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ADOPTION OF CLIMATE-SMART AGRICULTURE IN AFRICA

CONSTRAINTS, INCENTIVES AND RECOMMENDATIONS

September 2016

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LIST OF ACRONYMS

CA	Conservation agriculture
CCAFS	Climate change, agriculture, and food security
CIAT	International Center for Tropical Agriculture
CLI	Crop-livestock integration
CSA	Climate-smart agriculture
CSRP	Climate smart rice production
FAO	Food and Agriculture Organization
FFS	Farmer Field School
FMNR	Farmer managed natural regeneration
GIIF	Global Index Insurance Facility
HURDL	Humanitarian Response and Development Lab
ICT	Information and communication technology
IWMI	International Water Resource Management Institute
LC	Local conventions
MCC	Millennium Challenge Corporation
NGO	Non-governmental organization
PES	Payments for ecosystem services
SRI	System for rice intensification
USAID	United States Agency for International Development

EXECUTIVE SUMMARY

Climate-smart agriculture (CSA) is an approach to agriculture that can offer farmers in Africa substantial benefits in terms of increased productivity and income, better risk management, and improved resilience to climate change. As such, CSA has become a key development goal, championed by donors and governments alike. Despite this focus, however, the adoption of CSA approaches and practices by smallholder farmers has been slow, piecemeal, and largely unsustained.

The common narrative is that adoption depends on accessibility, promotion and training around specific CSA technologies and increased access to markets. However, this narrative misses a number of key behavioral change factors, including the wider social, political, and institutional environment in which agriculture is embedded. These include broader livelihoods, identity roles and responsibilities (including gender), decision-making timeframes, and farmer risk management perspectives. These factors all greatly shape the incentives to adopt CSA approaches.

This report fills this knowledge gap by conducting a rigorous and systematic analysis of the factors shaping the adoption of CSA. Initially, a literature review was undertaken to establish the accepted state of knowledge on the key factors governing CSA adoption. This was followed by interviews with technical experts to compare these factors with the current understanding of CSA among practitioners. Finally, fieldwork was carried out in Burkina Faso and Kenya by local teams in order to get perspectives directly from farmers, as well as from national officials and experts. Through the qualitative triangulation of these data sources, the report was not only able to identify the most common factors shaping the adoption of CSA in Africa, but also to highlight key differences between common assumptions and farmer behavior.

Economics do matter to adoption but in a nuanced way.

The economic narrative is well known and includes barriers such as high initial cost, high long-term cost, diseconomies of scale, and poor access to credit and inputs. Unsurprisingly, cost is one of the top adoption factors across all data sources. However, disaggregating these costs reveals some key and overlooked differences between farmer perspectives and the conventional wisdom of practitioners. Farmers cite initial costs over twice as often as a barrier to adoption than technical experts, while long-term costs are not a significant factor of farmers' decision-making around CSA adoption. This points to the need for a better understanding on behalf of practitioners of different CSA costs, as well as the seasonal decision-making processes that underpin farmers' livelihood and CSA decisions.

To be adopted, CSA needs to align with society and cultural values and norms.

Agriculture, as a livelihoods activity, is a deeply socially embedded endeavor and farmers understand CSA through their own formal and informal systems and norms that govern factors such as labor, gender, identity, and beliefs. As developed throughout this report, such factors create often-unseen opportunities and risks for farmers that shape their CSA adoption but are

often overlooked by the CSA literature and expert interviews. The issue of short-term climatic risk, for example, is the second highest cited barrier by farmers but is completely overlooked by practitioners. Farmers may not adopt any CSA practice that lowers their capacity to address immediate risks of climate variability, even if that practice might be well targeted at future climate change.

Market forces and institutions form the foundation for CSA adoption.

In many African countries, structural constraints within markets and supporting institutions severely constrain the adoption of CSA approaches. These constraints are not unique to CSA but instead define and influence the entire agriculture sector. They include poorly functioning markets, dysfunctional government institutions, and weak land tenure systems. In order for CSA to be adopted in a sustained and collective way at a national scale, there are basic foundational conditions and good agricultural practices that are *required* within the agriculture sector that go beyond any specific farm technology. Achieving these conditions requires integrated programming that draws upon wider efforts in democracy and governance, economic growth, agriculture and food security, and disaster risk reduction.

CSA presents a unique and urgent opportunity to take a broader and more systematic view of the constraints in agriculture in Africa. The issues of adoption and dis-adoption addressed in this report help point the way towards interventions that might best unlock the potential of the smallholder farming. Properly implemented, CSA can make significant contributions to agricultural production and rural livelihoods, building resilience to current economic and environmental stresses on agrarian livelihoods, while pointing the way to a more secure and prosperous future of economic and social opportunity.

I. INTRODUCTION

The dilemmas of climate change and agriculture in development are well known but worth repeating. The world's population has been projected to reach 9.6 billion by 2050.[1] In line with this population growth is the increasing global consensus that our agricultural practices need to shift to improve the quality and quantity of food currently produced, particularly in sub-Saharan Africa.[2] These increases in production and shift in practices will occur on increasingly limited land area, on increasingly marginal soils, and in the face of a changing climate that threatens to negatively affect crop productivity and increase yearly variability.[3] This will necessitate greater adoption of 'climate-smart' strategies and technologies that increase production sustainably, increase adaptive capacity of farming systems to climate change, and mitigate agriculture's sizeable contribution to global greenhouse gas emissions, all of which are components that the approach of climate-smart agriculture (CSA) seeks to address directly.[4]

The purpose of this report is to conduct a rigorous and systematic analysis of existing evidence for the factors shaping the adoption of a climate-smart approach to agriculture, with a view to providing recommendations for United States Agency for International Development (USAID) policy and programming. The report focuses on CSA approaches of direct relevance to smallholder farmers in sub-Saharan Africa, the target demographic for this work.

The report addresses the following questions:

- What is known about the main factors driving the dis-adoption of CSA approaches?
- What incentives have proven to be effective in increasing adoption of CSA approaches?
- How should USAID and other development partners program CSA differently in order to ensure greater success in investments?

Section II goes over the methodology for the data collection and analysis of the three components of this study. Section III provides the broad framing of CSA, explaining what CSA is, how it fits into the political economy of agriculture, and how farmers understand climate change. Section IV presents our research and data collection findings from the literature review, expert interviews, and case studies. The top factors impacting the adoption of CSA are analyzed in Section V. Section VI presents a set of critical questions to assess the likelihood that a CSA approach will be adopted. Programmatic recommendations are presented in Section VII. Finally, section VIII provides questions for further research.

[1] United Nations, 2012, World Population Prospects: The 2012 Revision.

[2] Steenwerth, Kerri, Amanda Hodson, Arnold Bloom, Michael R. Carter, Andrea Cattaneo, Colin Chartres, Jerry Hatfield, et al. 2014. "Climate-smart agriculture global research agenda: scientific basis for action." *Agriculture & Food Security* 3:11.

[3] Brown, M.E. et al. 2015. *Climate Change, Global Food Security, and the U.S. Food System*.

[4] FAO. 2010. "Lessons from the field: Experiences from FAO Climate Change Projects." *Climate Change* Workshop.

II. METHODOLOGY

Given that CSA is an approach and not a list of practices, exhaustively covering all iterations of agricultural practices, technologies, or interventions that could be climate-smart in a particular context is neither appropriate nor helpful. In collaboration with USAID and technical experts, a diverse range of CSA technologies and strategies were selected as a means of obtaining detailed information on adoption constraints and opportunities that might inform a broader understanding of observed patterns of CSA. The twelve climate-smart technologies and strategies (hereafter referred collectively as "CSA approaches") represent both field-level technical technologies to agriculture and broader socio-economic and institutional strategies that shape both agricultural practice and its market, institutional, and social environment. While this report focuses on the 12 CSA technologies and strategies, it uses these heuristically as a means of identifying and illustrating the barriers and incentives to adoption among smallholder farmers in sub-Saharan Africa. The focal CSA approaches are detailed in Table 1 below and explained in detail in Annex I.

Table 1: Focal CSA Approaches

CSA technologies and strategies assessed as part of this study	
Field-level	1. Farmer managed natural regeneration (FMNR) 2. Conservation agriculture (CA) 3. Climate smart rice production 4. Crop-livestock integration 5. Integrated water resource management (IWRM)
Institutional	6. Index (weather) based crop insurance 7. Payment for ecosystem services 8. Safety net programs 9. Property and procedural rights frameworks 10. Agriculture and climate services 11. Climate smart villages; climate smart landscapes
Community	12. Collective action

Developing a 'Factors of Adoption' framework

In agriculturally-oriented research and practice, there is a wealth of documentation and analysis on the factors that influence agricultural decision-making and behavior change relevant to the adoption of CSA. In order to sort and group these factors, this report developed a custom 'Factors of adoption' framework. This framework incorporated a number of existing theories and approaches including Diffusion of Innovation Theory[5], Sustainable Livelihood approaches[6], Nature, Wealth, and Power systems[7], and Livelihoods as Intimate Government[8] to group

[5] Rogers, Everett M. 2003. *Diffusion of Innovations*. New York: Free Press.
[6] DFID, 1999. Sustainable Livelihoods Guidance Sheets (1999)
[7] USAID. 2013. Nature, Wealth and Power 2.0, Leveraging Natural and Social Capital for Resilient Development.

adoption factors into four categories. The four categories are as follows: economic and production characteristics; agro-ecological environment; social and cultural context; and enabling environment (markets, institutions, and policy). These categories were further broken down into 49 individual factors (see Annex 2: Factors of Adoption Framework). These 49 factors provided a uniform and comprehensive framework for the examination of constraints to and incentives for the adoption of the CSA approaches outlined above.

Components of the study

The study included three main approaches to data collection and analysis. These components were phased and designed to be complementary. Each dataset served as a point for the triangulation of findings from the other approaches and their datasets. This interpretative triangulation was anchored in the initial systematic literature review, which was undertaken to better understand the state of knowledge on CSA adoption and narrow the scope of research for this report. This was followed by interviews with technical experts. Finally, fieldwork was carried out in two countries by local teams in order to get narrative-based perspectives directly from farms and national officials and experts.

(1) Systematic literature review: The goals of the literature review were:

1) To establish the accepted state of knowledge on CSA adoption, particularly for the 12 technologies and strategies selected for this report, and
2) To identify experts from which to build a sample for interviews on CSA adoption.

The study team utilized several databases, including USAID's Development Exchange Clearinghouse, Web of Science, Scopus, Eldis, ResearchGate, Education Resources Information Center, Internet search engines, Google Scholar, and EBSCO Academic Search Premier. In addition to academic databases, our team conducted a series of interviews with agricultural development practitioners to identify additional resources. Those interviews included technical experts from the International Food Policy Research Institute (IFPRI), World Agroforestry Centre (ICRAF), Catholic Relief Services, and the World Bank.

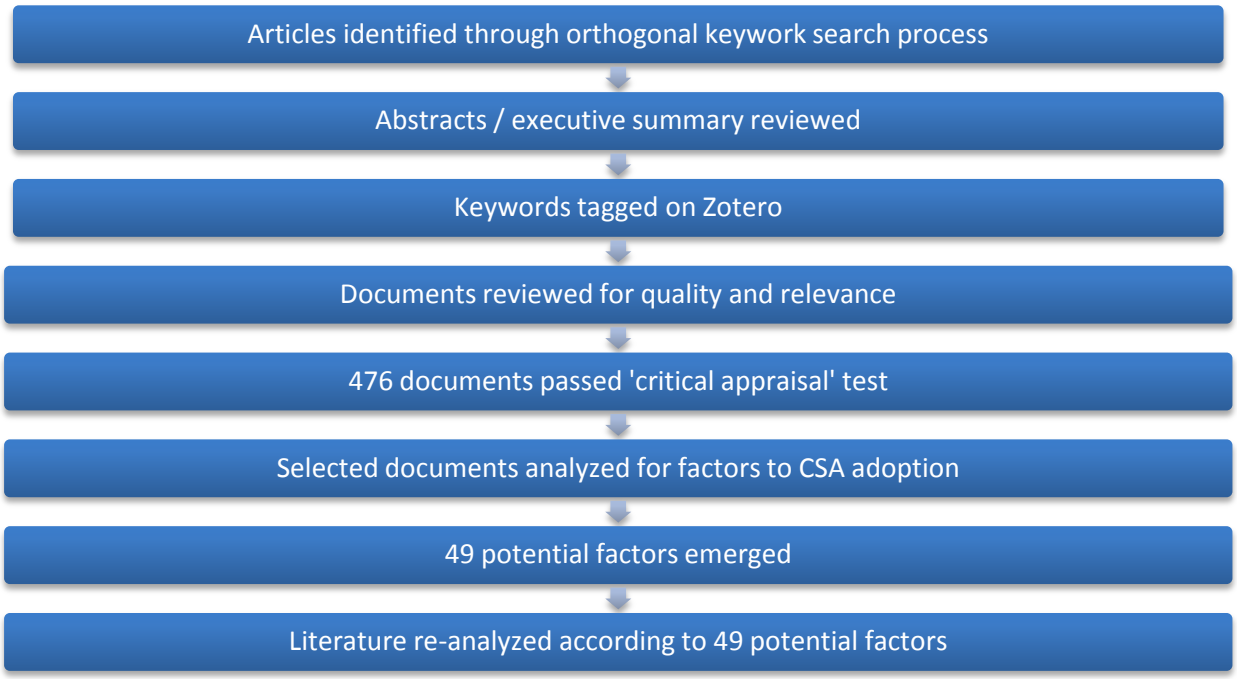
Documents were selected through a two-step process. First, abstracts or executive summaries were read to determine if the document was relevant to the research and were 'tagged' with relevant keywords (such as the CSA technology/strategy, location of the study, and author) in the online research and citation management tool Zotero. Second, assessment team members reviewed each document for quality and relevance. Through this process, 476 documents passed the critical appraisal test for their relevance to CSA and were included in our analysis.

These documents were then analyzed for barriers and incentives to CSA adoption, pulling out patterns and commonalities between the adoption factors for the focal CSA approaches. To conduct this analysis, the Integra team worked closely with the Humanitarian Response and Development Lab (HURDL) at Clark University. Forty-nine potential barriers or incentives (collectively called "factors") emerged from this standardized and comprehensive review. These

[8] Carr, Edward R. 2013. "Livelihoods as Intimate Government : Reframing the Logic of Livelihoods for Development." *Third World Quarterly 34(1) 77-108.*

factors were then re-applied to the literature to identify their impact on CSA across each of the focal technologies and strategies. A short list of the most commonly cited factors was developed to guide additional steps of the research (Components 2 and 3, see below). The full methodology for the literature review is included in Annex 3.

Figure 1 – Literature Review Process



(2) Interviews with Technical Experts: The second part of the study involved interviews with international technical experts to establish the state of knowledge for CSA adoption, as an approach, among practitioners. This was necessary because the academic literature can lag current practices and evidence by months to years. This component had two primary goals:

1) To triangulate expert opinions with the key findings from the literature review, and
2) To compare and contrast expert opinions across different stakeholder groups.

Stakeholders were selected to reflect a balance of different stakeholder groups and geographical experience. The first experts were identified through the literature review, and then a snowball sampling technique[9] was employed. The goal was to interview at least ten members of each stakeholder group, though this was not always possible (particularly with private sector agribusinesses, who were difficult to engage with this research). In total, 43 stakeholders were interviewed from across USAID, other development partners and implementers, government officials, non-government organizations, researchers, agribusinesses and farmers' unions. These interviews were conducted predominantly by phone using a questionnaire developed by the team based on the findings of the literature review. Questions were open-ended to facilitate discussion (a sample questionnaire is included in Annex 4).

[9] Snowball sampling is a non-probability sampling technique where existing study subjects recruit future subjects from among their acquaintances.

(3) In-Country Farmer Interviews: The final part of the study involved in-country field visits. These field visits had three primary goals:

1) To triangulate farmer responses with the key findings from the literature review and technical expert interviews,
2) To directly explore with farmers their decision-making processes under changing climates, including the potential synergies/trade-offs between production and resilience,
3) To observe the degree of CSA adoption, as an approach, at the local level, as well as the constraints and opportunities for specific climate-smart technologies and strategies.

In April and May of 2016, fieldwork was carried out in two countries: Burkina Faso in Francophone West Africa and Kenya in Anglophone East Africa. Two sites (varying primarily in rainfall) were visited in each country: Dano (wet) and Ouahigouya (dry) in Burkina Faso and Wote (wet) and Kibwezi (dry) in Kenya. Site selection in each country was guided by six criteria developed by the assessment team in consultation with USAID:

1) Area where several CSA technologies and/or strategies were present, and there were already documented and anticipated climate change impacts,
2) Area that reflects USAID priority programming, namely Feed the Future and Food for Peace,
3) Potential for value-addition to the literature review,
4) Ease of access,
5) Advice from technical experts, and
6) Areas where our team had significant field experience.

Each team was comprised of three members. The Kenya team was entirely female and the Burkina Faso team included one female. Data was collected at the household and village level through four complementary sampling techniques:

1) Direct observation,
2) Household surveys,
3) Focus group discussions, and
4) Interviews with government officials and project implementers.

Different qualitative methods were employed depending on the cultural context of the study sites. In Dano, for example, farmers were gathered in the public square of the villages for group interviews while in Ouahigouya, a door-to-door interview survey approach was adopted. One hundred forty-six (146) interviews were conducted in Burkina Faso, and 80 interviews were conducted in Kenya. A little over half (53 percent) of interviews were with women.

Triangulation of findings

Each aspect of the research described above is a partial picture of CSA adoption. The literature review, while presenting a comprehensive review of the current state of largely academic knowledge on CSA uptake, can only reflect the current focus and biases of that literature. Although the expert interviews cover a large number of individuals and relevant organizations,

they are not statistically representative of the entire CSA expert population. The field interviews, which speak clearly to farmer concerns and interests, cover only four sites in two disparate countries, leaving out many context-specific challenges in other parts of sub-Saharan Africa. Additionally, sampling within the sites followed a snowball method that is best at capturing dominant narratives in a given population. In totality, what this data provides are three dominant narratives of CSA adoption emerging from three critical information sources: that of the literature, that of the technical experts, and that of the farmers.

When combined, each of these methods and data plays a critical role in developing a coherent, rigorous narrative that triangulates these three dominant narratives. Our goal was to capture the *main factors* shaping CSA adoption and dis-adoption in sub-Saharan Africa. By triangulating the results of the three components, we were able to identify emergent factors shared across all components, as well as carefully include factors where there is strong agreement among just two components. Further, we can address discontinuities between the datasets that can highlight further areas of research or have implications for CSA programming. The results below, and in the appendices, reflect the triangulation of these datasets.

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III. FRAMING OF CLIMATE-SMART AGRICULTURE

This section provides an introduction to the key concepts surrounding CSA. This includes defining CSA, understanding smallholder farmers and their characteristics, recognizing that CSA is part of a socially and politically embedded system, understanding the timing of decision-making and past experience, and discussing the extent of adoption of CSA in Africa.

CSA should be viewed as an approach and not a set of practices.

CSA is a conceptual framework that helps address ways to: 1) sustainably increase agricultural productivity and incomes, 2) adopt and build resilience to climate change, and 3) reduce and/or remove greenhouse gas emissions, where appropriate.[10] In other words, CSA is about moving agriculture from its present state to one where productivity is higher, risk to farmers and the food system is lower, and agricultural activities make smaller contributions to factors that exacerbate climate change. This report recognizes that CSA is more than a list of practices and must be conceived holistically and systematically. It is an approach to agriculture. Despite clear benefits, ranging from the mitigation of climate change to the growth of agricultural income, the actual adoption of CSA by smallholder farmers has been slow, piecemeal, and largely unsustained.[11] While this report focuses on a limited subset of CSA technologies and strategies, it uses these heuristically to identify and illustrate the barriers to adoption generally of a climate-smart approach to agriculture among smallholder farmers in sub-Saharan Africa.

Smallholder farmers share a number of common characteristics that impact CSA adoption.

This report focuses on 'smallholder farmers' - the majority of sub-Saharan African farmers who are generally poor, farm relatively small areas (e.g., a few hectares), use minimal amounts of mechanization and inputs, and live at or near subsistence level. Smallholder farmers are a diverse demographic that encompass a host of social differences, including gender, age, income/livelihoods, ethnicity, religion and other factors. Some of these differences cut across the discussion of decision-making below, and permeate our understanding of CSA adoption. Despite this heterogeneity, smallholder farmers share several characteristics in terms of their decision-making and behavior change around new ideas related to their livelihoods.

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[10] Steenwerth, Kerri, Amanda Hodson, Arnold Bloom, Michael R. Carter, Andrea Cattaneo, Colin Chartres, Jerry Hatfield, et al. 2014. "Climate-smart agriculture global research agenda: scientific basis for action." *Agriculture & Food Security* 3:11; Giller, K.E. at al. 2009. Conversation agriculture and smallholder farming in Africa: the heretics' view. Field Crops Research, 114: 23-34; Knowler, D. and B. Bradshaw. 2007. Farmers' adoption of conservation agriculture: A review and synthesis of recent research, Food Policy 32(1): 25-48; FAO. 2015. Climate-Smart Agriculture: A call for action, *FAO RAP Publication*.

[11] Steenwerth, Kerri, Amanda Hodson, Arnold Bloom, Michael R. Carter, Andrea Cattaneo, Colin Chartres, Jerry Hatfield, et al. 2014. "Climate-smart agriculture global research agenda: scientific basis for action." *Agriculture & Food Security* 3:11

Smallholder farmers have **complex livelihoods**. Few farmers are totally dependent on farming. Agriculture is usually one of several activities that the typical "farmer" engages in the course of their livelihoods. Many combine farming with other activities like animal husbandry, petty trading, craft-making, and seasonal migration for wage labor (and not only in the off-season).[12]

Smallholder farmers also tend to be **highly risk-averse**. This risk aversion is linked to the various stresses and shocks they face, and the limited set of resources upon which they can draw to mitigate the impacts of these stresses and shocks.[13] The diversified and networked nature of their livelihoods is both an effective risk management strategy and a potential suboptimal strategy in a specialized world. On one hand, this diversification and networking creates significant opportunities for farmers to reach new consumers and identify new sources of income and food from which to draw. On the other, these networks can directly connect distant shocks into local agricultural and livelihoods systems, as was seen during the food price spikes in 2008.[14]

Smallholder agriculture is **deeply socially embedded** and is about much more than the mere production of food. Smallholder agriculture, as an aspect of agrarian livelihoods, serves to structure social orders at scales from the household to the ethnic group.[15] Thus, agriculture encompasses various roles and responsibilities in a household, community, and broader society, roles and responsibilities that are often quite durable and will greatly shape decisions about the adoption of CSA.[16]

Given the realities of African smallholder farmer livelihoods, and the place of agriculture in those livelihoods, we must understand the diverse and networked lives of farmers if we are to identify and implement programs and specific interventions to promote CSA that lead to long-term, sustained adoption of a modified approach to agriculture.

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[12] Carr, E.R., 2006, Postmodern conceptualizations, modernist applications: Rethinking the role of society in food security. Food Policy, 31(1), 14-29; Watts, M. J., & Bohle, H. G. 1993. Hunger, Famine and the Space of Vulnerability. *Geojournal*, *30*(2), 117–125; Maxwell, S. 1996. Food security : a post-modern perspective. *Food Policy*, *21*(2), 155–170; Gladwin, C. H., Thomson, A. M., Peterson, J. S., & Anderson, A. S. 2001. Addressing food security in Africa via multiple livelihood strategies of women farmers. *Food Policy*, *26*, 177–207.

[13] IFC. 2013. Working with Smallholders: A Handbook for Firms Building Sustainable Supply Chains; Carr E.R. 2011. Delivering Development: Globalization's Shoreline and the Road to a Sustainable Future.

[14] Brown, M.E. et al. 2015. *Climate Change, Global Food Security, and the U.S. Food System*.

[15] Carr, Edward R. 2013. "Livelihoods as Intimate Government : Reframing the Logic of Livelihoods for Development." *Third World Quarterly 34(1) 77-108.*

[16] For examples, see Benjaminsen, Tor A. 2010. "Enclosing the Land: Cotton, Population Growth and Tenure in Mali." *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography* 56 (1): 1–9; Förster, Till. 1998. "Land Use and Land Rights in the West African Savannah: The Senufo in Northern Côte d'Ivoire." *GeoJournal* 46: 101–11; Assé, Rainer, and James P. Lassoie. 2011. "Household Decision-Making in Agroforestry Parklands of Sudano-Sahelian Mali." *Agroforestry Systems* 82 (3): 247–61. doi:10.1007/s10457-011-9395-2; Koenig, Dolores. 2013. "Social Stratification and Labor Allocation in Peanut Farming in the Rural Malian Household." *African Studies Review* 29 (3): 107–27.

There is a significant mismatch between the timeframes in which farmers make decisions versus the timeframes where CSA benefits are realized.

The decision-making process that underpins investments in farming systems and the adoption of CSA is influenced by complex and interrelated economic, political and social dynamics. This process is highly context-specific, individually-driven, and rarely perfectly predictable. A significant challenge for the adoption of CSA is the mismatch between the timeframes in which farmers as individuals and as groups generally make decisions and those across which any particular program or intervention demonstrates benefits. These mismatches range across timescales, from hours to decades:

- ***Hourly*** - Farmers face significant livelihood decisions that must be made in a matter of hours. These include health-related decisions, where one must decide if selling off produce or an asset to access healthcare is necessary, and if so, what to sell. Women are often less empowered than men to make these short-term decisions.[17] In the absence of social safety nets, CSA interventions that reduce farmer flexibility in addressing such challenges or which draw down assets that might otherwise be mobilized in such situations are unlikely to be adopted. Who is responsible for such decisions varies depending on context and may depend on the decision at hand: for example, among matrilineal groups, caring for a sick child may fall to the mother and her extended family (as the children "belong" to this family) rather than the father and his family. Thus, how to address children's illnesses may be a decision that impacts women's livelihoods more than men's in these settings. In other, patrilineal, groups, the children may "belong" to the father's family, and thus become a factor in his livelihood decisions.[18]
- ***Seasonal*** - A vast number of farmer decisions are made at the seasonal temporal scale. These decisions incorporate information about the likely environmental and social conditions (e.g., school fees), as well as market conditions that influence both production and produce sales. CSA interventions that address seasonal stresses or shocks, such as those generated by climate variability, will buttress farmer decision-making. Interventions that *reduce* the options farmers have for negotiating these changes, such as an intervention that forces farmers to focus on a single crop or set of crops, are likely to result in farmer dis-adoption when market conditions introduce price stresses on those crops. Again, the identity, roles and responsibilities of the farmer will vary depending on context, which means decision-making processes and outcomes for particular activities or crops can change from community to community, or even between households within a community.
- ***Project*** - For the development partner or implementer, a project lifespan is usually three to five years. This creates pressure to produce measurable on-farm outcomes over this timeframe, whereas the most meaningful outcomes are only likely to emerge over longer timescales. "Quick win" projects that are rapidly adopted may work to address short-term

[17] UN Women. 2011. Enabling Rural Women's Economic Empowerment: Institutions, Opportunities, and Participation.

[18] Carr, Edward R. 2013. "Livelihoods as Intimate Government : Reframing the Logic of Livelihoods for Development." *Third World Quarterly 34(1) 77-108.*

issues but do so because they fit into existing agricultural decision-making and social structures that might impede adaptation over longer timescales.

- ***Long term*** - As some climate change impacts will be realized only across decades, some adaptations may not have immediately-realized benefits for farmers. With limited stocks of assets and with limited resources to protect those over more than a year, if that, farmers may not see the point of interventions or projects aimed at addressing climate change impacts that will occur twenty or more years in the future. In addition, social differences within a population can affect long-term decision-making. For example, if women are not allowed to have secure land tenure, they are unlikely to adopt the planting of drought-tolerant tree crops that take years to mature, and produce food for many years after the fact.[19] This discrepancy underscores the importance of implementing CSA interventions with interlinked short, medium, and long-term benefits that reinforce one another.
- ***Historical*** - CSA must also consider past interventions to understand farmer decisions and therefore the likelihood they will adopt any particular approach or, ideally, a suite of climate-smart approaches. When making decisions, farmers weigh their engagement with previous development programs, the market and the state (e.g., previous contact with agricultural extension services). These interactions impact social capital and levels of trust which can strongly impact engagement with new projects. Programming that does not take into consideration history will likely not overcome barriers to CSA adoption or provide effective incentives.

The extent of adoption of CSA in Africa

Agriculture production in Africa has increased significantly over the past couple of decades. However this increase is mainly due to the significant increases in areas under cultivation rather than increases in the productivity per hectare. The lack of widespread adoption of improved practices, particularly by smallholders, across the African landscape indicates the relatively poor productivity performance of agriculture in Africa.

As a newly defined approach, the data on CSA is limited and difficult to interpret. There is some qualitative and anecdotal evidence emerging of "success stories" in CSA adoption.[20] Aside from the significant issues raised above about adoption itself, there are large issues with consistency of data (e.g., the unit of measurement - hectares, households, farmers, crops, agro-ecosystems, etc.), which is influenced by the definition of adoption as well. There are also significant issues with *ex post facto* definitions of certain practices as contributing to climate-smart agriculture.

[19] For example, see Carr, Edward R. 2011. *Delivering Development: Globalization's Shoreline and the Road to a Sustainable Future*. New York: Palgrave Macmillan.

[20] CGIAR Research Program on Climate Change, Agriculture, and Food Security. 2013. Climate-smart agriculture success stories from farming communities around the world.

IV. KEY FINDINGS

The core document of this report is the literature review. The 476 documents it represents are representative of the state of the literature on CSA adoption, especially with regard to 12 common strategies and technologies (hereafter, CSA approaches). It is therefore the cornerstone of our methodological triangulation, as it represents the most broadly held understanding of CSA adoption available. Triangulation of data sources is a commonly-utilized tool in social scientific analysis to test the rigor and validity of findings generated through a single data source or a data source that cannot be subjected to statistical analysis or to answer questions that rely on more than strong associations between cause and effect in the data. Taken together, these disparate methods and the data they yield can be woven together into a single, coherent, rigorous narrative of CSA adoption that can inform future intervention selection and design.

Part 1. Literature Review

As outlined in the methodology section, 49 different potential barriers or incentives (collectively, "factors") emerged from this standardized review. These factors were then cross-walked with the literature specific to the focal CSA approaches to identify those with the highest impact on adoption. For each factor, an impact score from 0 – 3 was awarded across each of the 12 focal CSA strategies/technologies based on a summary of the literature for that strategy/technology.[21] A summary of the analysis is presented in Table 2. The table uses '+' to indicate a score of one, '++' to indicate a score of two and '+++' to indicate a score of three.

Out of a total potential score of 36, those factors that scored greater than 20 were deemed to be high impact. Those factors that scored greater than 10 were deemed to be medium impact, while factors that scored below 10 were deemed to be low impact. While the data collection and analysis is based only on the 12 focal approaches, it is used heuristically to identify those factors with the highest impact on adoption across all climate-smart approaches.

[21] The impact score was decided based on an average score from the members of the assessment team reviewing each CSA approach.

Table 2: Most commonly cited factors of adoption of CSA approach

Categories of factors influencing adoption	Factors	Farmer Manager Natural Regeneration	Conservation Agriculture	Climate Smart Rice Production	Crop-livestock Integration	Integrated Water Resource Management	Index (weather) Based Crop Insurance	Payment for Ecosystem Services	Safety Net Programs	Property & Procedural Rights Frameworks	Agriculture and Climate Services	Climate Smart Villages and Landscapes	Collective Action	EFFECT ON ADOPTION
Economic and Production Characteristics	**Long term cost**	+++	+	+	+++	+	+++	++	+++	++	++	+	++	**High**
	Initial cost	+++	+++	++	+++	++	+++	++	+++	+	++	++	++	**High**
	Transaction costs	++	+	+++	++	+++	+++	+++	+	+	+	+++	+	**High**
	Opportunity costs		++	+	++	++	+		+	+	+	++	+	Med
	Flexibility	+++	++	+	++	++		++	+	++		++	++	Med
	Multi-objective	+++	+	+	++	++	+	+	+	+++	+	++	++	High
	Perishability	+	+	+	+									Low
	Impact on yield	+	+	+++	+	++	++	+	++	+++	+	+	++	**High**
	Impact on farmer income	+	+	+++	+	+	+	+	++	++	+	+	+	Med
	Size of farm	+	++	+	++	+	+	+++	+		+	+++		Med
	Access to external inputs	++	++	++	++	+++	+	+	+		+	+	+	Med
	Labor availability	+	++	++	++	++	+				+			Med
	Access to credit		++	+	+++	++	++	+		+	+	+		Med
	Land availability	+		++	+	+	+		+	+		+	+	Med
	Private sector		+	+	+	+	++	+				+		Low
	Asset protection and insurance			+	+	+	+		+++	+++		+	++	Med
	Market availability		+	++	+	+	++	+	+		+	+		Med
	Asset value	+	+	+	+	++		+	++	+++		+	+	Med
	Population density		+	+	++	+				+	+	+	+	Low
	Intensification/ extensification	+	+	++	+	+	+		+	+		+		Med
The Agro-Ecological Environment	Rainfall zone	+	+	+	+	+								Low
	Topography			+	+									Low
	Soils			+	++									Low
Social and Cultural Context	**Values local knowledge**	+++	++	+	++	++	+	++		+	+	++	+++	**High**
	Farmer familiarity with practice or similar practices	+++	+	+	+++	++	++	++		+	+	+	++	Med
	Access to information		+	+	+	+	++	+		+	+	++	+	Med

	Compatibility with existing systems	+++	+	++	++	++	++	++	++	+	+	+	++	**High**
	Communication channels of information on practice	++		++	+	+	+	+++	+	+	+	+	++	Med
	Climate services	++	+				++				+	+		Low
	Extension services	+	+	+	+	++	+	++	++	+		+		Med
	Cultural and gender aspects relevant to decision making	+	+	+	++	+	+	++		+	+	++	+++	Med
	Risk management	+++	+	+	+	+++	+++	+	+++	+++		++	+++	**High**
	Local organizational capacity and collective action	+		+	++	+	++	++	+	+	+	+	++	Med
	Local discretionary decision making	+++	+	++	+	+	+	++	+	++	+	++	+++	**High**
	Local social capital	+		+	+	+	+			+	+	+++	+	Med
	Perceptions and Attitudes	+	+++		++		+	+	+++	+	++	+	+	Med
Governance Frameworks	Access to markets	+		++	++	+	+	+++	++	+		+		Med
	Market regulation			++		+	+		+	+	+	+	++	Med
	Institutional relations	+++	+	+++	+	+++	++	+++	+++	++	+	+++	+	**High**
	Subsidies			+			+	+		+	+	+		Low
	Policy framework			++		+	++	++	++	+	+	+	++	Med
	Land rights/tenure	++	+	+	++		+	+			++	+	+	Med
	Inclusion in decision-making			+		++	+	++		+	+	++	++	Med
	Access to recourse	++	+	+				+	+++	++	+	+	++	Med
	Impact on resilience	+	+	+	+	+++	++	+			+	+++	++	Med
	Social inclusion	+	++		++	+		++			+	+	++	Med
	Environmental footprint	++	+	+		+		+			+	+		Low
	Rights over resources	+	+	++	+	+++	+			+++		+	++	Med
	Conflict	+++	++		+	++	+	++	+++	++	++	++	+++	**High**

'+++' means high impact on adoption, '++' medium impact, '+' low impact, and a black space means no impact.

Based on the analysis of the factors of adoption contained in Table 2, a total of 11 factors were deemed to have a high impact on adoption. Five of these factors were economic and production characteristics, four factors were social and cultural, and two factors were in the enabling environment category. There were no factors with a high impact of adoption in the agro-ecological environment category.

Table 3: List of top factors with a high impact

Categories	Factors
Economic and Production Characteristics	Long-term cost
	Initial cost
	Transaction cost
	Multi-objective
	Impact on yield
Social and Cultural Context	Values local knowledge
	Compatibility with existing livelihood system
	Risk management
	Local discretionary decision-making
Enabling Environment (Markets, Institutions and Policies)	Institutional relations
	Conflict

Category 1: Economic and Production Characteristics

Across the literature, factors related to the socio-cultural context were found to have a medium impact on CSA adoption decision. When deciding on the adoption of new technology, farmers generally seek to maximize the returns on their investment. One of the most tangible factors in these cost-benefit calculations are **initial costs**, which cover the resource inputs that a farmer needs in order to begin adoption of any given CSA technology or strategy or combination. Another factor is **transaction costs,** which cover the time and non-physical resources spent by farmers in activities such as training or managing committees. When considering initial and transaction costs, it is important to distinguish between the different inputs, or production factors, required by multiple CSA technologies and strategies, as well as their availability to farmers. Certain ones, such as Conservation Agriculture and Farmer Managed Natural Regeneration, are heavily reliant on labor, making them more accessible to smallholder farmers with many labor-ready family members or with other ways to easily access labor.[22] Initial costs can also come in the form of monetary inputs, which constrains CSA adoption when farmers' access to credit and ready cash is lacking.[23] Most often, initial costs are a much larger barrier for women, although where strong microfinance programs targeting women, men may be more disadvantaged. Ways to overcome high initial costs can come in the form of tax credits on equipment, machine rentals, cost-sharing programs and direct subsidies. These kinds of direct

[22] Hassan. 2008. Determinants of African Farmers' Strategies for Adapting to Climate Change.
[23] Ibid.

assistance are most effective where CSA adoption is not feasible from an individual farmer's perspective, and assistance makes adoption an affordable and profitable option.[24]

Initial costs are only part of the full considerations of costs and benefits that farmers take into account when deciding to take up CSA approaches. **Long-term costs** cover the continuous management inputs and resources required for a farmer to maintain adoption of a CSA approach. Long-term costs were found to be crucial in the uptake of CSA as many approaches can take years before benefits are realized.[25] When long-term costs cannot be maintained, such as when a subsidy is removed, CSA dis-adoption occurs. In Zambia, for example, the discontinuation of government subsides led to large-scale dis-adoption of Conservation Agriculture.[26]

Impact on yield and **multi-objectivity** are also noted in the literature as factors that affect the adoption of CSA. Unsurprisingly, CSA technologies and strategies that can provide increased and stable yields, such as Climate Smart Rice Production and Integrated Water Resource Management, are likely to have a greater impact on adoption. In addition, given that farmers have limited resources, technologies and strategies that serve to meet a range of local needs, such as production, diversification and risk management, have a positive impact on adoption.[27] In the case of Malawi, the ability of agroforestry to increase yields, as well as provide alternative food and fuel production methods was found to be a key driver of adoption.[28]

Category 2: The Agro-Ecological System

Agro-ecological factors, including rainfall zones, topography, and soil quality were not found to have a positive or negative impact on adoption rates. This category of factors was thus removed from the factors table for the expert interviews and farmer surveys.

Category 3: Social and Cultural Context

Within the literature, factors related to the socio-cultural context were found to have a high impact on CSA adoption. Smallholder agriculture is deeply socially embedded and about much more than the production of food. Smallholder agriculture, as an aspect of agrarian livelihoods, serves to structure social orders at scales from the household to the ethnic group. Thus, agriculture encompasses various roles and responsibilities in a household, community, and broader society, roles and responsibilities that are often quite durable and will greatly shape decisions about the adoption of CSA. For example, in Sudanean and Sahelian West Africa, the oldest man in the household or extended family typically controls access to land and is responsible for making the agricultural decisions for everyone under his authority[29]. Therefore,

[24] Arslan et al. 2014. Adoption and Intensity of Adoption of Conservation Farming Practices in Zambia.

[25] McCarthy, et al. 2011. Climate Smart Agriculture: Smallholder Adoption and Implications for Climate Change Adaption and Mitigation.

[26] Arslan, et al. 2013. Adoption and intensity of adoption of conservation farming practices in Zambia.

[27] FAO. 2014. Climate-Smart Agriculture & Resource Tenure in Sub-Saharan Africa: A Conceptual Framework.

[28] Kaczan, et al. 2013. Climate-Smart Agriculture? A review of current practice of agroforestry and conservation agriculture in Malawi and Zambia.

[29] Carr, Edward R, and Kwame N Owusu-Daaku. 2016. "The Shifting Epistemologies of Vulnerability in Climate Services for Development: The Case of Mali's Agrometeorological Advisory Programme." *Area* 48 (1): 7–17.

decisions to implement CSA will tend to flow through these senior men if they are to be accepted locally. In coastal Ghana, on the other hand, men and women of the same household are, according to local land tenure norms, autonomous agricultural decision-makers on their respective farms.[30]

The importance of **risk management** also came out very clearly in the literature review. Where there are dynamic and robust systems of societally-based risk management (including those supported by good governance), the goals of producers are likely to reflect profit maximization. Where these systems are not in place, such as in Africa, producers are more likely to be concerned about risk management than profit maximization. In these cases, farmers are likely to forego opportunities to increase yields or profit, unless they also serve the goal of risk management. Thus, CSA approaches that do not include risk management components are less likely to be adopted.[31]

There is a strong consensus that a CSA approach that is **compatible with existing livelihoods** and leverages **local knowledge** is critical to facilitating adoption. Specific climate-smart technologies and strategies often differ from conventional farming traditions and knowledge in terms of soil preparation, seeding, fertilizer application, water management, etc. In regions where approaches are informally passed from generation to generation, several specific technologies and strategies within CSA appear too new to be easily holistically assimilated into African farming cultures.[32] Approaches that are foreign to local communities appear to require more effort and more time to adopt, as they can upset social relations,[33] or place a significant strain on the time and attention of farmers that detracts from current production. The converse explains the success of Farmer Managed Natural Regeneration and Local Conservation strategies. Farmer Managed Natural Regeneration, for example, starts with resources farmers already have, builds on local knowledge, and can be practiced on a large scale without ongoing government or development partner support.[34]

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doi:10.1111/area.12179; Carr, Edward R., Grant Fleming, and Tshibangu Kalala. 2016. "Understanding Women's Needs for Weather and Climate Information in Agrarian Settings: The Case of Ngetou Maleck, Senegal." *Weather, Climate, and Society* 8 (3): 247–64. doi:10.1175/WCAS-D-15-0075.1.

[30] Carr, Edward R. 2008. "Between Structure and Agency: Livelihoods and Adaptation in Ghana's Central Region." *Global Environmental Change* 18 (4): 689–99; Carr, Edward R. 2008. "Men's Crops and Women's Crops: The Importance of Gender to the Understanding of Agricultural and Development Outcomes in Ghana's Central Region." *World Development* 36 (5): 900–915; Carr, Edward R. 2011. *Delivering Development: Globalization's Shoreline and the Road to a Sustainable Future*. New York: Palgrave Macmillan.

[31] FAO. 2016. Managing Climate Risk Using Climate Smart Agriculture.

[32] Forum for Research in Africa. 2015. Barriers to Scaling Up / Out Climate Smart Agriculture and Strategies to Enhance Adoption in Africa.

[33] Carney, Judith A. 1996. "Converting the Wetlands, Engendering the Environment: The Intersection of Gender with Agrarian Change in The Gambia." In *Liberation Ecologies: Environment, Development, Social Movements*, edited by Richard Peet and Michael Watts, 220–34. London: Routledge; Schroeder, Richard A. 1999. *Shady Practices: Agroforestry and Gender Politics in the Gambia*. Berkeley: University of California Press; Schroeder, Richard A. 1997. "Re-Claiming'' Land in the Gambia: Gendered Property Rights and Environmental Intervention." *Annals of the Association of American Geographers* 87 (3): 487–508.

[34] World Vision International. 2012. Farmer Managed Natural Regeneration: An Effective Approach to Restoring and Improving Agricultural, Forested and Pasture Lands.

A CSA approach that is aligned with **local discretionary decision-making** is more likely to be adopted. In southern Mali, for example, the most senior man in the family serves as the principle decision-maker.[35] A drought or other event that compromises agricultural yield is not only a threat to the material well-being of the individual, household, family, and community but also a threat to the social standing of the senior man who makes agricultural decisions for his extended family. Therefore, in southern Mali, the adoption of CSA technologies and strategies is likely to be heavily mediated by the degree to which that bundled approach reinforces social standards, as opposed to addressing only agrometeorological risks.[36]

[35] Grigsby, William J. 2002. "Subsistence and Land Tenure in the Sahel." *Agriculture and Human Values* 19 (2): 151–64.

[36] For a parallel finding related to climate services, see Carr, Edward R, Sheila Onzere, Tshibangu Kalala, Kwame N Owusu-Daaku, and Helen Rosko. 2015. *Assessing Mali's l'Agence Nationale de La Météorologie's (Mali Meteo)*

Why did gender not emerge as a high factor influencing adoption?

USAID places top importance on the role of gender dynamics across its development work and there has been increasing recognition of the importance of gender dynamics in understanding CSA adoption. However, gender did not emerge as a top factor influencing adoption in the literature. A focus on a select number of specific factors, while vital to understanding CSA adoption, tends to under-emphasize cross-cutting issues such as gender, which underpin all actions by farmers.

All farmers engaged in agriculture in Africa are exposed to a number of interrelated risks, including weather and climate, markets and prices, institutions and policies. The literature indicates that women are often exposed to different risks than men, and indeed different women are exposed to different risks, depending on their roles and responsibilities with regard to agricultural production and livelihoods.[37] In certain contexts, social norms also limit women's ability to diversify their income through off-farm activities, thus constraining investment decisions. Accordingly, women face different perspectives, capabilities, and decision-making processes for adapting CSA approaches than men.[38] In Kenya, for example, levels of awareness of a CSA approach or particular climate-smart technologies or strategies are significantly lower for women than for men.[39]

There is no silver bullet for ensuring that climate-smart agriculture is also gender-smart.[40] If CSA can lower the labor burden on women, it has the potential to empower women to make their own decisions, which leads to more equitable outcomes. Conservation Agriculture is an example of a CSA technology that represents considerable labor-saving benefits through minimum tillage. However, labor-smart CSA technologies in of themselves are not enough to be gender-smart. Policies and institutional constraints that disproportionately impact women, through insecure land tenure or access to credit, must also be addressed.[41]

Category 4: Enabling Environment (Markets, Institutions, and Policy)

Within the literature, factors related to the enabling environment were found to have a high impact on CSA adoption. **Institutional relations** have a high impact on CSA adoption. Smallholder farmers may look to the state for at least three important functions: 1) the provision of public goods and services such as health, education, information, and infrastructure; 2) a source of risk management through disaster relief and social safety nets; and 3) insurance of a

[37] World Bank, 2015, Gender in Climate-Smart Agriculture: Module 18 for the Gender in Agriculture Sourcebook.

[38] Fisher, Monica, and Edward R. Carr. 2015. "The Influence of Gendered Roles and Responsibilities on the Adoption of Technologies That Mitigate Drought Risk: The Case of Drought-Tolerant Maize Seed in Eastern Uganda." *Global Environmental Change* 35. Elsevier Ltd: 82–92.

[39] Beuchelt et al. 2013. Gender and Institutional Aspects of Climate-Smart Agricultural Practices: Evidence from Kenya, Working Paper No. 79, CGIAR Research Program on Climate Change, Agriculture and Food Security.

[40] Taivalmaa, S. 2015. Is Climate-Smart Gender-Smart, World Bank Voices Perspectives on Development.

[41] World Bank, 2013, Improving Access to Land and Strengthening Women's Land Rights in Africa, Annual World Bank Conference on Land and Poverty 2013.

stable and fair set of rules for governing a market economy. In much of sub-Saharan Africa, however, the ability of the state to deliver these functions is limited.[42]

Paradoxically, **local natural resource conflicts** seem to be facilitators of the adoption of new strategies. Particularly true of 'soft' strategies, such as Local Conventions, conflicts over natural resources can create opportunities for the establishment of new rules of the game.

Why did land tenure not emerge as a high factor influencing adoption?

For similar reasons as detailed above for gender, as a cross-cutting issue, tenure only shows up as having a medium impact on adoption even though it is a central pillar of development. Land tenure defines how property rights are to be allocated within societies, how these rights can be used and transferred, and under what conditions. Land tenure may be well defined and enforceable in a formal court or informally applied through customary structures in a community.[43] Only 10 percent of rural land in Sub-Saharan Africa is formally registered, while the majority of land is undocumented and vulnerable to land grabs and expropriation.[44] Smallholders may be able to cultivate land but are unable to rent, sell, or use it as collateral. Their rights to the land may be limited because informal rights are not recognized by authorities, smallholder farmers can't afford paperwork and administrative costs, or simply because they are unaware of their rights.[45]

Even in settings where informal tenure is relatively secure, land tenure may be uncertain for particular groups, especially for women who must access land through men in their households or extended families, creating a disincentive for investment in agricultural improvements, including overall CSA.[46] In cases where little upfront investment is needed, secure land tenure may not impact the adoption of CSA. However, where there is a significant upfront capital investment (i.e. purchasing seedlings to start agroforestry) or labor investment (i.e. terracing), tenure security becomes a key factor. As such, farmers are less likely to invest in CSA if they have less certainty that they will be able to directly benefit from their effort.[47]

[42] Acemoglu, Daron and James Robinson. 2013. "Why Nations Fail: The Origins of Power, Prosperity, and Poverty.
[43] FAO, What is Land Tenure? http://www.fao.org/docrep/005/y4307e/y4307e05.htm.
[44] http://allafrica.com/download/resource/main/main/idatcs/00070465:a47aeca2fdbddaa064c23fb0fec0d706.pdf
[45] USAID. 2014. Land Tenure and Food Security, Presented by Karol Boudreaux on the 18th February 2014.
[46] Carr, Edward R. 2008. "Men's Crops and Women's Crops: The Importance of Gender to the Understanding of Agricultural and Development Outcomes in Ghana's Central Region." *World Development* 36 (5): 900–915.
[47] USAID. 2015. Land Tenure & Climate-Smart Agriculture, USAID Issue Brief.

Part 2. Key Findings from the Technical Expert Interviews

The second component of this study involved interviews with technical experts. The goal of this component was to 1) triangulate expert opinions with the key findings from the literature review, and 2) to compare and contrast export opinions across different stakeholder groups (i.e. government, development partners, private sector, civil society, and research institutes). In-person or phone interviews were conducted with a wide range of experts using a questionnaire that was refined and targeted as a result of the literature review. In total, responses from 43 experts were analyzed. To refine and validate the findings from these interviews, a focus group of Washington D.C. based experts met periodically over the study to discuss progress and preliminary results.

To add an additional level of analysis from the literature review, which looked at the level of impact on different factors on adoption, the expert interviews separated out the concepts of barriers and incentives to adoption. The literature seemed to draw a strong alignment between barriers and incentives (i.e. if lack of access to finance is a barrier, then the provision of credit should be an incentive). The assessment team wanted to test the hypothesis that the amelioration of a barrier would have a measurable positive impact on adoption. Table 4 displays the highest barriers to adoption disaggregated by expert stakeholder group.

Table 4. Barriers to Adoption of CSA as identified by Technical Experts

Categories of factors influencing adoption	Barriers	Development Partners (n=14)	Research Institutes (n=13)	Civil Society (n=9)	Government (n=4)	Private Sector (n=2)	Total (n=42)
Economic and Production Characteristics	Long term cost	14%	0%	67%	50%	50%	**26%**
	Initial cost	29%	8%	56%	0%	0%	**24%**
	Transaction costs	7%	8%	11%	0%	0%	**7%**
	Opportunity costs	21%	0%	0%	0%	0%	**7%**
	Size of farm	36%	31%	11%	50%	50%	**31%**
	Access to external inputs	14%	8%	33%	25%	100%	**21%**
Social and Cultural Context	Extension services	14%	8%	22%	25%	100%	**19%**
	Risk management	14%	15%	11%	25%	50%	**17%**
	Access to information	64%	8%	33%	0%	50%	**33%**
Enabling Environment (Markets, Institutions, and Policies)	Access to markets	7%	15%	11%	0%	0%	**10%**
	Institutional relations	0%	62%	22%	75%	0%	**31%**
	Subsidies	7%	15%	0%	75%	50%	**17%**
	Policy framework	14%	8%	0%	0%	50%	**10%**
	Land rights/tenure	7%	15%	0%	25%	0%	**10%**

**Underlined quantitative results are those that fall in the upper quartile of the results.*

The results of the expert interviews seem to align with traditional wisdom that lack of adoption is mainly due to cost of multiple or any individual strategy or technology, as well as the absence of information, technologies and training. Overall, 68 percent of respondents noted **cost in general** as the greatest barrier to adoption. When broken out by our adoption factors, **initial cost** was noted by 24 percent of respondents and **long-term cost** was noted by 26 percent of respondents. Access to information was the second most common barrier, noted by 33 percent of respondents. The **farm size (**i.e. diseconomies of scale) and **institutional relations** are the joint second highest cited barriers, noted by 31 percent of respondents.

Although some stakeholder group sizes are too small for any rigorous statistical comparison, there are some notable trends between groups. Government stakeholders (n=4) regarded ineffective **subsidies** as a major barrier (75 percent), serving only to reinforce political patronages, while development partners (n=14) only noted this as a barrier 7 percent of the time. In contrast, development partners noted **access to information** as the major barrier at 64 percent, while no government stakeholders cited it as a constraint. Civil society (n=9) noted **initial costs** and **long-term costs** as the highest barriers at 56 percent and 67 percent respectively. In contrast, researchers (n=13) noted **institutional relations** as the top barrier at 62 percent.

Table 5. Incentives to Adoption of CSA as identified by Technical Experts

Categories of factors influencing adoption	Incentives	Development Partners (n=14)	Research Institutes (n=13)	Civil Society (n=9)	Government (n=4)	Private Sector (n=2)	Total (n=42)
Economic and Production Characteristics	Flexibility	36%	38%	44%	50%	50%	**<u>40%</u>**
	Private sector	29%	15%	33%	0%	50%	**24%**
	Size of farm (Large)	0%	0%	0%	25%	0%	**2%**
	Access to credit	21%	8%	22%	0%	100%	**19%**
Social and Cultural Context	Farmer familiarity with practice or similar practices	29%	23%	33%	25%	50%	**29%**
	Extension services	14%	8%	11%	50%	50%	**17%**
	Risk management	57%	8%	55%	0%	100%	**<u>38%</u>**
	Local discretionary decision making	29%	46%	11%	50%	50%	**33%**
Enabling Environment (Markets, Institutions, and Policy)	Access to markets	29%	15%	22%	50%	100%	**29%**
	Institutional relations	57%	46%	67%	50%	100%	**<u>57%</u>**
	Secure land rights/tenure	36%	23%	33%	0%	100%	**31%**
	Subsidies	71%	0%	44%	0%	100%	**<u>38%</u>**

**Underlined quantitative results are those that fall in the upper quartile of the results.*

Table 5 presents the incentives to adoption identified by the different expert stakeholder groups. **Institutional relations** is the most commonly-mentioned incentive for CSA adoption, cited by 57 percent of respondents. This incentive was highlighted by the two respondents in the private sector (100 percent) and most of the nine respondents in civil society (60 percent). Institutional relations was also highlighted as a major barrier to CSA adoption, which suggests that addressing this barrier may have a direct impact on adoption. The **flexibility** of the CSA approach was found to be the second highest incentive influencing adoption, cited by 40 percent of respondents. This suggests that where farmers can choose from a basket of options, or to switch between choices, they are more likely to adopt a CSA approach.

The potential for **mitigating risk,** along with the provision of **subsidies,** were the joint third highest incentives at 38 percent each. This latter incentive was highlighted most by the private sector (100 percent, n=2) and development partners (71 percent, n=14). As did institutional relations, subsidies showed up as both a barrier and an incentive. This suggests that subsidies may be a useful mechanism for facilitating adoption but are rarely implemented correctly.

While there were many points in this analysis that showed convergence between a stated barrier and a stated incentive to adoption, it appears that even the expert community has not fully thought through the relationship between incentives and barriers to CSA uptake. Across these tables, there is convergence around the potential value of addressing **initial costs** (barrier) with **subsidies** (incentive), **access to external inputs** (barrier) with **subsidies** and **access to credit** (incentives), and the need to address inadequate **extension services** (barrier) with more and better **extension** (incentive). However, mismatches also occur. For example, incentives like **flexibility** and **improved local discretionary decision-making** are solutions without a clear problem on the barrier side of the equation. This does not mean these incentives are invalid, only that the practitioners do not seem to have traced the value of such incentives back to particular barriers they might address. Similarly, a large percentage identified secure **land tenure** as an incentive to adoption without citing it as a barrier, again suggesting that not all of these experts have systematically thought through why certain incentives work, and what issues those incentives address.

Part 3. Key Findings from the In-Country Farmer Interviews

The third component of this study involved field-level interviews and observations with African farmers. Two sites in Burkina Faso and two sites in Kenya were selected to provide case studies of how CSA is being adopted in practice. Site selection was guided by a number of criteria to present as broad a representation of African CSA as possible: Site selection in each country was guided by six criteria:

7) Area where multiple CSA technologies and strategies were present and there was already documented and anticipated climate change impacts,
8) Area that reflects relevant USAID priority programming, namely Feed the Future and Food for Peace,
9) Potential for value-addition to the literature review,
10) Ease of access,
11) Advice from technical experts, and
12) Areas where our team had significant field experience.

In total, 147 interviews were conducted in Burkina Faso and 81 interviews were conducted in Kenya (see Table 6) Interviews were complemented by field observations to local government offices, implementers' facilities and demonstration plots, local private sector agricultural operators, farms, and villages.

Table 6: Agro-characteristics of field sites

Site location	Climate	Average rainfall	Main crops grown	Dates of study	Total Number of interviews	Number of women interviewed
Kenya						
Wote	Wet	600mm	Maize (82.7 percent) Beans (79 percent) Sorghum (23.5 percent) Fruit (23.5 percent)	April, 2016	81	48
Kibwezi	Dry	<600mm				
Burkina Faso						
Dano Wet	Wet	900 – 1200 mm	Millet (79.6 percent) Maize (61.2 percent) Sorghum (57.1 percent) Groundnuts (47.6 percent) Beans (47.6 percent) Rice (34 percent)	May, 2016	147	30
Ouahigouya	Dry	600 – 900 mm				

Farmers' perceptions of climate change

Table 7: Climate Perceptions by Study Site

	Increase in Temp	Increase in Rainfall	Increased Drought
Burkina Faso (n=147)	97%	82%	77%
Kenya (n=81)	99%	95%	91%
Total (n=228)	98%	86%	82%

Table 7 shows climate perceptions between the countries studied. Farmers are aware of changes in overall patterns of temperature and precipitation in their lifetimes, and have also noted changing patterns of climate extremes and variability. Farmers in Burkina Faso and Kenya all reported increases in rising temperatures, as well as increases in drought and rainfall, depending on the time of year.

One important finding from the interviews is that while smallholder farmers have awareness that weather patterns are changing, they are unfamiliar with terminology and root causes of climate change (see Figure 2). This is in spite of what appears to be much publicity and communication efforts from international and national levels. The assessment team interviewed farmers link climate change to development projects, while others believe in trends that run counter to the state of international scientific knowledge being propagated. Some agree with the general evidence of change but interpret the changes within the narrative of desertification and not climate change. When asked to talk about what it will be like twenty years from now, many interviewees drew from the learned narratives of desertification and said that it will be hotter and drier because of abusive tree cutting and bush fires and would not be reversed if more trees were not planted. This supports findings from the literature which suggests that smallholder awareness of climate change, at least anthropogenic change over long periods of time, is low.[48] This insight has important implications for understanding farmers' motivations for CSA approaches. Without a long-term understanding of climate change, from a risk management perspective, smallholder adoption decisions regarding CSA are driven almost exclusively by short-term risk assessments. This also implies that CSA programming should build upon the risk management foundations that farmers already have in place.

Figure 2: Farmers' views of climate change:

"Yes I heard about it but I think that program ended last year." (Kenya)

"It's seasonal." (Kenya)

"Things are getting wetter and cooler." (Burkina Faso)

"Things are getting drier and hotter." (Burkina Faso)

"It's caused by bushfire and illegal woodcutting." (Burkina Faso)

"It's because people are acting immorally." (Burkina Faso)

[48] Akponikpe, P.B.I. et al. 2010. Farmers' perception of Climate Change and Adaptation Strategies in Sub-Sahan West-Africa. In ICID +1: 2nd International Conference: Climate Change, Sustainability and Development in Semi-arid Regions; Tschakert, P, 2007, Views from the Vulnerable: Understanding climatic and other stressors in the Sahel, Global Environmental Change, 17 (3-4), 381-396.

Farmers' diversification strategies

In our field sites, and more broadly in large parts of Africa, farmers have very diversified livelihoods. Activities that build on the processing and sale of agricultural products (such as alcohol production) and activities that are largely unrelated to agriculture (such as itinerant labor) are important means to diversify production. In addition, farmers operate diversified production regimes. These include farming a range of crops, cultivating multiple varieties of the same crop with traits that control for different climatic or market conditions, and farming crops for both market sale and subsistence consumption.[49] Farmers interviewed in Burkina Faso and Kenya often had upwards of five annual crops per growing season, a range of perennials, plus several different types of livestock. This is not unusual in sub-Saharan Africa. This diversification, as in other parts of sub-Saharan Africa, is a risk management and resilience strategy. Farmers in both sites indicated that agricultural diversification was, in part, an effort to manage weather and climate-related risk as crops have different characteristics, timing and rainfall tolerances.

Farmers' barriers to adoption

In keeping with the analysis of the expert interviews, constraints and incentives were separated. Table 8 provides the main factors cited by farmers as barriers to CSA adoption. Two data sets are provided. First, the top factors noted by farmers as a barrier to adoption are presented. Second, a weighted average of farmers noting factors as either a high, medium, or low impact is presented.[50] This provides for an analysis of not just main barriers faced by farmers but also how much of an influence that barrier has on adoption.

[49] For discussion of African livelihoods and their diversification, see de Haan, Leo J. 2005. *How to Research the Changing Outlines of African Livelihoods*. Rotterdam. http://repub.eur.nl/res/pub/22832/; Ellis, Frank, and M Kutenguke. 2003. "Livelihoods and Rural Poverty Reduction in Malawi." *World Development* 31 (9): 1495–1510.; Scoones, Ian. 2015. *Sustainable Livelihoods and Rural Development: Agrarian Change and Peasant Studies*. Rugby, UK: Practical Action Publishing; Bryceson, Deborah Fahy. 2002. "Multiplex Livelihoods in Rural Africa: Recasting the Terms and Conditions of Gainful Employment." Journal of Modern African Studies 40 (1): 1–28.; Bryceson, Deborah Fahy, C Kay, and J Mooij. 2000. Disappearing Peasantries? Rural Labor in Africa, Asia and Latin America. London: Intermediate Technology Publications; Bryceson, Deborah Fahy. 2002. "The Scramble in Africa: Reorienting Rural Livelihoods." World Development 30 (5): 725–39.

[50] To get a meaningful sense of the importance/severity of a barrier or incentive, responses were assigned on an ordinal scale (0=not a barrier/incentive, 1=low barrier/incentive, 2=medium barrier/incentive, 3=high barrier/incentive). A weighted average "score" for each barrier, giving an overall sense of the respondents.

Table 8: Barriers to CSA adoption as identified by farmers

Categories	Factors	Percentage of Farmers Noting Barrier to Adoption			Weighted Impact of Barriers to Adoption		
		Burkina Faso (n=147)	Kenya (n=81)	Total (n=228)	Burkina Faso (n=147)	Kenya (n=81)	Total (n=228)
Economic and Production Characteristics	Initial cost	68%	68%	**68%**	High *(2)*	High *(2)*	**High** *(2)*
	Flexibility	1%	12%	**5%**	Low *(0)*	Medium *(1)*	Low *(0.5)*
	Labor availability (lack of)	14%	43%	**25%**	Low *(0.5)*	Medium *(1.5)*	Medium *(1)*
	Size of farm (having a small farm)	3%	21%	**10%**	Low *(0)*	Medium *(1)*	Low *(0.5)*
	Access to credit	32%	59%	**42%**	Medium *(1.5)*	High *(2)*	Medium *(1.5)*
	Access to external inputs and infrastructure	12%	16%	**13%**	Low *(0)*	Low *(0.5)*	Low *(0)*
Social and Cultural Context	Access to information	13%	35%	**21%**	Low *(0.5)*	Medium *(1.5)*	Medium *(1)*
	Climatic risk / uncertainty	37%	79%	**52%**	Medium *(1.5)*	High *(2.5)*	**High *(2)***
Governance Frameworks (Markets, Institutions, and Policy)	Access to markets	30%	38%	**33%**	Low (0.5)	Low (0.5)	Low (0.5)
	Institutional relations (lack of government support)	19%	31%	**23%**	Medium (1)	Medium (1.5)	Medium (1)

**Underlined quantitative results are those that fall in the upper quartile of the results.*

Initial cost was the most frequently cited barrier to adoption, mentioned by 68 percent of farmers, with negligible differences between Burkina Faso and Kenya. These farmers also found it to be not only common, but also a barrier with a high negative impact on adoption (potentially a driving factor leading to non-adoption). This finding matches the literature review and the expert interviews.

The second highest factor was **climatic risk / uncertainty**[51] with 52 percent (this figure was substantially higher in Kenya with 79 percent than Burkina Faso with 37 percent). Interestingly, paralleling the rates of reporting, farmers in Burkina Faso saw this as a medium barrier to adoption, while those in Kenya saw climate risk and uncertainty as a high barrier to adoption (see text box).

[51] Climatic risk/uncertainty in this case refers to both intra- and inter-seasonal and intra- and inter-annual issues. These encompass both weather-related (short-term changes) and climatic (longer-term patterns) dynamics.

Perspectives on climatic risk: understanding the disconnect between CSA literature, experts, and farmers

Issues of climate variability do not emerge in the literature or the responses in the expert interviews as barriers to CSA adoption but were strongly cited in the farmer surveys. The explanation for this apparent disconnect may stem from the ways in which the two groups view climate variability and change and the contribution of CSA to their livelihoods. The literature on CSA and CSA experts generally think of CSA as inherently addressing issues of climate change, and therefore, questioning whether or not climate variability and change is a barrier to adoption seems nonsensical.

The problem with this reasoning is that the CSA literature, and many experts, fail to recognize that current smallholder agricultural practice is already developed to guard against weather-related risk, particularly variability in the timing and amount of rainfall. When a new practice is introduced, if that practice lowers the capacity of farmers to address the *immediate* risks of climate variability, the farmers will not adopt it because current variability is too great a risk (see above for discussion on timeframes). Thus, CSA technologies or strategies addressing long-term climate change will not be taken up unless they either incorporate existing approaches aimed at the management of short-term climate risk, or they can replace those short-term risk management tools with new tools. Additional research is needed across different field sites in sub-Saharan Africa to better unpack and verify this finding.

Access to credit was the third most-frequently cited barrier, referenced by 42 percent of respondents (this figure was substantially higher in Kenya with 59 percent than Burkina Faso with 32 percent). It was weighed as a medium barrier in Burkina Faso and a high barrier in Kenya. In both countries, farmers saw this as a medium barrier to adoption. **Labor availability** (25 percent), **institutional relations** (23 percent), and **access to information** (21 percent) were also noted as barriers. Each of these factors was seen as a medium barrier to adoption by farmers, suggesting that while these may be common barriers, they may not be the most critical barriers shaping CSA uptake.

Farmers' incentives to adoption

Table 9 provides the main factors cited by farmers as incentives to CSA adoption. Two data sets are provided. First, the top factors noted by farmers that are incentives to adoption are presented. Second, a weighted average of farmers noting these incentives as either a high, medium, or low impact is presented. This provides for an analysis of not just main incentives of farmers but also how much of an influence that incentive has on adoption.

Table 9: Incentives to CSA adoption as identified by farmers

Categories	Factors	Percentage of Farmers Noting Incentives to Adoption			Weighted Impact of Incentives to Adoption		
		Burkina Faso (n=147)	Kenya (n=81)	Total (n=228)	Burkina Faso (n=147)	Kenya (n=81)	Total (n=228)
Economic and Production Characteristics	Flexibility	0%	20%	7%	Low *(0)*	Medium *(1)*	Low (0.5)
	Access to credit	64%	28%	**51%**	High *(2)*	Medium *(1)*	Medium *(1.5)*
	Access to external inputs and infrastructure	37%	70%	**49%**	Medium *(1.5)*	High *(2)*	Medium *(1.5)*
	Farm size (Large)	3%	17%	8%	Low *(0)*	Medium *(1)*	Low *(0.5)*
Social and Cultural Context	Risk management (potential for)	1%	11%	5%	Low *(0)*	Low *(0.5)*	Low *(0.5)*
	Asset protection and insurance	1%	3%	2%	Low (0)	Low *(0.5)*	Low *(0)*
	Local discretionary decision making	0%	9%	3%	Low *(0.5)*	Medium *(1)*	Low *(0.5)*
	Collective action and local organizational capacity	13%	35%	21%	Low *(0.5)*	Medium *(1.5)*	Low *(0.5)*
	Access to information	16%	43%	25%	Low *(1)*	Medium *(1.5)*	Medium *(1)*
Enabling Environment (Markets, Institutions, and Policy)	Access to markets	32%	40%	**35%**	Medium *(1)*	Medium *(1.5)*	Medium *(1)*
	Institutional relations	19%	31%	23%	Medium *(1)*	Medium *(1.5)*	Medium *(1)*
	Access to recourse	0%	17%	6%	Low *(0)*	Low *(0.5)*	Low *(0.5)*
	Inclusion in decision making	1%	19%	8%	Low *(0)*	Medium *(1)*	Low *(0.5)*

**Underlined quantitative results are those that fall in the upper quartile of the results.*

Farmers most frequently cited **access to credit** (51 percent) as an incentive to CSA adoption, although there were differences between Burkina Faso and Kenya. Farmers in Burkina Faso cited access to credit as an incentive 70 percent of the time and saw this as a high incentive, whereas only 28 percent of farmers in the Kenya sample noted this incentive and when they did, they saw it as having a medium incentive. This finding is aligned with the barriers noted by farmers in Table 8, where 32 percent of farmers in Burkina Faso and 59 percent of Kenyan farmers noted access to credit a barrier, and both saw this as a medium barrier. This strong alignment suggests that the barrier of access to credit (which itself limits access to inputs and other needed assets) can be addressed with the proper provision of credit.

Similarly, there was a big difference in the perception of the second-most commonly cited incentive: **access to external inputs and infrastructure.** Farmers in Kenya cited this factor 70 percent of the time, seeing it as a high incentive for adoption, compared to 37 percent in Burkina Faso, who saw it as a medium incentive. Interestingly, access to external inputs and infrastructure was *infrequently* cited as a barrier in either Kenya or Burkina Faso. Therefore, while farmers may represent access to external inputs and infrastructure as an incentive for CSA uptake, this desire for access may reflect a broader desire for greater access to inputs and infrastructure, regardless of the CSA component of agriculture. This would explain why neither group of farmers listed access to inputs and infrastructure as a significant *CSA-specific* barrier to the uptake of an agricultural practice, as it is a barrier to all agricultural practice. The case of greater access to inputs and infrastructure requires greater unpacking to identify the CSA-specific inputs and infrastructural incentives that might drive adoption.

The third highest incentive was **access to markets**, which was cited by 32 percent of farmers in Burkina Faso and 40 percent of farmers in Kenya. While this is very similar to the percentages of farmers who identified access to markets as a barrier to adoption in both sites, in both cases this was cited as a low barrier to adoption. Much as with external inputs and infrastructure, it appears that a wider demand for access to markets transcends CSA-specific interventions and practices and therefore this response may reflect wider demand for agricultural incentives. This is unclear and will require greater unpacking to determine the CSA-specific aspects of market access that serve as incentives for adoption, and whether or not they address the market barriers to adoption identified by farmers.

In both cases, the data suggests that access to information and addressing institutional relations might be a larger issue for the Kenyan farmers, and therefore a productive means of enhancing CSA adoption, while in Burkina Faso such efforts would be aimed at a much less important barrier, and therefore be likely to have a much smaller impact on adoption.

Farmers' barriers to adoption disaggregated by sex

Not all farmers in a particular place will have the same roles and responsibilities, and therefore they will likely perceive different barriers and incentives for the adoption of CSA. While the particular identities relevant to these roles and responsibilities varies by place and usually

engage more than one aspect of identity e.g., gender and seniority or religion and livelihood)[52], the data in this study does not allow for this sort of analysis. However, it is worth disaggregating the data by gender to explore the degree to which incentives and barriers can vary within a single population and the need for gender-sensitive CSA interventions. Table 10 displays the response rates of farmers identifying barriers to adoption of CSA approaches, disaggregated by sex and study site. While overall trends remain the same as shown in Table 8, women and men differ in their assessments of constraints and therefore are likely to differ in deciding whether or not to adopt any given CSA approach.

Overall, the differences between the perceptions of men and women are common enough to demonstrate that female farmers may perceive or experience barriers differently than male farmers, which impact their adoption decisions. This finding is broadly commensurate with the literature on gender and agriculture in sub-Saharan Africa. Further, these findings suggest important contextual differences between the two sites, which means that the identification and treatment of barriers to CSA adoption must be addressed through programming in a contextually aware manner. Such awareness includes knowing how past policies, programs, and interventions impact current CSA adoption both due to the political economy of the place and the nature of the interventions/CSA approaches themselves.

Table 10: Farmers barriers to CSA adoption

Categories	Factors	Burkina Faso		Kenya	
		Male (n=117)	Female (n=30)	Male (n=33)	Female (n=48)
Economic and Production Characteristics	Initial cost	**64%**	**83%**	**82%**	**77%**
	Flexibility	2%	0%	12%	13%
	Labor availability (lack of)	21%	10%	42%	35%
	Size of farm (small)	3%	3%	12%	19%
	Access to credit	32%	33%	**70%**	52%
	Access to external inputs and infrastructure	13%	7%	24%	19%
Social and Cultural Context	Access to information	9%	30%	33%	29%
	Climatic risk / uncertainty	**34%**	**47%**	**61%**	**73%**
Enabling Environment (Markets, Institutions, and Policy)	Access to markets	27%	40%	39%	46%
	Institutional relations (lack of government support)	14%	17%	24%	42%

** Underlined quantitative results are those that fall in the upper quartile of the results*

[52] Carr, Edward R., and Mary C. Thompson. 2014. "Gender and Climate Change Adaptation in Agrarian Settings: Current Thinking, New Directions, and Research Frontiers." *Geography Compass* 8 (3): 182–97.

In Burkina Faso, female farmers report **initial cost** as a barrier to adoption at a significantly higher rate than male farmers (83.3 percent compared to 64.1 percent in Burkina Faso), while the reported rates of concern for this barrier are much closer between men and women in the Kenyan sample (81.8 percent to 77.1 percent). This likely reflects different roles and responsibilities of women and men in these two contexts with regard to agricultural investment, and thus creates very different levels of incentives for men and women. This conclusion is supported by a very similar pattern in the patterns of reporting **knowledge** as a barrier to adoption. In Burkina Faso, 30 percent of female farmers in Burkina Faso reported knowledge as a high barrier compared to 8.5 percent of men, while in Kenya around 30 percent of men and women reported this factor.

Another example highlighting the two points above is access to credit. For this barrier, the pattern was reversed. In Burkina Faso, around 30 percent of men and women reported this as a barrier. However, in Kenya men reported credit as a barrier to adoption more frequently (69.7 percent) than women (52.1 percent), suggesting that 1) access to credit is a larger part of the agrarian livelihoods in the Kenyan study area, and 2) within those Kenyan livelihoods, women's access to credit is somehow different than that of men, perhaps as an outcome of credit schemes targeted at women smallholders.

Farmers' incentives to adoption disaggregated by gender

Table 11 displays the response rates of farmers identifying 'high barriers to adoption' of CSA approaches, disaggregated by gender and study site. While the overall trends for all farmers remain the same as Table 9, there are interesting differences in the response rates

Table 11: Farmers incentives to CSA adoption

Categories	Factors	Burkina Faso		Kenya	
		Male (n=117)	Female (n=30)	Male (n=33)	Female (n=48)
Economic and Production Characteristics	Flexibility	0%	0%	15%	23%
	Access to credit	**60%**	**80%**	42%	19%
	Access to external inputs and infrastructure	35%	47%	**67%**	**73%**
	Farm size (Large)	3%	0%	18%	17%
Social and Cultural Context	Risk management (potential for)	2%	0%	9%	13%
	Asset protection and insurance	1%	3%	6%	2%
	Local discretionary decision making	0%	0%	9%	13%
	Collective action and local organizational capacity	14%	10%	36%	33%
	Access to information	15%	20%	42%	44%
Enabling Environment (Markets, Institutions, and Policies)	Access to markets	27%	**50%**	46%	35%
	Institutional relations	n/a	n/a	n/a	n/a
	Access to recourse	0%	0%	15%	19%
	Inclusion in decision making	1%	3%	18%	19%

As with barriers, there are clear differences between men and women that, while perhaps not surprising from the perspective of the literature, serve as important reminders of the role of identity in shaping the perception and experience of incentives among farmers in a particular place. Further, there are contextual differences that once again highlight the need for contextually-aware programming that identifies and leverages such incentives to change rates of CSA adoption.

Male farmers, for example, report **access to credit** as an incentive at a significantly higher rate than women in Kenya, but at a significantly lower rate in Burkina Faso, This reinforces the conclusion that in the Kenyan sample, credit is much more central to livelihoods than in the Burkina Faso sample, and that men are somehow more concerned with access to credit in the Kenyan sample than are women, whether because of the crops they grow, their specific roles and responsibilities, or the outcomes of previous interventions aimed at providing credit to women. In contrast, female farmers report **access to inputs** as an incentive at a higher rate than men, but on the whole this incentive is mentioned far more often than it is as a barrier.

V. LESSONS LEARNED FOR CSA ADOPTION

This chapter provides a triangulation of common findings and differences across the literature review, expert interviews, and in-country case studies and offers a narrative explanation for the root of similarities and discrepancies.

Table 12: List of top factors influencing adoption across all data sources

Categories	Factors	Literature Review	Barriers		Incentives	
			Technical Experts	Farmer Surveys	Technical Experts	Farmer Surveys
Economic and Production Characteristics	Long-term cost	High	26%	0%	0%	0%
	Initial cost	High	24%	68%	0%	0%
	Transaction cost	High	7%	0%	0%	0%
	Multi-objective	High	0%	0%	0%	0%
	Flexibility	Medium	0%	5%	40%	7%
	Impact on yield	High	0%	0%	0%	0%
	Opportunity cost	Medium	7%	0%	0%	0%
	Private sector	Low	0%	0%	24%	0%
	Size of farm	Medium	31%	10%	2%	8%
	Access to external inputs & infrastructure	Medium	21%	13%	0%	49%
	Access to credit	Medium	0%	42%	19%	51%
	Labor availability	Medium	0%	25%	0%	0%
Social and Cultural Context	Values local knowledge	High	0%	0%	0%	0%
	Access to information	Medium	33%	21%	0%	25%
	Farmer familiarity with practice or similar practices	Medium	0%	0%	29%	0%
	Compatibility with existing livelihood system	High	0%	0%	0%	0%
	Risk management	High	17%	52%	38%	5%
	Local discretionary decision-making	High	0%	0%	33%	3%
	Local social capital	Medium	0%	0%	0%	0%
	Extension services	Medium	19%	0%	0%	0%
	Asset protection and insurance	Medium	0%	0%	0%	2%
	Collective action and local organizational capacity	Medium	0%	0%	0%	21%
Enabling Environment (Markets, Institutions and Policies)	Institutional relations	High	31%	23%	57%	23%
	Conflict	High	0%	0%	0%	0%
	Policy framework	Medium	10%	0%	0%	0%
	Land tenure	Medium	10%	0%	31%	0%
	Impact on resilience	Medium	0%	0%	0%	0%
	Access to recourse	Medium	0%	0%	0%	6%
	Inclusion in decision making	Medium	0%	0%	0%	8%
	Access to markets	Medium	10%	33%	29%	35%
	Subsidies	Low	17%	0%	38%	0%

Economic and Production Characteristics

The first category concerns the economic and production characteristics of CSA approaches. These are the familiar constraints to the adoption of technologies by farmers that are often found in the literature. They include cost, familiarity and access to information, flexibility, and farm size. While the factors themselves are fairly well known, the report helps to identify relative importance. The list is not comprehensive, but does capture the most commonly reported barriers.

Unsurprisingly, cost appears to be the greatest factor governing adoption, although there are significant differences between farmers and the CSA literature / experts on the impact of initial costs versus long term costs.

As might be expected, cost is often one of the first barriers mentioned in the general agricultural adoption literature. Our literature review also confirms this is a barrier for CSA. Costs were also ranked very highly in the expert interviews and farmer surveys. Cost has many dimensions that require disaggregation, if we are to address them appropriately in development programming. The review identified initial costs, long-term costs, and transaction costs as key factors of adoption.

Initial costs were the top barrier identified in the farmer surveys, cited by 68 percent of farmers. Approaches that come with high initial costs, such as equipment, inputs and services (as in the case of Conservation Agriculture) require access to credit or subsidies to encourage farmer adoption. These resources are often absent or not well linked to CSA interventions. Long-term costs were cited as barriers to adoption in the literature and expert interviews, but interestingly did not emerge as a top constraint by farmers. Given the typical temporal frame of farmer decisions (usually seasonal), this finding makes a great deal of sense. Farmers are most concerned with the immediate costs facing their livelihoods in the short term, over planning for long-term shifts.

Some approaches seem to neglect or to under-estimate transaction and opportunity costs, failing to recognize that farmers have diverse livelihoods and other demands on their time and resources. These costs seem significant for many specific CSA approaches, such as Climate Smart Villages and Payment for Environmental Services. On the other hand, it appears that Farmer Managed Natural Regeneration, with its reliance on familiar practices, flexibility and local organizations and tenure regimes, has low local transaction costs, which seems to be a large factor in its adoption.

Access to credit and accessing external inputs and infrastructure is noted as a factor of adoption by all three data sources but may be underestimated by the CSA literature and technical experts.

Supporting the results that show costs as prominent barrier to adoption are complementary findings on access to credit. In our farmer surveys, access to credit was the second highest barrier to adoption (42 percent), and the highest ranked incentive to CSA adoption (51 percent). Access to credit was found to be have a medium impact on adoption and was cited by 19

percent of experts as an incentive to adoption. This suggests that while the common narrative is aware of the importance of finance, it may be underestimating its impact.

Access to credit helps farmers overcome the initial costs that the adoption of CSA practices demands. It is important to note that for effective adoption, access to credit also needs to be sustained and reliable over a long period of time. This allows farmers to fully realize the benefits of CSA adoption and pay off their financial obligations. Strong credit systems also help mitigate long-term, transactional and opportunity costs, which can force farmers into dis-adoption. In the Burkina Faso case study, farmers stated that a more accessible local bank would serve as a high incentive in adopting CSA practices. Having a local brick-and-mortar financial institution, or even some kind of mobile-money service helps facilitate continued access to credit and lowers their transportation cost and time (transactional and opportunity costs), allowing farmers to spend more time and resources increasing their resilience and productivity.

Similarly, access to external inputs and infrastructure featured strongly as a factor affecting adoption throughout the research, cited as a medium factor in the literature review and as an incentive by 21 percent of experts interviewed. Among incentives to CSA adoption discussed in the farmer interviews, access to external inputs and infrastructure scored second highest (49 percent), following access to credit. Lack of access to external inputs and infrastructure can drastically increase the cost of the necessary materials and tools, stopping poor farmers from adopting practices or disincentivizing adoption for farmers with higher levels of capital and resources. Where key inputs or infrastructure are just not available, the option for adoption of certain input-heavy CSA practices, such as Integrated Water Resource Management or Climate-Smart Rice Production is removed entirely. In both Kenya and Burkina Faso, farmers responded that various forms of increased access (through greater availability, government subsidies, and / or reduced prices) to the proper inputs, specifically fertilizers and pesticides, would serve as a great incentive to the adoption of CSA practices.

Farm size may have an impact on adoption of certain CSA approaches, but may be less important than commonly believed.

The small size of farms in Africa appears to be a constraint to agricultural development in general and therefore to CSA. Small farms lack economies of scale, making larger investments difficult. Further, their negotiating position within markets is weaker. Farm size was highlighted as a major constraint to adoption in the literature review, and this was supported by our expert interviews. In contrast, it seemed to be less of a concern during our farmer interviews, with only 10 percent of farmers believing farm size was a constraint to adoption.

Critical to addressing size constraints is some type of collective action, and this often comes with costs (transaction and opportunity) and requires a significant understanding of the local social context in which this collective action takes shape. Approaches like Conservation Agriculture seem to require larger holdings to generate outcomes that promote the sustained adoption of this approach, which may constrain adoption by additional farmers, whereas approaches that mitigate the constraints of small size seem to have better adoption rates. Farmer Managed Natural Regeneration, for example, requires minimal upfront investment and

its input packages are capable of being downscaled to small plots, allowing for the cost of this investment to be scaled to the size of the farm.

Social and Cultural Context

Just as important as ensuring the economic feasibility of CSA approaches is ensuring that these approaches are aligned to the broader social and cultural aspects relevant to livelihood decision-making. As developed throughout this report, farmers understand CSA through their own formal and informal systems and norms that govern factors such as labor, gender, identity, and beliefs.

Farmer familiarity and access to information are key factors to farmer adoption.

Taken together, findings emphasize the importance of linkages between climate smart approaches and established practice in CSA adoption. The literature review pointed towards farmer familiarity as a key factor of adoption, and experts interviewed (27 percent) mention that valuing local knowledge is important.

The case study also point to lack of information is a critical constraint. Farmer responses show us that 25.4 percent of farmers believe that access to information positively affects CSA adoption, and 20.6 percent believe that the lack of information negatively affects adoption of CSA approaches. This was reinforced by the expert interviews, which mentioned information as the second most important barrier to adoption after cost (33 percent). Women often face greater constraints in accessing information than their male counterparts, as a result gendered constraints in terms of literacy and access to mobile technologies.[53]

CSA approaches and practices that reduce risk and improve resilience are likely to have greater adoption by smallholder farmers, but risk and resilience must be understood in the context of existing livelihood and social systems.

Most agrarian livelihoods systems in sub-Saharan Africa are framed around the avoidance of catastrophic risk, such as monsoon failure in West Africa during large El Niño events.[54] Formal risk management mechanisms are less well developed, forcing smallholder farmers to manage their own risks through their household agricultural and livelihoods strategies. Across the board, risk

> *"I blame increased commercialization for fragility. Thirty years ago we were told that sorghum was a poor man's crop, that we should plant maize, plow in straight lines, clean our fields and take trees out of our fields. We did that. Now we are being told that we need to move to more drought resistant crops like sorghum, that we shouldn't plow – minimum tillage, that we should plant trees, that we should go back to the mulching techniques we used traditionally."*
>
> - Discussion with a local government environmental officer in Kenya

[53] Antonio, A and David Tuffley. 2014. The Gender Digital Divide in Developing Countries.

[54] Carr, Edward R. 2011. *Delivering Development: Globalization's Shoreline and the Road to a Sustainable Future*. New York: Palgrave Macmillan.

management was found to be crucial for adoption of CSA approaches. It emerged as a high adoption factor in the literature review and was cited by 38 percent of technical experts as an incentive to adoption. This was also reinforced by the farmer surveys.

While the literature review noted a range of risks, including biophysical, market, and institutional, technical experts commonly referenced market risk as a constraint to adoption. Diversification is critical strategy for mitigating market risk.[55] Farmers in Kenya indicated they cultivated a diversity of crops because they were not sure what the crop prices would be at the end of the growing season. By diversifying, they were hoping to get a least one crop that had a good price that year. Similarly, farmers surveyed in Burkina Faso farm short-cycle grains and groundnuts in an effort to gain a harvest during the hungry season, when prices for these crops are highest. CSA approaches that do not explicitly recognize and build on existing risk management efforts, or include some form of new risk management tools or opportunities to replace those that might be impacted by the intervention, are less likely to be adopted.

Somewhat surprisingly, 52 percent of farmers noted climatic risk as a factor impacting CSA adoption. While a focus on climatic this may seem counterintuitive, as explained earlier in this report, farmers do not have a robust understanding of the terminology and root causes of climate change and thus climatic uncertainty limits all investment decisions, even if these decisions could help mitigate this uncertainty. Interestingly, the case study interviews found that most farmers (95 percent) did not see offerings of asset protection and insurance as incentives to adopt CSA approaches, possibly due to distrust of institutions that would offer such services. This finding requires greater attention in the future to identify the causes of the low rate of interest in asset protection, and how that relates to high rates of concern for risk management and resilience among these same farmers.

Finally, to design effective CSA interventions, we must understand the ways in which they relate to existing livelihood and social systems. Production plays an important role in this wide framing of resilience, but increased production alone does not always increase resilience. In southern Ghana, for example, men are expected to earn more money than their wives. Failure to do so can result in men losing social status, which in turn can result in diminished access to agricultural land. Allowing women to farm even slightly increased areas of land would dramatically boost household food production and income, but at the risk of allowing women to earn more than their husbands. Empirical data across three agricultural seasons demonstrates that when such income thresholds were approached, men pulled back the amount of land their wives were allotted. While this ensured that men would maintain social status in the community, it also reduced the amount of food and money available to these households.[56] In this case, a change in agricultural practice that, by improving women's production or incomes, might increase resilience for the entire household is unlikely to be adopted because of the ways in which it would challenge the stability of the social order and attract sanctions.

[55] FAO. 2008. Managing Risk in Farming – Farm Management Extension Guide.

[56] Carr, Edward R. 2011. *Delivering Development: Globalization's Shoreline and the Road to a Sustainable Future*. New York: Palgrave Macmillan.

Enabling Environment (Markets, Institutions, and Policy)

This category of factors deals with the larger issues of market and institutional constraints. This category goes beyond the technological and economic field-level factors to address the formal and informal "rules of the game" that make it difficult for smallholder farmers to invest in and adopt CSA approaches. For markets, these factors go beyond physical access to markets and information, for example, to underline the pervasive issues of market allocation, information manipulation, collusion, monopsonies and monopolies. In terms of institutional failure, the factors go beyond the classical lack of extension and lack of inputs to include lack of contract enforcement, lack of appropriate means of recourse, nonexistent risk management and social protection programs, and corruption and patronage in farm subsidies and other state programs. These market and institutional constraints discourage production and stifle the adoption of CSA approaches.

Agricultural markets do not present a level playing field for smallholder farmers.

Customer demand is cited as a positive force in influencing the adoption of technology, as farmers with the ability to market and increase incomes have a strong incentive to adopt technologies that increase production. However, smallholder farmers face considerable challenges in the market and often perceive the market to be a source of risk, unpredictable and often operating to their disadvantage. Access to markets featured as a factor shaping CSA uptake across the study, cited in our expert interviews primarily as an incentive to adoption (29 percent). Results from the case study echo this, with farmers seeing proper access to markets as an incentive (35 percent) to adoption, and lack of access to markets as a barrier (33 percent).

There are several well-known challenges associated with markets that farmers face. One that is often cited is that of physical access to markets.[57] Rural farmers in Africa live in areas where transportation infrastructure is very limited and unreliable. This increases the cost of getting production to market and contributes to the loss of crops due to spoilage, forcing farmers to seek higher margins to compensate. Women often face greater challenges in accessing markets than men, particularly when it comes to cross-border trade.[58]

Another well-documented problem is access to market information.[59] Information asymmetries, with the farmer consistently on the poor information side, means that farmers are at a negotiating disadvantage relative to middlemen and buyers that cuts into profit margins. As with weak transportation systems, such loss of margins serves as a disincentive to increase production and market engagement. Market information systems have been designed and implemented that at least partially address this problem.

[57] Brookings Institute. 2013. Building Opportunities: Addressing Africa's Lack of Infrastructure.
[58] USAID. 2012. Women in Cross-Border Trade, Enabling Agricultural Trade Project Policy Brief.
[59] FAO. 2013. Smallholder Integration in Changing Food Markets.

Price spikes are another well-known and well-described issue.[60] Prices for agricultural commodities can change dramatically and for reasons well beyond the control of African farmers. The highly integrated global food system distributes the impact of production-related stresses and shocks across a global market, thus minimizing the acute effects of such issues across the system. Normal volatility in prices does not result in undue stress on producers (at least as measured in the rate of food-price related conflict), but price spikes are deeply problematic and can result in conflict within communities and even countries.[61]

When farmers talk about the market, however, a whole range of additional issues come up. In some instances they describe the market process as "throwing away their production". They encounter on a regular or frequent basis low prices because of the need to sell urgently for an emergency, the breach of contract by buyers, collusion among buyers, control of the physical space of markets, and corruption and patronage in subsidies. These events can seem sporadic and infrequent but they are part of a pattern that inhibits farmers from engaging in activities that would otherwise be profitable.

Running in place:

"The kind of problems we now have with farming here [in Wote] can be compared to a runner who is stuck at one point, not making any progress. We have a lot of technologies, and when we have had good rains, we produce enough for consumption and sale… but the prices are so low that we make nothing. We are not moving forward anymore, and any slight push like prolonged dry periods will take us backwards to where we started."

- Julius Sila Mwangangi, Mulani village, Wote, Kenya

Farmers' cash needs oblige them to enter the market, but since these institutions are extractive they discount their returns very steeply, as the return on any investment must be high in order to compensate for the risks involved. For example, the assessment team encountered a farmers' group in Kenya that lost $22,000 through breach of contract with a buyer. The group now must spread this cost over all additional market interactions. Approaches that increase production above subsistence must have tremendous rates of return in order to compensate for the risk of market failures to be attractive. Few approaches can meet this high bar. As a result, farmers feel that their production has little market value, and thus they tend to devalue market engagement.

Adoption is significantly constrained by dysfunctional government institutions.

Institutional relations was highlighted as a key factor to CSA Adoption across all of our research fields, ranking high in the literature review and seen as a barrier and incentive to CSA adoption in our farmer interviews (23 percent for both). Experts felt strongly about the importance of institutional relations in CSA adoption, with 31 percent viewing it as a key barrier and 57 percent stating that institutional relations were a strong incentive to farmer adoption, making it the highest mentioned factor among incentives in the expert interviews.

[60] Oversees Development Institute. 2013. Looking Back, Peering Forward – What has been Learned from the Food-Price Spike of 2007-2008.

[61] Bellemare, Mark F. 2015. "Rising Food Prices, Food Price Volatility, and Social Unrest", *American Journal of Agricultural Economics*.

Farmers' perceptions and relationships with the state influence their behavior, including investment and adoption of improved techniques. Critically, farmers often see the state and its institutions as not only failing to address risk management, but actually being an important source of risk for some farmers. Farmers do not know if inputs will be available on time and at what price. They are fairly certain that they will get little advice, particularly on their staple crops. If they have a contractual or agreement issue with a buyer or provider, they have little confidence that state institutions will intervene.

In both the Kenyan and Burkina Faso sites, for example, farmers viewed the state as largely absent. While there is evidence of extension support for some export crops such as cotton, extension services for staple crops is lacking, extension staff are often poorly trained, poorly equipped and unable to visit farmers on a regular and useful basis. When extension does exist, it is often repetitive and unresponsive to actual need and demand. Extension services, such as plowing in rows, are sometimes done year after year whether the farmers have understood and adopted it or not. This ineffectiveness limits the long-term benefits of CSA approaches, thus providing a significant risk of dis-adoption.

Removing bad policy is more important than making new policy

It was somewhat surprising across the literature review, expert interviews, and field studies that new policy or CSA specific policy was not regarded as a major factor in the adoption of CSA practice. Policy was only regarded as a constraint to adoption by ten percent of our expert interviews. This may be because policy frameworks in general are weak, especially in sub-Saharan Africa, and there is little relationship between policy and practice. Given the tenuous connection of the state to those in many rural areas, the question of the influence of policy on agricultural approaches may be moot because there is little governmental infrastructure to convert these policies into practice. However, in some sectors impacting agrarian livelihoods there is evidence for the negative impact of bad policies, suggesting they might impact CSA adoption. For example, the rescinding of restrictive and prescriptive policies on tree and forest management (and its implementation) in the early 1980s in the Sahel, for example, seems to have allowed local initiatives and approaches to flower and facilitated the adoption of Farmer Managed Natural Regeneration. There may be lessons here for types of policy approaches in general (enabling versus prescriptive) within the push to develop national CSA policies and frameworks. There also seems to be a plethora of overly prescriptive CSA policy development, such as requiring conservation farming, which is largely ineffective or have perverse effects.

Land tenure is identified as a medium impact factor to CSA adoption in the literature; however, it was only cited by less than 10 percent of farmers in the case study (with women farmers three timed as concerned about tenure than men). This reflects the differential impact of traditional land tenure systems on women and men, where generally men control access to agricultural land and women must access it through husbands or other male members of their families. Therefore, while men might have some concerns for more secure tenure, women will be the members of a community who most acutely feel the impacts of their insecure tenure, and will have that insecurity most clearly manifest in their decisions to take up CSA interventions.

VI. PROGRAMMATIC RECOMMENDATIONS

This report conducted a rigorous and systematic analysis of existing evidence for the factors shaping the adoption of a climate-smart approach to agriculture, with a view to providing recommendations for USAID and other implementers of CSA programming. This assessment includes three main approaches to information gathering and analysis. Initially, a (1) literature review was undertaken to better understand the state of knowledge on the adoption of CSA and narrow the range of research from a wide universe of approaches to a manageable number of representative approaches. This was followed by (2) interviews with technical experts to capture the current state of knowledge from those programming and implementing CSA in the field. Finally, (3) fieldwork was carried out in two countries by local teams in order to get perspectives directly from farmers, as well as from national officials and experts.

Through the qualitative triangulation of the data gathered through these three efforts, the assessment was able to identify the most common factors shaping the adoption of CSA across the representative approaches surveyed in this report (see Section V). These factors are divided into three categories: economic factors, social and cultural factors, and market and institutional factors. **Economic factors** are the most commonly understood factors shaping CSA adoption, and include initial cost, long-term cost, transactions cost, flexibility of the approach, and multi-objectivity. **Social and cultural factors** go beyond production and economic perspectives to understand the often unseen, socially embedded opportunities and constraints for farmers that shape their CSA uptake. These include farmer familiarity with particular technologies and strategies, the ways in which those leverage and reference local agricultural knowledge, the roles and responsibilities associated with identity (including, but not limited to, gender), and the ways in which a CSA approach impacts existing means by which farmers mitigate different risks in their livelihoods. **Enabling environment factors** address the broader formal and informal 'rules of the game' that make it difficult for smallholder farmers to invest in and adopt CSA.

This section builds on this analysis to provide programmatic recommendations to USAID and other CSA implementers on how to increase the adoption of CSA in Africa. Using the USAID Climate Resilient Development framework[62], it is structured around five distinct phases: 1) Scope, 2) Assess, 3) Design, 4) Implement and Manage, and 5) Evaluate and Adjust (see Figure 3).

[62] USAID Global Climate Change Office. 2014. "Climate-Resilient Development. A Framework for Understanding and Addressing Climate Change," March: 1–40. http://pdf.usaid.gov/pdf_docs/pbaaa245.pdf.

Figure 3: USAID's Climate-Resilient Development Framework

Phase I: Scope

The first step is in deciding to provide programmatic support to promote CSA as an approach is to define the scope of the problem. This requires establishing the development context (that is, the context into which agriculture fits) and assesses the vulnerability of the development goal of the target population to various stressors, climate and non-climate, that may put key inputs or enabling conditions for these goals at risk. Criteria for defining the scope of the problem are

included in Table 13 below. This step is critical to establish not just the context around a focal geographic area but also determine the extent of need for a CSA approach within development efforts.

Table 13: Criteria for defining the scope of the problem

Category	Key Questions
Geographic area	How large is the area to be addressed, how well connected is it to markets and other resources?
Primary objective(s)/development goals	Productivity, income generation, food security, resilience, and/or climate change mitigation)
The characteristics of the primary beneficiaries	What is the size and composition of the population in the area, what are the most common livelihoods activities associated with this population and how do they differ between women and men, what are the trends in population size, composition, and income at the community and household levels, and what are the gender dynamics within the composition and income trends?
Climatic conditions, including shocks and stressors	What sorts of activities are possible under the climatic regime, what climate-related shocks and stressors affect agriculture in the area?
Non-climatic shocks and stressors	What sorts are activities are possible under current non-climatic shocks and stressors (such as crime and violence, lack of enforcement of regulations, pollution, economic shocks)
Available financial and technical resources available for the program	What sort of support is possible to launch an intervention, and for how long?
Available CSA approaches	What are the available CSA approaches that have the potential to address the site-specific climate stressors?

Phase 2: Assess

If Phase 1 determined that CSA programming is critical for development, the next step is to identify the sources of vulnerability identified in the scoping stage. For example, if farmers are concerned with low farm incomes, the assess phase considers if the cause of such low incomes was constraints on production, access to markets or other forms of uncertainty. This, in turn will enable the design and implementation of interventions in Phase 3. Criteria for defining the scope of the problem are included in Table 14 below.

Table 14: Criteria for assessing the causes of identified problems problem

Criteria	Key Questions
By what means can we learn about root causes?	What methodologies are available to identify root causes? What are their relative strengths and weaknesses? What information can each methodology yield?
Root cause of problem	What is the underlying driver/drivers of the problem identified under scoping?
Social context of the problem	Who identifies this issue as a problem? How does this identification proceed from their locally-specific roles and responsibilities?

Phase 3: Designing and implementing sustainable interventions to support CSA adoption.

Assuming that there are specific and/or bundled CSA technologies and strategies that might address the key sources of vulnerability to lives and livelihoods in the target population, a careful design process can help to maximize the adoption and impact of CSA. The recommendations are grouped to reflect the three categories of factors found to have the highest impact on CSA adoption: economic factors, social and cultural factors, and market and institutional factors. While these recommendations focus on adoption and not scaling of particular approaches, any exercise in scaling is inherently a question of adoption, and therefore the issues addressed in this phase of the project will carry over into any future scale-up efforts.

3.1 Program design interventions to improve economic feasibility of a CSA approach.

The first set of recommendations addresses the locally specific constraints that impact the economic feasibility of a CSA approach. This report highlighted the strong impact that factors such as initial cost, long-term cost, and compatibility with existing livelihoods have on CSA adoption. As such, interventions that can positively impact these factors will increase the adoption of the CSA approach. These interventions have a programmatic advantage in that they can be targeted to remove specific barriers in specific places, with measureable impact. To ensure the design process takes these factors into account, we suggest the following questions be answered:

Table 15: Assessing the economic feasibility

Key question	Yes/No
Is there an evidence-base that this approach can address a critical need?	
Is the approach realistically affordable for smallholders?	
Are there short-term benefits to adoption that outweigh the cost of adoption?	
Are there long-term benefits to adoption that outweigh ongoing transaction costs?	
Is there flexibility in the approach (i.e. can it be partially adopted, adopted over time, or adopted on only part of a producer's land)?	
Is the approach scalable to a large number of smallholder farmers once it has been piloted?	

The questionnaire above highlights potential key barriers and critical incentives for CSA adoption that should be integrated into CSA programming. The findings of this report suggest a number of ways to address economic barriers or create economic incentives for CSA adoption.

Overcome high initial costs to CSA adoption by 1) ensuring access to appropriate financial mechanisms and 2) using an approach that guarantees short-term benefits.

There was a clear consensus across the different data gathered by this report that initial and cost is a significant barrier to CSA adoption and sustainability. As such, efforts to boost CSA adoption by addressing these barriers should consider interventions (or a portfolio of interventions) that couple short and long-term benefits. In addition, projects should consider financial mechanisms as an important component of their CSA interventions. Appropriate

mechanisms will vary by context, and implementers will have to identify those most appropriate for their project by engaging any of a number of organizations and projects involved in providing financing for CSA. One useful place to research innovative models for CSA financing is the Global Innovation Lab for Climate Finance.[63] The Climate Finance Lab screens proposals from around the world to identify instruments that have the potential to drive investment in developing countries at scale. It includes partners from governments including the U.S., pension funds, investment banks, and development finance institutions.

Provide extension support to ensure benefits from CSA overcome long-term costs.

The majority of common climate-smart technologies and strategies require implementation training or advice for farmers. A common failing of development assistance in CSA promotion is that, given the short funding cycle of projects, extension support has often focused on initial start-up or installation support. The USAID Partnering for Innovation project, for example, worked with Netafim in Kenya to provide technical assistance to install and use drip irrigation systems, but no long-term technical assistance was provided on how to better grow crops within this system.[64] This is a problem because sustained adoption of CSA is dependent on ensuring that the long-term benefits to the farmer exceed the long-term cost. Accordingly, any support for the introduction of any new individual or portfolio of CSA technologies and strategies needs to be tied to ongoing technical assistance to ensure that farmers are maximizing the efficiency of the system through the application of good agricultural practices.

In resource-constrained environments such as those in sub-Saharan Africa, the adoption and scaling of a CSA approach requires reaching a large number of farmers to maximize the impact of funding spent on training and extension, or the willingness to create structures to organize the farmers into smaller, more accessible groups. This can be costly. In achieving this scale, it may be easier to partner with actors who have already put structures in place, rather than starting from scratch. Possible partners could include large agribusinesses, input suppliers, NGOs, or government extension programs. The assistance provided must carefully consider the needs of different farmers, in terms of their identities and/or their locations. Whether donor-financed, or supported by other entities, any program of support must be sustainably financed to ensure this outreach continues to be delivered over time.

Support farmer awareness and access to information through demonstration plots and the use of Information and Communication Technology (ICTs).

Farmer familiarity and access to information were highlighted as highly important adoption factors across the literature review, expert interviews, and farmer interviews. Farmer awareness, such as through on-farm demonstration plots, can be an integral element in scaling CSA approaches, practices and technologies. In Nepal, for example, the performance in demonstration plots was found to be the key reason for the interest of farmers, many of which had initially withdrawn from CSA training programs.[65] The rise of ICTs in Africa also offers many

[63] http://climatefinancelab.org/

[64] Fintrac. 2016. Drip Irrigation Technologies: Lessons Learned when Working with Smallholders, Food Analytics Briefing Series.

[65] https://www.feedthefuture.gov/article/farmers-increase-food-security-climate-smart-agriculture-methods.

important avenues for boosting CSA adoption through access to information. ICTs can provide a range of different information services, including market prices, weather information, financial services, advisory services for agricultural extension, and early warning systems for disaster prevention. In Senegal, for example, the International Crops Research Institute for the Semi-Arid Tropics and the national meteorological agency are providing seasonal rainfall and long-term weather forecasts to over seven million people.[66]

However, it is important to remember, as demonstrated above, that different farmers will have different barriers and incentives to CSA adoption, both in terms of the roles and responsibilities associated with their identity, and across contexts. As recent work on the design and evaluation of climate services has shown, the provision and use of agricultural information is unequal, particularly with respect to gender, and can even reinforce existing inequalities within a household, community, or state. Therefore, the use of innovative communications technologies must be attentive to existing information flow and the causes of those patterns of flow, before identifying means of communicating with farmers.

Phase 3.2: Support interventions to address social and cultural factors affecting CSA adoption.

Just as important as ensuring the economic feasibility of a CSA program is to ensure that the portfolio of strategies and technologies within are aligned to the broader social and cultural contexts of livelihood decision-making. These contexts can often present hidden barriers to adoption, such as social roles or responsibilities. If these contexts are challenged or changed, sanctions could result for those farmers who defy expectations and adopt a new practice. To identify such barriers, and to identify an appropriate CSA portfolio and implement it in a manner that addresses such barriers, we recommend answering the following questions:

Table 16: Assessing the social and cultural feasibility

Key question	Yes/No
Is the approach compatible with local customs, social norms and traditions?	
Does the approach promote farmer autonomy and independence (i.e. non-reliance on development assistance, external inputs, or ongoing financial support)?	
Does the approach enhance risk and resilience among smallholders?	

Once these questions have been answered, and barriers and incentives identified, the data collected in this study suggests a number of possible design strategies that will maximize the uptake of CSA interventions.

Align CSA programming with the local culture, social norms and traditions.

This report shows that farmers' understanding of specific CSA technologies and strategies within their own cultural context is a key determinant in CSA adoption. For example, the Training-the-Trainers program of the CGIAR Research Program on Climate Change and Food Security (CCAFS) trained a core group of elected women who then took the message to more than 1500 additional women across India. As the women trainers knew what the other women

[66] CGIAR Research Program on Climate Change, Agriculture, and Food Security, 2015, Reaching More Farmers: Innovative Approaches to Scaling Up Climate-smart Agriculture.

could work on, they were able to convey this information in a manner that was understood clearly, in this case by turning it into songs, as that is how many of the women conveyed, shared and remembered important information.[67]

Ongoing USAID work on climate service design and provision employs an innovative livelihoods approach to assess local livelihoods decision-making structures and better understand how a given intervention will/will not fit into existing practices and structures.[68] Practices which are closely aligned with local structures and culture are likely to be quickly adopted but less likely to have a transformative effect on agriculture and livelihoods as they largely reinforce existing structures. Transformative interventions, on the other hand, may encounter high barriers to acceptance as they call into question existing social, economic, and power relations, even if they are likely to provide clear benefits in the short and long term.[69] Implementers will have to weigh carefully their goals (the temporal scale of the challenge to be addressed, short term versus long term impacts of the intervention, etc.).

Ensure access to risk management tools.

As noted throughout this report, there is a lack of cost-effective, inclusive, and targeted risk management programs available to farmers in Africa. As a result, their livelihoods, including agricultural activities, are set up to manage the various shocks and stressors they encounter. Thus, any attempt to promote a CSA approach must consider the ways in which that the portfolio of strategies and technologies might disrupt or augment existing risk management efforts by the farmers in question.

It is important to note here that both the risks and risk management tools used by farmers may not relate directly to agricultural practice or to weather and climate, as they are managing multiple stressors through their livelihoods. Therefore, the consideration of disruption needs to look beyond the farm and the climate if it is to be accurate. If the practice is disruptive of existing risk management efforts, uptake will be greatly enhanced if it is matched with risk management or mitigation tools, lest it disrupt existing risk management efforts and leave farmers more vulnerable to shocks and stresses than they were before the intervention.

One potentially useful tool that may become more readily marketable in the future is index insurance. Index insurance programs are one potential intervention that can address the insurance gap in Africa.[70] The programs 'index' measurable environmental conditions or production targets (such as rainfall or yields) to insurance payouts. When an index exceeds a certain threshold, farmers receive a fast payment (sometimes delivered via mobile phones). This is particularly powerful because it is not prescriptive, and therefore farmers can tailor it to fit

[67] CGIAR. 2015. Climate Smart Villages: https://ccafs.cgiar.org/climate-smart-villages#.VgX1IZ2qqko.

[68] Such as the work in Carr, Edward R, Sheila Onzere, Tshibangu Kalala, Kwame N Owusu-Daaku, and Helen Rosko. 2015. *Assessing Mali's l'Agence Nationale de La Météorologie's (Mali Meteo) Agrometeorological Advisory Program: Final Report in the Farmer Use of Advisories and the Implications for Climate Service Design*. Washington, DC; and ongoing work under the Mali Climate Change Adaptation Activity funded by USAID/Mali.

[69] Carr, Edward R. 2013. "Livelihoods as Intimate Government : Reframing the Logic of Livelihoods for Development." *Third World Quarterly* 34 (1): 77–108.

[70] FAO. 2010. Climate-Smart Agriculture – Policies, Practices and Financing for Food Security and Adaptation.

their livelihoods decision-making and particular means of risk management, two major factors shaping uptake of CSA. In other words, it presents a hedge against risk that allows farmers to identify other activities, including CSA opportunities, that are now plausible risks and for which they have resources and interest. One useful resource on index insurance is the Global Index Insurance Facility (GIIF) run by the World Bank.[71] GIIF supports the development and growth of local markets for index insurance in developing countries, and provides a number of partnerships, projects, and resources on its website.

3.3. Support interventions to address market and institutional structural barriers as factors to CSA adoption

As also noted in this report, structural constraints within markets and supporting institutions in many African countries severely constrain the adoption of CSA. These constraints are not unique to climate-smartness but instead define and influence the entire food security sector. As such, addressing these constraints requires an approach that goes beyond the mandate of being responsive to climate change to create the conditions necessary for agricultural markets that work for the poor and to build more accountable and inclusive public services. This will require integrated programming that draws upon wider efforts in democracy and governance, economic growth, agriculture and food security, and disaster risk reduction. To identify these issues, we suggest answering the following questions:

Table 17: Assessing the market and institutional feasibility

Key question	Yes/No
Does the farmer have credible and legitimate means of mitigating risk in case the approach fails?	
Does the approach integrate mechanisms that help farmers deal with market failure and allow for both market entry and market withdrawal?	
Is there complementarity or compatibility between this approach and existing approaches?	
Does the institutional environment (both local and national) support, or at the least not constrain, adoption of the approach?	
Does the existing land tenure arrangements support, or at the least not constrain, adoption?	
Are financial instruments available?	
Are dispute resolution mechanisms present, legitimate, and enforceable?	

Once issues related to market and institutional barriers and incentives have been identified, the data gathered in this report suggests several means of addressing these challenges.

Layer a systems approach onto CSA programming

The market and institutional factors to CSA adoption are not specific to one CSA technology or strategy or even one value chain. They cut across the whole agricultural sector. As such, the single-value chain approach that influences so much of Feed the Future programming is too narrowly focused to address the these factors of adoption. The market systems approach has been recently promoted by USAID's Leveraging Economic Opportunities (LEO) project, which

[71] https://www.indexinsuranceforum.org/.

can be adapted to CSA[72] and overall, a system approach has risen in prominence under the 2017-2021 Global Food Security Strategy.

Support economy-wide good agricultural practices

In Table 18 below, guidelines for agriculture sector reform are developed. These practices are not presented as direct programmatic recommendations, as there is no one-size-fits-all-solution to structural change. In addition, as these market and institutional barriers are systemic, these reforms are not unique for CSA though they are fundamental to unlocking farmer adoption of CSA.

Reform is a continuous system of change, not a linear process with starting and end points. The first step to effective and sustainable reform depends on a credible analytical understanding of the systemic constraints. Two useful methodologies currently utilized by USAID can be helpful in this regard. The first methodology is the Agribusiness Commercial Legal and Institutional Reform (AgCLIR) diagnostic. AgCLIR is designed to look at the laws that are in place in the agricultural sector, who is responsible for implementing them, and what are the cultural and social dynamics that may prevent these actors from fulfilling their duties. It provides an in-depth analysis of the key constraints to profitably starting and running an agribusiness and provides actionable recommendations to remove these constraints.

The second methodology is the Institutional Architecture for Food Security Policy Reform diagnostic ('Institutional Architecture'). Institutional Architecture provides a framework for mapping the institutional landscape, analyzing possible systemic constraints, and highlighting areas to improve the capacity and performance of the institutions involved in the policy change process. Six distinct and interrelated components are examined: Guiding Policy Framework, Policy Development and Coordination, Inclusivity and Stakeholder Consultation, Evidence-Based Analysis, Policy Implementation; and, Mutual Accountability. Each component has its own questionnaire and set of indicators, which determines the capacity of a specific component of the policy change process.

[72] https://www.microlinks.org/sites/default/files/resource/files/Market_Systems_Framework.pdf

Table 18: Guidelines for agriculture sector reform

Investing in more inclusive markets	• Help uncover and address the formal and informal barriers to market integration by small farmers (the cost of doing business); • Facilitate increased competition to avoid monopsonies and monopolies in the agriculture sector; • Help overcome the barriers that women and other marginalized populations face in the marketplace, for example through improved transportation to market for their crops. • Develop tools that monitor and increase the transparency of market transactions, including ICT for agriculture; • Monitor the development and impact of monopolies and monopsonies in agricultural markets, both local and at the level of the state and beyond, to ensure farmers can compete in those markets and get the best possible prices for their crops
Investing in the socially inclusive governance of agriculture	• Help develop and implement cost-effective and equitable means of enforcement of agriculture contracts, agreements, regulations and rules; • Improve the performance of property and procedural rights for small farmers, especially for women. • Develop and implement cost effective and equitable recourse platforms and processes, e.g., development of local accountable agriculture ombudsman; • Strengthen farmers' rights by supporting the participation of apex groups at national, regional, and local levels. • Improve the accountability for public agriculture services, for example by asking for farmer feedback on the quality and relevance of services provided, making that data public, and using that data to adjust such services; • Drive field-level investments and approaches through a bottom up farmer driven approach.
Conduct further research on the political economy of agriculture and the processes to develop inclusive agricultural institutions	• Further integrate democracy, rights, gender equality, and governance approaches into agriculture; • Better apply and customize the tools and approaches of political economy to improve the performance of agriculture; • Create an "observatory" organization that tracks performance of male and female farmers in the market place for better transparency, enforcement, and monitoring & evaluation.
Improve infrastructure and transport systems	• Invest in roads, markets and aggregation centers; • Invest in versatile ICT/"ICERT" development and deployment, using information-sharing platforms such as cloud-based GIS; • Invest in efficient irrigation systems that are more resilient to projected climatic and hydrological instabilities; • Invest in precision agriculture, including support ICT infrastructure; • Invest in gender-inclusive knowledge networks among farming communities, researchers/practitioners, policy makers, public service providers and donors.
Improve property and access rights frameworks	• Invest in gender-equitable land administration systems; • Invest in intellectual property rights systems that, while protecting the intellectual property rights do not choke off innovation by farmers and other small actors in the economy; • Improve both male and female farmers' access to decision-making, information, and collective action through, for example, climate information services that consider the different needs of different farmers in their target populations, and which deliver information relevant to that range of needs instead of a single subset.

Reinforce locally responsive devolution	• Create/reinforce local and gender equitable recourse mechanisms and ombudsmen; • Create/reinforce local capacities and rights over budgets and revenue generation; • Develop local contract enforcement mechanisms.
Help streamline, simplify and control overly restrictive policies that impact rural areas	• Resist the temptation to develop specific and narrow CSA policies. CSA is a suite of practices that has sweeping impacts on life and livelihoods in agrarian settings that goes beyond yield, income, and food security. Successful CSA programs will address the broad benefits of and challenges associated with CSA to ensure its sustainable uptake; • Link CSA to ecosystem-based adaptation at landscape levels; • Review economic policies that impact the rural sector and agriculture markets to identify sites that might favor the formation and activities of monopolies and monopsonies, and work to contain the influence of both • Amend policies as needed to improve gender-equality, while working with communities and governments (especially with women in both) to identify pathways of social change that are viable and will bring about desired changes.

Phase 4: Implement, Monitor and Evaluate

In this report, we condense the final two steps of the Climate Resilient Development framework into a single step: Implement, Monitor, and Evaluate. Effective CSA programming requires understanding not merely if farmers have taken up an approach, but which farmers, to what end, and with what impact.

Who has taken up a CSA approach, and how many have taken it up?

Any responsible project management will carefully measure the rates of uptake in a target population and evaluate who is taking up a CSA approach. As CSA is an approach that encompasses multiple strategies and technologies, adoption for CSA must go beyond measuring uptake of any one strategy or technology. If uptake is very low,or if it is concentrated in the hands of a small subset of farmers, it is critical to return to the design stage of the project and identify the factors producing these outcomes. For example, interventions that only appearto be taken up by senior men might be one too narrowly focused on a small set of crops controlled by these men and over which women have no authority or responsibility. Farmers might add crops to the roster to adjust such an intervention.

To what end have interventions been taken up?

While adoption is an important component of project success, it is critical to understand why farmers are taking up a specific or the portfolio of climate-smart technologies and strategies. For example, farmers might adopt not for climate-smart aspects but because a climate-smart approach improves yield in the short term. Men might adopt a practice not because it has any tangible agricultural benefit but because it reinforces their status in the community and household such they can maintain their control over women's work. Understanding the motivations behind the uptake of interventions is critical to identifying their likely future impacts and future conditions under which altered components of a CSA approach might be adopted. One approach to identifying the motivations for uptake is the Livelihoods as Intimate

Government approach[73], which has been employed to assess livelihoods decisions and climate services uptake in several sub-Saharan African contexts[74].

What impact have the interventions had?

When discussing impact, there are two major types that must be disaggregated. The first is the establishment of impact on agricultural and livelihoods outcomes, such as yields, incomes, and broader framings of resilience and vulnerability. Obtaining such data can be labor intensive, and must be carefully controlled for the influence of other factors like climate variability or shifts in markets. Also, it is critically important to measure such impacts against counterfactuals – that is, if there was no intervention, what would the outcome have been. It may be that CSA interventions brings no new production to the table, but they strongly buffers production against shocks and stressors, making agrarian livelihoods more resilient to climate variability and change and market uncertainty – undoubtedly a positive impact, even without greater yields.

The other area of impact to be considered is behavioral. While the rapid uptake of interventions is often shaped by their compatibility with existing social structures and livelihoods approaches, that compatibility can, in some contexts, reinforce practices or behaviors that will not 1) result in the achievement of development goals, such as gender equality and 2) may not bring about transformations in practice necessary to manage likely future climate and market regimes. Therefore, any study of impact should assess the degree to which interventions have impacted the way members of the target population make agricultural and livelihoods decisions. Work involving the Livelihoods as Intimate Government approach has already started to address just such a need in the context of climate services via efforts to establish "behavioral baselines" that capture agricultural and livelihoods decision-making at the outset of a project, and which can then be compared to re-assessment data at the end of the project to identify any changes in decision-making structures that can be associated with the intervention. Such efforts can help identify the motivations for uptake, as well as the likelihood the inteventions in question will address projected long-term climate-related challenges to development goals among the target population. These efforts remain nascent, and are an area into which much greater research is needed

[73] Carr, Edward R. 2013. "Livelihoods as Intimate Government : Reframing the Logic of Livelihoods for Development." *Third World Quarterly* 34 (1): 77–108.

[74] Examples of this work include Carr, Edward R, Sheila Onzere, Tshibangu Kalala, Kwame N Owusu-Daaku, and Helen Rosko. 2015. *Assessing Mali's l'Agence Nationale de La Météorologie's (Mali Meteo) Agrometeorological Advisory Program: Final Report in the Farmer Use of Advisories and the Implications for Climate Service Design*. Washington, DC.; Carr, Edward R, Grant Fleming, and Tshibangu Kalala. 2015. *Assessing Climate Service Needs in Kaffrine, Senegal: Livelihoods, Identity, and Vulnerability to Climate Variability and Change*. Washington, DC; Carr, Edward R., ed. 2014. *Assessing Mali's Direction National de La Meteorologie Agrometeorological Advisory Program: Preliminary Report on the Climate Science and Farmer Use*. Washington, DC: United States Agency for International Development; Carr, Edward R, Daniel Abrahams, Arielle T. De la Poterie, Pablo Suarez, and Bettina Koelle. 2015. "Vulnerability Assessments, Identity and Spatial Scale Challenges in Disaster-Risk Reduction." *Jàmbá: Journal of Disaster Risk Studies* 7 (1): 1–17. doi:10.4102/jamba.v7i1.201.

VII. ADDITIONAL QUESTIONS FOR RESEARCH

1) **What is farmer decision-making vis-a-vis uncertain and predatory markets and state structures?** We know that farmers often opt for agricultural and livelihoods approaches that allow for the withdrawal from markets under conditions of stress and uncertainty,[75] but we know less about the specific conditions in the market they seek to avoid or the best means by which we might address those conditions so they might capitalize on market advantages without succumbing to significant market risks.
2) **When is incremental change in approaches the best path to climate-smart outcomes, and when is a larger transformation necessary?** We need to better understand how to assess when working within an existing system and getting quick outcomes is the best outcome versus those situations where much broader change is necessary, and working within systems is likely to reinforce existing approaches and social norms, slowing such change.
3) **How do we identify the different groups of relevant actors in a given context to assess their specific barriers and incentives to CSA adoption?** It is clear that starting from preconceived categories is likely to overlook important contextually specific differences in a particular population.[76] However, only a few cases have started to explore how to identify such populations after arriving in the field.[77] Much more could be done to add new approaches or efforts that are cost- and time-effective.
4) **What are the greatest risks affecting farmers in sub-Saharan Africa today?** This is a deceptively complex question, as it inherently asks, "Which farmers are vulnerable to what?" which brings identity and geography into the analytic frame. Evidence, while present from numerous high-quality studies, remains geographically spotty and uneven in its focus on different social groups, limiting the general lessons that might be drawn from the existing literature.

[75] e.g Scott, James. 2009. "The Art of Not Being Governed an Anarchist History of Upland Southeast Asia." New Haven : Yale University Press; Carr, Edward R. 2011. *Delivering Development: Globalization's Shoreline and the Road to a Sustainable Future*. New York: Palgrave Macmillan.

[76] Carr, Edward R., and Mary C. Thompson. 2014. "Gender and Climate Change Adaptation in Agrarian Settings: Current Thinking, New Directions, and Research Frontiers." *Geography Compass* 8 (3): 182–97.

[77] e.g Carr, Edward R., Grant Fleming, and Tshibangu Kalala. 2016. "Understanding Women's Needs for Weather and Climate Information in Agrarian Settings: The Case of Ngetou Maleck, Senegal." *Weather, Climate, and Society* 8 (3): 247–64; Onzere, Sheila N, Tshibangu Kalala, Kwame N Owusu-Daaku, and Edward R Carr. 2015. *Piloting Intersectional Gender Assessments in Malawi: Challenges and Lessons Learned*. Washington, DC; Carr, Edward R, Sheila Onzere, Tshibangu Kalala, Kwame N Owusu-Daaku, and Helen Rosko. 2015. *Assessing Mali's l'Agence Nationale de La Météorologie's (Mali Meteo) Agrometeorological Advisory Program: Final Report in the Farmer Use of Advisories and the Implications for Climate Service Design*. Washington, DC.

5) **How might a CSA approach be best integrated with other development activities?** As noted throughout this report, CSA programming cannot be stand-alone, and instead much to integrated across a range of economic, social, and enabling environment approaches. Further research is needed on how this might be achieved, such that CSA becomes part of a suite of activities that address the full range of agrarian shocks and stressors and productively contributes to the resilience of agrarian populations.

6) **Why are farmers more concerned with the impact of state dysfunction and institutional failure on CSA adoption than experts in CSA**? It is likely that the impacts of state dysfunction may be hard to see without direct investigation and attention, as the state can impinge on many factors that shape livelihoods decisions and outcomes. Farmers are likely to be more aware of these impacts than experts who are focused more narrowly on agricultural practice alone.

7) **Why do farmers appear to identify both access to external inputs and infrastructure, and access to markets, frequently as barriers to CSA adoption, but have relatively little interest in the provision of inputs, infrastructure, and access to markets as incentives to CSA adoption?** This will require unpacking the general incentives and barriers faced by all farmers in a given place, whether engaged in CSA or not, by understanding the wider political economic and agro-ecological context of agriculture in that place.

VIII. CONCLUSION: MOVING CSA FORWARD

This report fills a key knowledge gap on CSA by conducting a rigorous and systematic analysis of key barriers and incentives to adoption in sub-Saharan Africa. It challenges the common narrative across CSA literature and technical experts that adoption depends largely on issues of accessibility, promotion, and training.

The report recognizes there are three main pathways to increasing the adoption of CSA in Africa. The first stays within the conventional economic narrative of adoption showing what can be done to increase efficiency and effectiveness. This narrative is well known and includes factors such as initial cost, long-term cost, diseconomies of scale, and access to credit and inputs.

Just as important as ensuring the economic feasibility of the approach is making sure that it is aligned to the broader social and cultural aspects relevant to livelihood decision-making. Agriculture, as a livelihoods activity, is a deeply socially embedded approach and farmers understand CSA through their own formal and informal systems and norms that govern factors such as labor, gender, identity, and beliefs.

A third critical pathway to increasing CSA adoption requires addressing broader market and institutional failures. In many African countries, structural constraints within markets and supporting institutions severely constrain the adoption of CSA. These constraints are not unique to CSA but instead define and influence the entire agriculture sector. As such, addressing these constraints requires integrated programming that draws upon wider efforts in democracy and governance, economic growth, agriculture and food security, and disaster risk reduction.

CSA presents a unique and urgent opportunity for a larger and more systematic view of the constraints in agriculture in Africa, and the issues of adoption and dis-adoption addressed in this report help point the way towards interventions that might best unlock the potential of the smallholder farming. Properly implemented, a climate-smart approach to agriculture can make significant contributions to agricultural production and rural livelihoods, building resilience to current economic and environmental stresses on agrarian livelihoods, while pointing the way to a more secure and prosperous future of economic and social opportunity.

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ANNEX 1. SELECTED CSA APPROACHES

Given that CSA is an approach and not a list of practices, exhaustively covering all iterations of agricultural practices, technologies, or interventions that could be climate-smart is neither appropriate nor helpful. As such, a diverse range of practices was selected collaboratively with USAID and technical experts as a way to get detailed information on adoption constraints and opportunities representative of the wide spectrum of a CSA approach.

The twelve approaches selected for are outlined in the following table:

Field Level Approaches	
Farmer Managed Natural Regeneration (FMR)	FMNR is a low-cost and sustainable land regeneration system that can be used to rapidly and efficiently return degraded croplands and grazing lands to productivity. FMNR involves supporting the regeneration of trees, as well as sustainable management to support crop and livestock production, provide sustainable supplies of fuel wood, and non-timber products such as edible seeds and leaves. It is used to combat poverty and hunger mainly amongst poor subsistence farmers by increasing food and timber production, and resilience to climate extremes.
Conservation Agriculture (CA)	CA refers to a suit of practices that are complementary and focus on increasing organic matter in the soil and reducing tilling of crop residues. CA includes no till or reduced till, crop rotation or intercropping, and soil cover/mulching. It may or may not include the use of improved or hybrid varieties, and inorganic fertilizers and herbicides.
Climate Smart Rice Production (CSRP)	Climate smart rice production (CSRP) in sub-Saharan Africa has focused on an integrated approach that has included making rice production systems more resilient while simultaneously contributing to reducing greenhouse emissions. The two core elements of CSRP are the introduction of improved rice varieties and agro-ecological techniques / practices associated with the system for rice intensification (SRI). Since 2013 improved varieties tolerant to abiotic stresses, including water and temperature stress, iron toxicity and salinity have been released. SRI, which encourages farmers to transplant early, optimize plant spacing, mechanically aerate soil and increase organic soil matter, has also been scaled up. Both CRSP aspects theoretically present a “triple win” for agriculture, climate security and food security by aiming to increase productivity and incomes, improve the resilience rice farming systems to climate change and variability, and reduce the contribution of rice to greenhouse emissions.
Crop-Livestock Integration	CLI is an integrated practice that is commonly found to in most of Sub-Saharan Africa. Keeping farm animals represents a way for farmers to improve nutrition and diversify incomes. CLI represents an approach to improving the efficiency between livestock and crop “sectors” of livelihoods. This includes a number of practices including improved fallow, push-pull pest management, manure and biogas digestion, and others.
Integrated Water Resource Management	IWRM includes an integrated and coordinated approach to the management, utilization and development of water resources. IWRM integrates socio-economic, environmental and technical aspects into a single framework with the aim of maximizing economic use without compromising the sustainability of the ecosystem. The practice also includes a number of water conservation and management techniques such the non-indigenous of plowing, ridge tillage, hilling, soil scarifying, sand dams and subsurface dams etc. and more traditional techniques such as stone rows, contours earthen bunds, zaï, half-moon, straw mulching.

Institutional Approaches	
Index (Weather) Based Crop Insurance	Index (weather) based crop insurance provides insurance protection to farmers against specific perils or events (deficit and excess rainfall, drought, flood). Contracts are written against specific perils or events (e.g. area yield loss, drought, hurricane, flood) that are defined and recorded at regional levels (e.g. at a local weather station). Indemnifications are triggered by pre-specified patterns of the index, as opposed to actual yields, which eliminates the need for in-field assessments.[78] Index based crop insurance has been regarded a major institutional innovation that could revolutionize access to formal insurance for millions of smallholder farmers and related individuals. It may also prove to be a valuable tool for unlocking rural credit and hence improving rural livelihoods.[79]
Payment for Environmental Services	PES, also known as payments for environmental services (or benefits), are incentives offered to farmers or landowners in exchange for managing their land and resources to provide some sort of ecological service such as clean water, biodiversity or carbon sequestration. They are in essence an attempt to deal with environmental externalities. In most cases they deal with carbon, water and biodiversity. Development partners have noted PES as a promising instrument to address challenges to sustainable natural resource management in Africa.[i] It has the potential to help raise new sources of sustainable finance, improve the efficiency of conservation actions, secure the flow of environmental services for businesses and infrastructures that rely on it, and ultimately provide benefits for poor, rural populations.
Safety Net Programs	Social safety nets or social protection programs refer to cash or in-kind transfer programs that seek to reduce poverty through redistributing wealth and/or protect households against income shocks. Social safety nets seek to ensure a minimum level income, a minimum level of nutrition, or help households manage risk.[80] Safety nets help vulnerable households be protected against livelihoods risks, maintain an adequate level of food consumption and improve food security. They also help prevent them from adopting damaging coping strategies and depleting their assets. In the context of agriculture, they might also alleviate liquidity constraints for smallholders, boost demands for farm products, foster income-generating strategies, and create multiplier effects throughout the local economy and allow for the adoption of practices that otherwise would seem risky.[81] Social safely nets have proven positive impacts on the adoption of improved technologies because it helps mitigate the risk of investing in something new.[82]
Agriculture and Climate Services	This broad practice is primarily centered on information and knowledge management in support of a more productive rural sector. These approaches aim at enabling farmers to make informed decisions, better manage risk, take advantage of favorable climate conditions and adapt to change. Because this area is so broad, this report focused in on the Farmer Field School (FFS) approach. FFS is a large-scale, decentralized program of education and facilitation for farmers wherein they become "experts" in managing the ecology of their fields. The educational concepts underpinning the FFS approach are drawn from adult non-formal education. FFS was first introduced in Sub-Saharan Africa in 1993.

[78] Hazell, P. et al. 2010. The Potential for Scale and Sustainability in Weather Index Insurance for Agriculture and Rural Livelihoods. Rome: International Fund for Agricultural Development.
[79] Carter et Al. 2015.
[80] FAO, "Lessons from the field: Experiences from FAO Climate Change Projects." *FAO Climate Change Days Workshop* (June 2010).
[81] Devereux et al. 2008 cited in FAO 2011.
[82] FAO, "Climate-Smart Agriculture: A call for action" *FAO RAP Publication* (2015).

Property and Procedural Rights Frameworks	Tenure security can be differentiated and includes land as well as trees and other natural resources. Tenure is a bundle of rights including right to exclude, access, transfer, manage and the security if benefits. The link between increased land tenure security and increased investment in agriculture is fairly well established in the literature.[83] However, there remains a dearth of empirical evidence on the exact mechanisms by which strengthened property rights and tenure security can spur adoption of CSA practices. It is also clear that increasing property rights and tenure security alone are often not sufficient to stimulate investment.
Climate Smart Villages and Landscapes	A number of approaches have been tried in order to scale up CSA by looking at the village or landscape as the operational entity. Climate-Smart Villages are villages where the promoters work at the village level to plan and develop activities. They are sites where multiple actors collaborate to identify the most appropriate climate-smart interventions in agriculture. Climate-smart landscapes are also multi-actor platforms encompassing multiple villages were higher level planning and implementation occur aiming at land-use that is better suited to climate concerns. In general these are externally convened approaches that can create new institutional forms.
Community Approaches	
Collective Action through Local Conventions	Collective action refers to action taken together by a group of people whose goal is to enhance their status and achieve a common objective. Theoretically there are clear advantages to collective action in economic, risk management and political terms. As the field of collective action is so broad, we have focused on local conventions as an example. Local Conventions (LCs) are local arrangements designed and elaborated by local communities in order to better manage natural resources. They often develop from a context of resource conflict or resource degradation and the communities desire to improve the situation. They seek to formalize rules and regulations, as well as sanctions against various actors for non-performance. LCs often involves the state, which acts as a mediator and enforcer of sanction agreements. Among their other qualities they are often seen as ways to mitigate conflict and hence mitigate risk and build resilience.

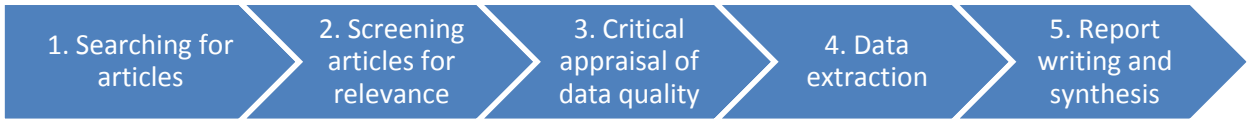
[83] Deininger, Klaus and Feder, Gershon. 2009. "Land Registration, Economic Development, and Poverty Reduction". Property Rights and Land Policies, eds. Ingram, Gregory K., and Yu-Hung Hong. Cambridge, MA: Lincoln Institute of Land Policy.

ANNEX 2: FACTORS OF ADOPTION FRAMEWORK

Categories of factors influencing adoption	Factors
Economic and Production Characteristics	Long-term cost Initial cost Transaction cost Opportunity cost Flexibility Multi-objective Product perishability Impact on yield Impact on farmer income Size of farm Access to external inputs and infrastructure Labor availability Access to credit Land availability Private sector Asset protection and insurance Market availability Asset value Population density Intensification / extensification
The agro-ecological environment	Rainfall zone Topography Soils
Social and cultural context	Values local knowledge Farmer familiarity with practice or social practices Access to information Compatibility with existing livelihood system Communication channels of information on practice Climate services Extension services Cultural and gender aspects relevant to decision making Risk management Local organizational capacity and collective action Local discretionary decision making Local social capital Perceptions and attitudes
Governance frameworks	Access to markets Market regulation Institutional relations Subsidies Policy framework Land rights / tenure Inclusion in decision-making Access to recourse Impact on resilience Social inclusion Environmental footprint Rights over resources Conflict

ANNEX 3: LITERATURE REVIEW METHODOLOGY

To conduct the literature review for the Climate-Smart Agriculture Uptake Study, the assessment rigorously reviewed the available literature on the 12 different practices. We identified documents through comprehensive keyword searches and filtered our results through multiple stages of review, ensuring that the final documents included were relevant and of high quality. We then we extracted information from these documents and analyzed it for barriers to and incentives for CSA adoption. This work resulted in the practice summary tables presented in Appendix 1. These were then synthesized to prepare the summary report. All told, the literature review involved five steps:



Searching and Initial Screening:

We used several databases of our document search. These were: Web of Science, Scopus, ELDIS, Research Gate, ERIC, USAID's DEC, EBSCO Academic Search Premier, Google Search, and Google Scholar.

In these databases we used the following keywords: Africa, Climate-Smart, Agriculture, Farm Field Schools, Climate Services, Crop-Livestock Integration, Index Based Insurance, Irrigation, Water Management, Soil Management, Conservation Agriculture, Collective Agriculture, CA, Conservation Farming, Conventions Locales, Farmer-Managed Natural Regeneration, FMNR, Agroforestry, Rice, Alternate Wet Dry, Improved Varieties, Local Decision Making, Property Rights, Tenure, Integrated, Climate Smart Landscapes, Extension Services, Barriers, Incentives, Property and Procedural Rights, tenure, irrigation, water drip.

Once we had the results we would begin to screen the articles for relevance. We did this in a two-step process. First, if the title appeared at all relevant then we would read the abstract or executive summary to determine whether or not an article was related to our research. If it appeared relevant we would then download the article and import it into Zotero, our citation management application, and Box, our cloud storage service.

Based on the abstract and introduction, each document was "tagged" in Zotero with initial keywords to help classify it. These tags were taken from the abstract and when possible included, author keywords, location of the study, our 12 practices, and any other helpful identifying information at the discretion of the reviewer. Examples of discretionary tags include ICT, language of document (if not English), or environmental conditions such as drought.

Besides using academic databases to find articles, we also relied on our African team members. An added benefit was that Dr. Barry and Dr. Oladele were able to use their graduate students to find and evaluate gray literature.

Additionally, our Washington-based team members, Jon Anderson and Jim Ozols, conducted a series of interviews with agriculture development practitioners and solicited gray literature directly from them. These sources include, but are not limited to, World Bank, ICRAF, Catholic Relief Services, IFPRI, and more. Articles obtained from interviewees were added directly to Zotero.

Critical Appraisal:

After a document passed our initial review and was uploaded onto Zotero and Box and tagged, it was assigned to a team member for review. Team members were assigned to review all articles tagged with a certain CSA practice. From here that team member would decide if and article should remain in Zotero or be removed from it based on quality and relevance. In some instances, documents that were judged to be promotional rather than academic were retained in the database as evidence that certain practices were promoted in certain ways.

As part of this appraisal additional tags would be added to documents that were not included as part of the initial tags in the searching and screening.

In the end, 476 documents are currently in Zotero, meaning that they have passed the critical appraisal. Our database includes over 250 tags.

Data Extraction and Synthesis:

As team members read the documents that corresponded to specific practices, they populated a table, one per practice, that examined how 52 different potential barriers or incentives (collectively, “factors”) were represented in the literature. By using these 52 factors we examined the 12 practices in a uniform and comprehensive manner. We also identified gaps in the literature for each one. In addition to the tables, each team member was tasked with writing an introduction explaining the different practices and summarizing the results of the table, highlighting the most important themes.

Based on this work we were able to complete a meta-analysis of the different practices, examining commonalities between them in terms of barriers and incentives. This led to the identification of key themes across types of practices. To conduct this analysis, the team worked very closely with our subcontractors at the Humanitarian Response and Development Lab at Clark University.

Results of the Review:

By entering search terms into the search engines listed previously, we returned 740 documents. Dr. Barry sent 163 documents and Dr. Oladele sent in 85 documents. No more than 25 documents came from interviewees in Washington. All told, this means that our team reviewed at least 1,013 documents (note: we do not know how many documents our African team members reviewed in whittling their collection down to 163 and 85, respectively). Of these over 1,000 documents reviewed, 476 passed the test of critical appraisal and remain in Zotero.

The following table presents the number of tags by CSA practice. Note that the total number of tags differs from the total number of documents, as many documents pertain to multiple practices and therefore have more than one tag.

Agriculture services focusing on Farmer Field Schools	95
Climate smart rice production	15
Conservation agriculture (CA)	41
Collective action focusing on local conventions (LC)	18
Crop-livestock integration (CLI)	28
Farmer managed natural regeneration (FMNR)	45
Index (Weather) based crop insurance	50
Integrated water resource management (IWRM)	59
Climate smart villages, climate smart landscapes (CSV/CSL)	10
Payment for environmental services (PES)	11
Property and procedural rights frameworks	12
Safety net programs	19

ANNEX 4: EXPERT INTERVIEW METHODOLOGY

Approach

For the second phase of our research, we interviewed 63 technical experts from different stakeholder groups. This included USAID, other development partners and implementers, government officials, non-government organizations, researchers, agribusinesses and farmers' union (a full list of interviewee organizations is presented in Table 4). These interviews were conducted using a questionnaire guide developed by the team based on the findings of the literature review, an example of which is provided at the end of this Annex, and included barriers and incentives to adoption, costs, risks, institutional relationships, farmer flexibility and familiarity, farmer decision-making, farm tenure and size, and procedural rights.

Organizations Surveyed	ACDI/VOCA, APEX, EEAF EU, Concern Worldwide, CCAFS / University of Vermont, CSAP, CRS, DFID, Ecoagricultural Partners, FSDA Africa, Government of Kenya, Individual Consultants, ISRA, Lead Analytics, MSU/FAO, National Farmer Federation, NORAD, Senegalese Association for the Promotion of Grass Roots Development, Reconcile, The Nature Conservancy, USAID, VACCID Africa, World Bank Project Consultants, WRI

Example Questionnaire

Below is an example transcribed questionnaire filled out by a team member during one of the expert interviews. All identifying information has been removed for privacy. All of our interviews were transcribed removing names and identifying information for analysis.

CSA uptake study: Questions

Note: Please begin the interview by reading the following two paragraphs to the interviewee

We are conducting a study on behalf of USAID/Washington's Africa Bureau on the uptake of Climate-Smart Agriculture (CSA) by smallholder farmers in Sub-Saharan Africa. As part of this study we have completed a literature review. We are now conducting interviews in an effort to help us validate our findings. Further, these interviews will help narrow down our selection of locations for two upcoming case studies. We hope to present a rigorous and thorough report to USAID that will assist in driving programs over the next few years.

Climate-Smart Agriculture (CSA) is the intersection of three main objectives: productivity, resilience and climate change mitigation. There is no definitive list of CSA practices but rather it is an approach that promotes these three primary goals. It seeks to ensure farm stability during periods of climate change and it may help to alleviate climate change through mitigation of greenhouse gasses.

Date: _____
Interviewer name: _____
Interviewee name: _____
Location: _____
Type of stakeholder: (circle one): Donor, Academic, Community member/farmer, End user, Private sector, NGO

For our study we chose to focus on 12 practices within CSA that cover a wide variety of practices. They include both hard and soft technologies, i.e. both biophysical practices and those that relate to the enabling environment.

What CSA practices have you been involved in or researched?

CSA Practices included in this study	Check all that apply
1. Farmer managed natural regeneration (FMNR)	
2. Conservation agriculture (CA)	
3. Climate smart rice production	
4. Crop-livestock integration (CLI)	
5. Integrated water resource management (IWRM)	
6. Index (weather) based crop insurance	
7. Payment for environmental services (PES)	
8. Safety net programs	
9. Property and procedural rights frameworks	
10. Collective action focusing on local conventions	
11. Agriculture services focusing on Farmer Field Schools	
12. Climate smart villages; climate smart landscapes (CSV/CSL)	
13. Other:	

1. What are the barriers to adoption of the practice(s)? Are these barriers indicative of the barriers to adoption of the CSA approach in general? (see definition in introduction to questionnaire). If not, what other barriers are important to CSA in general?
2. What incentive(s) would facilitate adoption of both the practices you've worked on and the CSA approach in general?
3. What are some important ways that you perceive CSA practices to interact with one another?
4. Describe the impact of costs on adoption of CSA practices: How important is long-term cost? How important is initial cost of adoption? How important are opportunity costs (The loss of potential gain from another practice including business as usual or working off farm) and transaction costs (The cost of doing business. Ex: Attending extension or farm group meetings, or extra time and travel associated with marketing a product)? What kind of financial tools and economic incentives can be used to increase adoption? Credit? Insurance? Subsidies? Describe the impact of risk on adoption? What are the bio-physical risks associated with CSA? How do they impact adoption of CSA? What are the market risks in terms of CSA practices? Do markets work well for farmers? What are the market imperfections that factor into farmers' approach to risk? What are the state risks? How does the government support adoption of CSA practices? Subsidies? Safety nets? Policy? Regulation? Market? Other? How does the farmer mitigate risk? How important is risk

management to adoption? How important is the potential impact of resiliency (the capacity to address and manage change) on adoption?

5. How important are the quality and quantity of institutional relations (from the farmers' perspective) to adoption? Relations with Government? Relations with private sector orgs? Relations with NGOs? Relations with other communities?
6. As part of our study, one area we are interested in is farmer flexibility and familiarity with practices and what are the impacts of wholly outside ideas versus those that build on the farmers existing knowledge. Also as part of this we are interested in whether or not a farmer's ability to adopt a practice over time, partially adopt or adapt a practice in a different way affects their long-term adoption? How important is the ability of the farmer to manipulate, phase, partially adopt, or otherwise modify the practice to adoption? How important is farmer familiarity and local knowledge?
7. How important is it that a practice impacts local discretion and decision-making processes? How can a practice encourage expanding local decision-making?
8. How do farm tenure and size impact adoption? How does small size impact adoption? How does secure tenure impact adoption?
9. How do procedural rights impact adoption? Access to non-local decision-making? (government, policy, farmer groups, prices) Access to information (market, technical, etc.)? Access to recourse?

ANNEX 5: FARMER SURVEY METHODOLOGY

Purpose and Objectives

The case studies under this activity were aimed at being an effective and efficient way of getting additional field level information and knowledge that can be triangulated with the other sources of knowledge (literature review and interviews with resource people) to help establish a robust footing for the study's recommendations.

The main objectives of the on-the-ground fieldwork include:

1. *Analyze CSA practices that we have studied through the literature and interview process in action in the field:* The case study will allow us to get a sense of the reasons for their adoption from the farmers' perspective and their importance to production/productivity; resilience and risk management and mitigation as appropriate.
2. *Further validate the emerging findings of the literature review and interview phases especially with farmers and rural producers:* The reading and listening phases have allowed for the refinement of hypotheses around constraints and opportunities for the adoption of CSA. The case studies provide a further opportunity to drill down and understand these issues – especially from the farmers' perspective. Thus the case studies will include farmer interviews.
3. *Explore the synergies between practices on the ground:* Case study locations and been selected partly because there are several ongoing CSA practices in use. The cases will thus help to concretely look at the possible synergies between practices. This will require interviews not only with rural producers but the promoters of practices being utilized.
4. *Explore directly with farmers their decision-making processes under changing climate (including the potential synergies/trade-offs between production and resilience):* We are developing a better understanding on how rural producers make decisions. The case studies will enable to further query producers about their decision-making processes.
5. *Get some first-hand (qualitative) observations of the extent of adoption and the constraints/opportunities for selected practices at the local level.*
6. *Explore the differences between policy and practice (national to local).*

Site selection

Site selection was guided by:

- Selection of geographical areas where several practices are present. This gives us the opportunity to explore the interaction between practices (instead of picking practices and identifying cases that illustrate those practices).
- The sites represent a diversity of practices.

- The sites allow comparison with USAID field experience and takes into consideration USAID programming.
- Areas where there is already some documentation/information. This allows for us to quickly zero in on cases that are liable to be revelatory. It also allows us to take a critical look at what is often fairly "promotional" material, to go past the first couple of layers of the onion.
- These areas are ones where the African members of the team have significant experience.

Thus, in collaboration with USAID, 2 sites in Kenya and 2 sites in Burkina Faso were selected.

Methodology and Field Work

The technical export questionnaire was modified for use with farmers, providing consistency across all interview groups. Interviews were complemented by field observations including visits to farmers' fields that have implemented improved techniques. The following visits were conducted necessary:

Visit	Purpose
Local government office (elected and administrative and technical)	Courtesy call and to ascertain familiarity with CSA both from a policy and practice perspective
Promoters' facilities (NGO, donor, research org, etc.)	Obtain information on types of practices and success
Promoters "demonstration plots" (photo of each plot)	Visual observation of "ideal" state of practice
Villages at least 5 per site	Interview farmers and farmers' groups
Farms at least 10 per site (photo of each practice with comparator as possible)	Visual observation of fields to compare with "control", demonstration plot and with interview
Local private sector agricultural operators (input suppliers, marketers, etc.)	Interviews on approaches to CSA at local level

Fieldwork was carried out by well-trained and experienced teams of local specialists guided by experts mentioned in Integra's proposal. Each team was comprised of 3 members – the Kenya team was entirely female and the Burkina team included one female. This component was carried out in April and May of 2016. A summary of the fieldwork is included below.

Site location	Climate	Average rainfall	Main crops grown	Dates of study	Total Number of interviews	Number of women interviewed
Kenya						
Wote	Wet	600mm	Maize (82.7 percent) Beans (79 percent) Sorghum (23.5 percent) Fruit (23.5 percent)	April, 2016	81	48
Kibwezi	Dry	<600mm				
Burkina Faso						
Dano	Wet	900 – 1200 mm	Millet (79.6 percent) Maize (61.2 percent) Sorghum (57.1 percent) Groundnuts (47.6 percent) Beans (47.6 percent) Rice (34 percent)	May, 2016	147	30
Ouahigouya	Dry	600 – 900 mm				

Links to Data

The raw data collected from the case studies can be found by following the links provided below. Please note that you will need a Google Account to access the data.

Kenya Farmer Survey Data

https://drive.google.com/a/integrallc.com/file/d/0B8n4fRJYNjFkNmJiM2gyZGhIM2s/view?usp=sharing

Burkina Faso Farmer Survey Data

https://drive.google.com/a/integrallc.com/file/d/0B8n4fRJYNjFkR21WS2JMcFFsVEk/view?usp=sharing