Climate-Smart Agriculture (CSA) within the Feed the Future Project Portfolio of USAID-Zambia: A CCAFS Deep Dive Review

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1. Objective

The Climate Change, Agriculture and Food Security (CCAFS) research program of the CGIAR is working with USAID to identify opportunities for advancing Climate Smart Agriculture (CSA) within its *Feed the Future* portfolio. CSA has three main objectives:

1) To sustainably increase agricultural productivity and incomes;
2) To adapt and build resilience to climate change; and
3) To reduce and/or remove greenhouse gas emissions, where *appropriate* (versus the FAO definition, which uses *possible*).

A visit in May 2015 by staff from CCAFS and USAID-BFS Washington to the Zambia Mission provided an opportunity to identify and discuss CSA-related activities within the country and the USAID zone of influence (ZOI). The five-day visit included a series of meetings with Mission staff, implementing partners of *Feed the Future* projects, agency personnel of the Government of Zambia, and the FAO-Zambia CSA specialist. The discussions were preceded by a document review of projects in the *Feed the Future* portfolio, shared in advance of the visit by the Mission, and other agriculture and climate change information available on the web. This report outlines key findings of the visit and suggests ways in which CSA can be further integrated into upcoming *Feed the Future* programming in Zambia. Although climate change has been a key theme in FtF, considerations are under way for CSA being an explicit cross-cutting theme. Five countries were selected for visits. Results from these inquiries will inform how FtF tracks CSA across the 19 focus countries, plus aligned countries.

2. Zambia Context

Zambia is a large country with three major agro-ecological regions, primarily based on climatic, geo-physical, soil types, farming systems and socio-economic parameters.[1] Of the 10 provinces in the country, *Feed the Future* activities are concentrated in the Eastern Province (Figure 1). The ZOI covers approximately 260,000 households or 84% of the rural households in the Province. Activities reach 68 to 79% of the households in 5 of the 8 Province districts. The region is one of the most challenged areas of the country in terms of poverty, food insecurity, and nutritional status.

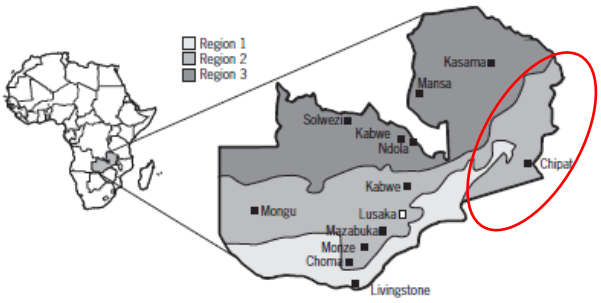

Figure 1. Zambia AER and the Eastern Province

[1] Conservation agriculture in Zambia: a case study of Southern Province. www.fao.org/ag/ca/doc/zambia_casestudy.pdf

A. Risk and Vulnerability

Zambia is particularly vulnerable to climate change and weather variability due to its high levels of poverty (59%) and dependency on agriculture and natural resources. Furthermore, a rapidly growing population also threatens the capacity of the natural resource base to provide adequate food, water and woodfuel. The current population of Zambia is about 15.5 million, which is expected to double by 2035.[2]

Main crops are maize (a staple of Zambian diet), cassava, sorghum, wheat, rice, groundnuts and high-value crops such as cotton, sugarcane and tobacco. Extreme weather events such as droughts, floods and heavy rainfall are expected not only to worsen in intensity and frequency, but also threaten to erase gains achieved in agricultural production before 2010.[3] Official data since then show that the yields of maize, groundnuts and even cassava have been variable and perhaps show a tendency of decline (Further discussion with figures on *area harvested* and *yields*, FAOSTAT data 1995-2013, in Annex).

Recurrent droughts and floods have caused widespread crop failure (Figure 2), though floods are of minor concern in the Eastern Province. During the 2004/05 drought, for example, nearly two-thirds of the country received little or no rainfall, which even affected large-scale agricultural producers. The following season (2005/06) drought left 1.2 million people - over 10% of the population - food insecure for up to 8 months. More than 25 districts (37.5% of Zambia) were affected, mostly subsistence farm families.

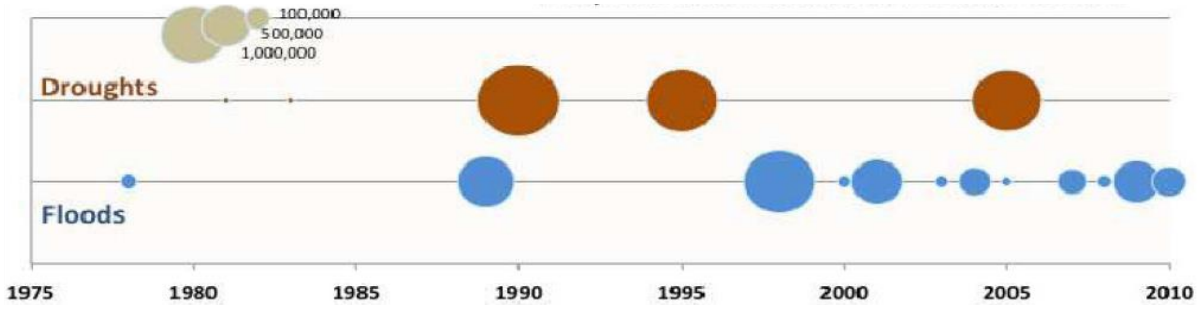

Figure 2. Relative impact of Zambian climate-related weather events (# people affected)[4]

Within the last 20 years, prolonged dry spells and shorter rainfall seasons have reduced maize yields to only 40% of the long-term average.[5] Under rain-fed conditions in the absence of adaptation measures, forecasts of additional declines range from 15%[6] to 30%[7] , and to a 66%

[2] Based on an annual growth rate of 2.8% (2010 Census Report).

[3] Zambia Strategic Programme for Climate Resilience 2011. https://www.climateinvestmentfunds.org/cifnet/investment-plan/zambias-ppcr-strategic-program

[4] Source: EM-DAT: OFDA/ CRED International Disaster Database, Université Catholique de Louvain, Brussels, Belgium.

[5] Government of Zambia and UNDP. 2009. *Adaptation to the effects of drought and climate change in Agro-ecological Regions I and II in Zambia* PIMS No. 3942

[6] Jones PG, Thornton PK 2003. The potential impacts of climate change on maize production in Africa and Latin America in 2055. *Global Environmental Change* 13: 51–59.

yield reduction based on a scenario of doubled CO_2 concentrations.[8] Though climate forecasts also show maize yield increases, if CO_2 fertilization is assumed.[9]

Climate in Zambia has experienced the following trends, based on 1960-2003 records:

- Mean annual temperature has increased by 1.3°C since 1960, an average rate of 0.29°C per decade.
- Mean rainfall has decreased by 1.9 mm/month (2.3% per decade), mainly due to decreases during peak months of the rainy season (December-February).
- In southern Zambia, rains have become less predictable and shorter (most notably in the south-western area), with rainfall falling in fewer, more intense events.
- If left unattended, climate change and variability could reduce GDP growth by 0.9% per year, costing Zambia US$4.3 billion in lost GDP over the next decade. Such an outcome would prevent 300,000 from surpassing the poverty line and jeopardize achieving national development goals.

Pilot Program for Climate Resilience (2011) *https://www.climateinvestmentfunds.org/cifnet/investment-plan/zambias-ppcr-strategic-program*

B. Government Agricultural Strategy and Policy

Although Zambia has achieved substantial improvements in the productivity of many staple crops since independence in 1964, gains at the national level have slowed and become inconsistent.[10] Such an outcome is due in part to agriculture policies of the Zambia government that continues a strong emphasis on maize – to the exclusion and detriment of other crops such as cassava, sorghum, millet and others that may be better adapted to changing climate conditions. Despite strains on the government budget and research findings that refute the effectiveness of such policies, reforms continue to be difficult. Pressures affecting government policy come from the public to maintain low food prices and private interests associated large farms and maize-related products and services such as seeds, fertilizers, and milling.[11] Consequently, the government spends over 69% of the agricultural budget on subsidies and purchases of maize. These maize policies accounted for 90-96% of the total budget allocated to the ministry's Poverty Reduction Programs (PRPs) during the 2006–2011 budget years.[12]

Although 85% of Zambians work in agriculture, the sector contributes less than 20% to the country's GDP.[13] Reasons include: (i) low levels of investment, (ii) land degradation, (iii) limited

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[7] Lobell D, Burke M. 2010. On the use of statistical models to predict crop yield responses to climate change. *Agricultural and Forest Meteorology* 150: 1443-1452;

[8] Zambia National Adaptation Programme of Action, September 2007.

[9] Müller C, Robertson RD, Richard D. 2014. Projecting future crop productivity for global economic modeling. *Agricultural Economics* 45(1): 1574-0862. (For relevant section of IPCC AR Chapter 22, see Annex.)

[10] Sitko N, Chapoto A, Kabwe S, Tembo S, Hichaambwa M, Lubinda R, Chiwawa H, Mataa M, Heck S, Nthani D 2011. Technical Compendium: Descriptive Agricultural Statistics and Analysis in Support of the USAID's Mission *Feed the Future* Strategic Review. FSRP Working Paper No. 52. April; FAOSTAT Maize 1985-2013; Govereh J, Jayne TS, Mason N, Chapoto A (2007) Trends in agricultural and poverty indicators in Zambia. Regional Strategic Analysis and Knowledge Support System for Southern Africa (ReSAKSS-SA); Country profile - Zambia New Agriculturalist.

[11] FSRP/IFPRI, personal communication 2015.

[12] Jayne TS, Chamberlin J, Muyanga M. 2012. Emerging land issues in African agriculture: implications for food security and poverty reduction strategies. In *Stanford Symposium Series on Global Food Policy and Food Security in the 21st Century*. Center for Food Security and the Environment, Stanford University, Palo Alto, CA.

[13] https://www.cia.gov/library/publications/the-world-factbook/geos/za.html

access to agricultural inputs such as fertilizer, and (iv) a reduced labor force due to HIV/AIDS.[14] Moreover, the ability of the agricultural sector to cope with increases in temperature and potential reductions in rainfall is largely insufficient. For example, despite having 104.8 billion m^3 of freshwater per year, this resource for irrigation is largely untapped.[15]

The World Bank has started activities to mainstream climate resilience into national economic planning. Efforts include integrating and/or increasing budgetary allocations to programs and projects that promote climate resilience (e.g. agriculture diversification, develop risk management and vulnerability plans, etc.).[16] Nevertheless, CSA-related agricultural practices are not new to Zambia. In the late 1980s, intensive tillage and a lack of soil cover, especially due to the common practice of burning crop residues, were being perceived as major causes of soil degradation. In response, a coalition from the private sector, government and donor agencies began promoting a conservation farming of agronomic and land management practices for small-scale land users consisting of minimum tillage, crop rotations, cover crops, planting basins and intercropping practices. In 2000, conservation agriculture (CA) became an official policy of the Zambian government.[17] Due this push, a large increase in the adoption of CA has been observed.[18] Use of practices, however, has not been permanent or consistent across the country. For some CA practices, dis-adoption has occurred due, in part, to the removal of subsidies, input packages or material rewards for uptake.[19]

3. Climate Smart Agriculture and the Feed the Future Portfolio

This section provides a summary of the *Feed the Future* with respect to CSA objectives and discusses current perceptions of CSA. A variety of efforts help agriculture adapt to a changing climate. These are categorized into three general approaches:

> **Approach 1: Farm technologies & practices.** Development, dissemination and management activities that contribute to CSA outcomes, namely adaptation, mitigation and productivity/income generation.
>
> **Approach 2: Incentive mechanisms** through improved performance of value chains, financial mechanisms, performance compensation, capacity building, data collection and analysis, enhanced governance or other means that promote adoption of climate smart technologies and practices.

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[14] National Adaptation Programme of Action on Climate Change. 2007 http://unfccc.int/resource/docs/napa/zmb01.pdf

[15] Zambia doesn't hold 60% of southern Africa's freshwater, but 4.5%. https://africacheck.org/reports/democratic-republic-of-congo-has-60-of-southern-africas-freshwater-not-zambia/

[16] Pilot Program for Climate Resilience of AfDB, WB, IFC, UNDP. DfID prioritizes climate information, climate resilient infrastructure, and sustainable agriculture. Concessionary Loan: 60.0 million Grant: 50.0 million

[17] According to the National Agricultural Policy (NAP) about 600,000 small scale farmers are targeted for conservation agriculture adoption by the year 2015 from the current 250,000. FAO.

[18] *Conservation agriculture in Zambia: a case study of Southern Province.* FAO.

[19] *Extension services and rainfall variability were the strongest determinants of CA adoption, while controlling for the confounding effects of unobservable household factors. This result suggests that farmers use CA practices as an adaptation strategy to mitigate the negative effects of variable rainfall. The Eastern province showed a significantly different trend in terms of both adoption and the intensity of adoption, indicating that the long-established CA activities in the province have had some impact – though high dis-adoption rates were observed.* Arslan A, McCarthy N, Lipper L, Asfaw S, Cattaneo A. 2013. Adoption and intensity of adoption of conservation farming practices in Zambia FAO. ESA Working paper No. 13-01

Approach 3: Multi-institutional participation and planning that foster integration and coordination of efforts across economic sectors (agriculture, forestry, fisheries, transportation, finance) at multiple political levels (community-based organizations (CBOs), producer organizations, businesses, agencies - national and international).[20]

Most CSA-related projects comprise more than one approach. Reviewing the *Feed the Future* projects (and other CSA-related efforts) according to these three aspects helps to assess (i) how the portfolio of USAID activities in Zambia may be achieving CSA goals - even though they may not currently be framed as such because CSA terminology has not been required in FTF, and (ii) the overall comprehensiveness of national CSA efforts.

A. Farm Technologies and Practices

An initial identification of CSA-related projects, which emphasizes **farm technologies and practices** within the current *Feed the Future* portfolio, is summarized in Table 1. Included are brief descriptions of the projects and associated types of CSA benefits (productivity & income, adaptation, mitigation).

Table 1. CSA-relevant technologies and practices in projects and associated benefits

***Feed the Future* Project**	**CSA-relevant activities**	**Productivity & income benefits**	**Adaptation benefits**	**Mitigation Benefits**
Commercial Agribusiness for Sustainable Horticulture (CASH) *Agribusiness in Sustainable Natural African Plant Products ASNAPP*[21]	Drip irrigation kits for smallholder farms 200m^2 to 5 Ha (treadle/solar pumps). Incremental approach to expensive packages. Seedlings for agroforestry, composting training. Horticulture.	Off-season horticulture/ diversification (including orange flesh sweet potato), fish production (promoted indirectly), private sector MOU to buy produce from farmers.	Improved water use with harvesting from roofs to ponds.	Reduction of production and post-harvest losses. Solar-based energy use.
PROFIT+ *ACDI/VOCA [A follow up to PROFIT 2005-10 DAI, which emphasized retain inputs & services, beef & cotton.]*	Focus on markets and private sector investment. Developing entrepreneurs at village level to commercialize products and to facilitate community-led management services.	Simple technologies/practices. Increased products market prices.	Most adoption on diversification, soil cover maintenance, agroforestry, shifting planting times. Index-based insurance is being built into rural credit systems.	Avoided crop losses
Zambia Agriculture Research and Development Project. CGIAR crop technology and dissemination projects	Sustainable Intensification of Maize-Legume Systems, Groundnut Innovation and Technology, Pro Vitamin A Maize, Aflatoxin Mitigation in Maize and Groundnut	Increased productivity and improved pest/disease resistance of maize, groundnuts, soybeans, orange-fleshed sweet potato, orange maize, cassava and cowpeas.	Reducing drought risks with early varieties. Diversifying system (legumes, short duration cowpea, intercropping sweet potato) into existing systems. Technologies improve or maintain soil moisture.	Reduction of crop losses

[20] Example components of an enabling environment that facilitate climate smart agricultural outcomes include climate information services, programmatic support for improved risk management, safety nets, or national policy frameworks such as national adaptation plans, NAMAs, etc.

[21] Also part of the Global Development Alliance.

Table 1. Continued

***Feed the Future* Project**	**CSA-relevant activities**	**Productivity & income benefits**	**Adaptation benefits**	**Mitigation Benefits**
Better Life Alliance - Global Development Alliance Partner: Community Markets for Conservation COMACO[22]	A private Zambian company generating income through CSA-relevant approaches. Over 100,000 farmers connected to an extension service. Created cooperative of farmer groups, and deliver services at a cost of US$16/farmer. Work through community leaders.	Value-added opportunities (10-20% price increase) for farms that adopt best practices. Farmer incomes increased from US$100 to $450 per year. Agroforestry with *Glirisidia* reduces cost of fertilizer by US$70-80.	Greater farm resilience from agroforestry, plus diversification strategies including sorghum and cassava.	Lower emission via low tillage, compost, agroforestry also reducing deforestation pressure by generating on-farm wood products.
Mawa: Zambia Economic Resilience for Improved Food Security Partner: Catholic Relief Services CRS	Project helps households find a balance between subsistence and market agriculture. 5 essential skills are enhanced: *financial* to grow and maintain assets; *group management* to plan and access services collectively; *innovation* to help farmers adapt to change; *sustainable production* to help protect and sustain soil, water and vegetation; and *business and marketing* to prepare farmers for markets.	Sufficient quantities of diverse, nutritious and quality foods at home. Effective engagement with markets. Through trained volunteers families with young children learn essential care, feeding and hygiene practices to support optimal nutrition for pregnant and breastfeeding women and children under two.	Improved NRM and agricultural production.	Reduced crop losses.

Other CSA-related projects, with adaptation & mitigation benefits, include Mission support of *Caritas Zambia* to install household fuel-efficient cook stoves, train villagers in the maintenance and care (coppicing) of trees, which will regenerate after being harvested for firewood and educate about the dangers of deforestation through drama performances and school programs.

B. Incentive Mechanisms

Achieving widespread practice of CSA requires adequate incentives to make changes. This sub-section describes how *Feed the Future* projects provides five types of incentives that foster transformative processes: (i) improved performance of value chains, (ii) financial mechanisms, business skills and governance, (iii) performance compensation, (iv) data collection and analysis, and (v) enhanced reach of communications.

[22] An interesting solution to CSA problem: By reducing burning, a common practice to catch mice became unavailable. To manage the pests and serve as a high-protein food, children lit ~50% of fires to burn vegetation and find the mouse holes. Competition was held for best design of traditional trap, with K1000 paid to winner. A child with a design consisting of a bucket with water and a rotating skewer with a roasted groundnut and maize bait attracted the mice, which then fall into water. 30-40 mice per night can be caught. Children roasting and selling mice generated nutritional benefits to their community.

(i) Value chain performance

In addition to the projects that emphasize input technologies and production practices highlighted above, two projects contain additional efforts that improve the performance and farmer participation in post-harvest and marketing links of value chains. One, the *Commercial Agribusiness for Sustainable Horticulture* (CASH) led by COMACO is a Zambian private-sector agro-processing business that collects, processes and markets food products such as peanut butter, honey, rice, dried mango, and breakfast cereals. Using a conservation brand *Its Wild* as a central component of a social enterprise approach, the company has become a significant employer in the Eastern Province, providing nearly 100 full-time equivalent jobs. Two, the *PROFIT+* project (Production, Finance and Improved Technology) of ACDI/VOCA also has a market and private sector investment focus. Efforts include fostering entrepreneurs at village level and private sector commercialization links. CSA-related activities were simple farm management technologies/practices such as crop diversification, soil covers, agroforestry, and shifting planting times. Albeit a minor contribution to mitigation, some promoted tomato varieties do not need staking, thus reducing pressure on forests. Also, the incentive factor is reduced labor, not environmental concerns.

(ii) Financial mechanisms, business skills and governance

Projects within the *Feed the Future* foster a variety support mechanisms, both community and externally managed, that facilitate the adoption of CSA practices. Four examples are highlighted. One, *PROFIT+* index-based insurance is being built into some of their rural credit system efforts – without explicit explanation to participants of the sometimes complicated financial mechanics. Two, the *MAWA* project applies a saving and internal lending communities (SILC) model. This enables farmers to have access to affordable finance to invest and expand their enterprises. Three, the *Development Credit Authority* (DCA) is a USAID and Swedish International Development Agency (SIDA) agreement with the Zambia National Commercial Bank, ZANACO, to encourage over $9 million in lending to individuals and small businesses in the agricultural sector. Improved agricultural services (inputs, management and outputs) can enable farmers to make farm investments. Four, the *CASH* and *PROFIT+* projects trained farmers in business skills, financial literacy, and aggregation approaches in order improve their negotiation and governance capacities when working with private sector buyers.

(ii) Performance compensation

Two types of performance compensation mechanisms were apparent within the portfolio: criteria scoring and market pricing. One, COMACO uses a scorecard to evaluate farmers, and their community, performance with respect to a number of natural resource management (NRM) criteria (e.g. poaching, farm practices) in order to determine price premia earned for marketing their production through the company. Although explicit criteria are used, evaluation and weighting of scores seem to be subjective and led by COMACO personnel. Two, *PROFIT+* is working with farm communities to improve post-harvest handling and packaging in order to improve market prices received by farmers.

(iv) Data collection, analysis and policy change

Besides the M&E efforts of all the projects, the portfolio contained two highlight efforts on data collection and analysis at a national scale. One, the *Food Security Research Project* (FSRP Phase 3) works with the national agriculture policy research institute (IAPRI) in managing surveys for USAID at farm & plot level. Aspects of food security, off-farm income, forest/tree products such as NTFP and charcoal production are included, though seasonal impacts of livelihoods are not examined. Also, FSRP engages in advocacy for agricultural policy reform and capacity building. Discussion revealed a difficulty of data supporting evidence that links diversification with food and nutritional security outcomes. Two, the *Famine Early Warning Systems Network* (FEWSNET) provides expertise to the Zambian Government on food security, early warning, humanitarian assistance, climate change adaptation and vulnerability assessments.

(vi) Communication

In addition to personal communication via extensionists and local project leaders, broader audiences are being reached with CSA-related messages via radio. COMACO is working with a local radio personality to share news and highlights of project activities. Cellphones are common communication tools with participants in *PROFIT+*.

C. Multi-Institutional Participation and Planning

This sub-section describes how the USAID-Zambia Mission fosters coordinated participation in CSA-related activities. Events range from formal meetings with high-level national and international representation to ad hoc communities of practice. In Zambia and Africa, a number of CSA alliances exist, often causing confusion. These include (i) Zambian CSA efforts under the 25-25 initiative, which is aligned with CSAA and NEPAD/COMESA, and having a target of reaching 6 million farmers by 2021, (ii) all 5 iNGOs working in Zambia, which created a CSA committee to make an inventory of associated projects (73), support strategies and policies, and develop a brochure and investment concept note. Zambia is taking leadership on putting CSA on the post 2015 agreement agenda.

Multi-institutional participation and planning also occurs in communities. Although many projects work with individual farmers and households, collective action is needed to achieve behavioral changes with respect to reducing crop residue burning, livestock management and forest use. Engagement with community leaders (chiefs) helps to make binding decisions to reduce charcoal production and protect National Parks in buffer regions. Other USAID projects such as the BioCarbon *Initiative for Sustainable Forest Landscapes* (ISFL) project while not working explicitly on CSA, have relevant national actors such as the National Farmers Union and Ministry of Agriculture. Furthermore, environmental government agencies see CSA as an opportunity to achieve environmental goals. Addressing agricultural expansion, a driver of forest degradation and deforestation, are explicit in both BioCarbon project and in REDD+ strategies. The Nyimba Forest Project (NFP), with CIFOR, is another REDD related project that fosters multi-institutional participation and planning, at a district-level scale.

4. Discussion

This section provides a commentary on the current perceptions of CSA in Zambia, highlights comments that arose during conversations with implementing partners, and documents future opportunities and challenges for *Feed the Future* programming.

A. Emerging Messages

Current perceptions of CSA

CA = CSA? Based on both document reviews and discussions with the national government and implementing partners of *Feed the Future* and other USAID projects in Zambia, CSA appears to a relatively well-known concept that addresses an important need. Nevertheless, a varied understanding of CSA became apparent. Given the history of conservation agriculture, which also emphasized better soil and crop management, CSA was often considered to be largely the same concept.

Meanwhile, for some non-FtF project development professionals, CSA appears to be a way to justify their focused position on "non-natural" agricultural inputs, such as being strictly against the use of GMOs, chemical fertilizers, pesticides, insecticides and herbicides. For example, Grassroots Trust sees CSA as a means to emphasize its "CSA-narrow" - yet holistic/organic farm management approach. Although areas of common ground were identifiable, such approaches of community empowerment, planned grazing and Farmer-Managed Natural [tree] Regeneration (FMNR).

Highlight comments by implementing partners

- Topics of *climate* and *climate variability* were not emphasized, yet when probed it became more evident that they are a major challenge facing the Eastern Province region

Nutrition diversification –> farm diversification & CSA

- CRS (MAWA): The higher-level goal of improved nutrition appears to make many project participants consider resilience-related aspects, like diversification, incorporation of legumes, and agroforestry.
- Discussion with ACDI/VOCA (PROFIT+) revealed that not having nutrition targets may limit the project scope to more critically examine the farming system and build resilience.

Reporting structure

- COMACO has mainstreamed M&E analyses on data on yield, performance, adoption and publishes documents to facilitate learning across the program, but the strict reporting structure of *Feed the Future* structure relegates many CSA-related benefits to be mentioned only in narratives.
- It was repeatedly noted that a project's scope of work is strongly linked to the reporting structure. Since the current FTF reporting structure emphasizes productivity, going beyond productivity would require high-level indicators on adaptation or mitigation benefits. This productivity focus is especially true for implementing partners that are strictly operating

based on the terms within FtF contract. Other implementing partners, with a broader range of activities (e.g., CRS, COMACO) were better able to integrate CSA-related goals such as crop diversity. CRS focused on crop diversity through their goal of meeting nutrition targets. However across the FtF portfolio, nutrition funding is only recently moving to the FTF ZOI. So, while nutrition is a high level indicator for FTF, it wasn't always a main focus of the projects visited.

Diversification & project flexibility

- Value chain improvements are important for livelihoods - but CSA benefits need to be better communicated. For example, while FTF has a focus to increase maize productivity, the goal is not necessarily to increase overall production. Smallholders require a certain production of maize to meet household needs. As part of a lower-risk food security strategy, if the required harvests are achievable on less land, the introduction of other crops (legumes, vegetables, etc.) can be accomplished. If transformative change in reducing consumption of staple maize is not feasible, then its intensification is likely necessary in order to achieve diversification.
- With ACDI/VOCA there was discussion about how additional opportunities emerge during their work on value chains that address broader CSA criteria, such drought resistance of alternative staples (like sorghum), shorter duration crops with market potential, or allowing work on associated farm products to facilitate farm diversification.
- ACDI/VOCA stated that avoided crop losses are being enjoyed by farmers adopting some of their practices. A subsequent discussion highlighted that much more could be done to bolster resilience of the system. For example, fertilizer is being applied only to maize.
- A lack of an adaptation/ resilience target appears to favor investments in crop specialization to generate substantial widespread productivity increases. Nevertheless, specialization could generate mal-adaptation in the short- and long-term. At a practice level, while a specialization effort for productivity benefits may be considered CSA, at development level such specialization (e.g. maize) may overlook the need for climate adaptation and resilience, thereby worsening climate-weather related risks.
- CSA-relevant value chain improvements require improvements of crucial upstream inputs. For example, legume seeds (e.g., groundnut) are not readily available. While diversification is a good general approach for climate change adaptation, modern, improved seeds have to be produced and distributed according a strategy on seed systems.
- The Mission staff coordinating and leading both FtF and GCC portfolio broadens CSA vision. GCC projects are seen as a beneficial complement to *Feed the Future* efforts, especially with regards to NRM aspects of agriculture, forest management and climate change (e.g., land tenure with COMACO, forest foods use with CIFOR, Nyimba Forest Project).[23]

Communication

- CIFOR mentioned that since crop residue management, land allocation and forest/tree use are often decided by a community, working with local cooperatives and village chiefs is essential. Such an approach can spur collective action and CSA-relevant behavioral changes.

[23] http://usaidlandtenure.net/documents/project-brief-tenure-and-global-climate-change-zambia

Also, the fostering of engagements amongst chiefs has enabled NRM experiences to be shared thereby influencing decisions across a communities.

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B. Recommendations: future opportunities & challenges

What needs to be done so that CSA is more resilient and effective than CA?

- Documentation on CA reveals that upscaling approaches have been largely prescriptive causing for many farmers to dis-adopt one or more of the component practices.[24] Rather than rely on subsidies and other external incentive mechanisms, FTF projects motivate changes in farm management by increasing production for household consumption and enhanced marketing opportunities. To further ensure that CSA technologies and practices are relevant and endure, concepts of farmer participation, co-development and adaptive management should be embedded in project *theory of change*.

Communication

- Opposition to genetically-engineered (GE) maize has arisen in Zambia, largely driven by attitudes from outside the country rather than evidence.[25] In a pre-emptive manner, CSA initiatives need to socialize the benefits of GE crops, such as lower use of pesticides and increased yields.
- A continued link between nutrition, for both rural and urban areas, is a strong household and market driver for CSA. Consumer demands in urban areas, especially for vegetables and legumes, can be further enhanced with nutrition training for families in health centers and schools along with public service announcement in newspaper, radio and TV programming.

Reporting

- When nutritional targets were present in projects, CSA outcomes were strengthened by evaluating both income and nutritional diversity during the off/hunger season. Rather than emphasizing a typically "narrow" focus on maize productivity in the primary cropping season, CSA should measure cropping diversity and it associated impacts to household food security.
- Additional CSA objectives could generate positive benefits by broadening vision that leads to more robust development and conservation outcomes. Nevertheless, complex and burdensome reporting requirements could raise M&E costs. Careful indicator selection and adequate funding will be needed to report on additional targets.
- CSA learning from M&E information at the ZOI/Mission level can be increased by synthesizing the diverse and rich data set being developed by multiple implementing partners. To inform future Mission programming, the identification of important complementarities across projects could be conducted along with periodic CSA reviews of the project portfolio. While a 4-day deep-dive exercise did provide a useful opportunity to understand the Zambia CSA context, a more detailed review would be required.

[24] For example, Arsland et al 2013 op cit.

[25] Fischer RA, Byerlee D, Edmeades GO. 2014. *Crop yields and global food security: will yield increase continue to feed the world?* ACIAR Monograph No. 158. ACIAR: Canberra. 634 pp.

Adaptive management

- Provide flexibility within FTF contract budgets (percentage or fixed level) to enable implementing partners to make adjustments for fostering opportunities and addressing challenges as they arise. This will enable farmers and implementing partners to choose value chains around broader criteria, or allowing more "work around the edge" on diversification.

Program prioritization

- Since the effects of climate change were not the main factor in determining the ZOI, other USAID bureaus may work in parts of the country that are drier and more prone to flooding, such as the south and east. Meanwhile, the northern and wetter part of the country has more forest to protect. Upcoming Mission programming will need to weigh the pros and cons of focusing activities in the Eastern Province. Perhaps participants in current activities could serve as ambassadors and technical experts to help scale-out impacts.

MIPP

- The Zambia mission is fostering an important MIPP by convening a CSA discussion amongst implementing partners and other development agencies. Continued periodic community of practice meetings can help share experiences and knowledge, thereby generating additional efficiency/effectiveness benefits of increased coordination across projects and the entire Mission portfolio. Additional cross-fertilization of ideas can be fostered with seminars presented by IPs and those of other donors in Zambia (such as Concern International, Conservation Farming Unit), along with FTF Innovation Labs, International Agriculture Research Centers and others conducting activities in neighboring countries.
- Additional coordination with GCC can enable more village leaders to share their CSA-related experiences in district/ sub-national gathering.
- Links between donor agencies can be enhanced. Coordination was not apparent with World Bank / AfDB CSA activities. Better partnerships and planning could help adapt and leverage *Feed the Future* successes to benefit other regions of the country.
- Although Zambia is a key player international CSA-related events, it is not clear how much a valuable yet narrower CA perspective is being maintained. Increased communications with relevant government agencies and FAO can help enhance. In addition, a comment/review of the national strategy can ensure that important aspects of CSA are addressed.

Incentive mechanisms

- Farm risks can be further reduced by improving post-harvest handling for perishable crops and grain storage, enhancing farmer participation in the governance of value chains and supporting better weather-crop planting information and, if viable, weather-harvest insurance schemes.
- Miombo woodlands are estimated to cover 60% of the country's total surface area and serve as a source of fuelwood or charcoal for more than 80% of households.[26] Additional co-located GCC

[26] National Adaptation Programme of Action on Climate Change. 2007 http://unfccc.int/resource/docs/napa/zmb01.pdf

projects can strengthen incentive mechanisms for generating valuable forest co-benefits such as

- carbon sequestration in
  - soils that improves soil health and productivity
  - trees that also improve supplies to cooking fuel, leaf litter and possibly soil nitrogen organic matter.[27]
- landscape-level diversity for household food security as an off-season (drought?) food source.

Climate-smart ≠ climate proof

- Although fostering access to low-cost irrigation can enable farmers to produce crops during dry seasons and reduce their exposure to drought, the capacity of water supplies does not seem to have been examined. Given that farmers purchase pumping and distribution equipment on a loan basis, their financial risk associated with the investment may not be adequately known. Additional water resource management, such as rainwater harvesting and storage ponds, may need to be included with irrigation projects. Available water and aquifer data and analysis may be applicable to the Zambia context.[28] Quick yet systematic reviews of potential social and environmental trade-offs (such as reductions or pollution of drinking water supplies) should also be required before project announcement.

5. Conclusions

The CCAFS CSA deep dive assessment in Zambia generated a number of conclusions relevant to USAID's strategy and program portfolio under *Feed the Future*, including:

- Climate vulnerability is high and likely to increase in the future due to high levels of poverty, population growth and dependency on agriculture. Extreme weather events such as droughts and floods are expected to threaten agricultural production.
- USAID's *Feed the Future* portfolio includes many CSA elements spanning the three approaches of *improved farm technologies and practices*, *incentive mechanisms* and *multi-institutional programming and planning*. These efforts will serve as a solid basis for further integrating CSA into its programming.

[27] Intercropping the leguminous drought-resistant *Faidherbia albida* in regions with annual rainfall of >750 mm can raise yields of maize in the absence of fertilizer. In conjunction with CA, harvests increased from 1.3 t/ha to 4.1 t/ha with trees (Garrity et al. 2010). The recommended density of planting is 100 trees per hectare, later thinned to 25–30/ha. Adoption on 300,000 ha is now claimed. in relatively wet locations (~1,000 mm annual rainfall), another example observed in Zambia is 'non-traditional' shrub intercropping where maize has been planted between alleys of leguminous *Gliricidia sepium* (Sileshi et al. 2012). Over 12–13 years of a continuous cropping experiment on poor soils, average maize yield without fertilizer doubled from 1.6 t/ha to 3.2 t/ha with planting between coppiced *Gliricidia* alleys. When fertilizer was used (nitrogen at a rate of ~100 kg N/ha plus phosphorus and potassium) in the absence of *Gliricidia* alleys, the average yield was 4.2 t/ha. One potential impediment to adopting alley cropping is labor required for frequent coppicing.

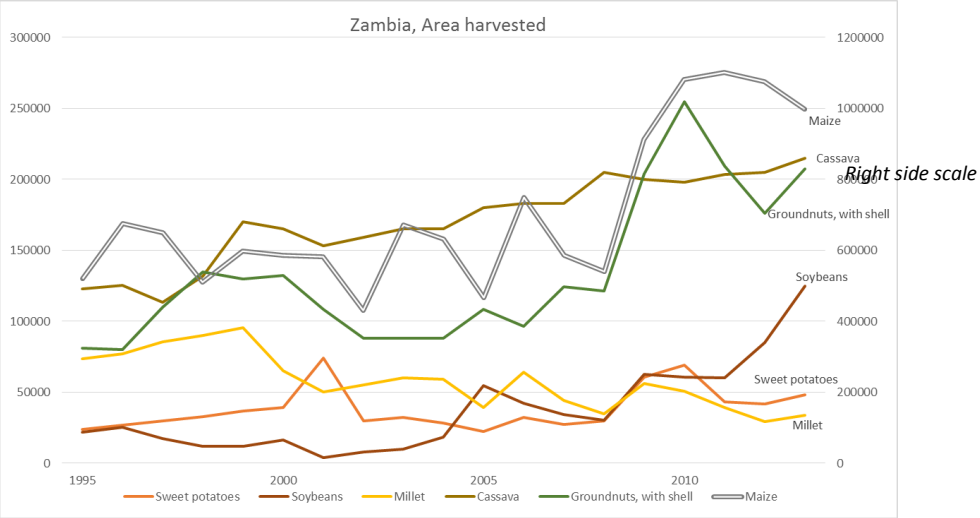
[28] Circle of Blue http://www.circleofblue.org/waternews/2015/world/groundwater-depletion-stresses-majority-of-worlds-largest-aquifers/ and *Assessment of Groundwater Management in West Africa in Light of Climate Change* http://community.eldis.org/.5b9bfce3/Groundwater%20in%20WA_CLEARED.pdf

Several possible pathways for building on that success can be pursued, including:

- The importance of Mission activities associated with mitigation, such as forest management and protection (REDD) and agroforestry, became apparent. Although beyond the scope of this review, which focuses on adaptation, these practices were reported during the electro-survey (in the Annex). Current efforts to improve livestock and energy management are relatively low and could be emphasized.
- Experiences from *Feed the Future* projects in the Eastern Province could inform future policies and field activities in other regions of the country through enhanced MIPP amongst implementing partners, donors and the government.
- Many of CSA technologies and practices highlighted in the electrosurvey were being addressed in the ZOI, Although levels of adoption were reportedly less than 2/3 of participating farmers. Thus, the USAID Mission in Zambia and *Feed the Future* faces a question of where to work in the country, either to enhance the substantial advances made in the Eastern Province, modify their focus to address other areas of the country (perhaps with additional multi-institutional linkages), or attempt achieving a balance of the consolidation and expansion.

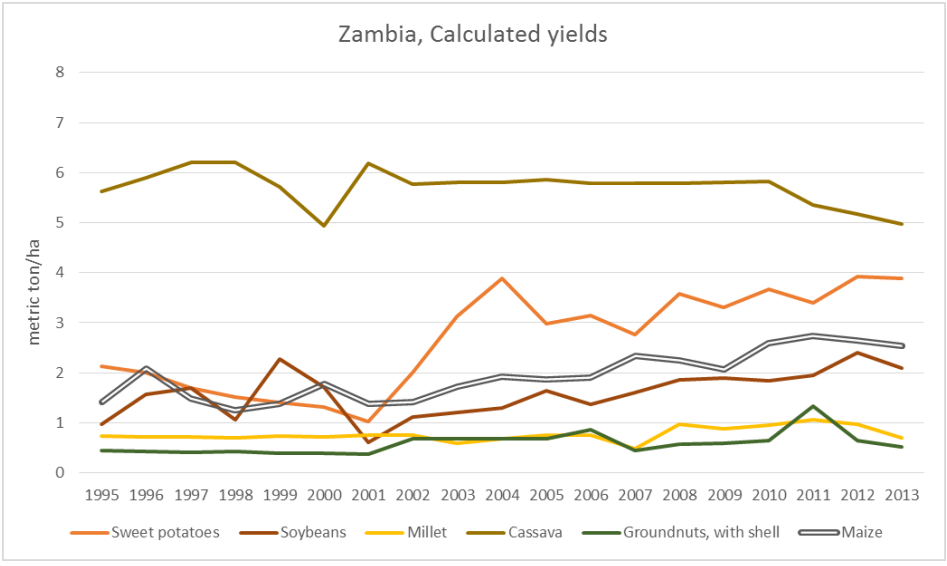
Annex

FAOSTAT data of select crops (area harvested, calculated yield; 1995-2013)



Reported area of agricultural crops is dominated by maize. Crops with larger increases in area are groundnuts, soybean and cassava, in addition to maize. Data show large variation in harvested area all selected crops, minus cassava. Maize area increased to over 1.4M ha in 2014 (Ministry of Agriculture and Livestock 2015). Maize production in 2015 estimated is expected to be 21% below the 2014 record output FAO 2015.

Yield increases have been most dramatic with sweet potatoes maize and soybeans. All crops show some level of yield variability. Despite being drought-resilient, cassava has shown three years of yield declines. According to official reports, maize has also dropped in the past few years, declining to 1.75t/ha in 2015 (Ministry of Agriculture and Livestock 2015).



Reported results from electro-survey

CSA tech & practice	Zambia
Fertilizer & residue inputs	3
Reduce post-harvest loss	3
Organic matter management	3
Reduced tillage	3
Reduced biomass burning	2
Other conservation ag	2
Irrigation efficiency	2
Nitrogen fertilizer efficiency	2
Other CSA activities	2
Farmplot crop diversification	2
Avoided conversion	2
New irrigation mechanics	2
New/different crops	2
Diversification w/ trees	2
Wood lot establishment	2
Weather/climate information	1
Other bioenergy	1
Reduced energy use	1
Crop harvest risk insurance	1
Water saving in rice	0
Biogas from manure	0
Stress-tolerant varieties	U
Ruminant management	*N*
Grassland management	*N*

Comments:
Improved practices pertaining to the themes of *soil & fertilizer management* (brown cells), and *reduced post-harvest losses* were reported as being adopted by 33 – 66% of FTF farmers in the ZOI. Practices of *water management* (blue cells) and *crop management* (green cells) were being adopted by <33% of farmers.

Pilot activities were reported for *energy and fuel management* (purple cells) along with the use of *weather information and insurance* (gray cells). Practices associated with livestock management were reported as being not applicable (perhaps mistakenly).

Legend

4	= > 66%
3	= 33-66%
2	= <33%
1	= pilot
0	= none
U	= unknown
N	= not applicable
A	= already common

With respect to participating FtF farmers

IPCC AR Chapter 22

Page 20:

"Climate change is *very likely* to have an overall negative effect on yields on major cereal crops across Africa, with strong regional variability in the degree of yield reduction (see also Section 7.3.2.1) (Liu et al., 2008; Lobell et al., 2008, 2011; Walker and Schulze, 2008; Thornton et al., 2009a; Roudier et al., 2011; Berg et al., 2013) (*high confidence*). One exception is in eastern Africa where maize production could benefit from warming at high elevation locations (A1FI scenario) (Thornton et al., 2009a), although the majority of current maize production occurs at lower elevations, thereby implying a potential change in the distribution of maize cropping. Maize-based systems, particularly in southern Africa, are among the most vulnerable to climate change (Lobell et al., 2008). Estimated yield losses at mid-century range from 18% for southern Africa (Zinyengere et al., 2013) to 22% aggregated across sub-Saharan Africa, with yield losses for South Africa and Zimbabwe in excess of 30% (Schlenker and Lobell, 2010). Simulations that combine all regions south of the Sahara suggest consistently negative effects of climate change on major cereal crops in Africa, ranging from 2% for sorghum to 35% for wheat by 2050 under an A2 scenario (Nelson et al., 2009)."