TGCC ZAMBIA CLIMATE-SMART AGRICULTURE

Baseline Impact Evaluation Report

This publication was produced at the request of the United States Agency for International Development. It was prepared independently by The Cloudburst Group.

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Prepared for the United States Agency for International Development, USAID Contract Number AID-OAA-TO-13-00019, Evaluation, Research and Communication (ERC) Task Order under Strengthening Tenure and Resource Rights (STARR) IQC No. AID-OAA-I-12-00030.

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TGCC Zambia Climate-Smart Agriculture

Baseline Impact Evaluation Report

DECEMBER 2016

CONTENTS

ACRONYMS AND ABBREVIATIONS

ATE	Average treatment effect
CAPI	Computer Assisted Personal Interview
CDLA	Chipata District Land Alliance
CLR	Cluster Level Reliability
COMACO	Community Markets for Conservation
COP	Chief of Party
COR	Contracting Officer's Representative
CSA	Climate-Smart Agriculture
CSOs	Civil Society Organizations
CSO	Central Statistics Office
DLA	District Land Alliance
E3/Land	Land Office, under the Bureau for Economic Growth, Education, and Environment
ERC	Evaluation, Research, and Communication
FRA	Food Reserve Agency
ICC	Intra-Class Correlation
IDIQ	Indefinite Delivery Indefinite Quantity Contract
IE	Impact Evaluation
IRB	Institutional Review Board
LTPR	Land Tenure and Property Rights
M&E	Monitoring & Evaluation
MDES	Minimum Detectable Effect Size
NGO	Non-Governmental Organization
RALS	Rural Agricultural Livelihoods Survey

RCT	Randomized Control Trial
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RFP	Request for Proposals
SSA	Sub-Saharan Africa
STARR	Strengthening Tenure and Resource Rights
SWC	Soil and Water Conservation
TGCC	Tenure and Global Climate Change Project
USAID	United States Agency for International Development
USG	United States Government

1.0 INTRODUCTION

This report presents results from the baseline data collection completed as part of an impact evaluation (IE) of the Climate-Smart Agriculture (CSA) pilot of the USAID Tenure and Global Climate Change (TGCC) program in Zambia. This IE is being implemented under USAID Contract Number AID-OAA-TO-13-00019, Evaluation, Research and Communication (ERC) Task Order under the Strengthening Tenure and Resource Rights (STARR) Indefinite Quantity Contract (IQC) No. AID-OAA-I-12-00030.

The USAID TGCC Zambia CSA pilot is a 2.5-year intervention designed to increase tenure security while also supporting agroforestry extension services given the low existing rate of CSA adoption in the study area. The TGCC pilot is being implemented in Chipata District, one of eight districts of Zambia's Eastern Province, from late summer 2014 through the end of 2016[1]. TGCC is a global program created by USAID to explore the relationship between secure resource tenure and the achievement of climate change adaptation and mitigation goals. In Zambia, TGCC will support activities that increase tenure security at the chiefdom, village, and household levels, while also supporting agroforestry extension services, primarily at the village level. The work also addresses USAID/Zambia's objectives of improving governance, reducing rural poverty through increased smallholder agriculture productivity, improving natural resource management, and improving the resilience of vulnerable households. The TGCC interventions that are a focus for the IE include:

1. Agroforestry extension in villages to facilitate tree planting adoption and survivorship on smallholder fields; and
2. A village-level land tenure intervention (hereafter, "tenure intervention") consisting of participatory mapping, village headperson land administration support, paralegal extension support for households[2], and provision of land information and dispute resolution training, including the facilitation of customary land certificates for households.

The overarching policy question of interest is:

How do changes in property rights that strengthen a farmer's perception of long-term security over farmland affect a farmer's decision to practice climate smart agriculture, including agroforestry, on their own fields?

The primary objective of the IE is to determine whether the village and household tenure interventions under TGCC strengthen the security of land tenure and resource rights for smallholders, thereby increasing farmer investment in sustainable agroforestry and uptake of other CSA practices. Evidence from the evaluation will substantially increase the knowledge base concerning the extent to which a range of land tenure-strengthening activities influence farmer decision-making and on-farm CSA investments in the Zambian context.

1 TGCC may subsequently expand into other chiefdoms, but it is expected that there will be at least a year between the close of the TGCC pilot in the initial five chiefdoms and the endline data collection.

2 This will be a secondary focus of TGCC to maintain consistency across all tenure treatments to the extent possible. To standardize the intervention across all villages, TGCC will focus primarily on training headpersons and indunas in dispute resolution, rather than providing paralegal or other support to directly resolve disputes.

The study uses a four-arm[3], cross-cutting randomized control trial (RCT) design, in which villages are randomly assigned to receive project activities, to address this policy question. The four arms of the RCT are:

1. Tenure;
2. Agroforestry;
3. Agroforestry and tenure; and
4. Control with no intervention of either kind.

Prior to the rollout of project activities, the baseline data collection was carried out in the communities targeted by the project in the Chipata District of Zambia's Eastern Province. This data collection effort sought to gather information on baseline conditions of the key outcomes of interest and on other important contextual factors that might interact with project activities. The three main outcomes of interest include:

1. Increased household perceptions of tenure security over their smallholdings;
2. Increased planned and applied agricultural investment and other land use plans resulting from perceived tenure security, including household adoption of agroforestry and other CSA activities; and
3. Distal (long-term) outcomes around improved agricultural productivity, livelihood improvements, and increased climate resilience that are expected to flow from the interventions over longer time horizons and are of broader interest to USAID.

This baseline report provides a brief description of research activities that were undertaken as part of the baseline survey and summarizes the baseline levels for the three outcome areas above. The findings presented are based on 294 villages included in the baseline sample.

The baseline survey analysis report has three objectives. The first is to improve our understanding of the land management and tenure security environment in the evaluation area. The second is to provide baseline estimates of indicators of household well-being, tenure security, and agroforestry and CSA activities[4]. The third objective is to explore baseline differences across the IE comparison (intervention) groups that will be used to measure the TGCC project's impact.

Following this introduction, the report is organized as follows: Section 2.0 provides background on the project, as well as a brief description of the study design; Section 3.0 describes the design and implementation of the baseline survey; Sections 4.0 through 7.0 provide baseline descriptive statistics on the three key study outcomes; Sections 8.0 provides an overview of the study's balance and power; and Section 9.0 briefly describes the expected next steps for the IE.

3 The village- and household-level tenure interventions of interest for the TGCC IE will only take place in the four chiefdoms where the TGCC program has also implemented chiefdom-level tenure interventions. These interventions include the facilitation of dialogue around improved land governance and the development of mechanisms to increase transparency in land allocation and land disputes, as well as training in land administration support.

4 To make the report more accessible, baseline estimates reported here include only key indicators; please see Annexes 8-9 for the full baseline data tables.

TENURE SECURITY

Nearly all fields used by respondents are managed through the customary system, which falls under control of the chiefs and headmen. Less than 20% of headmen (17%, N=43) report that their village has a committee to deal with land-related issues.

Households report a high level of satisfaction with their customary leaders and the management of village land. There is a high level of transparency around land management decisions even though very few meetings about land management have been held in their villages. The majority of households believe that village leaders are open about their decisions and allocate land fairly across households.

Households also report high levels of land tenure security. Less than 1% (N=55) of households report having any land reallocated in the past, and in a third of those cases (N=21), the land was reallocated to another household in the village who needed land. Households feel their fields are particularly safe from encroachment from family members, the village headman, or neighboring villages both in the long- and short-term. Elite capture, from either the chief or government officials, is thought to be more likely, and 40% (N=1409) of households believe it is likely or highly likely that the chief will give up at least one of their fields for investment purposes. Similarly, 35% (N=90) of headmen believe it is "likely" or "highly likely" that the chief will give up part of the village communal lands for investment purposes.

Even though households express a high level of tenure security, over ninety percent (92%, N=3224) would like to obtain documentation for their farmland. Respondents feel that documentation will reduce the likelihood of losing their land in the future. Headmen also believe there is a need for additional documentation, and the majority believe that customary land certificates will help secure land rights (80%, N=54) and reduce conflict (67%, N=45).

Households and headmen were also asked about the prevalence of various types of conflicts in the past three years. Over a quarter of households experienced a land conflict on at least one field. The most common dispute topics at the field level have close links to land rights; these include boundary disputes (69%, N=564) and disputes about inheritance (26%, N=209). According to headmen, most conflicts in their villages occur between their village and other villages, with slightly fewer conflicts taking place between or within households in the same village, and only seven villages experienced any disputes with outside investors.

AGRICULTURAL INVESTMENT AND LAND USE PLANNING

Overall, the adoption of CSA technologies such as planting in basins, preparing fields using zero tillage, and using drip irrigation is low. The majority of fields continue to be prepared using traditional ridging methods (85%, N=7528), as opposed to zero tillage (8%, N=748) or planting basins (10%, N=909). However, two-thirds of fields (N=5636) reportedly have old crop residue left on the field after harvest and then tilled into the field, a CSA-recommended practice.

Households tended to adopt these field investments for soil productivity or yield related reasons as opposed to tenure security related reasons. For example, households were more likely to choose zero tillage for improved soil quality (36%, N=269), to prevent soil erosion (17%, N=124), or because the method is easy and quick (19%, N=142) than because the method strengthened claim to land (<1%, N=2), raised the value of the land (0%. 0), or strengthened the ability to bequeath land to their children (0%, 0). Despite low levels of investment, the lack of paper documentation for their fields does not reportedly discourage households from adopting agricultural improvements on their fields.

AGROFORESTRY

Eleven percent (N=383) of households currently practice agroforestry, spread across 5% of fields (N=404). The most popular type of agroforestry species is *Musangu*, planted in 38 villages (14%). The majority of households (58%, N=235) intercrop their agroforestry trees with other crops, such as groundnuts and maize. Like other CSA practices, the primary reasons for uptake are to improve soil fertility (78%, N=318) and improve crop yields (25%, N=75) as opposed to strengthening the household's claim to the land. Similarly, the most common benefits that households report receiving from their agroforestry trees are improved soil fertility (36%, N=134) and higher overall crop yield (25%, N=45). The main reasons households cite for not planting agroforestry trees are a lack of knowledge about how to care for agroforestry trees (42%, N=1295) and lack of seeds (41%, N=1268).

Village-level land management rules about topics including animal grazing, tree cutting, tree ownership, and setting fires are important for creating an environment where agroforestry trees can thrive. The large majority of households and headmen report that rules exist about the grazing of livestock on communal land, cutting trees on fields, and setting fires, but fewer villages have rules about animal grazing after harvest or about fencing. These rules are reportedly well-understood, and rule breaking is monitored, though household respondents suggest that the rule breakers are not always punished.

BALANCE AND POWER

Overall, all four treatment arms of the study are well-balanced across nearly 150 key indicators. These indicators include land tenure, land governance, agricultural investment, and long-term outcomes at the household, field, and village levels. On average, each treatment arm has 12 unbalanced indicators that are both statistically significant and have a high level of bias, but most these indicators are for rare events, such as access to credit, having paper documentation for land, or the existence of rules about setting fires or tree ownership. The low frequency of these events makes the indicator more likely to be imbalanced.

Power calculations were updated from the design report assumptions to account for the data collected during baseline. The new power calculations show that the study is well-powered across all four treatment arms to capture changes across 85 key outcome measures at the household and field level, and most indicators have a detectable effect size at or below the estimates put forward in the design report. As in the balance section, the few indicators that are underpowered are variables that occur rarely. The study is slightly under-powered to detect the village-level changes put forward in the design report, due to the lower number of villages surveyed.

GENDER EQUALITY AND FEMALE EMPOWERMENT

Gender equality and female empowerment (GEFE) objectives are integrated across the evaluation and program implementation. The household survey is conducted with both female and male-headed households. In cases where respondents were not available, the survey was directed towards the spouse of the head of household[5]. Moreover, a third of focus group discussions are conducted with women to capture qualitative differences in how men and women perceive issues related to tenure security and agroforestry. Overall, women and men have similar perceptions of governance and tenure security across many key indicators. Women are not more likely than men to believe their land may be encroached upon by any actor in either the short or long term. Women also share men's favorable

[5] There was not sufficient funding to conduct a survey specifically for wives of household heads to examine intra-household dynamics.

opinions of their village leadership, and are equally likely to believe that their leaders are fair and that land-related decision making is transparent. There are significant differences between male and female-headed households regarding demographic factors, such as level of education, assets owned, and area of land farmed, and these differences are noted in the report.

The interventions also have specific GEFE components. For example, the land tenure intervention stressed the inclusion of women's names on customary land certificates, required a percentage of women to take part in Village Land Committee leadership, and involved women in the process of defining village and household boundaries. The agroforestry intervention did not target women specifically, but did encourage women to participate. Future analysis will look closely at sub group differences between men and women and the ways in which the TGCC program impacts GEFE.

2.0 BACKGROUND TO THE PROJECT AND EVALUATION

PROJECT BACKGROUND AND EVALUATION OBJECTIVES

Supervised by USAID's Land Office under the Bureau for Economic Growth, Education, and Environment (E3/Land), the TGCC program explores the relationship between secure resource tenure and the achievement of climate change adaptation and mitigation goals globally. The TGCC Task Order was awarded to Tetra Tech in 2013 under the Strengthening Tenure and Resource Rights (STARR) IQC. One component of this work will seek to understand the role of increasing land and resource tenure security on the adoption of CSA, specifically agroforestry, in Zambia (Kabwe, Bigsby, & Cullen, 2009). To examine this interaction, TGCC is supporting activities that increase tenure security at the chiefdom, village, and household levels, while also supporting agroforestry extension services, primarily at the village level.

TGCC is being implemented over a 2.5-year period, beginning in the third quarter of calendar year 2014, across five chiefdoms in Chipata District of Eastern Province, Zambia. The chiefdoms are: Mnukwa, Mkanda, Mshawa, Maguya, and Saili. Community Markets for Conservation (COMACO) is the agroforestry implementing partner, and the Chipata District Land Alliance (CDLA) is the land tenure implementing partner[6]. Figure 1 on the following page presents a map of Zambia with Eastern Province and the study area highlighted.

6 The TGCC pilot is being implemented in two successive 1-year phases, with implementing partners selected through a competitive selection process.

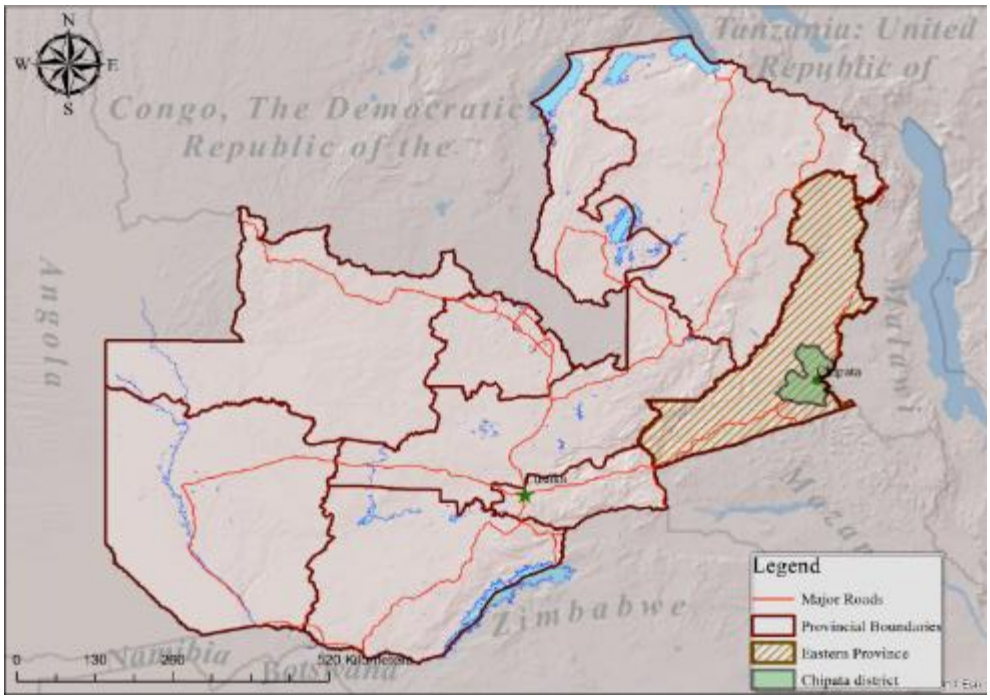


FIGURE 1. TGCC STUDY AREA, CHIPATA DISTRICT

Agricultural production supports the livelihood of over 70% of Zambia's population, including 78% of women. Relative to other countries in the region, Zambia, and in particular Eastern Province, has an abundance of fertile land, water, and a favorable climate for agricultural production. Yet, despite these favorable conditions, 80% of rural Zambians live in extreme poverty, and incidences of stunting and malnutrition impact rural communities at much higher rates than their urban counterparts (Sitko et al., 2011).

Individual land holdings are small, and a quarter of the rural population nationwide farms on only one hectare of land (Sitko et al., 2011). The primary crop grown is maize, and for most farmers it is the only crop they grow, which makes them very vulnerable to weather conditions or pests that would damage the crop. Replanting is a common occurrence, especially as seasonal rainfall patterns seem to have shifted the start of rainy season later into November. Folk wisdom calls for planting to begin on Independence Day, October 24, and if households plant according to tradition instead of following the changing weather patterns, their first crop will fail to grow, and they will be forced to replant or lose their harvest (Sitko et al., 2011). In the face of climate change challenges, CSA processes, such as drip irrigation and digging basins, can help farmers use rainwater more efficiently and grow their crops with less rainfall. Other CSA technologies, such as agroforestry and minimal tillage, can mitigate some of the effects of climate change by reducing runoff, eliminating burning of fields, and increasing the number of trees planted.

Yields for crops in Zambia are well below global averages, though the top 10% of smallholder farmers produce as much as four metric tons more than the country average, depending on the crop, which suggests great potential for yield improvement (Sitko et al., 2011). Despite efforts by the Zambian government and NGOs, adoption of chemical fertilizer, hybrid maize seeds, herbicide, and other

agricultural investments remain low. Even though nearly every subsistence-farming household grows their own maize, 36% of rural households are net buyers of maize (Sitko et al., 2011).

Eastern Province has some of Zambia's most favorable agro-ecological conditions in terms of rainfall, soil quality, and the absence of the tsetse fly. There is also ample irrigation potential, which allows for a diverse mix of crop and livestock enterprises. Because of its proximity to Lusaka and other urban centers, Chipata, similar to neighboring districts in Eastern Province, has received much assistance from government, NGOs, and donor organizations over the past decade and is the geographic focus of out-grower schemes[7] and conservation farming support. Maize is the staple crop, but a wide variety of other crops are grown, including groundnuts, beans, rice, sorghum, cassava, millet, sweet potato, sunflower, cotton, rice, tobacco, and paprika, along with vegetables (e.g., tomatoes and onions) and fruits (e.g., bananas, citrus fruits, and guavas).

Despite favorable Zambian agricultural policy encouraging CSA and a number of organizations actively promoting conservation agriculture and agroforestry, especially in Eastern Province, uptake of CSA practices, in particular agroforestry, has been limited. Statistics analyzed from the 2012 Rural Agricultural Livelihoods Survey (RALS) from Chipata District show agroforestry species were planted on 6% of fields (N=84) / 8 % of households (N=31) surveyed[8]. Globally, a lack of adequate tenure security and extension support are important reasons for low agroforestry adoption rates (Pattanayak et al., 2003). Additionally, smallholder insecurity of property rights to land and trees[9], and a lack of land management rules that protect trees on farms from being grazed or subject to uncontrolled burns are hypothesized to be key constraints in Zambia (Ajayi and Kwesiga 2003). Other reasons for low agroforestry adoption rates include difficulty accessing inputs, including seedlings and water, and lack of knowledge about the benefits of agroforestry (Pattanayak et al., 2003). The land tenure interventions included in the pilot activities under TGCC are designed to address tenure related constraints. The primary objective of this evaluation is to determine whether the village and household tenure interventions implemented under TGCC strengthen the security of land tenure and resource rights for smallholders and, in turn, increase farmer investment in sustainable agroforestry and other CSA practices.

The TGCC program involves interventions at the chiefdom, village, and household levels. The proposed IE is designed to focus on two interventions at the village and household levels:

1. Agroforestry extension in villages to facilitate tree planting adoption and survivorship on smallholder farms[10].
2. A village-level land tenure intervention (hereafter, "tenure intervention") consisting of participatory mapping, village headperson land administration support, paralegal extension support for households, and provision of land information and dispute resolution services, including the facilitation of customary land certificates for households. Here, customary land certificates are informal certificates of recognition issued by the chief recognizing the land holdings of village households; there is no legal

7 Outgrower schemes, or contract farming, describe arrangements where small-scale farmers produce on their own land under contract, typically in exchange for inputs and technical advice and a guaranteed buyer for their product at a pre-arranged percentage of final sale price.

8 If missing responses are included at the field level, the RALS data shows agroforestry planted on only 5% of fields.

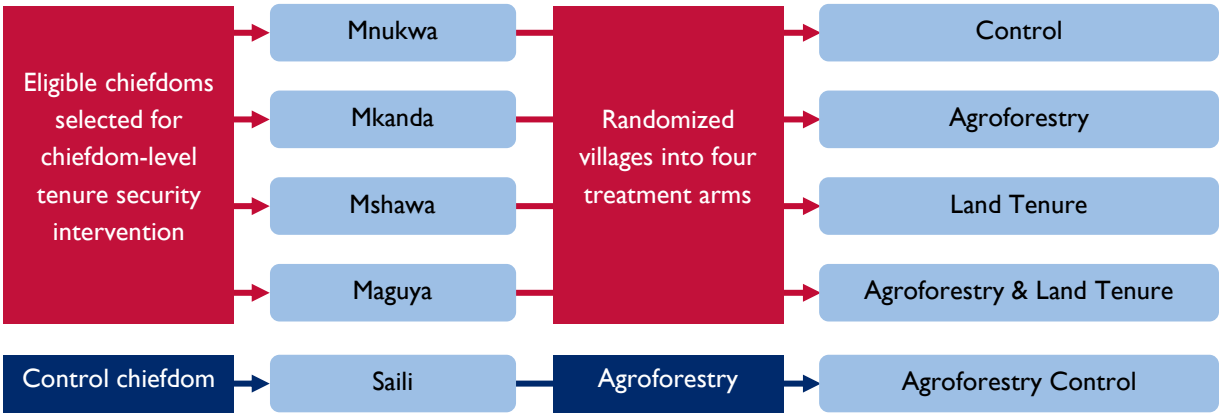
9 Under the legal framework at the start of the pilot, all trees belong to the state, which is presumed to undermine incentives to plant trees.

10 In some villages without access to surface or subsurface water for irrigation, TGCC built shallow wells.

framework for officially administering these documents[11]. It is anticipated that once a village has been selected for the tenure intervention most, if not all, households in that village will have their land certified.

Note that the village- and household-level tenure interventions of interest for the TGCC IE will only take place in the four chiefdoms where the TGCC program has also implemented chiefdom-level tenure interventions. These interventions include the facilitation of dialogue around improved land governance and the development of mechanisms to increase transparency in land allocation and land disputes, as well as training in land administration support. To strengthen the evidence base on the impact of improved agroforestry extension services in the absence of any chiefdom-level tenure interventions, a fifth chiefdom (Saili) was added to the design. However, due to the small number of chiefdoms involved in the study, the evaluation cannot generate statistically valid impact estimates of the chiefdom-level interventions. Given the prevailing governance context, it is expected that any chief-level changes in policy or administration as a result of these interventions will ultimately be implemented/enforced by the headmen—a position held by both men and women—at the village level[12]. Nonetheless, the program impacts identified by the TGCC IE cannot be generalized outside of areas that have received the TGCC chiefdom-level intervention. Therefore, any measured impacts will be generalizable only in areas where the chiefdom-level interventions have taken place.

FIGURE 2. PROGRAM IMPLEMENTATION DESIGN



IMPACT EVALUATION DESIGN

To assess the individual and joint effect of each of the tenure and agroforestry interventions, the evaluation design is a four-arm village-level RCT. The proposed sample size for the original RCT evaluation design was 300 villages, with 75 villages in each treatment arm evenly distributed across the four chiefdoms[13]. In addition, 50 more villages in a 5th study arm (Saili chiefdom) were included in the original evaluation design to provide an additional agroforestry comparison in a chiefdom not involved in

11 Technically, the chiefs have legal authority to allocate customary land on behalf of the president. While the certificates are not expressly provided for by law, they are also not prohibited.

12 At the same time, in any villages in these chiefdoms where headpersons do not implement/enforce these rules (i.e., since they were not asked by the chief to do so), the risk of trickle-down to the village and households is considered to be small and thus considered to be a reasonable limitation to the IE design and of low risk.

13 As detailed below, the actual number of villages in each chiefdom and treatment arm is lower than originally anticipated, in part because there were a smaller number of eligible villages in each chiefdom than anticipated.

the TGCC project[14]. The villages in this 5th arm of the study receive an agroforestry intervention similar to that received by the TGCC Agroforestry villages. However, villages in the 5th arm do not receive a tenure intervention at any level. The objective of this 5th arm of the study is to better understand the impact of the chiefdom-level tenure intervention by testing whether there is a difference in areas that receive both the agroforestry and the chiefdom-level tenure intervention as compared to areas that receive only the agroforestry extension.

Figure 2 above illustrates the distribution of the four types of interventions, which constitute the four "arms" of the IE. It details the different interventions that treatment villages will receive (agroforestry extension, tenure security strengthening activities, or both), as well as the associated control group villages.

BASELINE SURVEY DESIGN

RESEARCH QUESTIONS

As described above, the ***overarching policy question*** that underlies this TGCC IE is:

> How do changes in the administration of customary property rights that strengthen a farmer's[15] perception of long-term security over farmland affect a farmer's decision to practice climate smart agriculture, including agroforestry, on their own farms?

The IE is also designed to advance our understanding of several secondary questions:

1. Do chief- and village-level tenure strengthening activities around sustainable land use planning, participatory village mapping, and clarified land allocation processes reduce land disputes within villages?
2. To what extent do improvements in village land management, allocation, and adjudication processes contribute to more positive perception of tenure security over farmland, as well as encourage the adoption of longer-term CSA land uses, including agroforestry and soil and water conservation?
3. Are land tenure strengthening activities alone sufficient to change farmer behavior towards greater agroforestry uptake, or is it necessary to couple land tenure strengthening with agroforestry extension to see significant change in agroforestry uptake rates?
4. Given existing relevant information, technical and institutional barriers to agroforestry, how does improved farmer access to agroforestry knowledge, inputs and related extension resources alone (absent any land tenure intervention) affect farmer decisions to engage in agroforestry?
5. How does improved farmer access to agroforestry extension resources additionally impact a farmer's decision to engage in agroforestry?

To address the primary and secondary research questions, the evaluation team developed five survey instruments: (1) household survey[16], (2) headperson survey, (3) land tenure key informant interview, (4) agroforestry key informant interview, and (5) focus group protocol for women, youth, and land-constrained households[17]. The survey instruments were developed by ERC staff and consultants with significant involvement from E3/Land and input from the TGCC project and their partners. In line with

14 Please refer to Annex I for the TGCC Zambia IE Design Report.

15 In the context of the TGCC IE, the term 'farmer' includes both male and female farmers.

16 Whenever possible, the household survey was conducted with the self-identified household head.

17 Please refer to Annexes 2-6 for the TGCC Zambia IE data collection instruments.

USAID Research Policy[18], the design and instruments were submitted to a rigorous peer review process led by E3/Land that included external subject matter experts, as well as knowledgeable USAID staff and STARR partners[19]. The survey development was informed by previous surveys undertaken in Zambia, most significantly the 2012 Rural Agricultural Livelihood Survey (RALS), conducted by Michigan State University and Zambia's Central Statistics Office (CSO), and the 2008 Zambia Headman[20] Survey conducted by Zambia's CSO. A variety of resources developed by USAID and the STARR Partner networks were also drawn on to develop the land tenure and conflict sections.

The household survey and headperson survey are two structured quantitative instruments that were administered by an electronic data collection effort (also known as computer assisted personal interviewing, or CAPI). The broad objectives of these instruments were to collect data about household well-being, land tenure and security, and CSA practices, including agroforestry. In addition, they were intended to collect basic social, economic, demographic, and related characteristics of the households surveyed, including a focus on proxy indicators for five broad categories of variables that are important for understanding farmer adoption of agroforestry: household and farmer preferences; resource endowments; market conditions; field biophysical conditions; and perceived risk and uncertainty (Pattanayak et al 2003; Mercer 2004).

The quantitative instruments were designed to cover three main outcomes of interest, including:

1. Increased household perceptions of tenure security over their smallholdings;
2. Increased planned and applied agricultural investment and other land use plans resulting from perceived tenure security, including improved adoption of agroforestry and related CSA activities; and
3. Distal outcomes around improved agricultural productivity, livelihood improvements, and increased climate resilience that are expected to flow from the interventions over longer time horizons and are of broader interest to USAID.

Table 2.1 details the different modules included in the household survey and the headperson survey. Each module was designed to cover specific topics in relation to the outcomes of interest.

TABLE 2.1. MODULE TOPICS BY SURVEY

Household Survey		Headperson Survey
Household information	Agroforestry and related extension	Headperson information
Overall farm and land questions	Land use rules	Village information
Field overview	Governance and accountability	Village land assets
Agroforestry—field roster	Livestock assets	Inheritance and land use rights
Field investments and improvements	Household and agricultural assets	Land management
Tenure status	Land-related extensions	Land allocation and inheritance
Land conflict	Income from labor, livestock, and other non-agricultural sources	Customary land certificates
Agroforestry general	Group participation and relationships	Land conflict

18 Please refer to https://www.usaid.gov/policy/scientific-research

19 Please refer to Annex 7 for the TGCC Zambia IE external review feedback and evaluation team responses.

20 In Zambia, the term "headperson" is not typically used; rather, "headman" and "headwoman" are used. To be gender-neutral while also culturally-relevant, these terms will be used interchangeably throughout this document.

The qualitative instruments serve two primary purposes: 1) to add a social context within which to situate the statistics and 2) to add depth to the overall research and the descriptive IE data. Qualitative data was collected to provide context to the quantitative data and to triangulate responses from the household and the headperson survey, particularly about sensitive topics, like land disputes and governance. Focus groups were conducted with women, youth, and land-constrained households in 60 villages with six to ten respondents per group. The discussions centered around agroforestry, land tenure, and land disputes, as well as land governance and management practices.

In addition to focus groups, key informant interviews were conducted with Land Key Informants and Agroforestry Key Informants in a subset of villages in the study area. Land key informants included either members of a Village Land Committee, *indunas* (representatives of the chief), or village elders who were familiar with land rules in the community. The agroforestry key informants were lead farmers in community farming groups who were knowledgeable about the prevalence of and obstacles to CSA practices, including agroforestry, in the village.

3.0 BASELINE DATA COLLECTION

ENUMERATOR TRAINING AND FIELD SCHEDULE

The baseline data were collected by a Zambian firm, Rural Net, in close cooperation with ERC. Enumerator training began with a training of the trainers at the Rural Net main office in Lusaka, led by the Cloudburst Group ERC In-Country Coordinator. The field managers, supervisors, and qualitative data collectors were trained on the household survey, the community survey, key informant interviews, focus groups, and sampling. This training lasted seven days and included a one-day pilot activity outside of Lusaka. The pilot activity provided feedback about the content and length of the questionnaire and allowed investigators to improve the survey instrument and sampling framework prior to enumerator training.

Enumerator training took place over eight days: five days in Lusaka and three days in Chipata, in Eastern Province. Training was led by the field manager, with assistance from the supervisors and qualitative staff and support from the ERC In-Country Coordinator. Training included a field test in Katete District of Eastern Province. Enumerators were trained on best practices for interviewing, the ethics of research with human subjects, electronic data collection devices, and the household survey instrument in English and Chinyanja, a regional language used in the study area. Training contained both lectures, role plays, and group exercises and provided two days for enumerators to practice the survey in small groups, share their questions and advice, and practice using LG smartphones and Open Data Kit, the tools selected for electronic data collection.

The field team consisted of seven supervisors, four qualitative researchers, and 31 survey enumerators. Enumerators were primarily recruited from Lusaka and included 21 men and ten women. Most enumerators had a four-year degree, and all had experience in similar data collection exercises. All enumerators and trainers were fluent in both English and Chinyanja.

Approval was received from Zambia's ERES Converge Institutional Review Board (IRB) on June 10, 2014. Informed consent was received from each participant after reading a statement about the purpose of the research, the content of the survey, any risks or benefits, and the time commitment. Participants were assured their participation was voluntary and could be withdrawn at any point and their answers would be kept confidential. If respondents agreed to participate, they were asked to sign or fingerprint the informed consent document.

Data collection took place between mid-June 2014 and mid-August 2014. The field team consisted of six teams of five enumerators and one supervisor who were each responsible for surveying one village (15 households) each day. The teams worked in all chiefdoms simultaneously for the first half of data collection, rotating chiefdoms each week, and then all teams worked in a single chiefdom for the second half of data collection, at the request of TGCC.

SAMPLE SELECTION

Sample selection took place at the chiefdom, village, and household levels. There are several programs promoting agroforestry and CSA in Chipata District supported by non-governmental organizations (NGOs), including COMACO, Total Land Care, Conservation Farming Unit, etc. Given that there are such programs nearly everywhere in Eastern Province, the decision was made to avoid chiefdoms where COMACO was already actively promoting these practices. Chiefdoms with active programming by the implementing partner (COMACO) related to agroforestry and CSA were eliminated from the study sample.

Based on the criteria described below, four chiefdoms were selected for the RCT: Mnukwa, Mkanda, Mshawa, and Maguya. Chiefdoms with significant differences were excluded to ensure that the selected chiefdoms were as similar as possible on the characteristics most relevant to the desired program outcomes. Outside of the RCT design, Saili was selected as the 5th chiefdom to serve as an agroforestry control with no chiefdom-level interventions. Four of these chiefdoms are led by male Ngoni chiefs (Mnukwa, Mshawa, Maguya and Saili); whereas, Mkanda is led by a female Chewa chieftaness.

Factors that were considered in chiefdom selection:

- Level of chief. The one paramount chief—i.e. the chief of all Ngoni chiefs—was excluded;
- Tribe of the chief. Although Ngoni chiefs outnumber Chewa chiefs, one Chewa chiefdom was included to at least qualitatively explore any outcome differences between communities practicing patrilineal versus matrilineal inheritance traditions;
- Gender of the chief. Although most chiefs in the area are male, the one Chewa chiefdom selected is headed by a female;
- Presence of electrification at the chief's palace;
- Chief's literacy as a proxy for the basic administrative capacity needed for program implementation. Chiefs with extremely limited literacy were excluded;
- Existence of inter-chief boundary conflicts. Chiefdoms involved in well-known boundary conflicts with other treatment chiefdoms[21] were excluded;
- Use of customary land certificates. Only chiefdoms with no experience with certificates were included;
- Major soil type as a proxy for the agro-ecological conditions required for successful agroforestry adoption;
- Proximity to urban centers as a proxy for deforestation pressure. Peri-urban chiefdoms were excluded.

From the four chiefdoms involved in the RCT, a village list was collected from each chief of all villages that contained 15 or more households[22] and were accessible by motorbike in the rainy season. This list helped to ensure the desired sample size would be reached, as well as assist with program implementation. 276 villages were included on the final list, and each of these villages was randomly assigned to one of the four groups: control (69 villages), agroforestry (69 villages), land tenure (69 villages), or land tenure plus agroforestry (69 villages). The sample was stratified by chiefdom so that each of these four groups is appropriately represented in each of the chiefdoms. An additional 50 villages

21 There is a well-known boundary dispute between Chieftaness Mkanda and the neighboring Chief Chanje; the Chanje Chiefdom was excluded from the pilot because customary certificates have already been issued there. It is also worth noting that Mkanda Chiefdom does not appear on official government maps, as it was created after Independence, and the chiefdom maps still in use today date to the colonial era.

22 As reported by the chief; not all villages were found to have at least 15 households in practice.

were randomly selected from a village list prepared by the chief in the 5th treatment arm of Saili Chiefdom to receive the agroforestry treatment.

Table 3.1 below details the number of villages and respondents by treatment group, while table 3.2 details the number of villages and respondents by chiefdom. The final number of villages included in the baseline data collection is 294 versus the expected 350. This discrepancy is due to several factors. First, the four main chiefdoms selected for the study area were smaller than expected and contained fewer than the desired number of 300 villages. As a result, all eligible villages in the study area were randomized and included in the baseline data collection. Second, a number of villages that contained fewer than 15 households were excluded from program involvement, as TGCC noted practical and budget constraints to including these small villages[23]. Third, there were problems with the chiefs' village listings for the sample frame[24]. For example, several villages were listed twice under different names, and several villages were located in Malawi or outside of the TGCC study area. Adding to the sample challenges, the data collection firm was not able to locate several villages. These challenges, though unfortunate, were not necessarily unexpected given the lack of spatial data on chiefdom and village locations and boundaries in Zambia. The impact of surveying in a smaller number of villages than originally anticipated is discussed in detail in Section 9.0, Power. Overall, the evaluation remains sufficiently powered to detect small to moderate policy relevant effects measured at the household level.

TABLE 3.1. SURVEY SAMPLE BY TREATMENT

	Household survey		Headperson survey
Response Categories	Village N	Household N	Respondent N
Agroforestry extension intervention	61 (21%)	727 (21%)	50 (19%)
Land tenure intervention	62 (21%)	720 (20%)	59 (23%)
Agroforestry and land intervention	64 (22%)	738 (21%)	56 (22%)
Pure control	62 (21%)	704 (20%)	54 (21%)
Agroforestry control (Saili chiefdom)	45 (15%)	633 (18%)	40 (15%)
Total N	294	3,523	259

TABLE 3.2. SURVEY SAMPLE BY CHIEFDOM

	Household survey		**Headperson survey**
Chiefdom	**Village N**	**Household N**	**Respondent N**
Mnukwa	59 (20%)	651 (19%)	48 (19%)
Mshawa	85 (29%)	1013 (29%)	49 (19%)
Mkanda	56 (19%)	578 (16%)	79 (30%)
Maguya	49 (17%)	643 (18%)	43 (17%)
Saili	45 (15%)	638 (18%)	40 (15%)
Total N	294	3523	259

23 For example, creating a village land committee to improve governance may have limited impact in small villages where all people are related.

24 For each chiefdom, the chiefs provided the list of villages to TGCC. These lists were used as the sample frame. Due to time and budget constraints, the data collection firm did not have the time and resources required to groundtruth the original lists.

From each village, fifteen households were randomly selected, stratified by female-headed households[25], households with tin roofs (a proxy for income), and whether the household was the same tribe as the village headman[26]. The data collection supervisors in each village completed household sampling on the day the village was surveyed.

Out of the evaluation study sample, TGCC implemented the agroforestry interventions in 177 villages and the land tenure intervention in 130 villages.

CHALLENGES ENCOUNTERED

This section describes problems with non-response and listing error. Despite several challenges, data collection proceeded without serious threats to the survey's validity.

NONRESPONSE

RESPONDENTS NOT PHYSICALLY IN THE VILLAGE OR UNABLE TO PARTICIPATE

The timing of the survey (July–August) coincided with the post-harvest period in Chipata District. This time of year is common for weddings and other family events that involve household travel to and extended stay in other villages. During the data collection, there were respondents who were physically away from the village and who would remain away throughout the duration of the survey. Every attempt was made to learn when the household was expected to return and to collect contact information. Missing respondents were followed-up with at least twice before the end of the data collection period.

In other cases, respondents—particularly male household heads—appeared inebriated when the enumerators arrived at the villages. There were also several cases where respondents were mentally or physically handicapped. In each of these cases, respondents could not ethically consent to be interviewed and, if no other adult household member was available, were recorded as a nonresponse.

RESPONDENTS UNWILLING TO PARTICIPATE

Chipata District has a number of active agricultural initiatives and development projects. Each year, a variety of programs and organizations conduct surveys in the area, including in villages where TGCC is working. The main reason for a respondent's outright refusal in the baseline survey was that they had participated in surveys in the past, and that surveys "took too long" and the respondent "saw no benefit" from participating.

The other common reason that respondents refused to participate in a survey was fear of Satanism, spurred by sudden illnesses, deaths, or unexplainable disappearances of children in some communities. This was especially true in villages where a survey for another organization occurred around the same time as an unfortunate incident. In one case, an enumerator was made to hold a respondent's rosary before the interview could begin as a way to prove the enumerator was not a Satanist. Efforts were taken to engage with the headperson and other village leaders to help gain the trust of the community, but these were not always successful.

25 A female-headed household is defined as a household lead by a woman who is widowed, unmarried, divorced, or in a polygamous marriage but does not reside with her husband. Some women may also self-identify has a female-headed household if they are the primary earner or decision maker in their household, particularly amongst members of the Chewa tribe.

26 Supervisors were trained to use tablets, a Python computer code that automated the household randomization, and carefully designed listing sheets to take a census of the village.

LISTING ERROR

Errors made by the village headperson when listing household heads for the randomization represents another reason for nonresponse. This led to spouses or dependents being included as household heads during the randomization. If two members of the same household were both randomly selected, one of the members had to be counted a non-response. This error may have occurred deliberately, if the headperson believed that the people he or she listed would benefit in some way, or accidently, if the headperson did not keep reliable records of the village population.

FEMALE RESPONDENTS, NON-HOUSEHOLD HEAD

For many of the same reasons there are high rates of non-response—men being away from the village or being inebriated at the time of the interview—there are high rates of female non-heads of household completing the survey on behalf of the household head[27]. It was common for household heads to say they were too busy to be interviewed and that the enumerator should talk to his wife.

In addition to the husband directly requesting his wife be interviewed in his place, women were more likely to be found in the village, particularly the center of the village, as opposed to the fields or neighboring communities. Women were also more likely than men to complete a survey while simultaneously doing other work, such as childcare, cooking, or shelling maize, and were less likely to refuse a survey because they were busy. Table 3.3 indicates the number of survey respondents by gender.

TABLE 3.3. SURVEY RESPONDENTS BY GENDER

Gender	Household survey respondent	Headperson
Male	52% (1819)	93% (239)
Female	48% (1704)	7% (18)
Total N	3523	257

27 In cases where a woman who was not the household head completed the survey, the household remains categorized as a male-headed household.

4.0 CONTEXT AND SAMPLE CHARACTERISTICS

SAMPLE CHARACTERISTICS

The baseline survey provides a wealth of information on the characteristics of households, villages, and village heads. Fifty-four percent of villages (N=137) have been in existence for over 50 years, and the current headman has been in that leadership role for 12 years, on average.

Households in the village are generally clustered around a central area, and the surrounding area is made up of agricultural fields. The average distance a household travels from the center of the village to their fields is 2.56 km, though the nearest fields are .3 km from the center of the village, on average, and the farthest fields are an average of four km away.

Villages in the sample are quite remote, and there is significant variation across reported distances in the study sample. Table 4.1 shows the average distance from the center of the village to various points of interest. The average distance to the nearest BOMA[28] (small town) is 34 km from the village center, and the nearest paved road is 16 km on average. The nearest road accessible by buses and trucks is five km away from the village, and to board a minibus, a respondent must travel an average of four km.

The remote location of the villages can make buying and selling goods challenging. On average, the nearest Food Reserve Agency (FRA) collection point is eight km away from the study sample villages. Locations for selling crops to private buyers are slightly closer at six km on average. The nearest market place is on average eight km away and usually operates once a week. The nearest bank or microfinance office is 33 km away from the village.

Social services are closer to the village than market and financial service points. A borehole is located two km on average from the center of the village. The average village has a primary school three km away and a health clinic six km away. Agricultural camp officers, who provide information about government farming programs and conduct educational trainings or farming inputs, are located an average of seven km from villages in the evaluation sample. Finally, mobile phone service is common, if not always reliable, and on average, there is an area with mobile phone network approximately one-half a km from the center of the village.

28 British Overseas Management Administration

TABLE 4.1. DISTANCE FROM CENTER OF THE VILLAGE, IN KM

Point of interest	Headperson survey	
	Mean (μ)	Std. Deviation (σ)
Boma	34	12
Tarmac road	16	15
Road useable for busses or trucks year-round	5	7
FRA buying/collection point	8	7
Minibus boarding point	4	5.5
Mobile phone network	0.42	1.79
Place to sell crops to private buyers	6	8
Market place	8	9
Primary school	3	3
Secondary school	19	13
Clinic	6	6
Bank or microfinance office	33	13
Borehole	2	19
Agricultural camp officer	7	8
Distance to nearest fields	0.3	0.65
Average distance to fields	2.56	19
Distance to farthest fields	4	19

Table 4.4 and table 4.5 present the characteristics of the households and headmen surveyed, respectively. The average age of household survey respondents is 42 years old, and sixty-six percent (N=2322) of household respondents are monogamously married. The average household consists of 5 people. 61% of respondents (N=2145) identify as members of the Ngoni tribe, a patrilineal tribe. Only the Mkanda chiefdom was predominantly Chewa—83% of respondents (N=481) are members of the matrilineal Chewa tribe. Two-thirds of respondents (N=2361) were born in the village where they currently live.

As one may expect, male respondents have received more formal education than female respondents. Forty-four percent (N=1219) of male respondents have completed Grade 7 or higher. This number is considerably lower for women—only 24% (N=190) have completed at least Grade 7. Female respondents are also 18% more likely than male respondents to have received no formal education (31%, N=251). Over half of female heads of household (53%, N=428) are illiterate.

TABLE 4.4. HOUSEHOLD CHARACTERTISTICS

Characteristics	All	Male head of household	Female head of household
Head of household age (years)	44 (σ=16)	41 (σ=15)	53 (σ=17)
Ngoni tribe	61% (2145)	60% (1624)	65% (521)
Chewa tribe	31% (1113)	32% (882)	29% (231)
Matrilineal	24% (832)	21% (556)	36% (276)
No education	19% (659)	13% (354)	31% (251)
Completed Grade 7 or higher	20% (780)	25% (692)	11% (88)
% Illiterate[29]	34% (1195)	28% (767)	53% (428)
% Monogamously married—head of household	66% (2322)	85% (2322)	0% (0)
Average # household members	5 (σ=3)	5 (σ=3)	5 (σ=3)
Household labor (# members > 12 years of age)	3 (σ=2)	3 (σ=2)	3 (σ=2)
Household head born in the village	67% (2361)	68% (1836)	66% (525)
Elite network—Household has family ties to the chief	23% (792)	18% (625)	5% (167)

Compared to the average household, the village headperson is 15 years older (57, SD=14) and six percent and more likely to be monogamously married (72%, N=185). The headman is also slightly more likely to have been born in the village where they currently live compared to other respondents (65%, N=167). Nearly three-quarters of headman (73%, N=187) identify as members of the Ngoni tribe. Headmen also appear wealthier than household respondents, since the proportion of village headpersons with iron sheets versus grass-thatched roofs is 19% higher than the household population (39%, N=100). The village headmen have received more formal schooling than the general population. 56% of village headmen (N=145) have completed Grade 7 or above, and just 9% (N=22) have no formal education at all.

TABLE 4.5. HEADPERSON CHARACTERISTICS

Characteristic	Average
Age	57 (σ=14)
Ngoni tribe	73% (187)
Chewa tribe	23% (58)
Monogamously married	72% (184)
No education	9% (22)
Completed Grade 7 or higher	56% (145)
Born in the village	65% (167)

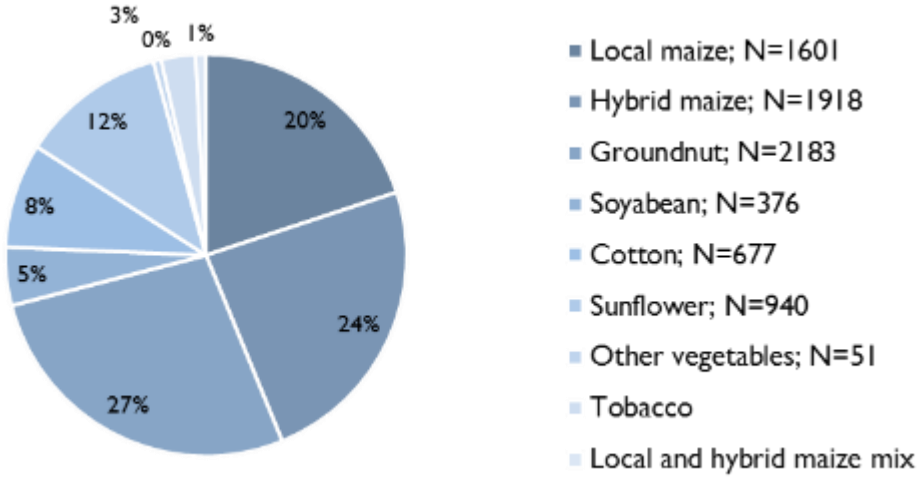
29 This figure may be inflated due to desirability bias

LAND USE AND FIELD CHARACTERISTICS

Table 4.6 includes characteristics of fields used or owned[30] by households in the sample. The primary method for acquiring farmland is inheritance. Two-thirds of the fields households use (67%, N=5941) are inherited, while a quarter are acquired through allocation by the headman (26%, N=2257). Renting (3%, N=245) and borrowing (3%, N=242) are less common, and only 1% (N=52) of fields are purchased. On average, households have owned their fields for at least 25 years. Customary land can be rented in nearly half of all villages (45%, N=114), but despite the relatively high potential for a land rental market, 93% (N=3225) of households did not rent from other households during the 2013/2014 agricultural season. Borrowing land from other households was also a rare occurrence: approximately 6.5% of households borrowed land from other households during this same time period.

The head of household is most likely to be the primary decision-maker for (74%, N=6528) determining what crops to plant, what inputs to use, and how to sell the harvest. Most fields are defined by relatively flat terrain and are located an average of 2024 meters (σ=2312) away from the household (N=304). At the time of the survey[31], maize, Zambia's staple crop, is grown on 43% of all the fields (N=3648). Other common crops were groundnuts, planted on 27% of fields (N=2183), sunflowers (12%, N=940), cotton (8%, N=677), and other vegetables and cash crops. Figure 3 shows the types of crops planted in greater detail.

FIGURE 3. PRIMARY CROPS GROWN



30 Ownership in this question does not imply legal ownership or holding of a title

31 Cropping allocations change annual in Zambia based on prices and access to inputs

TABLE 4.6. FIELD CHARACTERISTICS, BY GENDER OF HOUSEHOLD HEAD

Field characteristics	All	Male head of household	Female head of household
Land area owned in ha (2013/2014)	1.95 (σ=1.86)	2.03 (σ=2.06)	1.93 (σ=1.80)
% of households that rent from other households	7% (241)	7% (191)	6% (50)
% of households that borrow from other households	6% (225)	7% (177)	6% (48)
Average field slope	1.41 (σ=.53)	1.41 (σ=.54)	1.43 (σ=.53)
% of fields replanted	42% (3543)	42% (2779)	41% (764)
% of households with crops for sale/barter	56% (1962)	56% (1523)	55% (429)
% of fields acquired by inheritance	67% (5930)	67% (4622)	67% (1308)
Average length of field holding time (years)	25 (σ=24)	25 (σ=24)	24 (σ=23)
Average distance from the household dwelling to fields (meters)	2024 (σ=2312)	6889 (σ=2036)	1983 (σ=2209)
% of fields with household head as the primary land use and management decision maker	74% (6528)	74% (5084)	74% (1444)

According to headperson respondents, the biggest challenges to agricultural productivity include a lack of inputs (fertilizer, seeds), unexpected weather, and lack of knowledge. Nearly half (42%, N=3543) of all fields had to be re-planted[32] during the last agricultural season, likely due to unseasonal rainfall patterns in November and December 2013. Land scarcity was also noted by a quarter of headmen (25%, N=64) as an obstacle to households meeting their livelihood needs. Although Zambia is cited as a land-abundant country (e.g., Deininger et al. 2010 and Jayne et al. 2014), over half (56%, N=145) of headpersons report that households in their village cannot obtain additional land for crop production in their village. Yet despite apparent land shortages, only 6% (N=209) of households report requesting additional land from village authorities in the past 5 years.

LIVELIHOODS

Outside of agriculture, employment is scarce. Some people, especially younger unmarried men, will migrate to larger towns within Eastern Province searching for seasonal work as laborers for large-scale agriculture producers or for construction work until planting or harvest time, when all hands are needed in the family fields. Others may travel outside the province for work. These patterns are not the norm, however, and large-scale seasonal migration is uncommon (Sitko et. al, 2011). In the study sample, approximately 8% (N=298) of households report that a member of their household migrated to find work in the past year.

Ganyu is a social safety net that has developed in Eastern province. It represents a system of hired labor that provides a source of food or cash to households in need. Nearly all households engage in *ganyu* as both laborers and as employers depending on the household and community needs. The number of days a household engages in *ganyu* is a good indicator of financial stress within a household, but because of the social pressure to provide for members of the community, the inverse—the number of days a household hires *ganyu*—does not reveal much about a household's financial well-being. In the study sample, 43% (N=1483) of households report being hired for *ganyu* labor. Among those hired for *ganyu*, the average number of day was 18 (σ=24).

32 Either partially or entirely

The following sections of the baseline report provide information on baseline levels of the outcomes the TGCC program hopes to influence, balance statistics across treatment arms, and a discussion of the next steps for the research. The specific outcomes of interest discussed in the report include tenure security, land governance, and agricultural investment, including uptake of agroforestry and CSA.

5.0 OUTCOME 1—TENURE SECURITY

To describe household perceptions of tenure security over their smallholdings, the following tables provide baseline measurements across a number of tenure-related subjects, including: land disputes; perceptions of land allocation; likelihood of forced removal and elite capture; strength of boundaries; and paper documentation. Descriptive statistics for the household survey and headman survey are presented for key indicators[33].

LAND TENURE AND ADMINISTRATION

LAND TENURE STATUS AND KEY DECISION MAKERS

Smallholder farmers, particularly in Zambia's Eastern Province, grow subsistence crops of maize, as well as cash crops of cotton and tobacco on customary lands controlled by the chiefs. The 1995 Land Act of Zambia vests all land in the Zambian President and recognizes only two types of land: customary and state land. State land includes all land occupied by the national government, as well as land held by individuals who lease the land from the state, including those lands that previously were freehold estates. Customary land, which is legally recognized to be administered by chiefs, represents the remainder of land in Zambia, estimated as between 66 percent and 95 percent of land[34].

While it does not specifically define property rights in land, the Zambian Constitution of 1991 does recognize individual property rights and protects those rights against deprivation by the government, except in cases authorized by law. Customary lands, which are not registered with the government, are largely regulated outside the statutory and official realm of Zambian government. In the TGCC IE study sample, 98% (N=8715) of fields used by surveyed households were reported as being under customary tenure status[35]. Local chiefs have the authority to administer customary land within their chiefdoms. The traditional leaders grant use and occupancy rights, regulate transfers of land, control use of communal land, and hear disputes (USAID, 2014).

Customary lands in Zambia, therefore, generally fall under control of the chiefs. Chiefs exercise this authority through their headmen (often more than 300 per chiefdom) and are advised by a council of *indunas* consisting of a dozen to a few dozen individuals. At the local level, the headmen, who have direct authority over the village(s)[36] within their domain, make decisions about local land allocations.

33 A comprehensive series of descriptive statistics for this outcome area and statistics disaggregated by gender and chiefdom is available upon request.

34 Chiefdom boundaries do not exist that are both current and commonly recognized in Zambia.

35 92% of respondents selected the customary land category directly. 612 households selected an "other" category and noted that their land had been inherited through the family; we interpret this to be customary land. The remaining responses were either 'don't know' or 'customary land converted to state land'.

36 According to the 1972 Village Act, which describes the role and function of headmen, communities that do not have a headperson often have a "chairperson." In practice, the chief typically recognizes a headperson when a new village is established. In some cases, a headperson

The baseline results highlight the central role of the headperson in land governance and decision-making. As table 5.1 shows, approximately 82% (N=2885) of household respondents said that the headman/woman is the most important decision maker for land related issues in the village. Less than 20% of headmen (17%, 43) report that their village has a committee to deal with land-related issues[37]. Transcripts from focus group discussions also highlight the central role of the headman. For example, a woman in Mkanda said, "What gives us strength to claim the land is because the headman knows each person's field or the headman has a record of all the land in the village and the owner."

TABLE 5.1. MOST IMPORTANT DECISIONS-MAKER

Response Category	Respondent
Headperson	82% (2885)
Chief	13% (462)
Induna	1% (40)
Village Land Committee	1% (40)
Individuals	1% (36)
No one	1% (28)
Elders	<1% (12)

LOCAL LAND ALLOCATIONS

The headman survey included a series of questions on land management and decision-making. Headmen were asked how they would prioritize various groups in the community when making decisions about land allocation. Headmen were asked how they would prioritize giving land amongst the following groups:

1. A male or a female-headed household
2. A small family or a large family
3. A household where a male member was related to village authorities or a household where a female member was related to village authorities
4. A wealthy family or relatively poor household

As table 5.2 illustrates, a significant number of respondents did not choose to prioritize the various groups and stated that they consider each group equally. For those respondents who did select a priority category, the findings show a bias towards large families, female-headed households, and poor families. The headperson survey results may be subject to social desirability effects[38]; household-level responses on this issue indicate that a fairly large proportion of households think that vulnerable groups—such as women, the elderly, and poorer households—are indeed disadvantaged by land allocation decisions in their village. Despite this, findings from the household survey detailed below seem to confirm a high average level of overall satisfaction with land governance in the villages.

may have authority over more than one village, for example, before a headperson is selected for a new village, or where a headperson is unable to carry out their duties.

37 Of the 43 villages that have established a village land committee, 74% of these committees had at least one female member, and 49% had at least one member under the age of 35.

38 Social desirability effects occur when respondents provide responses that they believe are expected or "socially accepted" by enumerators.

TABLE 5.2. HEADPERSON LAND ALLOCATION PRIORITIES (N=257)

Gender		Family Size		Relationship to Authorities		Economic Status	
Male household head	22% (57)	Large family	65% (167)	Male head or spouse related to village authorities	24% (62)	Relatively wealthy household	2% (5)
Female household head	30% (76)	Small family	7% (18)	Female head or spouse related to village authorities	22% (56)	Relatively poor household	63% (163)
Both are considered equally	47% (120)	Both are considered equally	27% (70)	Both are considered equally	54% (138)	Both are considered equally	34% (88)
Don't know/prefer not to respond	1% (4)	Don't know/prefer not to respond	1% (2)	Don't know/prefer not to respond	<1% (1)	Don't know/prefer not to respond	<1% (1)

As indicated in table 5.3 below, 85% (N=2969) of Households 'strongly agree' or 'agree' that rules about land are clear and well-known and that decisions about customary land allocation are fair. Eighty-threes percent (N=2863) of households either 'strongly agree' or 'agree' that village leaders allocate land fairly across households, and 86% (N=2980) of households provide positive affirmation that leaders are accountable for the land allocation decisions they make, with no significant difference in male-headed vs. female-headed households. However, 14% (N=500) of respondents did not express agreement that land related decision-making is transparent. Although 14% is in the minority, this figure lends support to the notion that there is some scope to address land governance issues, hence bolstering a need for the TGCC project. Future work will delve into understanding better what characterizes this group of respondents.

TABLE 5.3. HOUSEHOLD'S ASSESSMENT OF LAND GOVERNANCE

Response Category	Village leaders are open about their decisions		Village leaders allocate land fairly across households		Rules are clear and well known		Village leaders are accountable for their decision making		Satisfaction with customary land management[39]	
	N	%	N	%	N	%	N	%	N	%
Strongly Agree	952	27%	928	27%	952	27%	765	22%	909	26%
Agree	1943	56%	1935	56%	2017	58%	2215	64%	1909	55%
Neither Agree or Disagree	136	4%	105	3%	147	4%	170	5%	265	8%
Disagree	294	8%	351	10%	248	7%	207	6%	275	8%
Strongly Disagree	70	2%	65	2%	45	1%	35	1%	56	2%
Don't know or prefer not to respond	67	2%	78	2%	53	1%	70	2%	109	3%

Transcripts from the focus group discussions indicate that it is the public nature of land allocation that ensures a high degree of transparency for decision-making and accountability for leaders. A member of a focus group in Chombola, Maguya with land-constrained households said, "Land is allocated transparently because the whole village is involved… Allocations are done with village witness, if done in secrecy the Headman can be called to account." Another focus group participant, a woman from Mashati, Mshawa said, "It is transparent as it is done publicly in the presence of witnesses, so that even though one dies, children also would know where that land is and other people who were there as witnesses." Speaking specifically about land allocations for newcomers, a woman from Chamfombo, Saili said, "The headman would inform everyone that we have a visitor and they need to be given land. After they have been given, the whole village is informed. That is how transparent it is."

High levels of reported transparency by households around land allocation issues are in contrast with the low frequency with which many households report participating in village-wide land-related meetings. 69% (N=177) of headmen reported that no meetings were held about land related issues in their village in the past year, and, as described in table 5.4 below, 60% (N=2060) of household respondents reported that they never attended a meeting about land rights, land allocation processes, land conflicts, or the resolution of disputes. Among household respondents that had never attended a land-related meeting, 55% (N=1138) said that they had not attended because "no land related meetings had been held in their village," while 31% (N=644) said that "they had not been informed or did not know about the meetings." Table 5.5 displays this information on the reasons for household non-participation in land-related meetings.

TABLE 5.4. HOUSEHOLD PARTICIPATION IN LAND-RELATED MEETINGS

Response Category	Respondent N	Percent (%)
Always	489	14%
Often	341	10%
A few times	213	6%
Once or Twice	295	9%
Never	2060	60%

39 This is scaled as 'very satisfied' to 'very dissatisfied' in the survey instrument.

TABLE 5.5. REASONS FOR HOUSEHOLD NON-PARTICPATION IN LAND-RELATED MEETINGS

Response Category	Respondent N	Percent (%)
Not interested	157	8%
Feel they are not useful	24	1%
Was not informed/invited/ did not know about the meeting	644	31%
No meetings were held on these issues	1138	55%
Busy working/travelling	92	4%

Although over 80% (N=2863) of households reported that land was distributed fairly across households in the community, over three-quarters of the survey sample agree that certain groups, including women, the elderly, the poor, and those of a different tribe than the headman, are disadvantaged in decisions about land allocation. Table 5.6 below displays these results. Although the percentage of respondents who 'strongly agree' or 'agree' that a group is disadvantaged is above 80% for all groups, those who do not share the tribe of the headman are most likely to be considered disadvantaged in land allocation decisions (86%, N=2980), followed by poor households (85%, N=2969).

TABLE 5.6. HOUSEHOLD PERCEPTION OF GROUPS DISADVANTAGED BY LAND ALLOCATION DECISIONS

	Women		Elderly		Poor		Minority Tribe	
Response Category	N	%	N	%	N	%	N	%
Strongly Agree	952	27%	928	27%	952	27%	765	22%
Agree	1943	56%	1935	56%	2017	58%	2215	64%
Neither Agree or Disagree	136	4%	105	3%	147	4%	170	5%
Disagree	294	8%	351	10%	248	7%	207	6%
Strongly Disagree	70	2%	65	2%	45	1%	35	1%
Don't know/Prefer not to respond	67	2%	78	2%	53	1%	70	2%

Analysis of the qualitative data suggests that households related to the headman and outsiders may be advantaged in decisions relating to land allocation. Multiple focus group participants suggested that village members belonging to the headperson's family had better access to land. For example, a woman in Maguya said, "Yes, there are groups in this village who receive extra advantages when it comes to land allocation, those people that are belonging to the headman's family"[40]. Another group of women in Maguya explain, "If all the members of your family have died and you were not in the village, you will find other people using your family land. It becomes impossible to re-possess that land especially if the occupants belong to the headman's family. The headman's family members grab the land from you. There is nothing you can do in this case because the headman will be on their side. You just suffer in your poverty." A member of a focus group discussion with land-constrained individuals in Saili said, "There is a group who receives extra advantages when allocating land. It is the headman's family."

Focus group participants also suggest that outsiders and elites are given advantages. A land-constrained focus group in Maguya explained, "Land in this village is given to any, but others are having advantages… To get proper land, you need to be known…as I said, the problem goes very deep, for others money

40 According to custom in this part of Zambia, the headman's family typically has the customary right to claim large areas of land as the "founding family" in the village; however, their land is subsequently allocated to individuals over time.

talks." A woman in Mnukwa said, "Especially those close to the family of the headman are advantaged… and those who come from other villages asking for land here are treated more important than us."

PERCEPTIONS OF TENURE SECURITY

Despite the fact that virtually all farmland across the surveyed villages is allocated to households via informal customary tenure, the baseline results show a fairly high degree of perceived tenure security among survey respondents.

In terms of tenure insecurity overall, it looks like a key dichotomy seems to be emerging in which households are not extremely concerned about their fields being reallocated by headpersons to another household in the village for farming use. However, a greater proportion of households (and headpersons) worry about their land being confiscated by higher authorities beyond the headperson for other purposes, such as investment.

The overwhelming majority of household respondents report that the likelihood of land reallocation, elite capture, or encroachment of fields the household customarily uses is 'impossible' or 'highly unlikely'. Headmen similarly report a high degree of confidence that village lands they administer are unlikely to be allocated away from the village or removed from their domain of control. However, a slightly lower degree of security is expressed among headmen with regards to unauthorized confiscation of individual fields used by households within their villages. At the field level, the unauthorized confiscation of fields by chiefs and field encroachment by other households within the village represent the two greatest sources of insecurity concerns for headmen. The baseline findings also indicate important intra-household level variation in perceived tenure security across fields. For example, although 90% of households have at least one field[41] where they report that households from a neighboring village encroaching upon their field to be 'impossible' or 'highly unlikely', the results also show that 40% of households have at least one field where they feel encroachment from a neighboring village may be 'likely' or 'highly likely'. Future analysis and reporting will focus on understanding the factors driving this field-level variance.

LIKELIHOOD OF LAND REALLOCATION

Overall, respondents believe the likelihood of their fields being reallocated is low. Households were asked at the field level, about the likelihood that their field would be reallocated by the headmen or encroach upon by an extended family member, both in the next three years and beyond. Their responses are detailed in table 5.7 and table 5.8. Table 5.8 demonstrates that 94% (N=3318) of households stated that it was either 'impossible/would never happen' or 'highly unlikely' that at least one of their fields would be reallocated by the village headperson, and 93% stated that it was either 'impossible/would never happen' or 'highly unlikely' that someone from their extended family would take over at least one of their fields. However, at the same time, 21% (N=742) of households report they believe it is 'very likely' or 'likely' that at least one of the fields their household currently uses will be reallocated within the next 1–3 years by the village headperson, while 29% (N=1011) report they believe it is 'very likely' or 'likely' that at least one of the fields their household currently uses will be encroached upon within the next 1–3 years by their extended family. Slightly more households expect to be forcefully removed by their extended family than to have their land reallocated by the headman.

41 Households have an average of 2.5 fields

TABLE 5.7. PERCEIVED LIKELIHOOD OF REALLOCATION OR FORCED REMOVAL, BY FIELD

Response Category	Reallocation by headperson: 1–3 years		Reallocation by headperson: beyond 4 years		Encroachment by extended family: 1–3 years		Encroachment by extended family: beyond 4 years	
	N	%	N	%	N	%	N	%
Impossible/Would never happen	6659	75%	6619	75%	6389	72%	6369	72%
Highly unlikely	1030	12%	849	10%	960	11%	786	9%
Unsure/I don't know	185	2%	200	2%	140	2%	148	2%
Likely	792	9%	784	9%	1158	13%	1178	13%
Very likely	155	2%	368	4%	170	2%	337	4%
Happening right now	2	<1%	3	<1%	8	<1%	9	<1%

TABLE 5.8. PER HOUSEHOLD, PERCEIVED LIKELIHOOD OF REALLOCATION OR FORCED REMOVAL

Response Category	Field reallocation by village headperson		Extended family forced removal	
	1–3 years	Beyond 3 years	1–3 years	Beyond 3 years
Household level—at least one field—'Impossible/would never happen' or 'highly unlikely'	94% (3318)	93% (3294)	93% (3268)	92% (3245)
Household level—at least one field—'Very likely' or 'likely'	21% (742)	25% (880)	29% (1013)	32% (1132)

The qualitative analysis of the focus group transcripts also indicates evidence of low perceived risk of land reallocation across all groups. Almost every focus group participant noted that their land was not at risk of being reallocated. Instead, respondents reported that the landholder was widely known, as it had been passed down from generation to generation. For example, a member of the land-constrained focus group in Changwa, Mshawa said, "It is my field inherited from my parents therefore, no one can reallocate land from me unless it is somebody else's field." A woman in Masiwa, Saili said, "It can't be reallocated, because this is land inherited from your parents. No one can reallocate from you." A land-constrained focus group respondent in Mshawa said, "I was given that field from the beginning, and the boundaries were drawn. Here in the village people know who these fields are for. And if someone wants to borrow one acre it is up to you to give it to that person or not."

The baseline survey instruments also collected data on actual land reallocation. Very few households (2%, N=63)) in the sample have experienced land dispossession (i.e., reallocation of a parcel for use by others outside the household). Actual dispossession events were fairly widely distributed across villages in the sample (19%, N=55), rather than clustered as common events within a small number of villages. Concerns that field dispossession was 'likely' or 'very likely' ranged from 15% to more than 25% of surveyed fields across the six different sources of dispossession. Across these different groups, households were most concerned about dispossession by chiefs for investment purposes, as well as about boundary disputes with other households within the village.

Less than 1% of households (N=55) report having their land reallocated in the past. Among those respondents, reallocation happened on only one instance, and the average size of landholdings

reallocated was 1.23 ha. The largest plot of land reallocated was 4 ha. As shown in table 5.9, the primary reason land was reallocated was that another household in the village needed the land for cultivation (33%, N=21). This is consistent with Zambian cultural norms, where the needs of the community are more important than individual ownership. Land "grabbing" does apparently occur, however, as in several cases, the respondent said the chief or headman "grabbed" the land (5%, N=3) or decided it belonged to another household (17%, N=11). Similarly, in six cases (10%) the land was reallocated because it was not in use or the respondent was away from the village.

TABLE 5.9. REASON LAND WAS REALLOCATED

Response Category	Respondent
It was sold	2% (1)
Rented/borrowed	11% (7)
State land	6% (4)
Another family needed it/relative needed it	33% (21)
Land was not in use	10% (6)
Land is fertile	2% (1)
Headman used it for their own purpose	5% (3)
Headman/chief said it belonged to another family	17% (11)
Small field size/area	2% (1)

These findings suggest that the actual reported cases of land reallocation align with the perception that reallocation is uncommon. However, such cases of reallocation are widely distributed across surveyed villages. Moreover, there is a much higher proportion of households who report concern over potential reallocation on at least one of the fields in the short-term relative to those who have actually experienced reallocation. Thus, it may be possible that the occasional dispossession event in a village, though rare, is sufficient to maintain some level of concern across households in the village.

The low frequency of actual land reallocations also mirrors results in the headperson survey regarding land conversion and sales. Nearly all (98%, N=252) of headmen/women say that no customary land has been sold. Over 80% (N=213) of headmen/women report the absence of a mechanism to convert village land into titled property, and almost 90% (N=228) report that it is not possible to buy or sell customary land without first changing it to titled land.

ELITE CAPTURE

Households and headpersons were also asked a series of questions about the likelihood that elites ("big people") or chiefs would confiscate land for various purposes. The results in Tables 5.10 and 5.11 show that the likelihood of elite capture is perceived to be relatively low. Confiscation of fields by elites in the next three years is only deemed 'likely' or 'highly likely' by 9% (N=22) of headmen. However, a higher proportion of both headmen and households believe that it is possible for the chief to take a field or community land for investment purposes. Specifically, at the household level, 40% (N=1393) of households with multiple fields have at least one field where they report the likelihood of confiscation by the chief, and 35% of headmen/women believe it is 'likely' or 'very likely' that the chief will take land for investment.

TABLE 5.10. PER FIELD OWNED BY A HOUSEHOLD, PERCEIVED LIKELIHOOD OF ELITE CAPTURE

	Elite capture: 1–3 years		Elite capture: beyond 4 years		Chief reallocation: 1–3 years		Chief reallocation: beyond 4 years	
Response Category	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Impossible/would never happen	6319	71%	6292	71%	5617	63%	5604	63%
Highly unlikely	968	11%	831	9%	938	11%	805	9%
Unsure/I don't know	213	2%	228	3%	300	3%	318	4%
Likely	1163	13%	1128	13%	1742	20%	1677	19%
Very Likely	159	2%	340	4%	218	2%	414	5%
Happening right now	1	<1%	6	<1%	5	<1%	3	<1%
Prefer not to respond	29	<1%	27	<1%	32	<1%	31	<1%

TABLE 5.11. PER HOUSEHOLD, PERCEIVED LIKELIHOOD OF ELITE CAPTURE

Response Category	Elites/Big people may take this field without your permission in 1–3 years?	Chief will give up this field for investment purposes in 1–3 years
Household level—at least one field—'Impossible/would never happen' or 'highly unlikely'	93% (3271)	89% (3129)
Household level—at least one field—'Very likely' or 'likely'	28% (993)	40% (1393)

ENCROACHMENT

Tables 5.12 and 5.13 below present field and household-level perceptions regarding the likelihood of encroachment by other households or villages. The descriptive statistics in the tables below reveal a number of interesting insights into the perceived likelihood of forced removal, encroachment, and elite capture of lands. First of all, it is noteworthy that there is no statistically significant difference in responses across female-headed households versus male-headed. Second, it seems that households perceive a greater threat that the chief will give up one of their fields for investment purposes or that someone within their village will encroach on their land, as compared to headman reallocation or land grabs by extended family or elites. The former finding is perhaps unsurprising given the Zambian legal context, which encourages customary land to be converted to statutory land (with the permission of the chief) as a prerequisite for formal titling. This is reportedly one of the most controversial aspects of the existing legal framework governing land in Zambia (Adams, 2003).

TABLE 5.12. PERCEIVED LIKELIHOOD OF ENCROACHMENT, BY FIELD

	Intra-village encroachment: 1–3 years		Intra-village encroachment: beyond 4 years		Inter-village encroachment: 1–3 years		Inter-village encroachment: beyond 4 years	
Response Category	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Impossible/would never happen	5609	63%	5599	63%	6332	72%	6299	71%
Highly unlikely	892	10%	763	9%	1019	12%	855	10%
Unsure/I don't know	169	2%	185	2%	155	2%	168	2%
Likely	1791	20%	1745	20%	1114	13%	1105	12%
Very Likely	325	4%	492	6%	183	2%	378	4%
Happening right now	39	<1%	39	<1%	19	<1%	18	<1%

TABLE 5.13. PER HOUSEHOLD, PERCEIVED LIKELIHOOD OF ENCROACHMENT

Response Category	Encroachment by other households within the village 1–3 years?	Encroachment by neighboring communities 1–3 years?
Household level—at least one field—'Impossible/would never happen' or 'highly unlikely'	93% (3288)	82% (7361)
Household level—at least one field—'Very likely' or 'likely'	28% (1007)	90% (3159)

LAND DOCUMENTATION

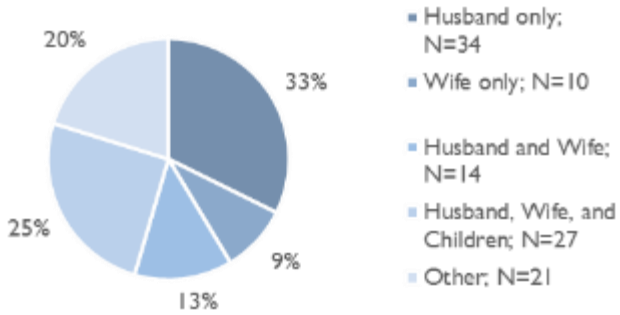
Very few households (2%, N=86) hold any form of documentation for the customary land that they use. figure 4 below presents statistics on the prevalence of field and household-level paper documentation. Less than 1% of fields have any documentation (N=106), but of those fields that do have documentation, customary land certificates[42] are the most common type (66%, N=70). The male head of household was the only name listed on 33% (N=34) of documents, as shown in figure 5. A quarter (N=27) of documents list the entire family—husband, wife and children—and 13% (N=14) list both the husband and wife. Nine percent (N=10) of documentation only show the wife's name, and another 9% (N=10) show the name of a different family member. As shown in figure 6, only 6% of households reported that they had received information about customary land certificates in the past 12 months.

Despite the high levels of perceived tenure security, the overwhelming majority of households 91% (N=3212) in the sample stated a desire to acquire some form of paper documentation for their land.

FIGURE 3. HOUSEHOLD HAS PAPER DOCUMENTATION FOR THEIR LAND

At the same time, the data reveal that households clearly desire more widespread documentation than the current status quo. Respondents state that they would like to acquire some form of documentation for 80% of fields in the study (N= 7035). At the household level, 92% (N=3224) of households stated they would like to obtain such documentation, as seen in figure 7. The most common reason for not wanting a

FIGURE 5. HOUSEHOLD MEMBER LISTED ON LAND DOCUMENTATION



42 As the survey took place before the implementation of customary land certificates through the implementing partner, the entity that distributed these certificates is unknown.

form of documentation is that households feel their land rights are already secure (6%, 531).

Both traditional leaders and subjects appear attuned to the use of documentation, such as customary land certificates, as a mechanism to increase household security over occupancy rights to land and to help resolve conflicts. In the TGCC IE baseline results, 36% (92) of headmen/woman respondents have some degree of familiarity with customary land certificates, whereas 64% (165) are 'not at all familiar.'

Among headmen who report some awareness of customary land certificates, 74% (N=68) believe that issuing customary land certificates is either a 'very good' or 'good' policy. Eighty percent (N=54) of those headmen noted that customary land certificates would help to secure tenure rights, and 67% (N=45) said that the certificates would help reduce conflict.

FIGURE 4. HOUSEHOLD HAS RECEIVED INFORMATION ABOUT CUSTOMARY LAND CERTIFICATES

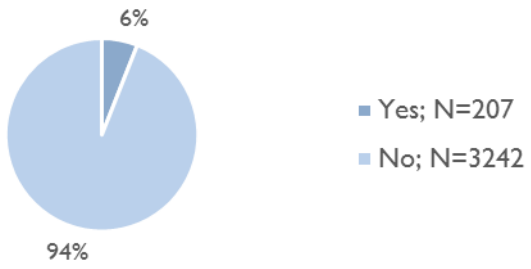
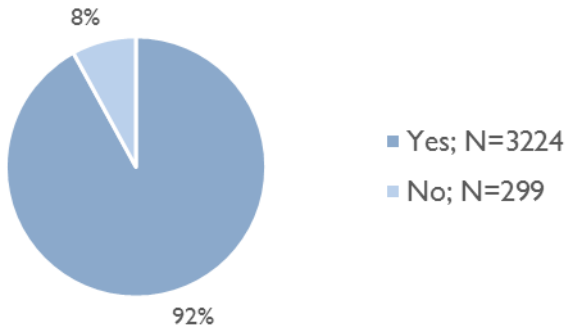


FIGURE 5. HOUSEHOLDS WANT TO OBTAIN PAPER DOCUMENTATION FOR THEIR LAND



Of the 14 headmen (5%) that said issuing customary land certificates represents a bad policy, the primary reasons given were that certificates would 'take away use rights from poor households' (79%, N=11) and/or 'reduce the power and influence of traditional authorities' (50%, N=7).

While 62% (N=159) of headmen believe that households in their village are interested in obtaining customary land certificates, only five headmen (<1%) reported that households in their village had requested a customary land certificate, with only one household actually receiving a certificate. Indeed, the household findings show that more formal land documentation is currently exceptionally rare.

As seen in table 5.14 below, 86% (N=6035) of households report that the primary desire for a land certificate in order to reduce the likelihood of a household losing their land. Similarly, another 9% (N=649) report that a certificate would strengthen their claim to their land and insure their children would inherit the property.

TABLE 5.14. PRIMARY REASON HOUSEHOLD WANTS TO OBTAIN PAPER DOCUMENTATION

Response Category	Field N	Percent (%)
Reduce likelihood of losing my land	6035	86%
Strengthens the ability for my children to inherit the land	649	9%
Proof of ownership	148	2%
Protects investments I have made on my land	105	1%
Helps me to obtain access to credit	32	<1%
Other	4	<1%

Just to have documentation	17	<1%
Avoid land conflicts	7	<1%
Free inputs/help from the government	9	<1%
It is required by law	7	<1%
The chief recommended it	2	<1%

When households were asked about the negative effects of not having a certificate, the fact that it made them afraid to lose their land accounted for 67% (N=340) of negative effects reported. That households do not have evidence that their land belongs to them accounted for 11% (N=56) of negative effects reported.

Respondents in the focus group discussions expressed a strong desire for paper documentation. The majority of focus group respondents had no knowledge of customary land certificates, yet stated that they would want one if they could have one. The main reason given for wanting a certificate was that the certificate would bring security and provide evidence of ownership. The quotes below demonstrate the benefits respondents anticipate receiving from land documentation.

MAGUYA Women, Ngeleni: "This would be very good… That certificate would be the best evidence of my ownership so that if there is any dispute I would boldly approach the chief with it…. At the moment we do not have any evidence, it is just your word against thieves."

MNUKWA Youth, Tambala: "Yes because you have a supporting document…No one can either grab or sell the land without my consent"

MSHAWA Women, Mwanamankhonyo: "It is measuring the hectares of my field with the people that have come to give the papers and after that they write out to the Certificate and hand it over to me. We won't have disputes with those whom we share boundaries with as that will clearly be defined."

MSHAWA Youth, Manjanja: "I would like to have such a paper…when you have such a paper, you feel safe because there is no one who can take away your land."

SAILI Land-Constrained Households, Chamfombo: "It is good to have the certificate because I would have the assurance that none would bring disturbances to my land and the certificate would act as future security... The certificate would strengthen claim to land by both my children and grandchildren after I die."

SAILI Women, Chamfombo 380: "As they have said here, somebody else might come and ask you to move out of the land. And if you say that because this land is my parents', they will ask you to move. But for me with papers, I could go to government offices or the Chief's place and report that they want to reallocate land from me but these are my papers for the land and I would refuse to leave the place. The papers will act as my security for the land."

Overall, these quotes suggest that respondents believe that paper documentation for their land will strengthen tenure security by providing proof of ownership, solidifying claims to land, and promoting dispute resolution.

LAND DISPUTES

Much existing research has demonstrated a link between weak tenure and resource rights and conflict prevalence and intensity. More intense and frequent conflict is expected when land tenure and resource

rights are weak and insecure. As such, the prevalence of land-related land disputes in the study areas also provides important insights into tenure security. Over a quarter (26%, N=905) of households experienced at least one land conflict on one of their fields in the past 3 years, and prior disputes were recorded for 11% of fields surveyed (N=1007). These results are displayed in table 5.15 below.

The household survey asked about eight types of land-related disputes in total, listed in table 5.15. The baseline survey defined disputes as confrontations that took a long time to resolve, led to violence or property destruction, or required the involvement of a third party to resolve. For households that experienced disputes, the average number of disputes was 1.28 across all fields. Boundary (69%, N=564) and inheritance (26%, N=209) disputes are the most frequent types of disputes. Disputes regarding fencing, unauthorized fires, renting, or tree cutting/ownership are exceptionally rare. Survey results indicate there is little difference in dispute frequency or the prevalence of these eight types of land-related disputes across gender or chiefdoms.

The majority of focus group participants also said that boundary disputes were the most common type of dispute in their village, and the headman was the most important conflict resolution actor. Furthermore, focus group respondents who reported an absence of disputes in their village attributed the lack of disputes to the fact that boundaries in their village are well known. For example, a woman in Mshawa stated, "Everyone in this village knows our boundaries so we can't expect cases of disputes."

TABLE 5.15. FIELD LEVEL, PREVALENCE OF DISPUTES BY DISPUTE TYPE

Response Category	Field % (N)
Overall	11% (1007)
Boundary	69% (564)
Inheritance	26% (209)
Rent	1% (11)
Reallocation	8% (63)
Grazing	3% (24)
Tree Cutting	1% (12)
Tree Ownership	1% (6)
Fire	<1% (3)
Fence	<1% (1)

Headmen were asked a series of questions about the prevalence of the same eight types of land-related disputes across four categories of actors including: inter-village, outside investors, inter-household and intra-household. Most disputes occur between households within a village. In particular, a total of 213 inter-household disputes were reported by headmen/women, and these occurred across 30% (N=78) of villages in the survey. The two most frequent types of inter-household conflict include livestock grazing (46%, N=97) and boundary disputes (40%, N=85). The second most reported type of conflict is conflict within the village. Headmen reported 205 inter-village conflicts across 43% (N=111) of villages. The two most frequent types of inter-village conflict include boundary conflicts and land reallocation disagreements.

With the exception of reports of livestock grazing disputes, these results confirm and expand upon the household-level information regarding land conflict types and incidences within the project areas. The discrepancy between the headman and household reports of the prevalence of grazing disputes could be due to differences in interpretations about what constitutes a dispute. Whereas the headman may interpret intra/inter-household disputes over livestock grazing as conflicts to be reported, households might consider these minor disagreements. To supplement the discussion above about the prevalence of disputes, Table 5.16 below presents the number of villages that experienced various types of disputes.

TABLE 5.16. HEADPERSON REPORTS OF DISPUTE PREVALENCE

Response Category	# of villages experiencing inter-village disputes	# of villages experiencing disputes with outside investors	# of villages experiencing inter-household disputes	# of villages experiencing intra-household disputes
Dispute about any topic	111	7	78	60
Disputes about boundaries	90	5	47	25
Disputes about natural resources	9	1	3	2
Disputes about reallocation of land away from households	29	1	7	7
Disputes about grazing of livestock	13	4	22	21
Disputes about cutting trees	5	3	2	2
Disputes about ownership of trees	0	0	0	0
Disputes about fires or burning	4	0	2	2
Disputes about fencing	2	0	1	0
Disputes that led to destruction of property	7	0	2	1
Disputes that led to violence	11	1	3	1

The headmen survey results also suggest there is little evidence of escalating conflict intensity or frequency across the study areas. Table 5.17 shows that the overwhelming majority of headmen report that disputes across each of the four categories have 'decreased' or 'remained' the same over the past three years. For example, 45% (N=117) of headmen reported that the frequency of inter-village disputes had decreased; while 41% (N=105) of headmen reported that the frequency of inter-village disputes had remained the same. Despite the large total number of disputes reported, headmen further stated that only 3% (20) of disputes resulted in violence, and only 2% (N=12) of disputes resulted in the destruction of property.

TABLE 5.17. PER FIELD OWNED BY A HOUSEHOLD, PERCEIVED LIKELIHOOD OF ENCROACHMENT AS REPORTED BY HEADMEN

Response Category	Inter-village		Outside investors		Inter-household		Intra-household	
	Frequency	Intensity	Freq.	Intensity	Freq.	Intensity	Freq.	Intensity
Decreased	45% (117)	45% (116)	18% (46)	17% (44)	42% (108)	42% (107)	36% (93)	36% (92)
Increased	14% (35)	13% (33)	1% (3)	1% (2)	5% (12)	5% (14)	4% (10)	4% (10)
Stayed the same	41% (105)	42% (108)	80% (205)	81% (207)	52% (133)	52% (133)	60% (152)	60% (153)

In terms of dispute resolution, the baseline results from the household survey indicate that the largest proportion of respondents 32% (N=246) reported that their dispute was resolved within a couple of days, and 73% (N=589) report satisfaction with the outcome. Tables 5.18 and 5.19 below demonstrate these results.

TABLE 5.18. LONGEST TIME IT HAS TAKEN FOR A DISPUTE TO BE RESOLVED

Response Category	Respondent N	Percent (%)
A couple of days	246	32%
About 1 week	96	12%
Several weeks	43	5%
About 1 month	100	12%
Several months	89	11%
About 1 year	96	12%
2-3 years	83	10%

More than 3 years	53	6%

TABLE 5.19. HOUSEHOLD SATISFACTION WITH OUTCOME OF DISPUTE

Response Category	Respondent N	Percent (%)
Very satisfied	236	29%
Satisfied	353	44%
Neutral	42	5%
Dissatisfied	128	16%
Very dissatisfied	40	5%

6.0 OUTCOME 2—AGRICULTURAL INVESTMENT AND LAND USE PLANNING

This section summarizes baseline levels of planned and actual agricultural investment, including CSA practices, across fields and households over the past five years.

The baseline survey asked about a number of different field-level agricultural practices, with a particular interest in activities that have a high up-front investment of time, labor, or cash but that improve land and yield potentials over a longer time horizon. Theoretically, farmers are less likely to undertake these activities on fields where they believe their tenure security is threatened (e.g., Feder 1988). Table 6.1 shows current adoption levels with respect to the use of planting basins, zero tillage, ridging, fences, manure, fertilizer, and drip irrigation. With the exception of fairly traditional ridging techniques and fertilizer application, field-level land investments in improving agricultural yields are not currently widely implemented by farmers in the project area. There is especially low uptake of fencing and all forms of irrigation, as well as the zero tillage practices that are often promoted as a component of conservation farming in the area.

In particular, costly upfront land investments with longer time to returns are generally uncommon, with planting basins, which are shallow holes that disturb less soil than ridging, being implemented on 10% of fields (N=909), live fencing on 1% of fields (N=88), and drip irrigation on less than 1% of fields (N=5).

Even conservation farming techniques that require low additional or even less effort than traditional farming practices are implemented at low rates. Crop residue is ploughed into 64% of fields (5686), instead of the less labor-intensive practice of leaving the residue on top of the field that conservation farming recommends. Only 8% of fields (18% of households) practice zero tillage or ripping, an alternative to plowing fields that improves soil quality and is faster than plowing. Thirty-six percent[43] of households (N=1278) use manure on 18% of their fields (N=1568), which involves fewer chemicals and is less expensive than traditional fertilizer. The most adopted conservation farming practice is crop rotation, employed on 82% of fields (N=7264). This suggests farmers may lack knowledge about the benefits of conservation farming or lack training in how to implement these low-cost, low-labor agricultural investments.

The tables below clearly illustrate Zambian farmers' preference for traditional farming methods over newly introduced techniques and investments. Sixty-three percent of fields (N=5288) are prepared using a conventional hand hoe, and 85% of fields (N=7528) are planted using ridging, either prepared by a hand hoe or with a plow. After ridging, applying fertilizer is the most common investment, adopted by 77% (N=2728) households on 40% of fields (N=3317). The Zambian government has invested

43 This is slightly more than the number of households who own cattle (27%, N=920)

considerable resources in increasing fertilizer use, and provides fertilizer at subsidized prices to farmers. Table 6.1 shows field and household-level uptake for a range of field investments and improvements and includes the test statistic for differences in investment uptake between female- and male-headed households. Table 6.2 presents specific results for crop residue use.

TABLE 6.1 HOUSEHOLD-LEVEL UPTAKE FORFIELD INVESTMENTS

		Field	All HH
Planting basins	N	909	789
	%	10%	22%
Zero tillage	N	748	626
	%	8%	18%
Ridging	N	7528	3300
	%	85%	94%
Fencing	N	88	77
	%	1%	2%
Manure	N	1568	1278
	%	18%	36%
Crop rotation	N	7264	3219
	%	82%	91%
Fallowing	N	656	559
	%	7%	16%
Drip irrigation[44]	N	5	5
	%	<1%	<1%

TABLE 6.2. HOUSEHOLD USE OF CROP RESIDUE, BY FIELD

Response Category	Number (#)	Percent (%)
Left in fields then plowed/incorporated into the field	5636	66%
Burned in the field[45]	1085	13%
Cut and spread on the field/cut and left on the field	758	9%
Cut and removed from the field and fed to animals	127	1%
Cut and removed from the field for other household uses	56	1%
Grazed by animals	385	5%
No crop residue/field not yet harvested	418	5%

Recall that only 2% (N=86) of households surveyed reported having paper documentation for their fields. On 74% (N= 106) of fields with documentation, respondents indicated that the lack of formal documentation would **not** discourage their adoption of agricultural improvements on fields that they use. Similarly, 93% of respondents *without documentation* said that its absence did not discourage field-level investments. This is captured in table 6.3.

44 There is no test statistic due to the small sample size.

45 This figure may underreport the actual incidence of burning due to a desirability bias.

TABLE 6.3. EFFECT OF FORMAL DOCUMENTATION ON HOUSEHOLD'S AGRICULTURAL INVESTMENT

Response Category	Does the lack of formal documentation discourage agricultural improvements on this field?	Would lack of formal documentation discourage agricultural improvements?
No	93% (7995)	74% (78)
Yes	6% (520)	26% (28)
Don't know/Prefer not to respond	2% (52)	0% (0)

Households that reported investing in activities to improve their fields were also asked why they chose to invest in these activities, specifically the reasons behind improving fields by using planting basins, zero tillage, ridging, fencing, fallowing, and investing in irrigation practices that reduce water use. Table 6.4 details the reasons given for each of the five investment activities[46]. The reasons reported for household investment in these field-level activities help provide a window into the current levels of farmer knowledge and uptake around conservation agriculture practices, such as planting basins, and drip irrigation. For example, when asked the reasons why the household chose to plant basins, 50% (N=451) of respondents said that it was to improve soil quality, while 16% (N=142) of the reasons given were to improve crop yields. To improve soil quality and to improve crop yields are the two most common reasons across all the activities, except for fencing (25%, N=22). The single most-often cited reason for fencing fields was to protect fields from animal grazing. For the most part, only fencing was associated with the respondent's desire to strengthen claim to land, to raise market value of land for later sale, to strengthen their ability to bequeath land to their children, or to raise the value of their land to use as collateral[47].

46 We exclude drip irrigation due to the small sample size.

47 In the final section of the report, we discuss ongoing research that uses the TGCC household and headperson data to explore correlations between field-level investment and household indictors of tenure security.

TABLE 6.4. REASONS HOUSEHOLD UNDERTOOK FIELD INVESTMENTS

	Zero tillage		Ridging, Mounding, Terracing		Fencing		Fallowing		Planting Basins	
Primary Reason	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Prevent soil erosion	124	17%	1348	18%	18	20%	101	15%	114	13%
Protect from floods	106	14%	1752	23%	19	22%	37	7%	89	10%
Improve soil quality	269	36%	2152	29%	6	7%	286	44%	451	50%
Improve crop yields	70	9%	1518	20%	6	7%	19	3%	142	16%
Strengthen claim to land	2	<1%	20	<1%	5	6%	1	<1%	1	<1%
Raise market value of land	0	0%	0	0%	0	0%	0	0%	0	0%
Strengthen ability to bequeath land to children	0	0%	1	<1%	2	2%	1	<1%	0	0%
Raise value of land to use as collateral	0	0%			0	0%	0	0%	0	0%
Help soil hold water	6	<1%	49	<1%	0	0%	9	1%	45	5%
Reduce weeds	4	<1%	23	<1%	0	0%	0	0%	2	<1%
Help secure fertilizer	0	0%	1	<1%	0	0%	0	0%	13	<1%
Try something new/NGO	2	<1%	1	<1%	0	0%	0	0%	24	3%
Promised something for using this method	1	<1%	0	0%	0	0%	0	0%	0	0%
This is an easier/quicker way	142	19%	233	3%	3	3%	0	0%	10	1%
Protect my land	0	0%	0	0%	1	1%	0	0%	0	0%
This is the traditional method	0	0%	328	4%	0	0%	0	0%	2	<1%
Reduce pests	0	0%	0	0%	0	0%	0	0%	0	0%
Helps organize planting	0	0%	8	<1%	0	0%	0	0%	0	0%
Demarcation/serve as a boundary	0	0%	0	0%	4	5%	0	0%	0	0%
Protect from animal grazing	0	0%	0	0%	22	25%	1	<1%	0	0%
Protect from fire/wind	0	0%	0	0%	0	0%	28	4%	0	0%

7.0 OUTCOME 3—AGROFORESTRY

Agroforestry activities are widely perceived as a set of longer-term sustainable land use practices that can help meet a range of rural development objectives related to improved land use and farmer livelihoods. Agroforestry contributes to higher soil fertility, prevents soil erosion and runoff, and reduces the threat of fire and many pests[48]. In Zambia, planting *Faidherbia Albida*, or *Musangu* trees, is particularly encouraged, as the native trees fix nitrogen in their roots and leaves, reducing farmers' need to purchase chemical fertilizer. Despite favorable Zambian agricultural policy encouraging agroforestry and a few organizations and development projects actively promoting conservation agriculture and agroforestry, uptake of the CSA practice of tree planting has been limited. Possible reasons for the low adoption are thought to at least partially include smallholder insecurity of property rights to land and trees and a lack of land management rules that protect trees on farm from being grazed or subject to uncontrolled burns (Ajayi and Kwesiga, 2003). Other factors may include the large thorns released from *F. Albida* and the fact that most agroforestry species attract grazing animals to the field.

PHOTO COURTESY OF THE CONSERVATION FARMING UNIT

In addition to helping prevent soil erosion, pests, and other crop risks, intercropped *Musangu* trees provide the particular benefit of increasing the amount of nitrogen available in the soil so that crops can more easily thrive.

This section describes baseline levels of agroforestry and relevant CSA activities. We measure agroforestry species coverage and seed use by capturing relevant statistics across a variety of species that take different forms (tree, shrub, cover crop). The data in our sample indicate a currently low rate of agroforestry species uptake. 11% of households (N= 383) currently practice agroforestry, and this is implemented across 5% of fields sampled in the study (N= 404). The survey results suggest this low uptake rate may be driven primarily by a lack of access to seedlings, and a lack of knowledge amongst farmers of the benefits that planting trees may provide. These results also suggest limited access to agroforestry extension services.

48 There is evidence that elephants are attracted to Glyricida, however Chipata district does not represent an active wildlife corridor for elephants.

Eleven percent of households have planted agroforestry species on at least one field, and 5% of all fields have agroforestry species planted (404 out of 8859 fields).

Across villages, the most popular type of agroforestry species planted is *Musangu* (38 villages), followed by *Sesbaniaseban* (14 villages) and *Gliricidia* (11 villages). 58% of households (N=235) intercrop their agroforestry species with other crops, such as groundnuts (54%, 126), maize (20%, 46), and cotton (7%, 17). The remaining households plant their species in perimeter (20%, 79) or block formations (22%, 88). Both planting patterns deliver fewer benefits for the soil than intercropping, although perimeter planting may be used to reinforce boundary claims. Eighty percent of households (322) have planted agroforestry tree on half their field or less. On average, the first agroforestry trees were planted 4 years ago, in 2010. These statistics are detailed in Figures 8 & 9

FIGURE 8. AGROFORESTRY PLANTING PATTERNS

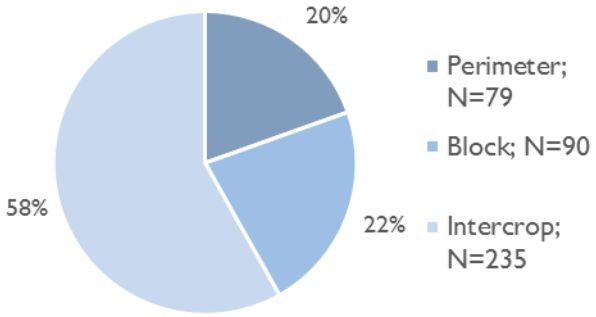
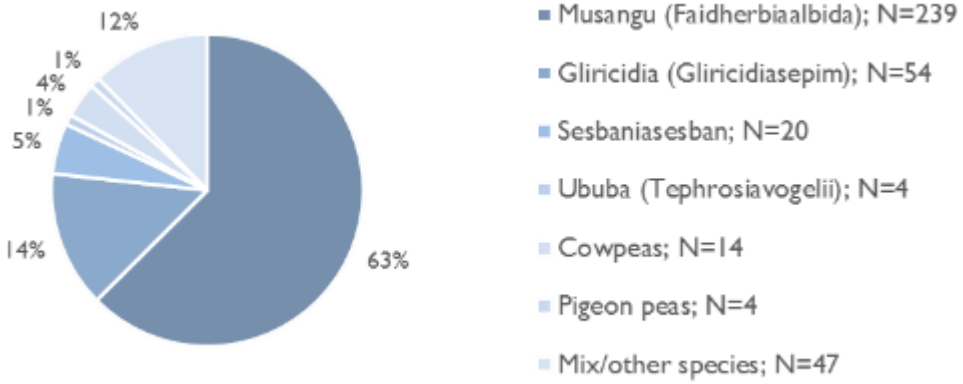


FIGURE 9. AGROFORESTRY TREE SPECIES PLANTED



Improving the fertility of the soil was the overarching motivation behind agroforestry planting. When asked why respondents chose to plant agroforestry trees, the most common primary reason given for 78% of fields (N=317) was that the trees improve soil fertility. Improved soil quality was given as a primary reason on 11% of fields (N=46), as was improved soil moisture (2%, N=10). 'Trees prevent soil erosion' was reported as the primary reason for 7% of fields (N=41). Table 7.1 outlines the primary and secondary reasons for agroforestry species planting across fields.

TABLE 7.1. REASONS FOR PLANTING AGROFORESTRY SPECIES

	Reason 1		Reason 2	
Response Category	**Number (#)**	**Percent (%)**	**Number (#)**	**Percent (%)**
More fertile for the soil	317	78%	1	<1%
Improved moisture	10	2%	41	15%
Substitute if crop fails	0	0%	10	4%
Prevent soil erosion	5	1%	36	13%
Protect from floods	4	1%	5	2%
Improve soil quality	46	11%	6	3%
Improve crop yields	4	1%	71	25%
Strengthen claim to land	4	1%	7	2%
Strengthen ability to bequeath land to children	1	<1%	0	0%
Replaces fertilizer/reduces the amount of fertilizer needed	1	<1%	5	2%
Used for fuel or fencing	0	0%	8	3%

Fifty-two percent (209) of fields have experienced no benefits from their agroforestry trees, either because the trees are still too young, or because the trees have not survived. Nevertheless, many households have seen benefits from their agroforestry trees. Of those fields that have experienced benefits, many fields have reportedly demonstrated improved soil fertility (36%, N=134), improved crop growth around the trees (46%, N=70), and higher overall crop yields (25%, N=45). Other benefits include greater availability of food (8%, N=21), reduced weeds (6%, N=17), and reduced soil erosion (5%, N=9). These benefits are listed in table 7.2.

TABLE 7.2. BENEFITS FROM PLANTING AGROFORESTRY SPECIES

	Reason 1		Reason 2	
Response Category	**Respondent N**	**Percent (%)**	**Respondent N**	**Percent (%)**
No benefits experienced yet	209	52%	0	0%
Improved soil fertility	129	32%	5	4%
Reduced weeds	2	<1%	8	6%
Improved crop growth around the tree	15	4%	55	42%
Reduced labor time on weeding activities	4	1%	3	2%
Higher overall crop yield	18	4%	27	21%
Increased fuelwood availability	0	0%	1	1%
Increased pollination	2	<1%	0	0%
Increased shade	1	<1%	2	1%
Reduced soil erosion	2	<1%	7	5%
Availability of food	14	3%	7	5%
Do not have to buy fertilizer	1	<1%	6	5%
Selling the tree seeds	0	0%	1	1%
Use as timber/fuelwood	0	0%	2	2%

Analysis of the focus group discussions reveals similar themes. Respondents expect planting agroforestry trees will improve the fertility of the fields. According to a women's focus group participant in Kabunyula, Mkanda, trees "help retain soil fertility. It helps fertilize the soil and holds water so that it does not dry up quick." The qualitative data also indicates that households understand that it takes several years for the benefits from trees to appear. A land-constrained focus group participant from Mambato, Mshawa said "I am expecting the benefits to show this coming season because the leaves are starting to fall. Our expectation is that as the *Musangu* leaves drop, they will provide lime for the soil, as well as both the top and bottom dressing fertilizer. The *Musangu* tree provides all these." A Saili woman participant echoed these remarks, commenting "Because if they grow big, the leaves from the trees will act as fertilizer like urea. If trees are many in the field, it will bring fertility to the soil and you don't have to apply chemical fertilizers." Focus group participants were also aware that trees had positive environmental benefits, even if they did not have exposure to agroforestry specifically. Trees are associated with bringing rain and promoting crop growth. According to a Masha woman, "If trees are cut down, rains are delayed to start but if trees are there, it helps bring rains on time."

Focus group participants also mentioned that planting trees strengthened claims to land. A woman from Changa, Mshawa, stated "Planting trees is a way of strengthening claim to land because the tree will be evidence that the field is that person's." A youth from Isilayere, Mshawa concurs, saying "It will strengthen our claim to the land because we are the ones that planted those trees there. My parents have died and I plant trees in the field, no one can come and get that land from me since I am the one who planted those trees. Even reallocating land, no one can reallocate it from one because you are the one who cleared the land and started tilling it and also plant agroforestry trees there."

As shown in table 7.3, low uptake is attributed to a lack of knowledge on tree planting (42%, N=1295) and the lack of access to seedlings (41%, N=1268). Challenges or risks from agroforestry tree planting were not reported as a primary deterrent. 64% (N=172) of households who are currently practicing agroforestry noted that they have not experienced any challenges or risks, as shown in table 7.4. Additionally, 68% (N=2359) of households report not receiving any advice on agroforestry in the past 12 months, illustrated in table 7.5.

TABLE 7.3. HOUSEHOLD REASONS FOR NOT PLANTING AGROFORESTRY SPECIES

Response Category	Respondent N	Percent (%)
Lack of knowledge on tree planting	1295	42%
No seeds	1268	41%
Not enough labor/too busy	99	3%
Not enough water for tree planting	79	3%
I can't protect seedlings or trees from livestock grazing on my field	24	1%
I can't protect seedlings or trees from fires on my fields	15	<1%
No benefit to doing so/field is already fertile	208	7%
Not enough certainty the land will be mine in the future	56	2%
Other	12	<1%
Don't know	61	2%

TABLE 7.4. CHALLENGES OR RISKS TO PLANTING AGROFORESTRY TREES

Response Category	Respondent N	Percent (%)
Pests/weeds/disease	20	7%
Competition for water	28	10%
Human-wildlife conflict	2	1%
No risks	172	64%
The trees/seedlings die	34	13%
Pest + competition for water	5	2%

TABLE 7.5. PRIMARY AGROFORESTRY CONSULTANT IN THE PAST 12 MONTHS

Response Category	Respondent N	Percent (%)
Youth Group Leader	9	3%
Neighbor	22	8%
Government extension agent	56	21%
Cooperative or farmers' association	38	14%
NGO/company extension agent	69	26%
Did not consult with anyone	57	21%
Don't know	11	4%

These statistics closely align with supporting qualitative data collected via the baseline survey, which provide additional information to explain why planting agroforestry trees is currently uncommon amongst farmers in the program areas. Lack of access to seedlings, lack of rain and irrigation, and no education on trees were mentioned most often as the reasons why trees were not planted in the focus group discussions. Referring to a lack of knowledge of tree planting as a barrier to agroforestry, a woman in Maguya said, "Where I came from we had planted but here no one has come to teach us… I did not plant because I do not know the benefits of these trees as I have not received any training on the trees." Another woman in Mashati, Mshawa said, "The reason I have not planted trees in my garden, because there is no one to educate us on agroforestry trees… There has been no one to explain to us the purpose of these trees." Referring to a lack of seedlings, a member of a land-constrained focus group in Changa, Mshawa said, "I have not planted because seedlings are difficult to get here in the village. It is difficult because we have not done it before." A woman in Manjanja, Mshawa said, "We are willing to plant these trees even today its only that we have nowhere to get them from."

LAND MANAGEMENT RULES

The survey included a series of questions on land management rules to investigate rules that directly or indirectly protect trees on farm from being grazed or subject to uncontrolled burns. Headmen and households were asked a series of questions about rules and penalties related to grazing livestock, cutting of trees, ownership of trees planted in shared fields, fires, and fencing, all of which are hypothesized to affect the adoption of agroforestry practices (e.g., Ajayi and Kwesiga, 2003).

Table 7.6 indicates the reported existence of rules, by households and headmen.

TABLE 7.6. RULES IN EXISTENCE

Response Category	Household survey		Headperson survey	
	Respondent N	Percent (%)	Respondent N	Percent (%)
Livestock grazing on communal lands	2449	71%	225	88%
Livestock grazing after harvest	1113	32%		
Cutting trees on fields	2468	71%	206	80%
Ownership of trees	879	25%	42	16%
Setting fires on fields	2091	60%	199	77%
Fencing of land on fields	224	6%	14	5%

The most common rule regulates the grazing of livestock on communal land. Nearly 90% of headmen (88%, N=225) and 71% of households (N=2449) report their village has a rule about grazing livestock. The rule is monitored in 95% of villages (N=214), and 88% of headmen (N=194) report their community has a good understanding of the rule. Over three-quarters of headmen (82%, N=181) report at least half of the households in the village follow grazing rules. For those households who do not follow the rule, 97% of headmen reported penalties existed, the most common being reimbursement equal to the value of crops destroyed or giving a chicken or a goat. The household survey tells a similar story, with 76% of households (N=1866) reporting that rule breakers are always punished and 68% of households (N=1670) reporting that most or all households comply with the punishment.

After grazing, tree cutting was the most prevent rule, existing in 87% of villages (N=180), according to headperson respondents. Monitoring exists in 87% of villages (N=180), and 85% (N=154) of headmen report their communities have a good understanding of the rule. Eighty-seven percent of villages (N=180) have punishments established for breaking rules about tree cutting, but compliance with the rule and with penalties is lower than compliance with grazing rules and punishments. Only 48% of headmen (N=126) report at least 50% of households comply with the rule, the lowest level of compliance of any rule. Similarly, just 46% of households (1138) claim that most or all households comply with the punishment for breaking the rule.

While rules about tree cutting are found in a majority of villages, only 16% of headmen (N=42) and 25% of households (N=877) report rules about tree ownership. Where rules do exist however, understanding is high (85%, N=154), and penalties exist in 86% of villages (N=36). Surprisingly, this is the only rule category where households are more likely to report the rule exists than the headman. The percent of households that report high compliance with the punishment (63%, N=555) and enforcement of punishments (56%, N=497) is also higher than the percent of headmen who claim at least 50% of households followed the rule about tree cutting (50%, N=18), whereas in every other rule type, the headman's estimate of compliance is higher. It is possible the extensive questioning about agroforestry activities present in the household survey but not in the headman survey had a type of priming effect, or led households to believe there was a benefit to their community by claiming these rules exist (such as receiving trees for free, as some programs in the area have done).

Rules about fires or burning are common, found in 78% of villages (N=199), according to the headman survey. It is interesting to note that only 60% of households (N=2091) report rules about fires or burning, the largest discrepancy of any of the five rules. Though headmen continue to report high levels of understanding (86%, N=156) and compliance (71%, N=127), the household survey tells a slightly different story. Only 56% (N=1176) of households believe that rule breakers are always punished, and of those who are punished, just 37% (768) state that all or most households comply with the penalty.

Fencing is the activity least likely to be governed by a rule. Only 14 villages, 5% of the sample, report having a rule about fencing, and even fewer (64%, N=9) have penalties for breaking the rule. Rates of monitoring and compliance are comparable to the rates across other types of rules. The statistics on penalties, compliance, and enforcement of rules are detailed below in table 7.7.

TABLE 7.7. REPORTED EXISTENCE OF, MONITORING OF, AND COMPLIANCE WITH LAND USE RULES

Response Category		Grazing Livestock	Tree cutting	Tree ownership	Fires or burning	Fencing
Headperson survey respondents	Good understanding of the rules?	88% (194)	85% (154)	94% (34)	86% (156)	88% (8)
	Monitoring exists	95% (214)	87% (180)	79% (33)	89% (177)	79% (11)
	>50% compliance with rules?	82% (181)	48% (126)	50% (18)	71% (127)	66% (6)
	Penalties exist	97% (219)	87% (180)	86% (36)	90% (180)	64% (9)
Household survey respondents	Penalty compliance–most or all households	68% (1670)	46% (1138)	63% (555)	37% (768)	64% (144)
	Enforcement—rule breakers are always punished	76% (1866)	61% (1514)	57% (497)	56% (1176)	58% (131)

In transcripts from focus group discussions, the rules most commonly mentioned as being broken, and the least effective, were those rules that restrict burning and the cutting of trees. For example, when asked if village members comply with rules, women in Saili said, "People do not comply with rules for setting fires to fields but when you are not there, people set fires to your field. And they would do the same with cutting of trees they will cut when you are not around. Would you say people comply with the rules? No, people don't comply with the rules…. People do not comply, for example the person I share field boundary with, could either set fire to my field or cut trees in my field. And we would ask them why they did that because that field is mine."

It is interesting that many focus group participants, whether they stated that rules that restrict the cutting of trees existed in their village, described the fairness and importance of these rules for natural resource and environmental protection. For example, members of a youth focus group in Mashati said, "The rules restricting cutting trees in other people's field is fair because you destroy soil fertility and during rainy season the rains would wash away the soil (cause soil erosion). In strong winds there are no trees to reduce the speed of wind that cause erosion or blow away the roofs… Yes tree cutting rules are good not only the trees in the fields but also around homes. They provide shade and reduce the intensity and speed of winds." Women in Saili said, "For prohibiting cutting trees in the field, rules are fair because trees help prevent soil erosion and if you apply chemical fertilizer, for it not to be washed away…For prohibiting cutting anyhow, the wind prevents rain to come on time… Rains are delayed in coming; trees shield the wind from blowing and rains come on time." Another woman in Mshawa said, "That rule is particularly necessary because cutting of trees destroys the environment. The rule is necessary for the preservation of the environment."

8.0 BALANCE & POWER

BALANCE

METHODS FOR ASSESSING BALANCE

The TGCC IE is a Randomized Control Trial (RTC), which relies on randomization to assign villages to either the treatment or the control group and compares outcomes between the two groups to measure the treatment effect of TGCC. RCTs rely on the assumption that by assigning the treatment randomly, the control and treatment groups will be statistically identical (or "balanced") across key indicators at baseline.

This report uses two approaches to gauge balance between the treatment and control groups on a variety of factors. The first is a fixed effects linear model, using village-level clustered standard errors, where variables are regressed against a dummy variable indicating the arm of the TGCC treatment. In short, this allows us to test whether treatment status alone "predicts" a difference between the treatment and control groups for a given outcome. With a well-balanced sample, we expect there to be no statistically significant differences between treatment and control groups. In other words, in this ideal scenario, we expect that treatment status is not a good predictor of outcomes. While this is a well-used method of testing balance, many dataset properties, such as sample size, may affect significance (Imai et al 2008).

The second way we test balance is by taking the standardized difference in means for each variable, and reporting the standardized percent bias (Austin 2009). Under this approach, variables with an absolute percent bias < 25% are considered balanced (Stuart 2010). Typically, in this context, a statistically significant regression estimate, but a low % bias indicates a low response rate or very uniform response, where unique responses tend to be in one group. At the baseline, these two measures are sufficient to show that the control group can act as an accurate counterfactual to the treatment group for the endline analyses.

In general, all four arms of the study are well-balanced across many outcome and control indicators. Balance tests were run for a total of 147 variables across seven major categories: tenure security, land governance, investment in agriculture, long-term outcomes, village-level demographics, field-level outcomes aggregated to the household level, and household demographics. Table 8.1 shows a summary of imbalance by presenting the number of indicators that are statistically significant for each category across each treatment arm, and in parenthesis, the number of indicators that are both statistically significant and have a level of bias above 25%. The sections that follow explain the balance for each treatment arm in greater detail. The complete balance tables can be found in Annex 5.

Overall, the analysis shows that, except for rare events that have a small sample size, the study is well-balanced across several key outcome and control indicators. This includes the Agroforestry Control arm, although that group was not included in the randomization.

TABLE 8.1. SUMMARY OF IMBALANCE ACROSS ALL TREATMENT ARMS

Indicator category (# of indicators tested)	Agroforestry	Land Tenure	Agroforestry + Land Tenure	Agroforestry Control
Tenure Security (30)	5 (0)	3 (2)	2 (0)	3 (0)
Land Governance (42)	5 (2)	7 (4)	10 (2)	7 (2)
Investment in agriculture (19)	12 (2)	8 (0)	1 (1)	8 (3)
Long-term outcomes (3)	0 (0)	2 (0)	0 (0)	2 (0)
Village-level demographics (25)	2 (2)	8 (8)	6 (6)	10 (10)
Field-level outcomes aggregated to household level (17)	4 (1)	1 (0)	1 (0)	4 (1)
Household demographics (10)	2 (1)	2 (0)	1 (0)	3 (1)
Total (146)	30 (8)	31 (14)	21 (9)	37 (17)

AGROFOERSTRY

The Agroforestry treatment group is well-balanced across most indicators. It is particularly well-balanced across outcome indicators related to tenure security and long-term outcomes. In both categories, no indicators are both statistically significant and biased at a level higher than 25%.

Of the 146 indicators tested for balance, 30 are statistically significant, and eight of these are both statistically significant and biased at a level higher than 25%. These eight indicators indicate that the agroforestry group has a greater number of fields (significant at the 1% level and biased at the 36% level), and larger fields (significant at the 1% level and biased at the 27% level) than the control group. The agroforestry group is also more likely to use fertilizer (significant at the 1%, and with a 25% level of bias) and plant basins (significant at the 1% level, with a 29% level of bias). The agroforestry group is also more likely to have rules about grazing animals (significant at the 1% level and with a 53% level of bias) and is more likely to enforce rules about tree ownership (significant at the 10% level and with an 87% level bias), though villages with rules about tree ownership are rare.

Of the variables that are statistically significant but have a low level of bias, households in the agroforestry group are more likely to have made various agroforestry investments, including planting agroforestry trees (significant at the 10% level), leaving their fields fallow, ridging, and zero-tillage. The agroforestry group also has a higher number of disputes, particularly boundary disputes, than the control group.

LAND TENURE

The Land Tenure treatment group is also well-balanced across most key indicators. Of the 146 indicators tested for balance, 31 are unbalanced, and of those, 14 are both unbalanced and are biased at the 25% level or higher. The indicators related to tenure security are particularly well-balanced, as are the indicators related to investment in agriculture, field-level outcomes, and household demographics.

Village-level demographics are the most unbalanced in the Land Tenure group. Villages in the Land Tenure treatment are located farther away from many services, including tarmac roads (significant at the 10%, 33% level of bias), mobile phone service (significant at the 5% level, 39% level of bias), secondary schools (significant at the 1% level, 60% level of bias), health clinics (significant at the 1% level, 56% level of bias), boreholes (significant at the 10% level, 34% level of bias), and agricultural field offices (significant at the 5% level, 46% level of bias) than villages in the treatment group. The Land Tenure group also

appears to have slightly lower tenure security (significant at the 10% level, with a 32% level of bias), particularly regarding the threat of the chief selling their land (significant at the 10% level, with a 35% level of bias).

The Land Tenure treatment group is also unbalanced across a few indicators related to village rules. Land tenure villages have more village rules, according to an index of all village rule topics, significant at the 10% level and biased at the 37% level. In particular, they have more rules about setting fires (significant at the 5% level and biased at the 40% level), though such rules are rare. Rules are also more likely to be enforced (significant at the 10% level, and biased at the 37% level). Finally, Land Tenure treatment households report having more meetings about land management than the control group, significant at the 10% level and biased at the 38% level.

Like the Agroforestry group, the Land Tenure treatment group also has higher update of various agricultural investments, though the level of bias for these indicators is below 25%. These investments include planting agroforestry trees, both at the household and field level, using ridging, leaving fields fallow, and spreading manure.

AGROFORESTRY + LAND TENURE

The Agroforestry + Land Tenure group has the best balance of all four treatment arms. Only 21 of the 146 variables tested are unbalanced, and of these, just nine are both statistically significant and have a percent bias above 25%. The unbalanced variables are primarily village-level demographic outcomes, and villages in this group appear to be farther from various services than control villages, including markets, secondary schools, and boreholes. Headmen in these villages are also slightly older than headmen in control villages (significant at the 5% level and biased at the 40% level).

Households in the Agroforestry + Land Tenure group are also unbalanced across a few key land governance indicators, though most have a level of bias below 25%. In general, land governance practices are more favorable in the treatment group than the control group. Women, the elderly, poor people, and those from different tribes from the headmen are all more likely to be disadvantaged in land decisions than households in the control group, significant at the 10% level for all groups but women, which is significant at the 5% level. However, households in the Agroforestry + Land Tenure group are more likely to believe that leadership decisions are transparent and fair, significant at the 10% level.

There are three land governance indicators that are both statically significant and have a high level of bias. However, instances of all three of these indicators are rare and the very small sample size contributes to the higher level of imbalance. These are: Rules about setting fires (significant at the 5% level, 47% level of bias), the enforcement of rules about tree ownership (significant at the 10% level, 40% level of bias), and the number of *Musangu* trees planted (significant at the 10% level, 32% level of bias).

AGROFORESTRY CONTROL

The Agroforestry Control was not a part of the randomization design. Nevertheless, we tested the balance for this arm of the study to determine whether it was valid to treat it as a comparison arm for the Agroforestry group as the study design originally intended. Like the other three arms, the Agroforestry Control treatment group is also well-balanced across important indicators, especially related to tenure security and land governance. Of the 146 indicators tested, 37 are statistically significantly different than the control group, and 17 of these are also biased at a level greater than 25%.

However, of these 38 indicators, 15 are rare events with very small sample sizes that contribute to the higher level of imbalance.

Ten of the indicators that are statistically significant and have a high level of bias are related to village-level demographics. This does suggest that villages in Saili chiefdom are different than control villages in important ways that will be taken into consideration in the analysis, and may be more remote or have less access to services. Roads, mobile phone service, health clinics, banks, markets, and agricultural offices are all located farther from villages in the Agroforestry control group than the control group. Villages in Saili are also less likely to be led by a headwoman (significant at the 5% level with a 40% level of bias), and are larger than control villages (significant at the 5% level with a 47% level of bias).

Households in the agroforestry control group also own larger areas of land (significant at the 5% level with a 30% level of bias), more likely to have black soil on their fields (significant at the 1% level with a 37% level of bias), and more likely to have rules about animal grazing (significant at the 10% level with a 39% level of bias) and setting fires (significant at the 10% level with a 37% level of bias). They are also more likely to use manure (significant at the 1% level with a 34% level of bias) and chemical fertilizer (significant at the 1% level with a 39% level of bias).

POWER

In this section, we update the power calculations at the community and the household level using the baseline sample. At the IE design stage, we necessarily conducted the power analyses using target numbers of communities and approximated intra-class correlation (ICC) values in the absence of actual data. Refer to Annex I—TGCC IE Design Report for more detail on the initial calculations. Using the updated number of communities and ICC values, we have a stronger sense of how well this IE will be able to detect treatment changes.

Power calculations are presented for all four treatment arms for outcome indicators related to tenure security, land governance, investment in agriculture, and long-term outcomes such as socioeconomic status and agricultural productivity.

The original power calculations assume 75 villages per treatment group and 15 households per village, and an MDES of .54 at the village level and .30 at the household level. As noted in previous sections, baseline data was collected for slightly fewer villages and households than originally assumed, an average of 64.3 villages per treatment group and 13.7 households per village. Tables 9.1 and 9.2 show a summary of results for the four main outcome categories at the household and village level.

Compared to the original design expectations, the evaluation is well-powered to detect changes at the household level across all treatment groups. Indicators that have an MDES greater than .30, typically capture rare events, such as land rentals or land documentation, and the small N skews the result. Indicators related to tenure security are generally well-powered, and the average MDES across all four treatment groups is lower than the original assumption. The agroforestry and agroforestry control treatment groups have the largest number of households and the lowest average MDES across all four indicator categories.

The highest MDES for all treatment groups are indicators related to Land Governance, with a range of .27 to 2.25 at the household level and .64 to 2.01 at the village level. However, the range is highly skewed by two indicators that occur very rarely, the enforcement of rules related to tree ownership, and punishment for rules related to tree ownership. If these two variables are eliminated, the largest

MDES drops substantially to 0.42. The mean, minimum, and maximum MDES for each indicator category across treatment arms at the household level are shown in table 8.2.

TABLE 8.2. SUMMARY OF MDES ACROSS INDICATORY CATEGORIES AND TREATMENT GROUPS AT THE HOUSEHOLD LEVEL

	Land Tenure			Agroforestry			Agroforestry + Land			Agroforestry Control		
MDES	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Tenure Security	.26	.24	.33	.25	.22	.34	.28	.23	.39	.21	.16	.34
Land Governance	.40	.31	1.56	.34	.27	1.19	.49	.37	2.25	.34	.28	1.19
Investment in Agriculture	.34	.22	.86	.35	.22	.92	.37	.23	.96	.27	.16	.67
Long-term outcomes	.29	.22	.24	.26	.22	.30	.32	.22	.40	.24	.16	.30

A larger concern is the loss of power at the village level, due to number of villages reducing from 300 to 257. The lowest MDES at the village level is .57, slightly higher than the original estimation, but the highest MDES is 2.01, associated with Land Governance indicators in the Agroforestry+Land treatment group. As at the household level, eliminating the two rare outlier indicators drops the maximum MDES to 0.81. Still, on average, the evaluation will not be sufficiently powered to detect the village-level changes originally anticipated. The mean, minimum, and maximum MDES for each indicator category across treatment arms at the village level are shown in table 8.3.

TABLE 8.3. SUMMARY OF MDES ACROSS INDICATORY CATEGORIES AND TREATMENT GROUPS AT THE VILLAGE LEVEL

	Land Tenure			Agroforestry			Agroforestry + Land			Agroforestry Control		
MDES	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**
Tenure Security	.64	.64	.64	.68	.68	.68	.65	.65	.65	.57	.57	.57
Land Governance	.75	.64	1.49	.81	.68	1.91	.80	.65	2.01	.68	.57	1.6

Full tables showing the ICC, MDES, point change, and percent change for key indicators related to tenure security, land governance, investment in agriculture, and long-term outcomes can be found in Annex 9—Power Calculations Tables.

9.0 NEXT STEPS

The baseline data are expected to be publicly available for broader research use in early 2017.

The endline data collection for the TGCC IE is scheduled for June–August 2017. This corresponds with the period of baseline data collection, thereby eliminating seasonal effects in the results. This timeframe also allows for a three-year intervention time frame.

In the meantime, the evaluation team will continue with baseline data analysis. Future work will include correlation and regression analysis on the factors linking household indicators for tenure security to investment and CSA uptake. Moreover, the research team will integrate the household dataset with the rich set of village-level spatial, institutional, socio-economic, and related factors (e.g. distance to major roads, market access, administrative centers, etc.) to help answer questions about how broader village context shapes land use, governance, and disputes/conflict processes. The qualitative data and findings will also be integrated into the current quantitative baseline analyses to enable better interpretation of the quantitative findings and the validation of hypothesized mechanisms (or identification of other potential mechanisms) around drivers of increased tenure security, its role in changing farmer decision-making and undertaking CSA land investments, and broader livelihoods and well-being outcomes.

Specifically, the team will undertake sophisticated modeling to examine the current relationship between tenure security and land investments through instrumental variables analysis and household-level propensity score matching.

Finally, the team will develop a pre-analysis plan to guide the endline analysis. The plan serves as an important guide for assessing the rigor and validity of the final analysis. The pre-analysis plan with include descriptions of the data and indicators for hypothesis testing, and outline the empirical strategy that will be employed for analysis. The authors will complete and register the plan prior to endline data collection.

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ANNEX 1—DESIGN REPORT

The TGCC Zambia IE Design Report can be found in a separate document.

ANNEX 2—HOUSEHOLD DATA COLLECTION INSTRUMENTS

The TGCC Zambia IE household data collection instruments can be found in a separate document.

ANNEX 3—HEADPERSON DATA COLLECTION INSTRUMENTS

The TGCC Zambia IE headperson data collection instruments can be found in a separate document.

ANNEX 4—FOCUS GROUP DISCUSSION INSTRUMENTS

The TGCC Zambia IE focus group discussion instruments can be found in a separate document.

ANNEX 5—YOUTH GROUP LEADER KEY INFORMANT INTERVIEW INSTRUMENT

The TGCC Zambia IE Youth Group Leader Key Informant Interview instruments can be found in a separate document.

ANNEX 6—VILLAGE LAND COMMITTEE LEADER KEY INFORMANT INTERVIEW INSTRUMENT

The TGCC Zambia IE Village Land Committee Leader Key Informant Interview instruments can be found in a separate document.

ANNEX 7—REVIEW AND RESPONSE MATRIX

The TGCC Zambia IE comment matrix of external review feedback and evaluation team responses can be found in a separate document.

ANNEX 8—BALANCE STATISTICS

Balance statistics are presented for each of the four treatment arms: Agroforestry, Land Tenure, Agroforestry+Land Tenure, and Agroforestry Control. The first column of each table below indicates the variable of interest. For each treatment group, the first column gives us the estimated effect of being in the either the Agroforestry, Land Tenure, Agroforestry + Land Tenure, Control, or Agroforestry Control group on the variable of interest. The reference group is the pure control arm. The % Bias column for each treatment group gives the Standardized Mean Difference, or the measure of distance between the two group means.

On the following pages, tables present control variables describing demographic and landholding data, as well as expected outcome variables at baseline, including tenure security, land governance, investment in agriculture, and long-term outcomes such as socioeconomic status and agricultural productivity. All variables are reported at either the respondent, household, or field level. Most variables are either reported as binary responses, or on a scale. With binary variables, a 0 is "No", and 1 is "Yes." For variables measured on a scale, lower values are generally more "positive" responses (e.g., "Strongly Agree", or "Very Good"), and higher values are more "negative" (e.g., "Strongly Disagree", or "Very Bad"). Rare events, defined as applying to 10% of the sample or less, are denoted with an asterisk (*).

TABLE A8.1. TENURE SECURITY—ALL TREATMENT ARMS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Land Expropriation and Reallocation									
Short-term HH Tenure Security Index (1 is most secure, 6 is least secure)	0.106 (1.749)	10%	-0.025 (1.806)	2%	0.052 (1.852)	7%	-0.068 (1.77)	-0.052 (1.711)	1%
Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	0.114 (1.859)	8%	-0.054 (1.83)	1%	-0.008 (1.839)	2%	-0.037 (1.91)	-0.011 (1.903)	1%
Short- and Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	0.172 (2.507)	10%	-0.053 (2.558)	1%	0.038 (2.594)	5%	-0.084 (2.544)	-0.048 (2.495)	1%
Household perceived expropriation risk from other HHs	1.865 (1.265)	3%	1.935 (1.317)	3%	2.029 (1.358)	10%	1.901 (1.271)	1.835 (1.211)	5%
Household perceived expropriation risk from elites	1.668*(1.072)	11%	1.646 (1.134)	9%	1.71** (1.159)	14%	1.554 (1.021)	1.597 (1.037)	4%
Household perceived expropriation risk from neighboring community	1.585 (1.014)	4%	1.628 (1.12)	0%	1.685 (1.156)	5%	1.625 (1.072)	1.597 (1.033)	3%
Household perceived expropriation risk from chief	2.002***(1.286)	20%	1.885 (1.276)	11%	1.815 (1.215)	5%	1.755 (1.155)	1.866 (1.233)	9%
Household perceived expropriation risk from headman"	1.63**(1.042)	16%	1.468 (0.966)	0%	1.479 (0.983)	1%	1.47 (0.94)	1.471 (0.939)	0%
Household perceived expropriation risk from extended family	1.703 (1.123)	6%	1.52*(1.009)	11%	1.574 (1.064)	6%	1.637 (1.055)	1.637 (1.059)	0%
Household perceived expropriation risk index (1 is most secure, 6 is least secure)	2.167 (0.946)	2%	1.893*(0.782)	32%	1.946 (0.944)	23%	2.147 (0.826)	2.292 (0.967)	16%
Headman perceived expropriation risk from elites	1.58 (1.012)	4%	1.508 (0.898)	3%	1.518 (0.914)	2%	1.538 (0.917)	1.575 (0.747)	4%
Headman perceived expropriation risk from neighboring community	2.24 (1.572)	3%	1.949 (1.305)	18%	1.964 (1.293)	17%	2.192 (1.401)	2.575 (1.483)	27%
Headman perceived expropriation risk from chief	2.68 (1.544)	2%	2.22*(1.353)	35%	2.357 (1.482)	24%	2.712 (1.433)	2.725 (1.467)	1%
Land Disputes and Conflict									
Village experienced land-related conflict	0.38 (0.49)	5%	0.441 (0.501)	0.074	0.429 (0.499)	5%	0.404 (0.495)	0.525 (0.506)	24%
Number of land disputes experienced by village	0.58 (0.883)	18%	0.678 (0.899)	0.109	0.625 (0.926)	15%	0.827 (1.712)	0.875 (1.09)	3%
Number of land disputes about boundaries	0.32 (0.621)	29%	0.508 (0.858)	0.118	0.5 (0.739)	13%	0.654 (1.52)	0.625 (0.925)	2%
Number of land disputes about land allocation	0.14 (0.351)	16%	0.102 (0.305)	0.225**	0.107 (0.366)	21%	0.25 (0.883)	0.1 (0.379)	22%

TABLE A8.1. TENURE SECURITY—ALL TREATMENT ARMS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Change in frequency of land related disputes-0=lower, 1=same, 2=higher	0.645 (0.485)	17%	0.725 (0.396)	0.014	0.723 (0.449)	2%	0.731 (0.5)	0.688 (0.43)	9%
Change in Intensity of land related disputes-0=lower, 1=same, 2=higher	0.645 (0.471)	9%	0.725 (0.373)	0.087	0.728 (0.458)	9%	0.688 (0.472)	0.725 (0.43)	8%
Experienced at least one dispute on field	0.154** (0.317)	14%	0.102 (0.228)	0.053	0.135 (0.282)	8%	0.114 (0.245)	0.126 (0.268)	5%
Experienced boundary dispute on field	0.097** (0.259)	15%	0.057 (0.167)	0.042	0.076 (0.214)	6%	0.064 (0.183)	0.06 (0.182)	2%
Number of disputes experienced on field	0.22** (0.637)	15%	0.116 (0.328)	0.064	0.17 (0.484)	7%	0.14 (0.403)	0.144 (0.403)	1%
Longest time to resolve a dispute on field	3.443 (2.408)	10%	3.52 (2.338)	0.069	3.507 (2.327)	8%	3.686 (2.461)	3.833 (2.427)	6%
Dispute resolution satisfaction	2.301 (1.279)	3%	2.07 (1.053)	0.164	2.286 (1.176)	2%	2.258 (1.225)	2.2 (1.072)	5%
HH confident that the chief will enforce land rights in the event of a dispute	0.898 (0.303)	7%	0.905 (0.294)	0.047	0.896 (0.306)	8%	0.918 (0.275)	0.913 (0.282)	2%
Land Documentation									
HH has paper documentation for at least one field*	0.014 (0.119)	12%	0.017 (0.128)	10%	0.011* (0.102)	15%	0.032 (0.178)	0.008** (0.088)	18%
Field has paper documentation*	0.014 (0.113)	1%	0.013 (0.109)	2%	0.009 (0.094)	5%	0.015 (0.117)	0.005 (0.072)	10%
Field has customary certification*	0.007 (0.083)	2%	0.011 (0.102)	5%	0.006 (0.077)	0%	0.006 (0.077)	0.002 (0.041)	7%
Land Rental Activity									
HH rents out land*	0.023 (0.151)	4%	0.032 (0.176)	9%	0.032 (0.176)	9%	0.018 (0.134)	0.043*(0.204)	15%
Access to Credit									
HH obtained formal loan from bank or microcredit institution*	0.071** (0.256)	23%	0.043 (0.204)	12%	0.032 (0.175)	6%	0.022 (0.146)	0.072** (0.258)	24%

TABLE A8.2. LAND GOVERNANCE—ALL TREATMENT ARMS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Land Management									
Headperson reports existence of Village Land Committee*	0.2 (0.404)	7%	0.136 (0.345)	25%	0.143 (0.353)	23%	0.231 (0.425)	0.125 (0.335)	28%
Land management-related meeting held in village in past year*	0.26 (0.443)	23%	0.254 (0.439)	24%	0.321 (0.471)	9%	0.365 (0.486)	0.375 (0.49)	2%
Number of land management-related meetings held in village in past year*	0.94 (2.094)	21%	0.627* (1.244)	38%	0.964 (1.716)	21%	1.462 (2.839)	0.85 (1.369)	27%
HH reports existence of Village Land Committee*	0.221 (0.415)	13%	0.187 (0.39)	5%	0.196 (0.398)	7%	0.168 (0.374)	0.125 (0.331)	12%
Frequency of HH participation in land management-related meetings	0.9 (1.164)	3%	0.803 (1.143)	5%	0.8 (1.114)	6%	0.862 (1.161)	0.706 (1.074)	14%
HHs is satisfied with the way VLC is managing customary land in village	1.963 (0.909)	5%	1.971 (0.809)	4%	2.074 (0.975)	7%	2.007 (0.909)	2.102 (0.839)	11%
HH believes village leaders/VLC are trusted and honest	1.913 (0.908)	4%	1.938 (0.84)	7%	2.021 (0.981)	16%	1.881 (0.812)	1.952 (0.772)	9%
HH believes the village leaders/VLC protect comm. land from being taken or encroached	1.765 (0.82)	6%	1.826 (0.793)	14%	1.865* (0.886)	18%	1.72 (0.75)	1.847 (0.792)	16%
HH believes land related decision making is transparent	0.333 (0.475)	5%	0.429 (0.5)	14%	0.269 (0.452)	19%	0.357 (0.497)	0.475 (0.506)	24%
Index: HH perception of land leaders, 0 is worse, 4 is best	5.503 (2.294)	3%	5.62 (2.17)	8%	5.84 (2.446)	17%	5.437 (2.175)	5.676 (2.161)	11%
Land Allocation									
HH believes vulnerable groups disadvantaged in land allocation decisions	0.203 (0.403)	6%	0.197 (0.398)	4%	0.202 (0.402)	6%	0.181 (0.385)	0.18 (0.385)	0%
HH believes that village leaders allocate land fairly across HHs	1.958 (0.985)	10%	1.985 (0.962)	13%	2.011 (1.013)	16%	1.865 (0.825)	2.03* (0.944)	19%
HH feels women have been disadvantaged in land allocation decisions	3.082 (1.365)	12%	3.066 (1.389)	13%	2.989** (1.401)	18%	3.243 (1.384)	3.018* (1.37)	16%
HH feels elderly have been disadvantaged in land allocation decisions	3.348 (1.276)	13%	3.392 (1.285)	10%	3.333* (1.294)	14%	3.517 (1.281)	3.413 (1.236)	8%
HH feels poor have been disadvantaged in land allocation decisions	3.182* (1.352)	13%	3.111** (1.364)	18%	3.124* (1.335)	17%	3.356 (1.345)	3.036*** (1.33)	24%
HH feels HHs not sharing tribe with headman disadvantaged in land allocation decisions	3.161** (1.386)	15%	3.073*** (1.385)	22%	3.163* (1.329)	16%	3.371 (1.36)	3.05*** (1.333)	24%

TABLE A8.2. LAND GOVERNANCE—ALL TREATMENT ARMS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
HH equity indicator for land allocation	0.017* (1.63)	15%	-0.033** (1.689)	18%	-0.048** (1.671)	19%	0.276 (1.735)	-0.079** (1.613)	21%
HH believes that decisions about customary land allocation are fair	1.984* (0.962)	18%	1.951 (0.933)	15%	1.985* (0.89)	19%	1.825 (0.786)	1.887 (0.788)	8%
HH believes that land allocation processes are transparent	1.963 (1.022)	9%	1.978 (0.971)	11%	2.011* (0.969)	15%	1.873 (0.899)	1.982 (0.884)	12%
HH believes land allocation decision-makers are accountable to constituents	1.91 (0.808)	1%	1.908 (0.806)	1%	1.942 (0.782)	4%	1.914 (0.847)	1.938 (0.732)	3%
Index: HH perception of land allocation, 0 is worse, 4 is best	0.012 (1.37)	11%	0.001 (1.398)	10%	0.068 (1.395)	15%	-0.132 (1.301)	-0.013 (1.164)	10%
Land Rules and Governance									
HH believes rules about land are clear and well-known	1.944 (0.908)	11%	1.905 (0.859)	7%	1.94 (0.895)	11%	1.851 (0.803)	1.944 (0.817)	12%
Overall land governance indicator	0.019 (1.845)	1%	-0.002 (1.762)	2%	-0.12 (1.66)	8%	0.034 (2.278)	0.065 (2.22)	1%
Existence of rule in village about grazing livestock	0.96*** (0.198)	53%	0.881 (0.326)	25%	0.839 (0.371)	13%	0.788 (0.412)	0.925* (0.267)	39%
Existence of rule in village about cutting trees	0.84 (0.37)	22%	0.814 (0.393)	15%	0.786 (0.414)	8%	0.75 (0.437)	0.825 (0.385)	18%
Existence of rule in village about ownership over trees on shared fields*	0.16 (0.37)	4%	0.237 (0.429)	16%	0.107 (0.312)	19%	0.173 (0.382)	0.125 (0.335)	13%
Existence of rule in village about use of communal land by neighboring villages	0.22 (0.418)	7%	0.339 (0.477)	19%	0.268 (0.447)	4%	0.25 (0.437)	0.2 (0.405)	12%
Existence of rule in village about use of communal land by outsiders or investors	0.14 (0.351)	32%	0.288 (0.457)	4%	0.196 (0.401)	17%	0.269 (0.448)	0.225 (0.423)	10%
Existence of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	0.78 (0.418)	32%	0.814** (0.393)	41%	0.839** (0.371)	47%	0.635 (0.486)	0.8* (0.405)	37%
# of rules regulating village land that are monitored for rule breaking	2.78 (1.075)	19%	3.068* (1.425)	37%	2.839 (1.29)	22%	2.538 (1.421)	2.9 (1.277)	27%
Village monitors for breaking of rule about grazing livestock	0.938 (0.245)	19%	0.962 (0.194)	8%	0.915 (0.282)	27%	0.976 (0.156)	0.973 (0.164)	2%
Village monitors for breaking of rule about cutting trees	0.905 (0.297)	31%	0.854 (0.357)	16%	0.932* (0.255)	40%	0.795 (0.409)	0.879 (0.331)	23%
Village monitors for breaking of rule about ownership over trees on shared fields*	0.5* (0.535)	87%	0.786 (0.426)	27%	0.833 (0.408)	15%	0.889 (0.333)	1 (0)	47%

TABLE A8.2. LAND GOVERNANCE—ALL TREATMENT ARMS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Village monitors for breaking of rule about setting fires for land clearing, land preparation, or post-harvest burning*	0.897 (0.307)	23%	0.875 (0.334)	16%	0.936 (0.247)	36%	0.818 (0.392)	0.906 (0.296)	25%
% of rules in village that are monitored for rule breaking	0.91 (0.24)	1%	0.923 (0.157)	9%	0.936 (0.186)	15%	0.908 (0.194)	0.935 (0.19)	14%
Penalty for breaking of rule in village about grazing livestock	0.938* (0.245)	36%	0.962 (0.194)	28%	0.979 (0.146)	21%	1 (0)	1*** (0)	NaN
Penalty for breaking of rule in village about cutting trees	0.905 (0.297)	18%	0.812 (0.394)	9%	0.909 (0.291)	19%	0.846 (0.366)	0.909 (0.292)	19%
Penalty for breaking of rule in village about ownership over trees on shared fields*	0.625 (0.518)	61%	0.929 (0.267)	13%	0.833 (0.408)	15%	0.889 (0.333)	1 (0)	47%
Penalty for breaking of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	0.923 (0.27)	23%	0.917 (0.279)	21%	0.915 (0.282)	20%	0.848 (0.364)	0.906 (0.296)	17%
% of rules in village that have penalties rule breaking	0.923 (0.203)	4%	0.896 (0.216)	18%	0.93 (0.209)	0%	0.93 (0.149)	0.952 (0.138)	15%
# of rules in village that have penalties rule breaking	2.82 (1.044)	16%	3.085 (1.579)	31%	2.857 (1.354)	17%	2.615 (1.457)	2.95 (1.26)	25%
Index: Land Rules, where 0=weakest, 6=strongest	2.793 (1.017)	19%	3.073* (1.432)	36%	2.845 (1.285)	21%	2.564 (1.403)	2.917 (1.258)	27%

TABLE A8.3. AGROFORESTRY—ALL TREATMENT ARMS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Agroforestry Uptake									
HH engages in agroforestry on at least one field*	0.107 (0.309)	12%	0.138** (0.346)	22%	0.107 (0.31)	12%	0.072 (0.259)	0.093 (0.291)	8%
Field planted with agroforestry trees or shrubs*	0.051* (0.163)	12%	0.067*** (0.197)	20%	0.044 (0.152)	7%	0.034 (0.127)	0.04 (0.142)	5%
% of field planted with agroforestry trees or shrubs*	3.473 (1.509)	14%	3.75 (1.305)	5%	3.684 (1.432)	0%	3.678 (1.456)	3.948 (1.22)	20%
Musangu seedlings planted on field*	0.593 (0.491)	4%	0.622 (0.485)	2%	0.454* (0.495)	32%	0.613 (0.491)	0.746 (0.439)	29%
Gliricidia seedlings planted on field*	0.107 (0.311)	24%	0.197 (0.396)	1%	0.235 (0.419)	10%	0.194 (0.398)	0.085 (0.281)	32%
Agricultural Investment									
HH engagement in fallowing to improve field(s)	0.153** (0.36)	20%	0.147** (0.354)	19%	0.112 (0.315)	0.083	0.087 (0.282)	0.157** (0.364)	22%
HH engagement in agricultural investment to improve field	0.952** (0.174)	13%	0.951** (0.171)	13%	0.942 (0.189)	0.08	0.926 (0.212)	0.945 (0.174)	10%
Short-term Agricultural Investment Index	-0.042 (0.987)	8%	0.025 (1.539)	3%	-0.046 (1.041)	0.086	0.064 (1.499)	0.019 (1.264)	3%
Long-term Agricultural Investment Index	-0.075** (0.814)	11%	-0.001 (1.348)	4%	-0.046 (1.009)	0.08	0.054 (1.457)	0.076 (1.497)	2%
HH planted basins on field	0.154*** (0.307)	29%	0.107 (0.252)	12%	0.094 (0.232)	0.064	0.08 (0.2)	0.098 (0.244)	8%
HH practiced zero tillage on field*	0.114* (0.271)	13%	0.071 (0.222)	4%	0.054 (0.199)	0.119	0.08 (0.237)	0.106 (0.273)	10%
HH practiced ridging, mounding or terrace on field*	0.818*** (0.341)	18%	0.823*** (0.336)	17%	0.884 (0.275)	0.031	0.875 (0.277)	0.837* (0.322)	13%
HH added manure or compost on field*	0.199*** (0.339)	21%	0.19*** (0.325)	19%	0.149 (0.281)	0.05	0.135 (0.263)	0.238*** (0.338)	34%
HH practiced crop rotation on field*	0.789 (0.367)	1%	0.783 (0.367)	1%	0.788 (0.359)	0	0.788 (0.361)	0.787 (0.352)	0%
HH improved field through fallowing*	0.103*** (0.267)	22%	0.078* (0.224)	13%	0.062 (0.193)	0.05	0.052 (0.178)	0.096*** (0.235)	21%
Number of seasons field left fallow in past 5 years	0.182*** (0.552)	19%	0.153** (0.526)	13%	0.13 (0.443)	0.084	0.096 (0.36)	0.2*** (0.612)	21%
Fertilizer used on field*	0.415*** (0.353)	25%	0.349 (0.301)	6%	0.324 (0.287)	0.03	0.333 (0.289)	0.44*** (0.264)	39%
Kgs of fertilizer applied per hectare*	111.504 (259.67)	1%	82.606 (109.51)	7%	74.962 (102.743)	0.094	108.396 (492.442)	165.526** (404.247)	13%
Kgs of fertilizer applied*	77.98* (111.025)	12%	67.537 (110.156)	3%	58.467 (108.103)	0.043	63.552 (129.906)	106.231*** (198.164)	26%

TABLE A8.4. LONG-TERM OUTCOMES—ALL TREATMENT ARMS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Agricultural Productivity									
HH reported improved crop growth around trees on field as result of planting agroforestry trees	0.008 (0.067)	7%	0.016** (0.104)	14%	0.004 (0.037)	1%	0.004 (0.049)	0.007 (0.046)	5%
HH reported higher overall crop yield on field as result of planting agroforestry trees	0.006 (0.066)	8%	0.013*** (0.092)	15%	0.003 (0.031)	2%	0.002 (0.029)	0.008** (0.062)	13%
Livelihood Improvements									
Asset-based wealth index: Assets(counts), Livestock(counts), land area owned, roof construct	-0.093 (1.735)	6%	-0.109 (1.75)	7%	-0.153 (1.894)	9%	0.02 (1.871)	0.369** (2.134)	17%

TABLE A8.5. VILLAGE-LEVEL DEMOGRAPHICS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Sex of village headman	0.04 (0.198)	16%	0.153 (0.363)	24%	0.054 (0.227)	9%	0.077 (0.269)	0** (0)	40%
Age of village headman	0.94 (0.24)	35%	0.966 (0.183)	26%	0.929** (0.26)	39%	1 (0)	0.975 (0.158)	22%
# of HH in village	28.54 (20.221)	22%	32.966 (27.645)	5%	35.732 (33.362)	4%	34.558 (33.985)	53.75** (47.434)	47%
Village experienced land-related conflict	0.38 (0.49)	5%	0.441 (0.501)	7%	0.429 (0.499)	5%	0.404 (0.495)	0.525 (0.506)	24%
Village has a VLC	0.2 (0.404)	7%	0.136 (0.345)	25%	0.143 (0.353)	23%	0.231 (0.425)	0.125 (0.335)	28%
Index: Land Rules, where 0=weakest, 6=strongest	2.793 (1.017)	19%	3.073* (1.432)	36%	2.845 (1.285)	21%	2.564 (1.403)	2.917 (1.258)	27%
Km to nearest boma	5.86 (1.385)	9%	6.068 (1.096)	8%	6 (1.321)	2%	5.981 (1.229)	6.5** (0.934)	48%
Km to nearest tarmac road	2.76 (2.273)	4%	3.153 (2.18)	14%	2.75 (2.353)	4%	2.846 (2.155)	5.4*** (1.809)	128%
Km to nearest road accessible all year	1.34 (1.507)	29%	1.39* (1.509)	33%	1.107 (1.41)	12%	0.962 (1.047)	1.5* (1.502)	42%
Km to nearest FRA Office	1.94 (1.331)	21%	1.881 (1.19)	27%	2.125 (1.63)	6%	2.212 (1.258)	2.075 (0.944)	12%
Km to nearest minibus pickup	1.26 (1.026)	14%	1.136 (1.181)	2%	1.054 (1.354)	5%	1.115 (1.096)	1.275 (1.261)	14%
Km to mobile phone service	0.36 (0.802)	22%	0.051** (0.289)	39%	0.143 (0.401)	15%	0.212 (0.498)	0.05** (0.221)	42%
Km to nearest place to sell crops	1.22 (1.389)	13%	1.508 (1.394)	9%	1.125 (1.402)	20%	1.385 (1.239)	2.1** (1.837)	46%
Km to nearest market	1.94 (1.544)	23%	1.797* (1.436)	32%	1.714* (1.546)	36%	2.327 (1.844)	2.375 (1.564)	3%
Km to nearest primary school	1.02 (0.515)	19%	1 (0.455)	22%	1.054 (0.961)	12%	1.173 (1.043)	1.05 (0.677)	14%
Km to nearest secondary school	3.72 (2.08)	28%	3.153*** (1.818)	61%	3.357** (2.058)	47%	4.288 (1.934)	4.35 (1.875)	3%
Km to nearest health clinic	1.58* (1.126)	35%	1.407*** (0.768)	56%	1.5** (1.221)	40%	2.019 (1.35)	1.35*** (0.533)	65%
Km to nearest bank	5.62 (1.872)	23%	5.61 (1.848)	24%	5.696 (1.768)	19%	5.981 (1.18)	6.475** (0.96)	46%
Km to nearest borehole	0.6 (0.808)	4%	0.373* (0.522)	34%	0.321** (0.508)	41%	0.635 (0.95)	0.6 (0.545)	5%
Km to nearest agricultural camp office	1.96 (1.737)	2%	1.424** (0.747)	46%	1.625 (1.287)	23%	1.923 (1.355)	1.175*** (0.594)	72%
Village has a road accessible by bus or truck all year	0.28 (0.454)	26%	0.254* (0.439)	32%	0.375 (0.489)	6%	0.404 (0.495)	0.3 (0.464)	22%
Village has a point where households can sell crops to private buyers	0.36 (0.485)	7%	0.186* (0.393)	32%	0.464 (0.503)	28%	0.327 (0.474)	0.175* (0.385)	35%
Village has a market	0.06 (0.24)	21%	0.034 (0.183)	9%	0.125** (0.334)	41%	0.019 (0.139)	0.025 (0.158)	4%
Village has a primary school	0.12 (0.328)	8%	0.102 (0.305)	2%	0.161 (0.371)	19%	0.096 (0.298)	0.1 (0.304)	1%
Village has a borehole	0.48 (0.505)	4%	0.644 (0.483)	29%	0.696** (0.464)	41%	0.5 (0.505)	0.425 (0.501)	15%

TABLE A8.6. FIELD-LEVEL DEMOGRAPHICS AGGREGATED AT THE HOUSEHOLD LEVEL

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Field has clay soil	0.168 (0.344)	7%	0.221 (0.38)	8%	0.161 (0.335)	9%	0.193 (0.361)	0.246** (0.385)	14%
Field has sandy loamy soil	0.456* (0.454)	15%	0.344 (0.431)	10%	0.386 (0.441)	1%	0.389 (0.45)	0.437 (0.446)	11%
Field has loamy soil	0.166 (0.338)	2%	0.21 (0.377)	10%	0.208 (0.376)	10%	0.174 (0.355)	0.183 (0.357)	3%
Field has silt soil	0.012 (0.102)	9%	0.021 (0.131)	1%	0.017 (0.112)	4%	0.022 (0.14)	0.025 (0.146)	2%
Field has gravel soil	0.027 (0.154)	7%	0.012 (0.096)	5%	0.011 (0.097)	7%	0.018 (0.121)	0.008 (0.08)	9%
Field has black soil	0.145* (0.32)	13%	0.172 (0.353)	5%	0.199 (0.368)	3%	0.19 (0.367)	0.075*** (0.239)	37%
Field has other soil	0.021** (0.126)	13%	0.016 (0.114)	9%	0.011 (0.093)	4%	0.007 (0.076)	0.013 (0.101)	7%
Distance from house to field (meters)	2384.03* (4936.189)	13%	2076.006 (2400.077)	9%	1910.822 (2976.949)	1%	1872.243 (2329.896)	2346.634* (3164.592)	17%
Area of field in ha	0.824*** (0.79)	28%	0.772*** (0.808)	19%	0.679 (0.439)	8%	0.645 (0.455)	0.622 (0.444)	5%
Field inherited	0.818 (0.292)	8%	0.809 (0.297)	5%	0.804 (0.298)	3%	0.794 (0.305)	0.801 (0.298)	2%
Field allocated	0.138 (0.265)	5%	0.127 (0.246)	9%	0.124 (0.245)	11%	0.151 (0.277)	0.121 (0.244)	12%
Field purchased	0.002 (0.037)	8%	0.003 (0.041)	7%	0.004 (0.053)	5%	0.007 (0.072)	0.002 (0.036)	8%
Field rented	0.016 (0.092)	3%	0.013 (0.074)	7%	0.018 (0.088)	2%	0.019 (0.094)	0.024 (0.1)	5%
Field borrowed	0.015 (0.075)	4%	0.019 (0.091)	9%	0.026*** (0.112)	15%	0.012 (0.069)	0.021 (0.099)	11%
Field acquired through other methods	0.002 (0.043)	6%	0.001 (0.019)	2%	0.001 (0.038)	4%	0 (0.009)	0 (0)	5%
Field has paper documentation*	0.014 (0.112)	1%	0.013 (0.109)	2%	0.009 (0.094)	5%	0.015 (0.117)	0.004* (0.06)	11%
Short and Long-term HH Tenure Security Index on Field- where 1=Very Secure & 6=Very Insecure	0.172 (2.507)	10%	-0.053 (2.558)	1%	0.038 (2.594)	5%	-0.084 (2.544)	-0.048 (2.495)	1%

TABLE A8.7. HOUSEHOLD DEMOGRAPHICS

	Agroforestry	% Bias	Land Tenure	% Bias	Agroforestry and Land Tenure	% Bias	Control	Agroforestry Control	% Bias
Gender of HH Head	0.246 (0.431)	4%	0.261 (0.44)	7%	0.268 (0.443)	9%	0.231 (0.422)	0.327*** (0.469)	22%
Age of HH Head	44.395* (16.319)	16%	44.5* (16.873)	16%	42.308 (16.577)	3%	41.865 (15.716)	44.673* (16.525)	17%
Head is under the age of 35 at baseline	0.335 (0.472)	11%	0.382 (0.486)	2%	0.413 (0.493)	5%	0.39 (0.489)	0.337 (0.473)	11%
HH Head's highest level of education	6.596 (3.666)	9%	6.918 (3.888)	0%	6.959 (3.902)	1%	6.933 (3.816)	6.762 (3.588)	5%
Household size	5.376 (2.733)	4%	5.139* (2.551)	13%	5.215 (2.724)	10%	5.485 (2.965)	5.479 (2.789)	0%
Ha of land owned	2.03 (1.918)	13%	2.082 (1.781)	11%	1.975 (1.69)	17%	2.318 (2.402)	1.696** (1.674)	30%
Number of fields	2.246*** (1.112)	37%	2.483* (1.183)	16%	2.476* (1.082)	17%	2.679 (1.246)	2.694 (1.287)	1%
HH owns less than 1 ha	0.286 (0.452)	7%	0.219** (0.414)	22%	0.257 (0.438)	13%	0.316 (0.466)	0.329 (0.47)	3%
HH had land reallocated in past 5 years*	0.019 (0.136)	3%	0.02 (0.141)	4%	0.023 (0.151)	6%	0.015 (0.12)	0.02 (0.139)	4%
Poorest quartile of HHs	0.258 (0.438)	2%	0.253 (0.435)	1%	0.264 (0.441)	3%	0.25 (0.434)	0.241 (0.428)	2%

ANNEX 9—POWER CALCULATIONS TABLES

The following tables show power calculations for the Agroforestry, Land Tenure, Agroforestry + Land Tenure, and Agroforestry Control treatment groups related to tenure security, land governance, agricultural investments, and long-term outcomes. Rare events, experienced by less than 10% of the sample, are denoted with an asterisk (*).

AGROFORESTRY

TABLE A9.1. AGROFORESTRY: LAND TENURE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Expropriation and Reallocation								
Short-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.88 (1.27)	0.05	28	4.77	0.24	0.3	16%
Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.61 (1.05)	0.04	28	4.77	0.23	0.25	16%
Short- and Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.61 (1.04)	0.07	28	4.77	0.25	0.26	16%
Household perceived expropriation risk from other HHs	HH-F	1.88 (1.23)	0.09	28	4.76	0.25	0.31	16%
Household perceived expropriation risk from elites	HH-F	1.55 (0.99)	0.08	28	4.77	0.25	0.25	16%
Household perceived expropriation risk from neighboring community	HH-F	1.67 (1.09)	0.06	28	4.77	0.24	0.26	16%
Household perceived expropriation risk from chief	Vil	2.15 (0.86)		25		0.68	0.58	27%
Household perceived expropriation risk from headman"	Vil	1.54 (0.94)		25		0.68	0.64	42%
Household perceived expropriation risk from extended family	Vil	2.21 (1.45)		25		0.68	0.98	44%
Household perceived expropriation risk index (1 is most secure, 6 is least secure)	Vil	2.71 (1.47)		25		0.68	1	37%
Land Disputes and Conflict								
Village experienced land-related conflict	Vil	0.4 (0.49)		25		0.68	0.33	82%
Number of land disputes experienced by village	Vil	0.72 (1.38)		25		0.68	0.93	129%
Number of land disputes about boundaries	Vil	0.5 (1.18)		25		0.68	0.8	160%
Number of land disputes about land allocation	Vil	0.2 (0.68)		25		0.68	0.46	230%
Change in frequency of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.68 (0.49)		25		0.68	0.33	49%
Change in Intensity of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.66 (0.47)		25		0.68	0.32	48%
Land Documentation								
HH has paper documentation for at least one field*	HH	0.02 (0.14)	0.03	19.8	4.41	0.28	0.04	200%
Field has paper documentation*	HH-F	0.01 (0.12)	0.01	28	4.78	0.22		22%
Field has customary certification*	HH-F	0.01 (0.08)	0.01	28	4.79	0.22		22%
Land Rental Activity								
HH rents out land*	HH	0.02 (0.15)	0.02	19.8	4.35	0.28	0.04	200%
Access to Credit								
HH obtained formal loan from bank or microcredit institution*	HH	0.06 (0.23)	0.16	19.8	4.4	0.34	0.08	133%

TABLE A9.2. AGROFORESTRY: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Management								
Headperson reports existence of Village Land Committee*	Vil	0.22 (0.42)		25		0.68	0.28	127%
Land management-related meeting held in village in past year*	Vil	1.23 (2.52)		25		0.68	1.71	139%
Number of land management-related meetings held in village in past year*	Vil	0.32 (0.47)		25		0.68	0.32	100%
HH reports existence of Village Land Committee*	HH	0.21 (0.4)	0.1	19.6	4.3	0.32	0.13	62%
Frequency of HH participation in land management-related meetings	HH	0.89 (1.16)	0.04	19.6	4.3	0.29	0.34	38%
HHs is satisfied with the way VLC is managing customary land in village	HH	1.98 (0.91)	0.03	19.6	4.24	0.29	0.26	13%
HH believes village leaders/VLC are trusted and honest	HH	1.9 (0.88)	0.07	19.6	4.29	0.31	0.27	14%
HH believes the village leaders/VLC protect comm. land from being taken or encroached	HH	1.75 (0.8)	0.06	19.6	4.29	0.3	0.24	14%
HH believes land related decision making is transparent	HH	0.34 (0.48)	0.35	12.5	0.36	1.19	0.57	168%
Index: HH perception of land leaders, 0 is worse, 4 is best	HH	5.49 (2.26)	0.07	19.8	4.41	0.3	0.68	12%
Land Allocation								
HH believes vulnerable groups disadvantaged in land allocation decisions	HH	0.2 (0.4)	0	19.8	4.41	0.27	0.11	55%
HH believes that village leaders allocate land fairly across HHs	HH	1.93 (0.94)	0.04	19.6	4.27	0.29	0.28	15%
HH feels women have been disadvantaged in land allocation decisions	HH	3.13 (1.37)	0.03	19.6	4.27	0.29	0.4	13%
HH feels elderly have been disadvantaged in land allocation decisions	HH	3.4 (1.28)	0.03	19.6	4.28	0.29	0.37	11%
HH feels poor have been disadvantaged in land allocation decisions	HH	3.23 (1.35)	0.01	19.6	4.28	0.28	0.38	12%
HH feels HHs not sharing tribe with headman disadvantaged in land allocation decisions	HH	3.22 (1.38)	0.02	19.6	4.28	0.29	0.39	12%
HH equity indicator for land allocation	HH	0.09 (1.66)	0.02	19.6	4.26	0.29	0.47	522%
HH believes that decisions about customary land allocation are fair	HH	1.94 (0.92)	0.09	19.6	4.29	0.31	0.29	15%
HH believes that land allocation processes are transparent	HH	1.94 (0.99)	0.01	19.6	4.28	0.28	0.28	14%
HH believes land allocation decision-makers are accountable to constituents	HH	1.91 (0.82)	0.08	19.6	4.29	0.31	0.25	13%
Land Rules								
HH believes rules about land are clear and well-known	HH	-0.03 (1.35)	0.08	19.6	4.28	0.31	0.42	1400%
Overall land governance indicator	HH	1.92 (0.88)	0.07	19.6	4.29	0.31	0.27	14%
Existence of rule in village about grazing livestock	HH	0.02 (1.98)	0	19.6	4.3	0.28	0.55	2750%
Existence of rule in village about cutting trees	Vil	0.88 (0.33)		25		0.68	0.22	25%
Existence of rule in village about ownership over trees on shared fields*	Vil	0.8 (0.4)		25		0.68	0.27	34%
Existence of rule in village about use of communal land by neighboring villages	Vil	0.16 (0.37)		25		0.68	0.25	156%
Existence of rule in village about use of communal land by outsiders or investors	Vil	0.24 (0.43)		25		0.68	0.29	121%

TABLE A9.2. AGROFORESTRY: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Existence of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.21 (0.41)		25		0.68	0.28	133%
# of rules regulating village land that are monitored for rule breaking	Vil	0.7 (0.46)		25		0.68	0.31	44%
Village monitors for breaking of rule about grazing livestock	Vil	2.66 (1.26)		25		0.68	0.85	32%
Village monitors for breaking of rule about cutting trees	Vil	0.95 (0.21)		22		0.72	0.15	16%
Village monitors for breaking of rule about ownership over trees on shared fields*	Vil	0.85 (0.36)		20		0.76	0.27	32%
Village monitors for breaking of rule about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.72 (0.45)		4		1.91	0.86	119%
% of rules in village that are monitored for rule breaking	Vil	0.86 (0.35)		17.75		0.81	0.28	33%
Penalty for breaking of rule in village about grazing livestock	Vil	0.91 (0.22)		24.5		0.68	0.15	16%
Penalty for breaking of rule in village about cutting trees	Vil	0.97 (0.16)		22		0.72	0.12	12%
Penalty for breaking of rule in village about ownership over trees on shared fields*	Vil	0.88 (0.32)		20		0.76	0.24	27%
Penalty for breaking of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.81 (0.4)		4		1.91	0.76	94%
% of rules in village that have penalties rule breaking	Vil	0.89 (0.32)		17.75		0.81	0.26	29%
# of rules in village that have penalties rule breaking	Vil	0.93 (0.17)		24.5		0.68	0.12	13%
Index: Land Rules, where 0=weakest, 6=strongest	Vil	2.73 (1.26)		25		0.68	0.85	31%
HH believes rules about land are clear and well-known	Vil	2.69 (1.23)		25		0.68	0.83	31%

TABLE A9.3. AGROFORESTRY: AGRICULTURAL INVESTMENTS

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Uptake								
HH engages in agroforestry on at least one field*	HH	0.1 (0.29)	0.08	19.8	4.41	0.31	0.09	90%
Field planted with agroforestry trees or shrubs*	HH-F	0.04 (0.15)	0.06	28	4.79	0.24		24%
% of field planted with agroforestry trees or shrubs*	HH-F	3.57 (1.49)	0.25	17	0.47	0.94	1.4	39%
Musangu seedlings planted on field*	HH-F	0.6 (0.49)	0.22	17.75	0.48	0.92		92%
Gliricidia seedlings planted on field*	HH-F	0.15 (0.36)	0.46	17.75	0.48	0.85		85%
Agricultural Investment								
HH engagement in fallowing to improve field(s)	HH	0.13 (0.34)	0.07	19.8	4.41	0.3	0.1	77%
HH engagement in agricultural investment to improve field	HH-F	0.94 (0.19)	0.06	28	4.79	0.24		24%
Short-term Agricultural Investment Index	HH-F	0.01 (1.27)	0.01	28	4.78	0.22		22%
Long-term Agricultural Investment Index	HH-F	-0.01 (1.18)	0.01	28	4.78	0.22		22%
HH planted basins on field	HH-F	0.12 (0.26)	0.06	28	4.78	0.24		24%
HH practiced zero tillage on field*	HH-F	0.1 (0.26)	0.1	28	4.78	0.26		26%
HH practiced ridging, mounding or terrace on field*	HH-F	0.85 (0.31)	0.05	28	4.78	0.24		24%
HH added manure or compost on field*	HH-F	0.17 (0.3)	0.11	28	4.78	0.26		26%
HH practiced crop rotation on field*	HH-F	0.79 (0.36)	0.09	28	4.78	0.25		25%
HH improved field through fallowing*	HH-F	0.08 (0.23)	0.06	28	4.78	0.24		24%
Number of seasons field left fallow in past 5 years	HH-F	0.14 (0.47)	0.06	28	4.78	0.24	0.11	79%
Fertilizer used on field*	HH-F	0.37 (0.32)	0.15	28	4.79	0.27		27%
Kgs of fertilizer applied per hectare*	HH-F	110.01 (394.86)	0.02	28	4.79	0.23	89.28	81%
Kgs of fertilizer applied*	HH-F	70.75 (121.12)	0.07	28	4.74	0.25	29.82	42%

TABLE A9.4. AGROFORESTRY: LONG-TERM OUTCOMES

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Productivity								
HH reported improved crop growth around trees on field as result of planting agroforestry trees	HH-F	0.01 (0.06)	0	28	4.79	0.22		22%
HH reported higher overall crop yield on field as result of planting agroforestry trees	HH-F	0 (0.05)	0.01	28	4.79	0.22		22%
Livelihood Improvement								
Asset-based wealth index: Assets(counts), Livestock(counts), land area owned, roof construct	HH	-0.06 (1.77)	0.03	19.8	4.35	0.29	0.51	850%

LAND TENURE

TABLE A9.5. LAND TENURE: TENURE SECURITY

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Expropriation and Reallocation								
Short-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.92 (1.29)	0.04	27.6	4.8	0.24	0.3	16%
Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.6 (1.08)	0.06	27.6	4.8	0.24	0.26	16%
Short- and Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.63 (1.1)	0.06	27.6	4.8	0.24	0.27	17%
Household perceived expropriation risk from other HHs	HH-F	1.82 (1.22)	0.07	27.6	4.79	0.25	0.3	16%
Household perceived expropriation risk from elites	HH-F	1.47 (0.95)	0.05	27.6	4.8	0.24	0.23	16%
Household perceived expropriation risk from neighboring community	HH-F	1.58 (1.03)	0.06	27.6	4.8	0.24	0.25	16%
Household perceived expropriation risk from chief	Vil	2.01 (0.81)		27.75		0.64	0.52	26%
Household perceived expropriation risk from headman"	Vil	1.52 (0.9)		27.75		0.64	0.58	38%
Household perceived expropriation risk from extended family	Vil	2.06 (1.35)		27.75		0.64	0.87	42%
Household perceived expropriation risk index (1 is most secure, 6 is least secure)	Vil	2.45 (1.41)		27.75		0.64	0.9	37%
Land Disputes and Conflict								
Village experienced land-related conflict	Vil	0.42 (0.5)		27.75		0.64	0.32	76%
Number of land disputes experienced by village	Vil	0.75 (1.34)		27.75		0.64	0.86	115%
Number of land disputes about boundaries	Vil	0.58 (1.21)		27.75		0.64	0.78	134%
Number of land disputes about land allocation	Vil	0.17 (0.64)		27.75		0.64	0.41	241%
Change in frequency of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.73 (0.45)		27.75		0.64	0.29	40%
Change in Intensity of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.71 (0.42)		27.75		0.64	0.27	38%
Land Documentation								
HH has paper documentation for at least one field*	HH	0.02 (0.15)	0.06	17.6	3.99	0.33	0.05	250%
Field has paper documentation*	HH-F	0.01 (0.11)	0.07	27.6	4.8	0.25		25%
Field has customary certification*	HH-F	0.01 (0.09)	0.06	27.6	4.83	0.24		24%
Land Rental Activity								
HH rents out land*	HH	0.03 (0.16)	0.03	17.6	3.95	0.32	0.05	167%
Access to Credit								
HH obtained formal loan from bank or microcredit institution*	HH	0.04 (0.19)	0.04	17.6	3.98	0.32	0.06	150%

TABLE A9.6. LAND TENURE: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Management								
Headperson reports existence of Village Land Committee*	Vil	0.18 (0.39)		27.75		0.64	0.25	139%
Land management-related meeting held in village in past year*	Vil	1.02 (2.17)		27.75		0.64	1.39	136%
Number of land management-related meetings held in village in past year*	Vil	0.31 (0.46)		27.75		0.64	0.3	97%
HH reports existence of Village Land Committee*	HH	0.18 (0.39)	0.07	17.4	3.9	0.34	0.13	72%
Frequency of HH participation in land management-related meetings	HH	0.82 (1.15)	0.09	17.4	3.89	0.35	0.4	49%
HHs is satisfied with the way VLC is managing customary land in village	HH	1.98 (0.84)	0.03	17.4	3.86	0.32	0.27	14%
HH believes village leaders/VLC are trusted and honest	HH	1.92 (0.83)	0.04	17.4	3.88	0.33	0.27	14%
HH believes the village leaders/VLC protect comm. land from being taken or encroached	HH	1.79 (0.78)	0.06	17.4	3.88	0.33	0.26	15%
HH believes land related decision making is transparent	HH	0.41 (0.5)	0.36	9	0.29	1.56	0.78	190%
Index: HH perception of land leaders, 0 is worse, 4 is best	HH	5.56 (2.17)	0.07	17.6	3.99	0.33	0.72	13%
Land Allocation								
HH believes vulnerable groups disadvantaged in land allocation decisions	HH	0.19 (0.39)	0	17.6	3.99	0.3	0.12	63%
HH believes that village leaders allocate land fairly across HHs	HH	1.95 (0.92)	0.04	17.4	3.88	0.33	0.3	15%
HH feels women have been disadvantaged in land allocation decisions	HH	3.12 (1.39)	0.07	17.4	3.88	0.34	0.47	15%
HH feels elderly have been disadvantaged in land allocation decisions	HH	3.43 (1.28)	0.06	17.4	3.88	0.33	0.43	13%
HH feels poor have been disadvantaged in land allocation decisions	HH	3.19 (1.36)	0.08	17.4	3.88	0.34	0.47	15%
HH feels HHs not sharing tribe with headman disadvantaged in land allocation decisions	HH	3.17 (1.38)	0.04	17.4	3.88	0.33	0.45	14%
HH equity indicator for land allocation	HH	0.06 (1.71)	0.08	17.4	3.88	0.34	0.59	983%
HH believes that decisions about customary land allocation are fair	HH	1.91 (0.89)	0.08	17.4	3.89	0.34	0.3	16%
HH believes that land allocation processes are transparent	HH	1.95 (0.95)	0.02	17.4	3.89	0.32	0.3	15%
HH believes land allocation decision-makers are accountable to constituents	HH	1.91 (0.82)	0.07	17.4	3.88	0.34	0.28	15%
Land Rules								
HH believes rules about land are clear and well-known	HH	-0.04 (1.37)	0.06	17.4	3.88	0.33	0.46	1150%
Overall land governance indicator	HH	1.89 (0.84)	0.06	17.4	3.89	0.33	0.28	15%
Existence of rule in village about grazing livestock	HH	0.01 (1.94)	0	17.4	3.89	0.31	0.6	6000%
Existence of rule in village about cutting trees	Vil	0.84 (0.37)		27.75		0.64	0.24	29%
Existence of rule in village about ownership over trees on shared fields*	Vil	0.78 (0.41)		27.75		0.64	0.26	33%
Existence of rule in village about use of communal land by neighboring villages	Vil	0.21 (0.41)		27.75		0.64	0.26	124%
Existence of rule in village about use of communal land by outsiders or investors	Vil	0.3 (0.46)		27.75		0.64	0.3	100%

TABLE A9.6. LAND TENURE: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Existence of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.28 (0.45)		27.75		0.64	0.29	104%
# of rules regulating village land that are monitored for rule breaking	Vil	0.73 (0.45)		27.75		0.64	0.29	40%
Village monitors for breaking of rule about grazing livestock	Vil	2.82 (1.44)		27.75		0.64	0.92	33%
Village monitors for breaking of rule about cutting trees	Vil	0.97 (0.18)		23.25		0.7	0.13	13%
Village monitors for breaking of rule about ownership over trees on shared fields*	Vil	0.83 (0.38)		21.75		0.73	0.28	34%
Village monitors for breaking of rule about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.83 (0.39)		5.75		1.49	0.58	70%
% of rules in village that are monitored for rule breaking	Vil	0.85 (0.36)		20.25		0.75	0.27	32%
Penalty for breaking of rule in village about grazing livestock	Vil	0.92 (0.17)		27		0.65	0.11	12%
Penalty for breaking of rule in village about cutting trees	Vil	0.98 (0.15)		23.25		0.7	0.11	11%
Penalty for breaking of rule in village about ownership over trees on shared fields*	Vil	0.83 (0.38)		21.75		0.73	0.28	34%
Penalty for breaking of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.91 (0.29)		5.75		1.49	0.43	47%
% of rules in village that have penalties rule breaking	Vil	0.89 (0.32)		20.25		0.75	0.24	27%
# of rules in village that have penalties rule breaking	Vil	0.91 (0.19)		27		0.65	0.12	13%
Index: Land Rules, where 0=weakest, 6=strongest	Vil	2.86 (1.53)		27.75		0.64	0.98	34%
HH believes rules about land are clear and well-known	Vil	2.83 (1.43)		27.75		0.64	0.92	33%

TABLE A9.7. LAND TENURE: AGRICULTURAL INVESTMENTS

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Uptake								
HH engages in agroforestry on at least one field*	HH	0.12 (0.32)	0.08	17.6	3.99	0.34	0.11	92%
Field planted with agroforestry trees or shrubs*	HH-F	0.05 (0.17)	0.08	27.6	4.83	0.25		25%
% of field planted with agroforestry trees or shrubs*	HH-F	3.72 (1.36)	0.14	19	0.53	0.86	1.17	31%
Musangu seedlings planted on field*	HH-F	0.62 (0.49)	0.39	19.75	0.55	0.79		79%
Gliricidia seedlings planted on field*	HH-F	0.2 (0.4)	0.4	19.75	0.55	0.78		78%
Agricultural Investment								
HH engagement in fallowing to improve field(s)	HH	0.13 (0.33)	0.04	17.6	3.99	0.32	0.11	85%
HH engagement in agricultural investment to improve field	HH-F	0.94 (0.19)	0.04	27.6	4.83	0.23		23%
Short-term Agricultural Investment Index	HH-F	0.05 (1.52)	0	27.6	4.81	0.22		22%
Long-term Agricultural Investment Index	HH-F	0.03 (1.41)	0.01	27.6	4.81	0.22		22%
HH planted basins on field	HH-F	0.09 (0.23)	0.09	27.6	4.82	0.25		25%
HH practiced zero tillage on field*	HH-F	0.08 (0.23)	0.13	27.6	4.82	0.27		27%
HH practiced ridging, mounding or terrace on field*	HH-F	0.85 (0.31)	0.05	27.6	4.81	0.24		24%
HH added manure or compost on field*	HH-F	0.16 (0.3)	0.08	27.6	4.81	0.25		25%
HH practiced crop rotation on field*	HH-F	0.79 (0.36)	0.08	27.6	4.81	0.25		25%
HH improved field through fallowing*	HH-F	0.07 (0.2)	0.05	27.6	4.81	0.24		24%
Number of seasons field left fallow in past 5 years	HH-F	0.13 (0.45)	0.04	27.6	4.81	0.24	0.11	85%
Fertilizer used on field*	HH-F	0.34 (0.3)	0.11	27.6	4.83	0.26		26%
Kgs of fertilizer applied per hectare*	HH-F	95.65 (357.33)	0.02	27.6	4.83	0.23	81.07	85%
Kgs of fertilizer applied*	HH-F	65.57 (120.57)	0.05	27.6	4.78	0.24	28.91	44%

TABLE A9.8. LAND TENURE: LONG-TERM OUTCOMES

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Productivity								
HH reported improved crop growth around trees on field as result of planting agroforestry trees	HH-F	0.01 (0.08)	0.06	27.6	4.83	0.24		24%
HH reported higher overall crop yield on field as result of planting agroforestry trees	HH-F	0.01 (0.07)	0.01	27.6	4.83	0.22		22%
Livelihood Improvement								
Asset-based wealth index: Assets(counts), Livestock(counts), land area owned, roof construct	HH	-0.07 (1.79)	0.09	17.6	3.93	0.34	0.61	871%

AGROFORESTRY+LAND TENURE

TABLE A9.9. AGROFORESTRY+LAND TENURE: LAND TENURE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Expropriation and Reallocation								
Short-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.97 (1.32)	0.06	27	4.8	0.25	0.32	16%
Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.63 (1.09)	0.06	27	4.8	0.25	0.27	17%
Short- and Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.66 (1.11)	0.06	27	4.8	0.25	0.27	16%
Household perceived expropriation risk from other HHs	HH-F	1.78 (1.19)	0.1	27	4.8	0.26	0.31	17%
Household perceived expropriation risk from elites	HH-F	1.47 (0.96)	0.05	27	4.8	0.24	0.23	16%
Household perceived expropriation risk from neighboring community	HH-F	1.61 (1.06)	0.07	27	4.8	0.25	0.26	16%
Household perceived expropriation risk from chief	Vil	2.04 (0.89)		27		0.65	0.58	28%
Household perceived expropriation risk from headman"	Vil	1.53 (0.91)		27		0.65	0.59	39%
Household perceived expropriation risk from extended family	Vil	2.07 (1.34)		27		0.65	0.87	42%
Household perceived expropriation risk index (1 is most secure, 6 is least secure)	Vil	2.53 (1.46)		27		0.65	0.95	38%
Land Disputes and Conflict								
Village experienced land-related conflict	Vil	0.42 (0.5)		27		0.65	0.33	79%
Number of land disputes experienced by village	Vil	0.72 (1.36)		27		0.65	0.89	124%
Number of land disputes about boundaries	Vil	0.57 (1.18)		27		0.65	0.77	135%
Number of land disputes about land allocation	Vil	0.18 (0.67)		27		0.65	0.44	244%
Change in frequency of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.73 (0.47)		27		0.65	0.31	42%
Change in Intensity of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.71 (0.46)		27		0.65	0.3	42%
Land Documentation								
HH has paper documentation for at least one field*	HH	0.02 (0.14)	0.02	17.25	3.42	0.38	0.05	250%
Field has paper documentation*	HH-F	0.01 (0.11)	0.01	27	4.81	0.23		23%
Field has customary certification*	HH-F	0.01 (0.08)	0.01	27	4.84	0.23		23%
Land Rental Activity								
HH rents out land*	HH	0.03 (0.16)	0.04	17.25	3.38	0.39	0.06	200%
Access to Credit								
HH obtained formal loan from bank or microcredit institution*	HH	0.03 (0.16)	0.02	17.25	3.41	0.38	0.06	200%

TABLE A9.10. AGROFORESTRY+LAND TENURE: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Management								
Headperson reports existence of Village Land Committee*	Vil	0.19 (0.39)		27		0.65	0.25	132%
Land management-related meeting held in village in past year*	Vil	1.2 (2.33)		27		0.65	1.52	127%
Number of land management-related meetings held in village in past year*	Vil	0.34 (0.48)		27		0.65	0.31	91%
HH reports existence of Village Land Committee*	HH	0.19 (0.39)	0.09	17	3.35	0.42	0.16	84%
Frequency of HH participation in land management-related meetings	HH	0.82 (1.13)	0.05	17	3.35	0.4	0.45	55%
HHs is satisfied with the way VLC is managing customary land in village	HH	2.05 (0.95)	0.04	17	3.3	0.4	0.38	19%
HH believes village leaders/VLC are trusted and honest	HH	1.97 (0.93)	0.06	17	3.34	0.4	0.38	19%
HH believes the village leaders/VLC protect comm. land from being taken or encroached	HH	1.81 (0.84)	0.09	17	3.35	0.42	0.35	19%
HH believes land related decision making is transparent	HH	0.3 (0.46)	0.64	6.33	0.18	2.25	1.04	347%
Index: HH perception of land leaders, 0 is worse, 4 is best	HH	5.69 (2.36)	0.1	17.25	3.42	0.41	0.98	17%
Land Allocation								
HH believes vulnerable groups disadvantaged in land allocation decisions	HH	0.19 (0.4)	0	17.25	3.42	0.37	0.15	79%
HH believes that village leaders allocate land fairly across HHs	HH	1.96 (0.95)	0.04	17	3.34	0.4	0.38	19%
HH feels women have been disadvantaged in land allocation decisions	HH	3.08 (1.4)	0.03	17	3.34	0.39	0.55	18%
HH feels elderly have been disadvantaged in land allocation decisions	HH	3.4 (1.29)	0.03	17	3.35	0.39	0.5	15%
HH feels poor have been disadvantaged in land allocation decisions	HH	3.21 (1.34)	0.04	17	3.34	0.4	0.53	17%
HH feels HHs not sharing tribe with headman disadvantaged in land allocation decisions	HH	3.24 (1.34)	0.03	17	3.34	0.39	0.52	16%
HH equity indicator for land allocation	HH	0.07 (1.7)	0.03	17	3.34	0.39	0.67	957%
HH believes that decisions about customary land allocation are fair	HH	1.93 (0.86)	0.05	17	3.35	0.4	0.34	18%
HH believes that land allocation processes are transparent	HH	1.96 (0.95)	0.02	17	3.35	0.39	0.37	19%
HH believes land allocation decision-makers are accountable to constituents	HH	1.93 (0.81)	0.05	17	3.34	0.4	0.32	17%
Land Rules								
HH believes rules about land are clear and well-known	HH	0 (1.36)	0.06	17	3.34	0.4	0.55	Inf%
Overall land governance indicator	HH	1.91 (0.86)	0.03	17	3.35	0.39	0.34	18%
Existence of rule in village about grazing livestock	HH	-0.06 (1.91)	0.01	17	3.35	0.38	0.73	1217%
Existence of rule in village about cutting trees	Vil	0.81 (0.39)		27		0.65	0.25	31%
Existence of rule in village about ownership over trees on shared fields*	Vil	0.77 (0.42)		27		0.65	0.27	35%
Existence of rule in village about use of communal land by neighboring villages	Vil	0.14 (0.35)		27		0.65	0.23	164%
Existence of rule in village about use of communal land by outsiders or investors	Vil	0.26 (0.44)		27		0.65	0.29	112%

TABLE A9.10. AGROFORESTRY+LAND TENURE: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Existence of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.23 (0.42)		27		0.65	0.27	117%
# of rules regulating village land that are monitored for rule breaking	Vil	0.74 (0.44)		27		0.65	0.29	39%
Village monitors for breaking of rule about grazing livestock	Vil	2.69 (1.36)		27		0.65	0.89	33%
Village monitors for breaking of rule about cutting trees	Vil	0.94 (0.23)		22		0.72	0.17	18%
Village monitors for breaking of rule about ownership over trees on shared fields*	Vil	0.87 (0.34)		20.75		0.74	0.25	29%
Village monitors for breaking of rule about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.87 (0.35)		3.75		2.01	0.7	80%
% of rules in village that are monitored for rule breaking	Vil	0.89 (0.32)		20		0.76	0.24	27%
Penalty for breaking of rule in village about grazing livestock	Vil	0.92 (0.19)		26.5		0.66	0.12	13%
Penalty for breaking of rule in village about cutting trees	Vil	0.99 (0.11)		22		0.72	0.08	8%
Penalty for breaking of rule in village about ownership over trees on shared fields*	Vil	0.88 (0.33)		20.75		0.74	0.25	28%
Penalty for breaking of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.87 (0.35)		3.75		2.01	0.7	80%
% of rules in village that have penalties rule breaking	Vil	0.89 (0.32)		20		0.76	0.24	27%
# of rules in village that have penalties rule breaking	Vil	0.93 (0.18)		26.5		0.66	0.12	13%
Index: Land Rules, where 0=weakest, 6=strongest	Vil	2.74 (1.4)		27		0.65	0.91	33%
HH believes rules about land are clear and well-known	Vil	2.71 (1.34)		27		0.65	0.87	32%

TABLE A9.11. AGROFORESTRY+LAND TENURE: AGRICULTURAL INVESTMENTS

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Uptake								
HH engages in agroforestry on at least one field*	HH	0.09 (0.29)	0.09	17.25	3.42	0.41	0.12	133%
Field planted with agroforestry trees or shrubs*	HH-F	0.04 (0.14)	0.08	27	4.84	0.25		25%
% of field planted with agroforestry trees or shrubs*	HH-F	3.68 (1.44)	0.21	16.25	0.45	0.99	1.43	39%
Musangu seedlings planted on field*	HH-F	0.53 (0.5)	0.13	17.25	0.47	0.96		96%
Gliricidia seedlings planted on field*	HH-F	0.22 (0.41)	0.19	17.25	0.47	0.95		95%
Agricultural Investment								
HH engagement in fallowing to improve field(s)	HH	0.1 (0.3)	0.03	17.25	3.42	0.38	0.12	120%
HH engagement in agricultural investment to improve field	HH-F	0.93 (0.2)	0.06	27	4.84	0.25		25%
Short-term Agricultural Investment Index	HH-F	0.01 (1.29)	0.01	27	4.81	0.23		23%
Long-term Agricultural Investment Index	HH-F	0 (1.25)	0.01	27	4.81	0.23		23%
HH planted basins on field	HH-F	0.09 (0.22)	0.05	27	4.81	0.24		24%
HH practiced zero tillage on field*	HH-F	0.07 (0.22)	0.19	27	4.81	0.29		29%
HH practiced ridging, mounding or terrace on field*	HH-F	0.88 (0.28)	0.05	27	4.81	0.24		24%
HH added manure or compost on field*	HH-F	0.14 (0.27)	0.06	27	4.81	0.25		25%
HH practiced crop rotation on field*	HH-F	0.79 (0.36)	0.06	27	4.81	0.25		25%
HH improved field through fallowing*	HH-F	0.06 (0.19)	0.03	27	4.81	0.23		23%
Number of seasons field left fallow in past 5 years	HH-F	0.11 (0.4)	0.04	27	4.81	0.24	0.1	91%
Fertilizer used on field*	HH-F	0.33 (0.29)	0.1	27	4.84	0.26		26%
Kgs of fertilizer applied per hectare*	HH-F	91.7 (356.21)	0.02	27	4.84	0.23	81.67	89%
Kgs of fertilizer applied*	HH-F	61.01 (119.49)	0.04	27	4.78	0.24	28.49	47%

TABLE A9.12. AGROFORESTRY+LAND TENURE: LONG-TERM OUTCOMES

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Productivity								
HH reported improved crop growth around trees on field as result of planting agroforestry trees	HH-F	0 (0.04)	0	27	4.84	0.22		22%
HH reported higher overall crop yield on field as result of planting agroforestry trees	HH-F	0 (0.03)	0	27	4.84	0.22		22%
Livelihood Improvement								
Asset-based wealth index: Assets(counts), Livestock(counts), land area owned, roof construct	HH	-0.09 (1.89)	0.04	17.25	3.37	0.39	0.74	822%

AGROFORESTRY CONTROL

TABLE A9.13. AGROFORESTRY CONTROL: LAND TENURE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Expropriation and Reallocation								
Short-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.87 (1.25)	0.03	37.4	6.83	0.17	0.21	11%
Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.61 (1.04)	0.03	37.4	6.83	0.17	0.18	11%
Short- and Long-term HH Tenure Security Index (1 is most secure, 6 is least secure)	HH-F	1.6 (1.04)	0.05	37.4	6.83	0.18	0.19	12%
Household perceived expropriation risk from other HHs	HH-F	1.87 (1.23)	0.06	37.4	6.83	0.18	0.23	12%
Household perceived expropriation risk from elites	HH-F	1.53 (0.98)	0.06	37.4	6.83	0.18	0.18	12%
Household perceived expropriation risk from neighboring community	HH-F	1.66 (1.08)	0.04	37.4	6.83	0.18	0.19	11%
Household perceived expropriation risk from chief	Vil	2.2 (0.89)		27.8		0.57	0.51	23%
Household perceived expropriation risk from headman"	Vil	1.56 (0.89)		27.8		0.57	0.51	33%
Household perceived expropriation risk from extended family	Vil	2.31 (1.46)		27.8		0.57	0.84	36%
Household perceived expropriation risk index (1 is most secure, 6 is least secure)	Vil	2.72 (1.47)		27.8		0.57	0.84	31%
Land Disputes and Conflict								
Village experienced land-related conflict	Vil	0.43 (0.49)		27.8		0.57	0.28	65%
Number of land disputes experienced by village	Vil	0.76 (1.3)		27.8		0.57	0.74	97%
Number of land disputes about boundaries	Vil	0.54 (1.12)		27.8		0.57	0.64	119%
Number of land disputes about land allocation	Vil	0.17 (0.61)		27.8		0.57	0.35	206%
Change in frequency of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.68 (0.48)		27.8		0.57	0.27	40%
Change in Intensity of land related disputes- 0=lower, 1=same, 2=higher	Vil	0.68 (0.46)		27.8		0.57	0.26	38%
Land Documentation								
HH has paper documentation for at least one field*	HH	0.02 (0.14)	0.03	19.8	4.41	0.28	0.04	200%
Field has paper documentation*	HH-F	0.01 (0.1)	0.01	37.4	6.84	0.16		16%
Field has customary certification*	HH-F	0.01 (0.07)	0.01	37.4	6.87	0.16		16%
Land Rental Activity								
HH rents out land*	HH	0.02 (0.15)	0.02	19.8	4.35	0.28	0.04	200%
Access to Credit								
HH obtained formal loan from bank or microcredit institution*	HH	0.06 (0.23)	0.16	19.8	4.4	0.34	0.08	133%

TABLE A9.14. AGROFORESTRY CONTROL: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Land Management								
Headperson reports existence of Village Land Committee*	Vil	0.19 (0.4)		27.8		0.57	0.23	121%
Land management-related meeting held in village in past year*	Vil	1.13 (2.26)		27.8		0.57	1.29	114%
Number of land management-related meetings held in village in past year*	Vil	0.33 (0.47)		27.8		0.57	0.27	82%
HH reports existence of Village Land Committee*	HH	0.21 (0.4)	0.1	19.6	4.3	0.32	0.13	62%
Frequency of HH participation in land management-related meetings	HH	0.89 (1.16)	0.04	19.6	4.3	0.29	0.34	38%
HHs is satisfied with the way VLC is managing customary land in village	HH	1.98 (0.91)	0.03	19.6	4.24	0.29	0.26	13%
HH believes village leaders/VLC are trusted and honest	HH	1.9 (0.88)	0.07	19.6	4.29	0.31	0.27	14%
HH believes the village leaders/VLC protect comm. land from being taken or encroached	HH	1.75 (0.8)	0.06	19.6	4.29	0.3	0.24	14%
HH believes land related decision making is transparent	HH	0.34 (0.48)	0.35	12.5	0.36	1.19	0.57	168%
Index: HH perception of land leaders, 0 is worse, 4 is best	HH	5.49 (2.26)	0.07	19.8	4.41	0.3	0.68	12%
Land Allocation								
HH believes vulnerable groups disadvantaged in land allocation decisions	HH	0.2 (0.4)	0	19.8	4.41	0.27	0.11	55%
HH believes that village leaders allocate land fairly across HHs	HH	1.93 (0.94)	0.04	19.6	4.27	0.29	0.28	15%
HH feels women have been disadvantaged in land allocation decisions	HH	3.13 (1.37)	0.03	19.6	4.27	0.29	0.4	13%
HH feels elderly have been disadvantaged in land allocation decisions	HH	3.4 (1.28)	0.03	19.6	4.28	0.29	0.37	11%
HH feels poor have been disadvantaged in land allocation decisions	HH	3.23 (1.35)	0.01	19.6	4.28	0.28	0.38	12%
HH feels HHs not sharing tribe with headman disadvantaged in land allocation decisions	HH	3.22 (1.38)	0.02	19.6	4.28	0.29	0.39	12%
HH equity indicator for land allocation	HH	0.09 (1.66)	0.02	19.6	4.26	0.29	0.47	522%
HH believes that decisions about customary land allocation are fair	HH	1.94 (0.92)	0.09	19.6	4.29	0.31	0.29	15%
HH believes that land allocation processes are transparent	HH	1.94 (0.99)	0.01	19.6	4.28	0.28	0.28	14%
HH believes land allocation decision-makers are accountable to constituents	HH	1.91 (0.82)	0.08	19.6	4.29	0.31	0.25	13%
Land Rules								
HH believes rules about land are clear and well-known	HH	-0.03 (1.35)	0.08	19.6	4.28	0.31	0.42	1400%
Overall land governance indicator	HH	1.92 (0.88)	0.07	19.6	4.29	0.31	0.27	14%
Existence of rule in village about grazing livestock	HH	0.02 (1.98)	0	19.6	4.3	0.28	0.55	2750%
Existence of rule in village about cutting trees	Vil	0.89 (0.31)		27.8		0.57	0.18	20%
Existence of rule in village about ownership over trees on shared fields*	Vil	0.81 (0.39)		27.8		0.57	0.22	27%
Existence of rule in village about use of communal land by neighboring villages	Vil	0.15 (0.36)		27.8		0.57	0.21	140%
Existence of rule in village about use of communal land by outsiders or investors	Vil	0.23 (0.42)		27.8		0.57	0.24	104%

TABLE A9.14. AGROFORESTRY CONTROL: LAND GOVERNANCE

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Existence of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.22 (0.41)		27.8		0.57	0.23	105%
# of rules regulating village land that are monitored for rule breaking	Vil	0.74 (0.44)		27.8		0.57	0.25	34%
Village monitors for breaking of rule about grazing livestock	Vil	2.74 (1.27)		27.8		0.57	0.73	27%
Village monitors for breaking of rule about cutting trees	Vil	0.96 (0.2)		24.8		0.61	0.12	12%
Village monitors for breaking of rule about ownership over trees on shared fields*	Vil	0.86 (0.35)		22.6		0.64	0.22	26%
Village monitors for breaking of rule about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.79 (0.41)		4.2		1.6	0.66	84%
% of rules in village that are monitored for rule breaking	Vil	0.87 (0.33)		20.6		0.67	0.22	25%
Penalty for breaking of rule in village about grazing livestock	Vil	0.92 (0.21)		27.2		0.58	0.12	13%
Penalty for breaking of rule in village about cutting trees	Vil	0.98 (0.13)		24.8		0.61	0.08	8%
Penalty for breaking of rule in village about ownership over trees on shared fields*	Vil	0.89 (0.31)		22.6		0.64	0.2	22%
Penalty for breaking of rule in village about setting fires for land clearing, land preparation, or post-harvest burning*	Vil	0.86 (0.36)		4.2		1.6	0.58	67%
% of rules in village that have penalties rule breaking	Vil	0.89 (0.31)		20.6		0.67	0.21	24%
# of rules in village that have penalties rule breaking	Vil	0.94 (0.16)		27.2		0.58	0.09	10%
Index: Land Rules, where 0=weakest, 6=strongest	Vil	2.81 (1.26)		27.8		0.57	0.72	26%
HH believes rules about land are clear and well-known	Vil	2.76 (1.24)		27.8		0.57	0.71	26%

TABLE A9.15. AGROFORESTRY CONTROL: AGRICULTURAL INVESTMENTS

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Uptake								
HH engages in agroforestry on at least one field*	HH	0.1 (0.29)	0.08	19.8	4.41	0.31	0.09	90%
Field planted with agroforestry trees or shrubs*	HH-F	0.04 (0.14)	0.04	37.4	6.87	0.17		17%
% of field planted with agroforestry trees or shrubs*	HH-F	3.68 (1.42)	0.19	19.8	0.67	0.67	0.96	26%
Musangu seedlings planted on field*	HH-F	0.64 (0.48)	0.27	20.4	0.68	0.65		65%
Gliricidia seedlings planted on field*	HH-F	0.13 (0.34)	0.33	20.4	0.68	0.64		64%
Agricultural Investment								
HH engagement in fallowing to improve field(s)	HH	0.13 (0.34)	0.07	19.8	4.41	0.3	0.1	77%
HH engagement in agricultural investment to improve field	HH-F	0.94 (0.19)	0.05	37.4	6.87	0.18		18%
Short-term Agricultural Investment Index	HH-F	0.01 (1.27)	0.01	37.4	6.84	0.16		16%
Long-term Agricultural Investment Index	HH-F	0.02 (1.29)	0.01	37.4	6.84	0.16		16%
HH planted basins on field	HH-F	0.11 (0.26)	0.05	37.4	6.86	0.18		18%
HH practiced zero tillage on field*	HH-F	0.1 (0.26)	0.11	37.4	6.86	0.2		20%
HH practiced ridging, mounding or terrace on field*	HH-F	0.84 (0.31)	0.06	37.4	6.85	0.18		18%
HH added manure or compost on field*	HH-F	0.19 (0.32)	0.1	37.4	6.84	0.2		20%
HH practiced crop rotation on field*	HH-F	0.79 (0.36)	0.07	37.4	6.84	0.19		19%
HH improved field through fallowing*	HH-F	0.08 (0.23)	0.06	37.4	6.84	0.18		18%
Number of seasons field left fallow in past 5 years	HH-F	0.16 (0.52)	0.06	37.4	6.84	0.18	0.1	62%
Fertilizer used on field*	HH-F	0.39 (0.31)	0.14	37.4	6.87	0.21		21%
Kgs of fertilizer applied per hectare*	HH-F	126.68 (398.52)	0.01	37.4	6.85	0.16	64.53	51%
Kgs of fertilizer applied*	HH-F	81.54 (149.73)	0.05	37.4	6.81	0.18	26.86	33%

TABLE A9.6. AGROFORESTRY CONTROL: LONG-TERM OUTCOMES

	Level	Mean (SD)	ICC	Cluster Number	Cluster Size	MDES	Point Change	Percent Change
Agroforestry Productivity								
HH reported improved crop growth around trees on field as result of planting agroforestry trees	HH-F	0.01 (0.06)	0	37.4	6.87	0.16		16%
HH reported higher overall crop yield on field as result of planting agroforestry trees	HH-F	0.01 (0.05)	0.01	37.4	6.87	0.16		16%
Livelihood Improvement								
Asset-based wealth index: Assets(counts), Livestock(counts), land area owned, roof construct	HH	-0.06 (1.77)	0.03	19.8	4.35	0.29	0.51	850%

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