community.

who came by bus for the day, mingled and spoke with local youths and farmers, and learned about how to conduct participatory research. Among other presentations on climate change science and adaptation (Figure 3.3), university climate researchers brought a mobile weather station and showed interested farmers how it works to record and transmit rainfall and temperature data.

Other methods that research team members used to gather information included observation, investigation, measurements, field sketches, audio-video recording, photographs and GNSS (Global Navigation Satellite System) surveys. The workshops, with participants' permission, included digital audio and video recordings, and photographs (Figure 3.1), which were used to document and share farmers' sensitivities to climate change impacts, and their adaptation capacities, including from a gender perspective.

On the day of the team's arrival for the workshop that wound up our research in each community, the local participants were already assembled in a church hall facility. After introductions were made and participants' attendance was taken, an information session on climate change awareness was held. The main activities were based on FGDs in small groups, facilitated by members of the research team, who also made presentations on different climate change topics including the dynamics of climate as it affects crop yields; crop production, processing, and protection; and the technologies and incentives available to farmers. Team members joined in the Q+A discussions with all participants.

Farmers shared their suggestions regarding key areas researchers could explore to bring agricultural dividends to local farmers and facilitate their adaptation to climate change. At the end of the session, certificates were issued to participants, and cutlasses were given out too, as thanks for everyone's participation and to aid their farming activities. All participants shared a meal at the end of the workshop (Figures 3.4 and 3.5).

Participatory aspects of the research design included researchers' gradual introductions to community members, facilitated by local organizations and individuals; various opportunities for individual and group information-sharing in informal conversations, interviews, FGDs, and workshops; familiarization of farmers and local youth with climate communication terms, climate science, and potential adaptation measures; building political agency and stakeholder engagement through the farmers' organizations and local networks; respectful acknowledgement and sharing of local knowledge and innovations in facing climate change; special attention to the particular

Fig. 3.4 and **3.5** Workshop participants received cutlasses in appreciation of their sharing knowledge on climate change.

socio-economic contributions and multi-vulnerabilities of women farmers; and opening up possibilities for further ongoing communication and linkages between the villages and the university at both inter-personal and institutional levels.

Results and Discussion: Farmers' Climate Change Knowledge and Adaptation Strategies

In both the research design and the interpretation of results, we relied on Jost et al. (2014) and the framework for understanding local adaptive capacity (LAC) developed by Jones et al. (2019) as part of the Africa Climate Change Resilience Alliance (ACCRA) initiative. Within this framework, LAC for smallholder farmers is seen as depending on the context-specific interaction of governance institutions, social learning, trust, collective action, creativity / innovation, and the availability of assets; particularities of gender, politics, and power are also important. The LAC model groups these characteristics in five distinct but interrelated attributes of adaptive capacity. These include the asset base; institutions and entitlements; knowledge and information; innovation; and agile, forward-looking decision-making and governance.

Assets are very important for smallholder farmers, as the poorest are most vulnerable to the effects of climate change and broader developmental stresses. Lack of assets is likely to affect the ability of smallholder farmers to cope with the effects of climate change. Gender is a strong determinant of asset limitations for women farmers. Institutions and entitlements mediate access to and/or control of asset-based resources. Knowledge and information are required for a better understanding of the observed and possible future climate change impacts and their complexity, awareness of climate change adaptation options, ability to test options, and the ability to incorporate interventions. Decision-making and governance are key to supporting the capacities of smallholder farmers in coping with the consequences of climate change. Organising response options can help them better handle the effects of climate change along with other socio-economic and ecological pressures. This can be achieved through effective innovation that involves both scientifically and traditionally focused technology and innovation tailored to local projects that help smallholders respond to climate change impacts and risks. LAC theorists also note the importance of context and dialogue among community members in this regard (Jones, 2019; Jost et al., 2014). In our analysis

of results from our research in the two communities, therefore, we consider all these factors as related to the adaptive capacity and practices of local farmers.

The outcomes of our research indicated that both crop and livestock farmers have certainly noticed changes in climate. During our participatory engagement with the farmers, the majority stated that they had perceived changes in times for the start and end of the rains during the growing seasons, and noticed that some crop yields are lower in recent years compared to the past thirty-year average. Livestock farmers are now finding it difficult to find water and green pastures during the prolonged dry spell. Nearly all the farmers perceived changes in the onset of rainfall. The level of awareness of local people about weather changes linked to global warming, and their sensitivities to this, are very strong.

Generally, the farmers perceive many changes in the climate system including the increase in the annual minimum temperature and reduction in the same in the coldest and hottest seasons, increase in the maximum temperatures in both seasons and reduction in the amount of rainfall in both seasons. Many farmers observed changes in the mean temperature, frequency of cold days, sunny days, and sunshine intensity and the intensity of heavy rainfall events was generally agreed to be on the increase. The frequency of warm days and changes in mean rainfall was agreed to be higher. The temperature is perceived to be on the increase only in the hottest season. Since rains are now delayed, cropping seasons are now shortened and planting dates are no longer fixed.

The farmers (both male and female) indicated that rainfall has been much more unreliable in recent years. The majority of the rural farmers perceived that "the climate is by far away from what we used to have in the past, the climate change has resulted into changes in the biophysical environment, poor yield of crops as a result of change associated with reduction in rainfall, attack of pests and diseases." They further stated that "some pests not known in years back are now prominent, while crops planted in the past are not as productive as they were, even tree crops are no longer sustainable."

The perceptions of farmers regarding changes in the intensity of rainfall and numbers of rainy days, heat changes/variability, and their sensitivities are generally consistent with climatic trend analysis. Previous studies have shown that sub-Saharan Africa is likely to be more vulnerable to climate change than other parts of the world, not only because the economy depends

on rain-fed agriculture, but also due to the difficult challenges of poverty including food security, health challenges, and low levels of infrastructural and technological development (Ayanlade & Ojebisi, 2019; Ayanlade et al., 2018a; Bryan et al., 2018; Mogomotsi et al., 2020; Morton, 2007; Thornton et al., 2011). Drought and heavy rainfall-induced floods are projected to become more frequent and severe, thereby increasing pressure on freshwater resources. In particular, there is high confidence (Ayanlade et al., 2018b; Hillie & Hlophe, 2007) that risks associated with increases in drought frequencies and magnitudes are projected, even at an average global temperature increase of 1.5°C, for many African countries. What worsens the situation is that nearly 41 per cent of the population in Africa lives below the international poverty line of US$1.90 per day (World Bank, 2018).

Earlier studies have shown that because the majority of crop-farming activities in Nigeria are rain-fed, rainfall is the most important element of climate-related risk, a change of which will greatly affect both crop and livestock farming in the country. Thus, crop and livestock farmers in Nigeria are likely to be severely affected because of their low levels of adaptive capacity to climate change/variability (Adejuwon, 2004; Boko et al., 2007; Liverpool-Tasie et al., 2019).

Farmers' perceptions of climate variability/change were based on the local climate parameters they identified, but it was apparent from all our information-gathering that these farmers are particularly vulnerable to climate change since the majority of them do not have enough assets or resources to cope with the situations they are experiencing. Many farmers who participated in our study made suggestions that facilitators should link them to policymakers who could intervene to help resolve their farming plight.

Some suggested that there is an urgent need to establish cooperatives headed by the local farmers with facilitators (perhaps from the university) as supporting members, who could provide advice on farming activities and help farmers gain access to agricultural loans and other incentives. In other words, the government could build the capacity of agricultural extension systems (Morton, 2007) and make available climate change education schemes (Ayanlade & Jegede, 2016), perhaps using communications technology innovations such as cell phone applications.

Our collaboration with local farmers' organizations allowed us to observe through participant observation the local mechanisms that exist in both communities to facilitate communication about problems farmers face: reliance

on elders and leaders, development of social trust, information-sharing, and development of creative initiatives to advance collective well-being. For example, the farmers' repeated suggestions and questions related to funding options and support for their climate resilience projects showed that they are interested in organizing a collective community-based appeal and approach to climate adaptation to take advantage of any institutional opportunities. While the three-month time frame of our research may not have given us a thorough understanding of how local governance institutions work and how power is distributed or implemented in each community, we agree with the LAC framework that this is fundamentally important and has many gender implications. The majority of farmers stated that "governments need to help rural farmers, with financial and mechanical aids to cope during climate extreme events." Such aids are most needed by female farmers who are heads of households; the majority of them stated that they "do not have adequate financial aids and assistance like the male farmers in their communities." Consequently, "female farmers are less able to adapt to climate change than male farmers"; this was agreed on during the FGDs.

In Nigeria, like many other African countries, medium- and long-term adaptive measures have been identified in the national communications to the United Nations Framework Convention on Climate Change. The Ministry of the Environment in Nigeria, for example, has identified emergency measures for adaptation in the National Adaptation Programmes of Action (NAPAs), which focus on agriculture, food security, water resources management, and other sectors. Many of the measures have not yet been fully implemented, leaving many farmers without a sound understanding of the challenges facing agricultural production that result from climate change and the plans for facing them. Though campaigns towards behavioural and policy change as a result of climate change may be a long-term adaptation matter, farmers' awareness of climate impacts, such as the frequency of extreme weather events, needs to be addressed expeditiously (Ayanlade et al., 2022) in the rural areas of southwestern Nigeria, and throughout the country—a major gap that this study addresses. The findings of this study, identify a need to build farmers' capacity development programmes to assist them in coping with the changing climate.

Nonetheless, farmers are very resourceful and are using options open to them to increase their climate resilience. We were able to document a number

of adaptation strategies that farmers are already adopting. These include the following:

- Shift planting dates to accommodate changes in onset of rains, even year to year.
- Irrigate using head-carried water from boreholes during droughts to keep plants alive (though this is very labour intensive and not practical at more than minimal scales).
- Plant new, water-intensive cash crops such as cucumber, watermelon, golden melon, carrot, and cassava species, at times of peak rainfall, to earn income to tide themselves through times of drought that may cause major rain-fed crops to fail.
- Minimize risk by sending family members to cities for work, who can remit funds to tide others through crop failures and drought.
- Seek funding for collective construction of new water wells and boreholes.

For all these adaptation strategies, we noted that several factors are related to specific farmers' ability to adapt and to determine their choice of adaptation methods. The principal factors determining their options are income, level of education, and years of farming experience. Farmers detailed that "lack of financial capital hinders the ability to purchase mechanized irrigation systems as adaptation methods during prolonged dry spells." Many of them claimed that they "have little income from smallholding farming and this is a major barrier to adopt some adaptation methods, especially those that are capital intensive." As per the LAC model, those with more assets and resources, knowledge and information, and entitlements are better able to innovate and take advantage of power differentials to adapt to climate change-driven shocks and trends.

With regard to differences between the Guinea Savanna and Rain Forest agro-climatic zones, we documented that rainfall variation and droughts are more frequent in the more northerly Guinea Savanna area, where there are fewer tree crops and thus more extreme dependence on annual rainfall and more pressure for irrigation. Through interviews with farmers, we also heard of incipient land conflicts between Hausa-speaking in-migrants who

are animal herders and longer-term Yoruba-speaking residents whose crops are sometimes harmed by grazing animals. This reflects migration pressures on farmers living further north in Nigeria, also caused by climate change. Such conflicts have the potential to damage adaptation requisites noted in the LAC model such as social trust, effective governance institutions, entitlements, and asset distribution, reducing adaptation ability for some and likely increasing economic disparities within the farm communities.

Conclusion

In this study, we used participatory research methods to assess smallholder farmers' sensitivity to climate change and their adaptation strategies. Our goal was to improve understanding of how climate change affects smallholder farmers and their socio-economic systems through the documentation and analysis of local indicators and perceived effects of climate change. The results show that the majority of smallholder farmers are sensitive to climate change, as many of them are aware of changes in both rainfall and temperature in recent years. The majority of farmers claimed that recent changes in rainfall and temperature have significant impacts on the development and yield of many crops. They acknowledged the evidence of climate change in their rural communities. They had good understanding of changes in climate conditions in recent years, which they said include shortness of the duration of seasonal rainfall, and consistent intensification of temperatures during the daylight and sometimes also at night. They acknowledged that while some farm pests are no longer evident, others are still very much present and cause serious damage to their crops. They are changing their farm practices as best they can, given their differing vulnerabilities and options, to adapt to these changing farm conditions while attempting to preserve their socio-economic resilience.

This research adds to knowledge about participatory ways to assess multi-risks and multi-hazards resulting from climate change. Since there is high confidence that multi-risks of climate change are likely to aggravate poverty in Nigeria, where millions of people's livelihoods depend on rain-fed agriculture and the immediate natural environment, these approaches have great implications for well-being.

Our participatory fieldwork, which included a range of research methods, allowed us to explore climate change from the "grassroots" perspective

of farmers, gathering detailed information about the many interacting factors identified in the LAC model as influencing climate adaptation abilities and overall social impacts of climate change. This in turn has enhanced the theoretical and scientific conclusions in the literature about the large impacts of climate change on smallholder agriculture in this particular context. Our experience with this participatory process, involving hundreds of local farmers and youth, researchers and university students, also gives us confidence that the research intervention itself has likely contributed to building social trust, innovation, and collective engagement—key factors in adaptation potential. As one senior chief told us at the final workshop, "I have never experienced such a thing before!" Several of the participants suggested, "we will appreciate it if this kind of programme can be organised for us again in this village, to help our farming activities under climate change."

We believe this kind of detailed, context-specific awareness needs to be replicated in other communities, since the ability to adapt at the local level is a prime determinant of community members' well-being.

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NOTES

1 All the authors contributed to this project in various ways: while the first author designed and coordinated the research, others assisted with focus groups and workshops, interviews with farmers, data analysis and writing, project logistics, language translation, and/or coordinating student participants' training as visitors while the research was underway.

2 We assessed our results using statistical models, and we report on those quantitative results more fully in other publications. The independent variables were the timing and duration of rainy and dry seasons, the adaptation methods currently employed by the farmers, and the length of time for which the respondent has been a farmer.

The dependent variables were crop yield, crop failure, and perceived variations in climate. These were used to calculate correlation and regression models. Data from the questionnaires and interviews were categorized based on different categories of farmers' perceptions of rainfall onset, amount, frequency and duration, intensity, variability/change, and cessation in the study area.

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