CHAPTER 1

Introduction

Climate change is a significant and growing threat to food security already affecting vulnerable populations in many developing countries and expected to affect more people, more areas, and more farmers in the future. Climate disruptions to agricultural production have increased over the past 40 years and are projected to become more frequent over the next 25 years (Hatfield et al. 2014, Hatfield and Pruege 2015). Farmers in many agricultural regions already appear to have experienced declines in crop and livestock production because of climate change–induced stress (Lobell and Field 2007; Lobell, Schlenker, and Costa-Roberts 2011). Although climate change is expected to produce both winners and losers, on balance, losses in productivity in many regions are expected to outweigh gains in other regions (Jarvis et al. 2011).

The scale of the potential impacts of climate change is alarming. For example, the National Research Council (2011) has projected that each degree Celsius of global warming will lead to an overall loss in crop yields of about 5 percent. As climate change continues, it is increasingly likely that current cropping systems will cease to be viable in many locations. Jones and Thornton (2008), for example, argued that by 2050, as many 35 million farmers may switch from mixed crop-livestock to livestock-only systems.

Developing countries are expected to receive the brunt of climate change (Morton 2007). The Intergovernmental Panel on Climate Change Fifth Assessment Report (AR5) projects that under more optimistic scenarios, climate change could reduce food crop yields in parts of Africa by between 10 and 20 percent, a large drop for already at-risk populations and regions (IPCC 2014). The outlook for key food crops across the African continent under climate change is mostly negative and indicates that low productivity, together with increasing global demand, will likely drive up food prices (Jalloh et al. 2013; Waithaka et al. 2013; Hachigonta et al. 2013). Climate change is expected to negatively affect the yields of most of Africa's major crops, with cereals showing the most consistent decline in each of the continent's regions (Sulser et al. 2015). Nelson and colleagues (2010) predicted that staple food prices could rise by 42 to 131 percent for maize, 11 to 78 percent for rice, and 17 to 67 percent for wheat between 2010 and 2050 as a result of the combined effects of climate change, increasing population, and economic growth. Moreover, localized weather shocks and emerging pest and disease outbreaks are already compromising stability in crop production, highlighting the urgency for immediate and adaptable management responses (FAO and PAR 2011).

The 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods represents Africa's shared commitment to transforming the agricultural sector for sustainable development on the continent between 2015 and 2025. The declaration sets out seven specific commitments for advancing the Comprehensive Africa Agriculture Development Programme (CAADP) agenda. The sixth commitment is focused on enhancing the resilience of livelihoods and production systems to climate variability and other related risks. In order to make good on these promises, rapid action is required. Such action will draw from new tools and techniques to build resilience to climate- and weather-related risks, commonly referred to as climate-smart agriculture (CSA). CSA comprises agricultural systems that contribute to the outcomes of (1) sustainable and equitable increases in agricultural productivity and incomes; (2) greater resilience of food systems and farming livelihoods; and (3) where possible, reduction or removal (or both) of greenhouse gas emissions associated with agriculture (including the relationship between agriculture and ecosystems). The agricultural production systems created through CSA methodologies and practices are expected not only to be more productive and efficient but also to increase resilience to the short-, medium-, and long-term shocks and risks associated with climate change and climate variability. The operational aspects of CSA still need substantial investigation. Agricultural practices in particular may be climate smart in some circumstances, but local contexts determine the enabling environment, trade-offs, and synergies (Below et al. 2012). As a consequence, conditions for adoption are highly context and location specific, highlighting the need for information and data to make the approach operational (McCarthy, Lipper, and Branca 2011).

As the official monitoring and evaluation report for CAADP at the continent level, the *Annual Trends and Outlook Report* (ATOR) plays an important role in promoting review, dialogue, and mutual accountability in support of evidence-based policy making and implementation. And in light of the growing intensity and frequency of climate change effects, the 2016 ATOR takes an in-depth look at the role of CSA in helping to meet Malabo Declaration goals and, in particular, the goal of enhancing the resilience of livelihoods and production systems to climate variability. Through a series of contributions in key areas spanning the regional to the household level, the report offers significant insights into the state of our knowledge and understanding of the role that CSA can play for agricultural development under changing climate regimes.

Chapter 2 describes the context in which policy and investment decisions will have to take place, finding that in the years leading up to 2050, African countries will continue to grow, and many will reach middle-income status. As the agricultural sector grows, it will need to become technologically more sophisticated to withstand the vagaries of climate and market conditions. Key to future growth will be regionally tailored, evidence-based efforts to address increased regional market integration and the regional shifts in agroecological conditions.

The next two chapters analyze CSA in Africa south of the Sahara (SSA) for more traditional crop production systems and for mixed crop-livestock systems, respectively. Chapter 3 shows the benefits of CSA adoption but also its limits when the approach is interpreted in a restrictive way and applied only to crop production. Chapter 4, while providing an assessment of possible investments in CSA in SSA, proposes a framework to prioritize among CSA interventions. Both chapters reach the conclusion that although multiple wins are possible, "silver bullets" do not appear to exist in climate-smart systems.

Chapter 5 focuses on the role of CSA in the context of trade flows in three regional economic communities (RECs): the Economic Community of West African States (ECOWAS), the Common Market for Eastern and Southern Africa (COMESA), and the Southern African Development Community (SADC). Likely agroclimatic changes will not only impact agriculture but also countries' ability to fully benefit from regional and international trade, especially when rainfed-based agricultural commodities dominate trade flow. The authors find that CSA practices have the potential to mitigate climate-induced risks in agricultural production and food security through increased and less volatile agricultural trade flows.

Chapter 6 provides important insights into the promises and limits of production risk management through financial mechanisms. In particular, the authors investigate the role that weather index insurance can play in generating better adaptation pathways to weather shocks for smallholder farmers than existing ones. Evidence from several pilot insurance programs shows that although the potential for innovative insurance mechanisms is real, additional work to understand their effectiveness and substantial scale-up efforts will be needed to achieve a sustainable expansion of efficient agricultural insurance markets in Africa.

The next two chapters bring to our attention localized experiences related to the adoption of CSA. Chapter 7 goes to the heart of the location specificity of CSA by investigating the potential benefits of using precision agriculture in the Democratic Republic of the Congo, finding that this approach can boost sustainable productivity through increased efficiencies in the use of inputs. Even though the use of precision agriculture may still be many years away, we can extrapolate an important lesson that applies to many other African countries: increased use of fertilizers, coupled with increased efficiency in their use, can lead to an optimal response to the effects of climate change. Chapter 8 uses information from several SSA countries to revisit the long-standing problem of practices that demonstrably show both on-farm and off-farm benefits that outweigh investment costs, yet scarcely get adopted. This is clearly a problem that affects CSA as well.

The last two chapters broaden our understating of CSA by connecting it to ecosystems, gender, and nutrition. Chapter 9 tackles the nexus of CSA, gender, and nutrition, providing an integrated conceptual framework with entry points for action as well as information requirements to guide interventions in the context of climate change. The authors clearly argue that to go beyond incremental approaches to adaptation, these types of integrated approaches are essential in order to address the development challenges that the future climate creates.

Chapter 10 considers ecosystem-based adaptation and CSA as new paradigms that offer an integrated solution to maximizing the productivity of agriculture and food systems under changing climate regimes. The author posits that ecosystem-based adaptation and CSA offer an opportunity to break from traditional approaches and the silos that have limited the capacity for improving the food security condition of many.

This collection of studies shows the breadth and richness of the knowledge that is accumulating around the CSA approach. Although clearly there is still much to be investigated, the information available can already be used to assist African countries in the design and implementation of national agricultural investment plans that account for climate change.

As in previous ATORs, Chapter 11 tracks progress on CAADP indicators outlined in the CAADP Results Framework for 2015–2025 in the areas of economic growth, food and nutrition security, employment, poverty, agricultural production and productivity, intra-African trade and market performance, and public agriculture-sector expenditure. It also reviews countries' progress in the CAADP implementation process and in strengthening systemic capacity to deliver results. The ATOR concludes with Chapter 12, which highlights key policy recommendations for the CAADP/Malabo agenda. Finally, the report's appendixes provide aggregate-level data on the CAADP indicators, organized by geographic regions, regional economic communities, economic characteristics, and CAADP groups, showing when a CAADP compact was signed or the level of CAADP implementation reached.