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USAID TGCC ZAMBIA CLIMATE SMART AGRICULTURE IMPACT EVALUATION

Impact Evaluation Design Report

AUGUST 2014

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ACRONYMS AND ABBREVIATIONS

ATE	Average treatment effect
CLR	Cluster Level Reliability
CSOs	Civil Society Organizations
CSA	Climate Smart Agriculture
DLA	District Land Alliance
H	Hypothesis
ICC	Intra-Class Correlation
IE	Impact Evaluation
IRB	Institutional Review Board
LTPR	Land Tenure and Property Rights
LTD	Land Tenure Division
M&E	Monitoring & Evaluation
MDES	Minimum Detectable Effect Size
NGO	Non-Government Organization
RALS	Rural Agricultural Livelihood Survey
RCT	Randomized Control Trial
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RFP	Request for proposals
STARR	Strengthening Tenure and Resource Rights
SSA	Sub-Saharan Africa
SWC	Soil and Water Conservation
TGCC	Tenure and Global Climate Change Project
USAID	U.S. Agency for International Development

1.0 INTRODUCTION

This report describes an impact evaluation (IE) design for the climate smart agriculture (CSA) pilot of the USAID Tenure and Global Climate Change (TGCC) program in Zambia. The USAID TGCC Zambia Climate Smart Agriculture pilot is a 3.5-year intervention supported by USAID. The CSA interventions, being implemented in the Chipata District, one of eight districts of Zambia's Eastern Province, are expected to commence in late summer 2014 and end in 2018.

The TGCC program, being implemented by Tetra Tech, was created by USAID to explore the relationship between secure resource tenure and the achievement of climate change adaptation and mitigation goals. 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 will support activities that increase tenure security at the chief, village and household levels, while also supporting agroforestry extension services, primarily at the village level. TGCC's proposed work in Zambia addresses the USAID/Zambia objectives of improving an enabling governance environment, as well as reducing rural poverty through increased smallholder agriculture productivity, improved natural resource management and improved resilience of vulnerable households.

Eastern Province has some of Zambia's most favorable agro-ecological conditions in terms of rainfall, soil quality, and absence of 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 outgrower schemes and conservation farming. Maize is the staple crop, but a wide variety of other crops are grown; including beans, groundnuts, 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, 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. The land tenure interventions included in the pilot activities under TGCC are designed to address these land tenure issues. The primary objective of this evaluation is to determine whether or not 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 CSA.

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

1. Agroforestry extension in villages to facilitate tree planting adoption and survivorship on smallholder farms; 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 and provision of land information and dispute resolution services, including the facilitation of customary land certificates for households. 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.

TGCC envisions working in approximately 6-10 chiefdoms. The chiefs have ultimate authority over the management of customary lands in Zambia; therefore the chief must clear project tenure interventions at the village and household levels, including the issuance of customary land certificates to households. Here, customary land certificates are informal certificates of recognition issued by the chief recognizing the land holdings of village households; although, they are not legally binding. Up to 300 villages will be included in the study, including up to 75 control group villages.

The evaluation team proposes a four-arm, cross-cutting randomized control trial (RCT) design to identify the interventions' direct and joint impact on key outcomes. The four arms of the RCT are:

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

Note that the village- and household-level interventions of interest for the TGCC IE will only take place in chiefdoms where the TGCC program has also implemented chiefdom-level interventions. These interventions include the facilitation of dialogue around improved land governance, the development of mechanisms to increase transparency in land allocation and land disputes, as well as training in land administration support. The inability to generate statistically valid results given the small number of chiefdoms under consideration rules out an impact evaluation design capable of identifying the impact 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. At the same time, any villages in these chiefdoms where headperson do not implement/enforce these (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. However, 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.

This impact evaluation is designed to rigorously assess the direct and joint impacts of the agroforestry extension intervention and tenure security strengthening interventions on four main types of outcomes. These categories are:

1. Changes in household perceptions of tenure security over their smallholdings;
2. Planned and actual agricultural investment and other land use plans resulting from perceived tenure security;
3. Household behavior change around agroforestry and related CSA activities; and

4. Distal outcomes around agricultural productivity, livelihood improvements and climate resilience, which are expected to flow from the interventions over longer time horizons and are of broader interest to USAID.

The IE will also address contextual issues and causal mechanisms through qualitative data collection, such as focus groups and interviews. In addition, the project team has requested access to official quantitative data, such as the 2010 Zambia Census and the 2012 Rural Agricultural Livelihoods Survey (RALS). This RALS data is important to the team because it will enable more accurate power calculations. In particular, since the RALS survey was conducted in Eastern Province, the data can be used to calculate intra-class correlation. Also, since the survey instruments will utilize many of the RALS indicators, an analysis of the data will allow the team to explore respondent variation across survey categories.

The TGCC program interventions are expected to be implemented through one primary agroforestry implementing partner and one tenure implementing partner. One consideration is that there are practical constraints to the number of villages that can receive the treatment in a given year. In particular, this number is a function of the number of individuals trained to implement the village-level tenure interventions and the amount of time spent in each village. To illustrate these tradeoffs in analytical power, given TGCC implementation across differing numbers of villages, this IE design report provides power calculations for two different scenarios:

1. TGCC implementation in a larger number of villages with a fewer number of households sampled in the IE data collection; and
2. TGCC implementation in a smaller number of villages with a larger number of households sampled for the IE data collection.

This report lays out the IE design, including discussion of the underlying logic of the proposed intervention and its envisioned impacts, a review of the literature surrounding agroforestry and tenure issues, key research questions and hypotheses to be tested, a detailed presentation of the evaluation design, sample requirements and power calculations, data requirements, and the proposed timeline and schedule of deliverables.

2.0 OBJECTIVES AND RESEARCH QUESTIONS

This impact evaluation of the TGCC program provides an opportunity to generate new information on key policy questions of interest to development practitioners across the agricultural, land and climate sectors. The ***overarching policy question*** that underlies this Tenure and Global Climate Project IE is:

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

This question is poorly understood at present. Evidence from this IE 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.

The IE, moreover, will also 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. Does reducing the uncertainty of farmers over village land management, allocation and adjudication processes produce a more positive perception of tenure security over their farmland, as well as make them more likely to adopt longer-term CSA land uses, including agroforestry and soil and water conservation?
3. What is the additional effect of documenting land occupancy at the household level on farmer perception of tenure security, as well as behavior change towards longer-term CSA land uses, including agroforestry and soil and water conservation?
4. 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 in order to see significant change in agroforestry uptake rates?
5. 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 tenure intervention) affect farmer decisions to engage in agroforestry?
6. What is the additional impact of combining tenure interventions with a reduction in information, technology and institutional barriers that also impede agro-forestry uptake? (How does improved farmer access to agro-forestry extension resources additionally impact a farmer's decision to engage in agro-forestry?)

3.0 THEORETICAL FRAMEWORK AND LITERATURE

BACKGROUND

Land tenure security and property rights governance issues have long been a central focus for a range of rural development initiatives in sub-Saharan Africa (SSA) that address poverty reduction, agricultural livelihoods, natural resource management, and gender disparities, among other issues. This section provides some brief background on land tenure and administration in the Zambian context. It discusses agroforestry as a risk smoothing activity and form of climate smart agriculture. It considers several known barriers to agroforestry adoption in SSA and examines research on programs and policies in tenure security and agricultural investment.

LAND TENURE AND ADMINISTRATION

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. USAID investments have long focused on improving agricultural production and increasing access to markets. While there has been a great deal of USAID and other donor research on constraints facing smallholder farmers — we do not fully understand the influence of resource tenure and the effects of tenure security on smallholder investment in long-term land productivity in the country. A number of Zambian legal and customary practices related to resource rights could be acting as disincentives to smallholder investment.

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.

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. 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 (Tetra Tech, 2014).

Customary lands in Zambia therefore fall under the complete control of the chiefs. The chiefs exercises this authority through their headmen/women (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 villages within their domain make local land allocations.

Individual smallholders commonly have no documentation of their rights to land, resulting in complex land disputes over boundaries or defense of rights in the event of divorce, death of a family member or arbitrary reallocation of land by chiefs or headperson. (They may make such allocations, for instance, to other villagers or to outside investors via the conversion of customary lands to title deeds.)

Both traditional leaders and subjects are increasingly 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. District Land Alliances (DLAs) may also play a role. DLAs are community-based organizations, founded under the broader umbrella consortium of the national Zambia Land Alliance, which promote greater security of land access and ownership via advocacy activities and community outreach in their respective districts of operation. These organizations have begun to pilot the use of paralegal extension agents in villages, who serve as focal points for land rights and conflict resolution information. In participating chiefdoms, they may help to facilitate the customary land certificate process for individual households.

Uncertainties over land allocation processes within villages also contribute to ongoing land conflicts. Insufficient access to arable land is a recognized driver of continued impoverishment in rural areas of Zambia (Jayne, T.S., B. Zulu, G. Kajoba, 2009). Prior research points to large variation in farmer landholdings among village households, significant numbers of land-constrained households even in villages where unallocated land is present, and widely varying perceptions around land availability and ease of acquisition of land for farm expansion. Although many factors are likely to feed into such variations, key characteristics have been found to include relations to local headmen; distance to markets, roads and district administrative centers; and whether a household is female headed (Jayne, T.S., B. Zulu, G. Kajoba, 2009).

AGROFORESTRY

Agroforestry activities are widely perceived as a longer-term sustainable land use practice that can help to meet a range of rural development objectives related to improved land use and farmer livelihoods throughout sub-Saharan Africa. Decades of existing research points to a range of realized or expected farmer benefits from agroforestry investment, including increased crop productivity and reduced variability in yields though such outcomes as increased soil fertility; increased livelihoods from higher and more reliable farm income; risk smoothing through crop diversification; and additional direct benefits provided by trees on farms, such as fuel, wood or fodder (Franzel, Coe, Cooper, Place, & Scherr, 2001; Mbow, Van Noordwijk, et al., 2014; Mercer, 2004). However, several barriers to widespread agroforestry adoption persist.

Prior research has tended to emphasize identifying the biophysical properties and benefits of agroforestry systems rather than examining cultural, demographic, and socioeconomic as well as more macro-scale factors that might impede wider adoption (Ajayi, 2007; Sirrine, Shennan, & Sirrine, 2010). Additional factors for adoption include the financial outlay required, explicit and implicit investments in labor, and the extent to which farmers have the necessary technical knowledge and skills to establish trees on farms and effectively engage in agroforestry. Compared with annual crops, trees require longer periods to produce mature crops — five to eight years for the Msangu and Gliricida trees contemplated in this intervention. These longer time frames may influence the decisions of farmers to engage in such

planting, especially given that decisions to plant trees may be influenced by perceived tenure security and expectations about access to and control of the land over longer planning horizons.

Despite decades of agroforestry research advancements, low adoption rates across the tropics continue to serve as a substantial barrier to wider realization of agroforestry benefits as well as to the theorized improvement in rural development outcomes (Franzel et al., 2001; Mercer, 2004). In more recent years, heightened awareness over projected negative effects of climate change across the region has promoted enhanced interest and effort for expanding agroforestry efforts in sub-Saharan Africa. Advocates of this approach cite it as a type of longer-term sustainable land use that can not only improve farmers livelihoods but also enable more effective adaptation and mitigation responses to climate change impacts in already food insecure regions of the continent (Mbow, Van Noordwijk, et al., 2014).

Existing syntheses of agroforestry adoption tend to focus broadly on five categories of factors: farmer preferences, resource endowments, market incentives, biophysical factors and risk/uncertainty (Pattanayak, Mercer, Sills, & Yang, 2003). Agroforestry can act as a mechanism for diversification of a farming portfolio. Farmers may use trees to complement rather than replace their crop-planted acreage, for example, through nitrogen fixing legumes that provide additional nutrients to the soil. They may use trees to improve soil management in order to improve yields or reduce risk. Uncertainty over land security, however, has implications for undertaking investments with future payoffs and may limit incentives that rely on a long time horizon. As a result, the lack of security effectively serves as a disincentive for farmers to engage in agroforestry, who must factor in the required upfront financial, labor and other investments; as well as delays of several years delay to realize expected soil fertility, yield, livelihoods and other benefits (Mbow, Smith, Skole, Duguma, & Bustamante, 2014).

In their 2003 meta-analyses of barriers to agroforestry adoption across 32 empirical case studies, (Pattanayak et al., 2003) identified tenure security and extension support as two of the most important determinates of increased agroforestry uptake (finding tenure security significant in 72 percent and extension support significant in 90 percent of cases that included these factors in their analyses). Wealth-based and gender aspects of agroforestry uptake are also reported in a number of studies across the sub-Saharan region, suggesting a particular need for monitoring, as well as targeted activities to support women's access to and representation within such extension activities (Kiptot, Franzel, & Degrande, 2014; Phiri et al., 2004). Additional disadvantages emerge around women's frequently greater insecurity over land and tree resources, as well as their access to labor, capital and knowledge services (Kiptot et al., 2014).

LINKED LAND TENURE AND AGROFORESTRY INVESTMENT

In sub-Saharan Africa, many questions remain around the efficacy of a number of activities that are hypothesized to strengthen farmer perceptions over tenure security of their farm holdings. Also at yet undetermined is the extent to which strengthened land tenure security incentivizes farmers to undertake longer-term sustainable land use investments such as agroforestry. Recent literature has paid particular attention to the role of customary land titles as a means of strengthening smallholder perceptions over security of tenure, and to alter their land use decision-making strategies involving longer-term land investments in sub-Saharan Africa (Place & Otsuka, 2001; Smith, 2004). Some studies have found very strong evidence of positive impacts (Deininger, Ali, & Alemu, 2011; Deininger & Jin, 2006). However, to date no clear consensus has emerged from empirical studies across varying SSA contexts on whether and how stronger land tenure security may, as a whole, incentivize farmer decision-making and pursuit of different land investment strategies on their farms (Place, 2009).

Researchers have used a widely varying range of methods to measure tenure security (Chris D. Arnot, Martin K. Luckert, 2011) and have studied disparate tenure strengthening activities for attaining tenure security objectives. Therefore it is unsurprising that we have only incomplete knowledge concerning the effects of particular land tenure strengthening activities on farmer perceptions of security (for instance in the Zambian context, provisioning of customary land certificates to strengthen occupancy rights, or the use of village-level clarification of land allocation processes). It is also unclear to what extent insecure tenure acts as an important barrier to climate smart agricultural practices across different socio-economic, institutional, biophysical, and related contexts. Evaluating the impact of different land-rights activities on tenure security as well as climate adaptation and mitigation, therefore, is necessary in order to better determine causality.

4.0 TGCC AND CSA INTERVENTIONS

Supervised by USAID's Land Tenure and Property Rights Division (LTD), the TGCC program explores the relationship between secure resource tenure and the achievement of climate change adaptation and mitigation goals. The TGCC Task Order was awarded to Tetra Tech under the Strengthening Tenure and Resource Rights (STARR) IQC. TGCC comprises four main tasks:

1. Adopt pilot tenure intervention activities to promote CSA;
2. Clarify legal and regulatory rights to benefits from payments for environmental services including payments under Reducing Emissions from Deforestation and Forest Degradation (REDD+);
3. Perform research on tenure, property rights and GCC mitigation and adaptation; and
4. Strengthen women's property rights under REDD+.

The planned TGCC tenure and agroforestry interventions in Zambia are part of the first task, pilot interventions. TGCC's proposed work in Zambia addresses the USAID/Zambia objectives of an enabling governance environment, as well as reducing rural poverty through increased smallholder agriculture productivity, improved natural resource management and improved resilience of vulnerable households.

In Zambia, TGCC will support activities that increase tenure security at the chief, village and household level, as well as introducing activities to support agroforestry. The TGCC program proposes a 3.5-year intervention in Chipata District, Eastern Province. The interventions are expected to be implemented through one primary agroforestry implementing partner and one tenure implementing partner. This section will first briefly outline interventions aimed at strengthening land tenure and then turn to agroforestry activities under the project.

TENURE SECURITY STRENGTHENING INTERVENTION

The interventions aimed at strengthening tenure consist of a set of activities that take place at the chiefdom, village and household levels. Administratively, all villages are nested within chiefdoms (high-level) with all households belonging to a village within a chiefdom (mid-level). TGCC envisions working in approximately 6-10 chiefdoms. The chiefs have ultimate authority over the management of customary lands in Zambia, so that tenure interventions at the village and household levels, such as the issuance of customary certificates to households, must first be cleared by the chief.

A description of the tenure interventions at each of the levels follows:

CHIEFDOM LEVEL:

The chiefdom level activities aim to increase transparency of land allocation, administration and decision processes and to strengthen smallholder rights to land and trees by:

- Facilitating a dialogue on land use management and improved tenure governance with chiefs and their *indunas* (advisory councils);
- Identifying and developing opportunities to make decisions on land allocation and land disputes more transparent; and
- Providing basic training in administrative support, where relevant.

VILLAGE AND HOUSEHOLD LEVEL:

Activities under the tenure intervention consist of establishing Village Land Committees, conducting participatory mapping, supporting paralegal extension services related to land issues through NGO partners and facilitating the issuance of customary land certificates. At the village level these efforts consist of:

- Documenting rules and regulations and strengthening land management systems through Village Land Committees (VLC). To the extent possible, TGCC will build on existing village institutions to create VLCs;
- Increase democratization of the customary land management process through VLCs institutional processes;
- Conducting participatory mapping through the development of a common village map that can be used as a tool by headmen when allocating land; and
- Supporting the dissemination of land management rules that are agreed at the chief level; and
- Supporting basic land administration processes with the headperson and Village Land Committees, including supporting their ability to administer customary land certificates.

In chiefdoms where the chief has given consent for customary land certification, the project will encourage households within villages selected for the tenure intervention to obtain customary land certification and give the opportunity to receive information on land administration and dispute resolution services. Although the customary land certificates are issued to households, based on existing experience in Zambia, it is anticipated that once a village has been selected for the tenure intervention most, if not all, households belonging to that village will pursue land certificates. In these activities:

- VLCs will document rules and regulations to increase participation, accessibility and transparency of land management systems.
- NGO paralegal extension agents provide households with:
  - Information on land law and rights;
  - Procedures for households to obtain customary land certificates, likely though the village headperson; and
  - Support for land dispute resolution.
- NGO paralegal extension agents facilitate the process through which households receive customary land certifications.

Although the land tenure interventions involve activities at each of the three levels (high-, mid-, and micro-, i.e. household, level), this impact evaluation focuses on identifying the effects of the village and household-level interventions. As noted earlier, the inability to generate statistically valid results given the small number of chiefdoms under consideration rules out a design identifying the impact of the chiefdom-level interventions.

AGROFORESTRY EXTENSION INTERVENTION

Through the agroforestry intervention, an extension agent provides support related to planting and establishment of *Msangu* (*Faidherbia albida*) trees and/or *Gliricidia* on cropland. *Msangu* is a thorny legume that can be interplanted with maize and other annual crops. Its flowers provide food for bees and the seed pods can be used as cattle fodder. The dense wood has many uses and medicinal uses exist. *Gliricidia*, another legume, is a shrub also attractive to bees that has recently been introduced to Zambia.

The agroforestry intervention is primarily focused on activities at the village level but also includes basic interactions with chiefs at the chiefdom level. The project couples chief level agroforestry involvement with tenure interventions at the chiefdom level related to land use management and transparent land administration. Thus, by default, all chiefdoms are subject to the same high-level chiefdom intervention.

At the sub-chiefdom level, extension agents are expected to visit treatment villages at least three times throughout the first year and at least twice in subsequent years, at least once prior to the rainy season and at least once after planting. Specifically, extension services should cover:

- Building and managing nurseries for seedlings;
- Choosing best planting times/sites/intercrops;
- Water and nutrient requirements to ensure establishment;
- Best practices to ensure seedlings are protected during establishment; and
- Identifying and using high quality seed stock.

Under the extension agent structure, the agroforestry partner will be able to reach any interested farmers at the village level.

According to program implementers, specific activities provided by the agroforestry extension agent will include:

- Travel to each village to answer questions, provide demonstrations, and encourage farmers on uptake of practices;
- Distribute high quality *Gliricidia* and *Msangu* seeds to farmers;
- Provide training — through new or expanded lead farmer programs — to farmers on seed germination and preparation, as well as transmitting best practices for care of seedlings prior to and after planting;
- Facilitate the use of lead farmers to disseminate information within their villages;
- Provide training on agroforestry practices within each community at least twice a year;
- Develop extension materials on *Gliricidia* and to a lesser extent Msangu;
- Conduct additional awareness raising activities in treatment communities, as appropriate;
- Collect monitoring data on seed/seedling planting, survival, and threats through TGCC mobile data collection units.

5.0 RESEARCH HYPOTHESES AND INDICATORS

This impact evaluation tests a number of research hypotheses, which follow from the general research questions, review of relevant literature, and pilot interventions and objectives under TGCC, with scope to measure and test for impact at the household and village levels. All villages where TGCC will be introducing either the tenure or agroforestry intervention will be in chiefdoms that have received the chiefdom-level interventions. In other words, all households in the study, including the control or comparison groups of households and villages, are within chiefdoms that have received the high-level intervention.

Specific hypotheses in this IE include:

At the village level:

- *H-1*. Villages receiving the tenure intervention (land use planning, participatory mapping, clarification of the land allocation process, paralegal extension services, and customary land certification) have lower village-wide incidence of land conflicts.
- *H-2*. Villages receiving the tenure intervention perceive increased transparency of land allocation process and accountability of land allocation decision makers.
- *H-3*. Villages receiving the agroforestry intervention have higher agroforestry and CSA uptake rates and planting survivorship.

At the household level:

- *H-4*. Households in villages receiving the tenure intervention perceive higher levels of tenure security.
- *H-5*. Households in villages receiving the tenure intervention are more informed about land laws and household rights.
- *H-6*. Households in villages receiving the tenure intervention have a higher rate of satisfactorily resolved land disputes.
- *H-7*. Households in villages receiving the tenure intervention have improved livelihood outcomes, including the adoption of soil conservation farming practices.
- *H-8*. Households in villages receiving the agroforestry intervention adopt agroforestry practices at a higher rate, and invest more in agro-forestry and related CSA activities.

In carrying out the impact evaluation, investigators will give particular attention to examining the heterogeneity of impacts among particular subgroups and disaggregated by the following where applicable:

- Female- vs. male headed households
- Matrilineal vs. patrilineal systems
- Land holding-constrained households (by quartile)
- Household income/poverty level (by quartile)
- Household farming system (cash crop vs subsistence)
- Households from a different tribe than the headperson

The large N household sample isstratified to provide coverage of female headed households, wealthy households, and households from a different tribe than the headperson thereby enabling the analysis of heterogeneous treatment effects, and other survey instruments (i.e. key informant, headperson, focus group discussions) will collect information specific to each of these subgroups as appropriate. Even though the IE design does not allow for identification of chief-level impacts as described earlier, we account for this by collecting additional data to better understanding of these relationships. In particular, the household and village survey instruments will also collect information on awareness of chiefdom-level policies which will be used in conjunction with a chief survey administered by TGCC to provide additional context on the extent to which high-level policies administered at the chiefdom level trickle down to villages and households.

Tables H1 through H8 detail suggested indicators to test these hypotheses. The tables provide specifics on outcome indicators plus corresponding details on data sources, measurement, and other considerations. Note that these outcome indicators will continue to be refined as the IE design process moves forward.

VILLAGE IMPACTS

H-1: VILLAGES RECEIVING THE TENURE INTERVENTION (LAND USE PLANNING, PARTICIPATORY MAPPING, CLARIFICATION OF THE LAND ALLOCATION PROCESS, PARALEGAL EXTENSION SERVICES, AND CUSTOMARY LAND CERTIFICATION) HAVE LOWER VILLAGE-WIDE INCIDENCE OF LAND CONFLICTS.

Indicators:

- **A.** Share of village households engaged in a land-related dispute with someone within the village
- **B.** Share of village households engaged in a land-related dispute with someone from another village
- **C.** Incidence of land-related conflict within the village
- **D.** Incidence of land-related conflict between villages
- **E.** Proportion of households who believe that land allocation processes are transparent
- **F.** Proportion of households who believe that land allocation decision-makers are accountable to village constituents
- **G.** Proportion of villages with headmen who have allocated land to female-headed households / support female inheritance rights to land

Notes:

1) Disaggregate by type of conflict/dispute. This village-level tenure intervention is not expected to have the same impact on all forms of land-related conflict. For example, boundary-related disputes may increase in the short term as a result of issuing customary land certificates.
2) For land-related conflict within the village, conflict within members of the household will also be considered.

Data sources:

A. Household survey
B. Headperson survey
C. YGL key informant interview
D. Land key informant interview
E. Focus group interviews

H-2: VILLAGES RECEIVING THE TENURE INTERVENTION PERCEIVE INCREASED TRANSPARENCY OF LAND ALLOCATION PROCESS AND ACCOUNTABILITY OF LAND ALLOCATION DECISION MAKERS.

Indicators:

- **A.** Percentage of households perceiving transparency of land allocation practices
- **B.** Percentage of households who perceive that land allocation decision makers are accountable to village constituents
- **C.** Percentage of households who are represented in land-related decision making bodies
- **D.** Percentage of households who are involved in land-related decisions at the village level

Data sources:

A. Household survey
B. YGL key informant interview
C. Land key informant interview
D. Focus group interviews

H-3: VILLAGES RECEIVING THE AGROFORESTRY INTERVENTION HAVE HIGHER AGROFORESTRY AND CSA UPTAKE RATES AND PLANTING SURVIVORSHIP.

Indicators:

- **A.** Proportion of village HHs engaging in agro-forestry
- **B.** Average number of seedlings planted per household
- **C.** Average number of seedlings surviving (tree survival rate) per household
- **D.** Average share of household farmland planted to trees
- **E.** Share of village engaging in agroforestry

Notes:

1) Where appropriate, the analysis disaggregates by the variety of tree promoted by the agroforestry intervention: *Msangu* and *Gliricidia*
2) An ancillary set of analyses considers impact of the joint agroforestry plus tenure intervention to examine the marginal impact of the tenure intervention as well as the tenure plus agroforestry intervention in comparison to the agroforestry intervention alone.

Data sources:

A. Household survey
B. YGL key informant interview
C. Land key informant interview
D. Headperson interview
E. TGCC program M&E

HOUSEHOLD IMPACTS

H-4: HOUSEHOLDS IN VILLAGES RECEIVING THE TENURE INTERVENTION PERCEIVE HIGHER LEVELS OF TENURE SECURITY.

Indicators:

- **A.** Perceived risk of being forcibly removed from the land

B. Household perceptions on bundle of land rights

Notes:

1) An index capturing perceived risk to be specified and will incorporate nature of the removal (whether by chief, headperson, village member, etc.) and considers the risk over the short- (1-2 years), medium- (3-5 years), and long-term (5+ years).
2) The bundle of land rights involves a number of indicators capturing several dimensions of LTPR. In particular, this will capture Ostrom's five types of land rights (Acheson, 2011): access, extraction, management, exclusion, alienation. This will also cover transfer rights, such as land rental activity or other temporary rights transfer (includes informal) and inheritance.
3) The working assumption is that customary certificates will be issued to all households in villages selected for the tenure intervention where the chief has consented. In instances where not all households actually receive a customary certificate, the analysis can then explore the differential impact of having a customary certificate versus not in villages where the tenure intervention has taken place.

Data sources:

A. Household survey
B. YGL key informant interview
C. Land key informant interview
D.

H-5: HOUSEHOLDS IN VILLAGES RECEIVING THE TENURE INTERVENTION ARE MORE INFORMED ABOUT LAND LAWS AND HOUSEHOLD RIGHTS.

Indicators:

A. Household scoring of knowledge of land rights and administration

Notes:

1) The household survey instrument will include a section designed to illicit knowledge of land administration and rights, which will be used to create an overall score.

Data sources:

A. Household survey

H-6: HOUSEHOLDS IN VILLAGES RECEIVING THE TENURE INTERVENTION HAVE A HIGHER RATE OF SATISFACTORILY RESOLVED LAND DISPUTES.

Indicators:

A. Share of household land under dispute
B. Time taken to resolve land disputes
C. Household level of satisfaction that the manner by which land disputes are resolved are fair

Notes:

1) Disaggregate by type of conflict/dispute. This village-level tenure intervention is not expected to have the same impact on all forms of land-related conflict. For example, boundary-related disputes may increase in the short term as a result of issuing customary land certificates

2) For land-related conflict within the village, conflict within members of the household will also be considered.

Data sources:

A. Household survey
B. Headperson interviews
C. YGL key informant interview
D. Land key informant interview
E.

H-7: HOUSEHOLDS IN VILLAGES RECEIVING THE TENURE INTERVENTION HAVE IMPROVED LIVELIHOOD OUTCOMES.

Indicators:

A. Expected changes in land use
B. Investments in agriculture-related technologies and yield-enhancing inputs
C. Adoption of reduced tillage and other soil conservation farming practices
D. Agricultural productivity and value of farm output
E. Value of household production
F. Household wealth and assets

Notes:

1) Expected changes in land use will consider shifts in agricultural and agroforestry activities as well as anticipated changes covering the near term (1-2 years), medium (3-5), as well as long-term changes (5+)
2) Investments in agricultural technologies will consider both intensification (i.e. increasing the amount of input per ha) as well as extensification (increasing overall input use as a result of expanding production area). Specific inputs include the use of purchased inputs, like synthetic fertilizer and pesticides, as well as investments in machinery.
3) Value of farm production includes marketed and non-marketed production (i.e. farm produce for own consumption)

Data sources:

A. Household survey

H-8: HOUSEHOLDS IN VILLAGES RECEIVING THE AGROFORESTRY INTERVENTION ADOPT AGROFORESTRY PRACTICES AT A HIGHER RATE, AND INVEST MORE IN AGRO-FORESTRY AND RELATED CSA ACTIVITIES.

Indicators:

A. Farmer benefits experienced due to agro-forestry and/or other CSA (e.g. SWC) investment
B. Number of seedlings planted
C. Number of surviving seedlings (tree survival rate)
D. Proportion of farmland devoted to trees
E. Investment in agroforestry

Notes:

1) Investment in agroforestry and CSA activities will consider investments involving a capital outlay (i.e. purchased machinery or inputs), implicit and explicit costs associated with developing new production skills (i.e. time spent attending agroforestry or other extension events), as well as the opportunity cost associated with agroforestry activities (i.e. time spent watering trees)
2) Where appropriate, the analysis disaggregates by the variety of plant promoted by the agroforestry intervention: *Msangu* and *Gliricidia*
3) An ancillary set of analyses considers impact of the joint agroforestry plus tenure intervention to examine the marginal impact of the tenure intervention as well as the tenure plus agroforestry intervention in comparison to the agroforestry intervention alone.

Data sources:

A. Household survey

It is important to note that the outcome indicators in this study are primarily focused on measuring perceptions and behavior: perceptions of tenure security and the anticipated future agricultural investments of farmers and CSA-related activities that households plan to undertake as a result of their perceived tenure security, as well as actual behavioral changes and decisions that households make. We do not necessarily expect to see significant improvements in longer-term outcomes during the relatively short lifetime of this study. We note, however, that distal outcomes, such as improvements in agricultural productivity, livelihoods and climate resilience, might also be measured by additional, follow-up research after this IE has ended. To allow for this possibility, the design allows for the collecting of data capturing a number of longer-term outcomes.

6.0 IMPACT EVALUATION DESIGN

The two interventions under evaluation include:

1. Agroforestry extension within villages, available to any interested household; and
2. Village/headperson-level tenure security strengthening activities targeted to villages as a whole, including village-level access to paralegal extension services around land law, rights, and facilitating household customary land certification, as well as land dispute resolution support.

The distribution of customary certificates to households is considered to be a part of the village-level land tenure intervention, since the working assumption is that customary certificates will be issued to all households in villages selected for the tenure intervention where both the chief and headperson have given their consent. Since all households are expected to receive a customary certificate, the analysis will not be able to explore the marginal impact of possessing a customary certificate. Put differently, unless there is variation in the uptake of the customary certificates among households sampled for the IE data collection, the evaluation will not be able to disentangle the village-level tenure activities from the household-level tenure activities. As a result of the level of control and influence that Chiefs and their headmen exert over the customary control of lands in chiefdoms, it is hypothesized that that if chiefs and their headmen exhibit an increased recognition of household land holdings and develop mechanisms that increase transparency in land allocation, then households will perceive increased tenure security and that the impact of the certificate over and above this is expected to be negligible.

In order to assess the individual and joint effect of each of the tenure and agroforestry interventions, we will implement a four-arm village-level randomized control trial (RCT). In addition, the evaluation involves data collection in a chiefdom that is separate from the RCT. The villages in this 5th arm of the study receive an agroforestry intervention similar to the TGCC IE AF intervention, however, they do not 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 chief-level intervention by testing the impact of the agroforestry extension only versus areas subject to agroforestry and the chief-level intervention.

VILLAGE-LEVEL RCT DESIGN

To identify the independent and interaction effects of the two village-level interventions (agroforestry and tenure), investigators will randomly assign up to 300 villages to one of four treatment arms. Up to 75 villages will receive the agroforestry intervention, up to 75 villages will receive the land tenure intervention; up to 75 villages will receive both the agroforestry and land tenure interventions. An additional set of up to 75 villages will serve as a control group during the period of the impact evaluation. Thus, whereas the interventions will be implemented in a total of 225 villages, the evaluation will involve data collection in the entire sample of 300 villages.

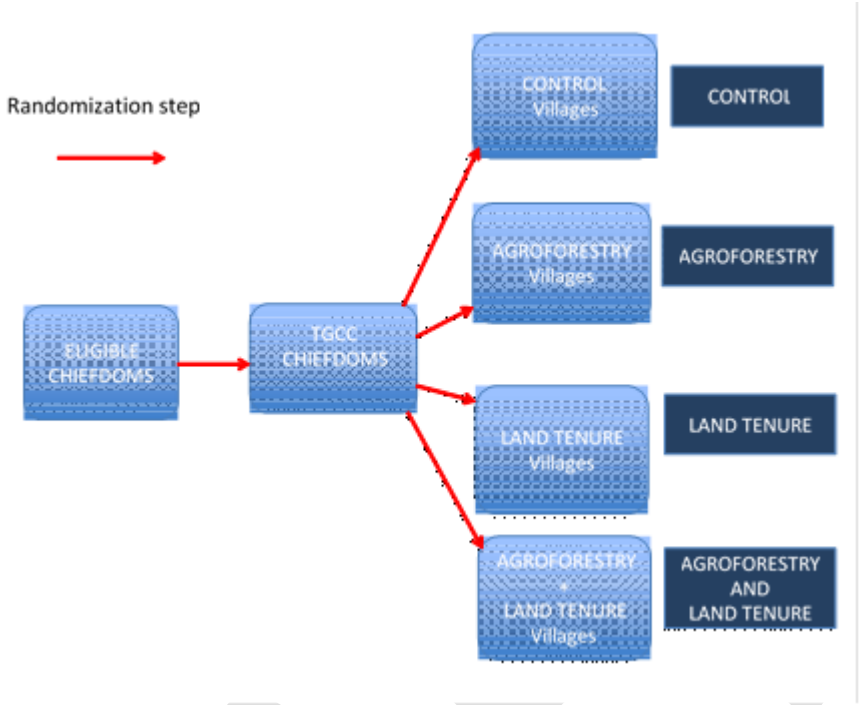

FIGURE 6.1. PROGRAM IMPLEMENTATION DESIGN

Figure 6.1 illustrates the distribution of the four types of intervention, 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.

As Figure 6.1 indicates, all chiefdoms within the eligible TGCC pool will receive chiefdom-level land-tenure strengthening activities, such as a land tenure and governance dialogue, activities to increase the transparency of land allocation processes, and basic administrative support. Since the chiefdom-level agroforestry involvement is coupled with the chiefdom-level tenure interventions, we do not have a pure 'agroforestry only' or 'tenure only' control because there are tenure or agroforestry interventions at the chiefdom-level. Village-level land-tenure-strengthening activities (such as participatory mapping at the village level, presence of a paralegal extension agent) will take place in all villages selected into both the tenure and tenure plus agroforestry arms. Village-level agroforestry extension activities will take place in all villages selected into both the agroforestry and tenure plus agroforestry arms. The villages in the control arm will receive neither the village tenure nor the village agroforestry intervention although they will be situated in chiefdoms which have received the high chiefdom-level activities.

The randomization plan is as follows. First, eligible chiefdoms for the TGCC project will be identified. Eligibility will be limited to areas where the TGCC project has received approval from the chiefs to implement the program. From the chiefdoms taking part in the TGCC interventions, and a list of villages under each chiefdom will be obtained. Across these TGCC chiefdoms, up to 300 villages will then be randomly selected to serve as eligible treatment or control villages. From the sample of eligible villages, a new round of random selection will take place where each village is placed into one of the four groups: control, agroforestry, tenure, or tenure plus agroforestry. The sample will be stratified by chiefdom so that each of these four groups is appropriately represented in each of the chiefdoms.

STRENGTHS OF THIS IE DESIGN

The major strength of this particular IE design is the use of a village-level randomized-control design to provide systematic evidence on the impact of LTPR interventions on development outcomes. RCTs are viewed as a powerful tool for providing robust evidence regarding program effects, as well as for testing causal arguments to inform program decisions and to justify resource allocations. A large body of literature describes the methodological benefits of using RCTs for impact evaluations (Angrist, Pischke, & Angrist, Joshua D., 2010; Banerjee, Abijit, 2008; Duflo & Kremer, 2008). These experimental methods allow strong causal identification by reducing selection and other endogeneity problems. Put differently, field experiments enable one to isolate the impact of the program on outcomes of interest because they control for other variables that might have also motivated changes in outcomes.

This evaluation is especially interested in exploring heterogeneous treatment effects for particular subgroups. The study will investigate differential effects on female-headed households, land-constrained households and/or poor households. Other subgroups of potential interest, based on existing literature, could include cash croppers versus subsistence-only farmers, and matrilineal versus patrilineal households.

The study will be able to determine possibilities for subgroup analyses targeted specifically to these groups pending receipt of existing survey data (2012 RALS; 2010 Census), which will enable investigators to determine expected membership proportions for each group. Baseline data collection will enable us to better determine the relevancy of these particular subgroup analyses. For quantitative data, we will make use of the household survey and stratify the sample accordingly. For the stratification, the priority groups are female-headed households and, to the extent possible, land holdings.

RISKS AND ADDITIONAL CONSIDERATIONS

A number of potential concerns come into play with all RCTs, for instance around trade-offs between internal and external validity (i.e. the extent to which the results are generalizable beyond the study area); the time, expense and logistical complications associated with implementing RCTs; and the perception that RCTs can be overly focused on differences in average outcomes and less so on understanding important drivers of outcomes. Addressing the first two of these concerns is beyond the scope of our IE design, since these issues are inherent in any RCT approach. Regarding the third issue, the RCT approach has been criticized for failing to address contextual issues and causal mechanisms that some consider to be more significant than the type of intervention (Blattman 2008). In particular, interactive confounders can present a serious challenge to random experiments that generally focus on identifying average treatment effects (ATE) (Deaton, 2010; Leamer, 2010). To address contextual issues and causal mechanisms, the study will also collect a significant amount of qualitative data — in the form of focus group discussions and key informant interviews — as well as analyze the monitoring and evaluation (M&E) data collected by the implementing partners.

The next few paragraphs briefly note additional considerations: heterogeneous treatment and adoption, bundled interventions, maturation of treatment effects, and duplication of intervention effort in the study area.

HETEROGENEOUS TREATMENT AND ADOPTION:

In terms of potential limitations of this IE design, the most important potential considerations relate to:

1. The potential variation in implementation of each of the interventions across villages; and
2. Differential uptake/adoption (i.e., of household customary certificates) across treatment groups.

Practically speaking, not all villages can be treated at the same time, so there will be time-varying factors as well as on-the-fly modifications as to how the interventions are delivered (for example, as a result of learning by doing, the experiences implementing the first few village-level interventions are used to improve delivery in subsequent villages). The possibility has also been raised that there may be two different implementing organizations introducing the same interventions, which further raises the potential for heterogeneous implementation. Concerning differential uptake, although the expectation is that most, if not all, households will obtain a customary certificate, if wide variations in the actual adoption rates were to transpire, this too would translate into heterogeneous adoption.

Given the relatively small number of villages in the study, we will not have the power to rigorously evaluate the effect of heterogeneous treatment implementation at the village level. Although it is impossible to fully anticipate and control for these eventualities, we can limit the potential risks by acknowledging these ahead of time and considering the alternatives. This is so even if we cannot be explicitly control for them in the IE design itself.

To monitor for variations in certification uptake, the IE team will allow for additional data collection at the village level with greater frequency. The high-frequency village survey instrument will be deployed in conjunction with the baseline and endline data collections with the possibility of being administered in off-years if necessary (2015 and 2016). The increased frequency of village-level data allows us to collect relevant time-varying program and non-program information to better understand factors contributing to variations in intervention uptake and adoption. To reduce the burden associated with this one possibility, it would be necessary to draw on the monitoring systems that DLAs already use to track the paralegal services that they provide in villages as well as the TGCC program M&E data.

In addition, collecting information on factors exogenous to or that are beyond our control as part of the impact evaluation design will better position us to explain any heterogeneity in the intervention. For example, due to the small number of chiefdoms to be covered by the intervention, it is simply not practical to identify the impact of chiefdom-level interventions due to a lack of statistical power from the small sample size. However, by including content in the household survey to elicit the extent to which chief-level interventions trickle down to individuals and supplementing this data with information gleaned from administering a chief survey, we will be able to control, albeit partially, for the chief effects.

BUNDLED INTERVENTIONS:

Given the manner in which interventions are to be implemented, we will not be able to disentangle the treatment effects for specific interventions within a bundle of activities. Due to the program implementation roll-out, the IE will not be able to tease out the particular impact of specific activities, for example, to separate out the effects of the village-level tenure interventions and the household-level certification activities. As mentioned, since we expect all households in the land tenure arms to adopt certification, we do not anticipate finding the necessary household level variation in certification uptake to enable an analysis of the marginal impacts of household certification.

MATURATION OF TREATMENT EFFECTS:

The project under evaluation represents a three-year intervention; we will collect evaluation data at baseline and the end of the third year. Full benefits to farmers from mature agroforestry trees — in terms of improved parcel-wide soil fertility and crop yields — are typically not expected until five to eight years after planting. Therefore, the research team does not expect to see evidence of agroforestry treatment effects for some long-term potential outcomes, such as climate change resilience and crop productivity or yields. As a result, the evaluation team will focus on analyzing indicators of agroforestry uptake (such as seedling survivorship, area planted, expected benefits) instead of the long-term benefits of uptake. Variables to measure expected longer-term outcomes, however, will still be included in the survey tools to allow for potential further data collection and analysis beyond the end of the program.

For the village and household-level indicators, the research team does expect to be able to see evidence, if present, of decreased land conflicts, altered farmer decision-making around land investments and changes in perceived land tenure security within the time frame of the project. We recognize, however, that three years is a relatively short time frame for such changes to occur, hence we will also measure tenure perceptions and expected land changes and investments, as well as those actually undertaken. Also, as noted earlier, a third wave of data could be collected two or three years after the completion of this evaluation, if there is interest in understanding the longer-term effects. This would build the knowledge base by adding a longitudinal study dimension.

DONOR DUPLICATION/COVARIATE IMBALANCE:

In Zambia's Eastern Province, there is a potential for unbalanced treatment and control groups to arise after the start of program implementation, due to uncoordinated donor efforts. This is a reasonable concern, given the current interest and extent of both agroforestry and land-based donor-support activity currently underway in each of the three potential districts for this study.

Given that the different treatment and control villages in our study will themselves be randomly distributed, we consider that there is low likelihood of new and confounding donor activity to align with this random distribution. However, if another development partner should decide to specifically focus in villages that fall only in one arm of the TGCC study, our research design could be compromised. The IE team discussed these issues with USAID/Zambia, and to the extent possible, the Mission will try to coordinate activities in the study area through the Eastern Province working group to avoid the introduction of new activities of a particular geographic scope that could harm the IE inferences.

7.0 SAMPLING AND POWER

This section describes the power calculations for the village-level RCT. Here, power refers to the probability of detecting an impact if one does exist; the associated power calculations indicate the sample size required for an evaluation to detect a given minimum desired effect size (MDES). For the TGCC IE, the research team will be measuring outcomes at the village and household levels. We have conducted power calculations for each of these levels.

- "Level I Design" refers to the calculation design used to assess the evaluation's power to detect village-level outcomes.
- "Level II Design" refers to the calculation design used to assess the study's power to detect household-level outcomes.

There is no pilot study data to draw on regarding key variables related to this study. This lack of data reduces confidence in the accuracy of our estimates for several parameters of the power calculations. Correspondingly, it reduces our confidence in the effect sizes expected from our power calculations. To improve the precision and power of the study, at a minimum, we will stratify by chiefdoms. Assuming that we can gain access to the 2010 Census data, it will also be possible to stratify on key constituency level socio-economic indicators and/or at a lower administrative level.

To account for the lack of calibrating data, we include relatively conservative estimates for each parameter of the power calculations presented below. It may be possible to further refine these parameters once existing survey data for Eastern Province are obtained (2012 RALS data and 2010 Census data requested). Given the conservative parameters we are currently using, we expect that these refinements are likely to further lower the number of households and villages needed to obtain sufficient power to detect effects and to lower the minimum detectable effect size we would be able to measure. (This means that the study would be able to detect finer-scale impacts than we currently estimate.) The power calculations were obtained using the Optimal Design software package (Raudenbush et al., 2011; Spybrook et al., 2011).

The discussion that follows assumes a power of 0.80 and estimates what will be the minimum detectable effect size (MDES) under alternative scenarios for the number of villages and households included in the sample.

BOX 7.1. KEY POWER CALCULATION PARAMETERS

The following describes the key parameters used to conduct the power analysis and sample size requirements for this impact evaluation.

α (alpha) is the Type I error and is also referred to as the p-value in statistics. Loosely speaking, this is the probability of concluding there was an impact when no impact actually exists. Typical values of α are 0.1, 0.05, and 0.01 with lower values indicating greater confidence in results (that is, less chance of concluding there is a program effect when there is none).

β (beta) is the Type II error. Loosely speaking, this is the probability of not concluding there was an impact when in fact an impact does exist. The sample power is equal to (1- β). Typical values of β are 0.1 and 0.2. Lower values of β indicate greater confidence in the results. Stated differently, lower values of β are associated with greater power.

B is the amount of variation explained by the pre-treatment data. Typical values are .05 and .20

CLR (Cluster Level Reliability) is an estimate of measurement error and is used to correct for the precision of outcomes measured at the village level.

σ^2 indicates that the evaluation is a fixed effect, versus a random effect, design. This means that we do not believe the villages in the study are necessarily representative of all villages in Zambia.

K is the number of stratification groups. Here these represent the number of chiefdoms.

J is the number of villages in each arm of the impact evaluation design. There are a total of four arms in this impact evaluation so the total number of villages will be Jx4.

Minimum Detectable Effect Size (MDES) - often represented by δ - is the magnitude of impact that can be detected for a given sample. The units of measure for δ are standard deviations from the mean. For example, if referring to household income and the average value is $1000 per household with a standard deviation of $100, then a value of δ=0.5 implies that incomes of $1050 or more are expected as a result of the intervention. In general, the smaller (larger) is δ the larger (smaller) will be the required sample size since a smaller (smaller) impact will require a larger (smaller) sample size in order to detect.

η is the number of households sampled per village.

Power is the probability of detecting an impact if one has occurred. The power of a test is equal to 1 minus the probability of a *type II error*, ranging from 0 to 1. Popular levels of power are 0.8 and 0.9. High levels of power are more conservative and decrease the likelihood of a type II error. An *impact evaluation* has high power if there is a low risk of not detecting real program impacts, that is, of committing a type II error.

Power calculations indicate the sample size required for an evaluation to detect a given minimum desired effect. Power calculations depend on parameters such as power (or the likelihood of Type II error), significance level, variance, and intra-cluster correlation of the outcome of interest.

LEVEL I DESIGN: VILLAGE-LEVEL OUTCOMES

This design represents a two-level stratified village randomized trial. As we noted earlier, the stratification will occur at the level of the chiefdoms. The power calculations are based on the following standard assumptions:

- α = .05
- B = .05 and 0.20

- σ^2 = 0 (fixed effects)
- K = 2 and J=55, J=65, J=75

In addition to these parameters (definitions given in Box 7.1), estimating the MDES at the village level also requires an assumption of the cluster level reliability (CLR). CLR reflects the imperfect measurement of group level outcomes. We have to take measurement error into consideration to look at village-level outcomes. The analysis assumes a value for CLR= 0.7, as this is the publishable standard. Table 7.1 summarizes these values.

Table 7.1. Summary of MDES under Various Assumptions for Design 1

Villages per arm	Power	Alpha	CLR	B	MDES
55	.80	.05	.70	.05	.64
55	.80	.05	.70	.20	.61
65	.80	.05	.70	.05	.58
65	.80	.05	.70	.20	.55
75	.80	.05	.70	.05	.54
75	.80	.05	.70	.20	.51

Source: Author's calculations

Figure 7.1 illustrates the relationship between minimum detectable effect size (MDES) and the number of villages in each treatment arm of the TGCC program.

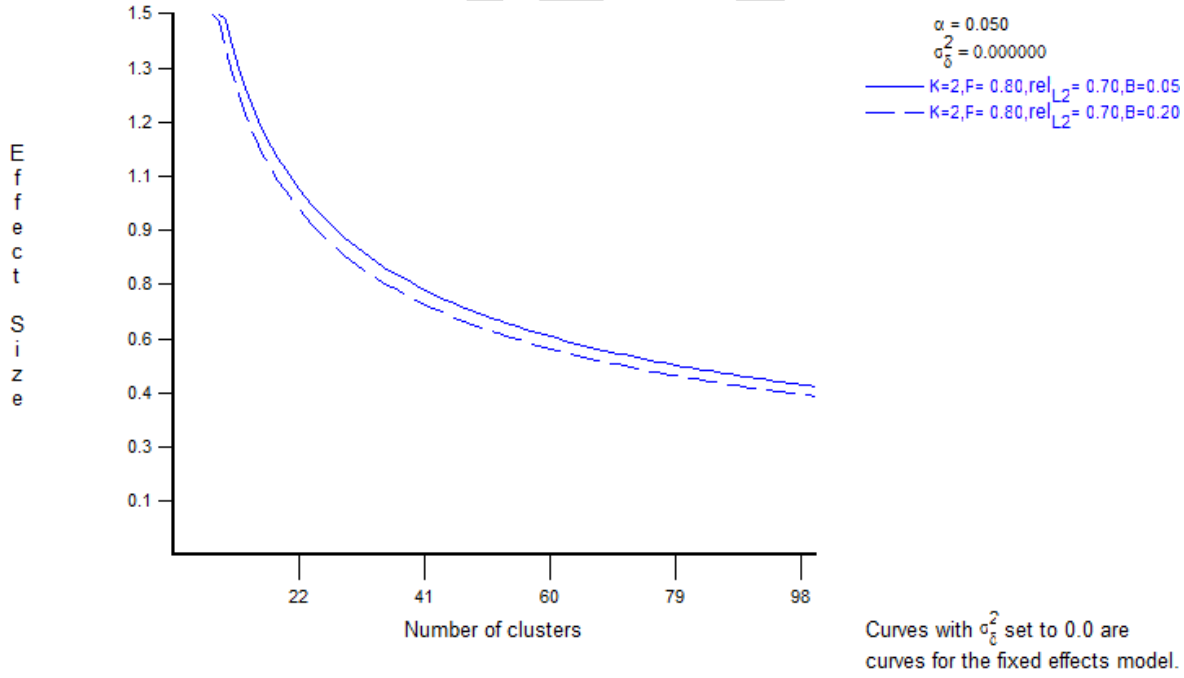

FIGURE 7.1. RELATIONSHIP BETWEEN MDES AND THE NUMBER OF VILLAGES FOR THE LEVEL I VILLAGE DESIGN

LEVEL II DESIGN: HOUSEHOLD-LEVEL OUTCOMES

This design represents a three-level stratified cluster (or village) randomized trial with outcomes measured at the person or household level. The first level is the variable for stratification (chiefdom), the second level is the treatment level (villages), and the third level is the measurement level (households). As noted earlier, the stratification will occur at the level of the chiefdoms. The power calculations for the Level II Design assume a panel survey or the taking of repeated measurements, in which the same households are re-surveyed over the lifetime of the study. A panel survey increases the power of the study.

Similar to the assumptions for the Level I Design, the power calculations are based on the following standard parameters:

- $\alpha = .05$
- $\sigma^2 = 0$ (fixed effects)
- K = 2 and J=55, J=65, J=75

In addition to these parameters, to estimate the household-level MDES requires information on the degree of correlation between households within a village or the intra-class correlation (ICC). The assumption here is that units within a group are correlated, which means that we do not gain completely new information from each additional unit surveyed. This "loss" of information has to be taken into account in the power calculations. Given the nucleated settlements in Eastern Province, we use a relatively conservative value for the ICC of .25. The MDES will decrease with lower ICC values. If we are able to gain access to IAPRI data, we can confirm the actual ICCs for representative villages from Eastern Province.

Table 7.2 provides the MDES under different assumptions about the sample size. While the standard parameters stay fixed, we alter (1) the number of households surveyed (N) from 10-20 and (2) the number of villages involved in each arm of the TGCC program from 55 – 75.

Table 7.1. Summary of MDES under Various Assumptions for Design 2

Villages per arm	Power	Alpha	N	ICC	MDES
55	.80	.05	10	.25	.39
55	.80	.05	15	.25	.36
55	.80	.05	20	.25	.34
65	.80	.05	10	.25	.35
65	.80	.05	15	.25	.33
65	.80	.05	20	.25	.31
75	.80	.05	10	.25	.33
75	.80	.05	15	.25	.30
75	.80	.05	20	.25	.29

Source: Author's calculations

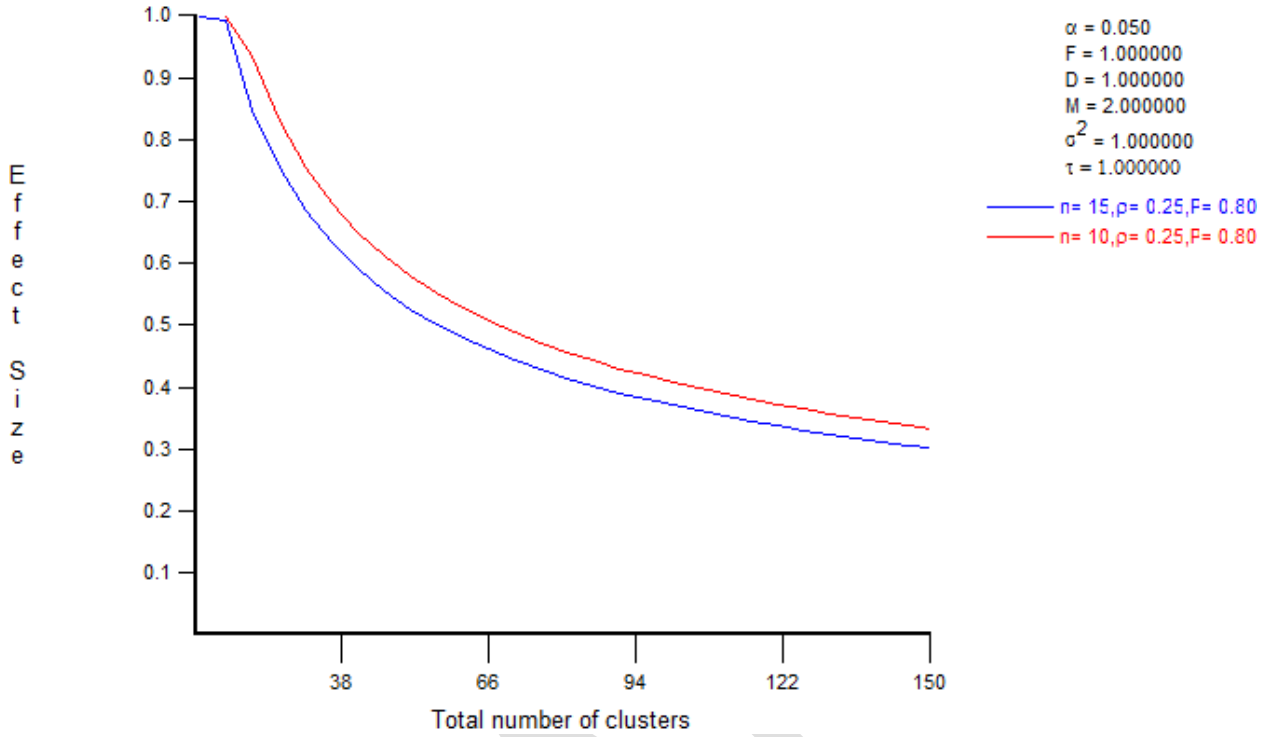

FIGURE 7.2: RELATIONSHIP BETWEEN MDES AND POWER FOR DESIGN 2, N=10, N=15

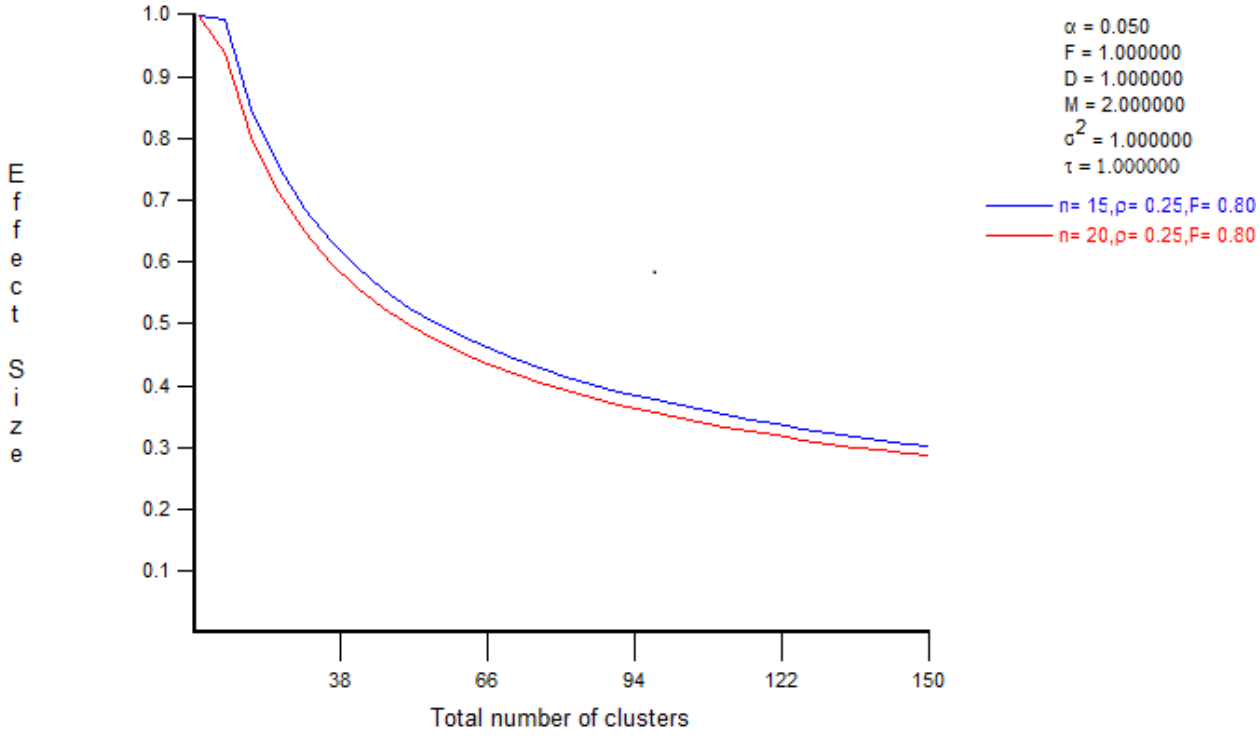

FIGURE 7.3: RELATIONSHIP BETWEEN MDES AND POWER FOR DESIGN 2, N=15, N=20

Table 7.3 summarizes the sample implications from the village- and household-level analyses.

Table 7.2. Summary of Village and Household MDES under Alternative Scenarios**					
Villages per arm	**Households/ village**	**MDES**		**Total sample for four-arm design**	
		Village	Household	Villages	Households
55	10	0.64	0.39	220	2200
55	15	0.64	0.36	220	3300
55	20	0.64	0.34	220	4400
65	10	0.58	0.35	260	2600
65	15	0.58	0.33	260	3900
65	20	0.58	0.31	260	5200
75	10	0.54	0.33	300	3000
75	15	0.54	0.30	300	4500
75	20	0.54	0.29	300	6000

Source: Author's calculations

Note: In this table, village and household model estimates were combined to consolidate village and household design results. However, strictly speaking the parameters used to specify the Level I village-level outcomes do not directly carry over to the Level II household calculations since the 'B' parameterization is not factored into the Level II calculations using this version of the software. Presented in this way, the estimates give a good impression of the village and household detectable effect sizes, however a simulation approach would be needed to provide more precise estimates of the corresponding household MDES.

** Model and parameter assumptions: i) power =0.80 (=1- β), ii) α==.05, iii) CLR=0.7 (for village), iv) ICC=0.25 (for HH calculations), v) B=0.20 (for village calculations)

8.0 DATA SOURCES AND DATA COLLECTION PLAN

PRIMARY DATA COLLECTION

Given the dearth of relevant and existing administrative or secondary data from each of the study villages that can be used directly for the impact evaluation, this research will need to rely largely on original data sources. In particular, the evaluation will utilize a number of original sources of data:

1. Large N household survey data collected at baseline and end line;
2. Headperson survey;
3. Focus group discussions with female-headed households, cash croppers versus subsistence only, matrilineal versus patrilineal households, land-constrained households and/or poor households;
4. Interviews with key informants, including a local agricultural extension representative(YGL), and individual focused on land issues, such as the induna, member of the Village Land Committee, etc.
5. Chief survey; and
6. M&E data from the implementing partners.

The baseline data collection is planned for June-August of 2014. It will be comprised of a large N household survey, village-level survey, headperson survey, focus group discussions and key informant interviews. Moreover, in between the baseline and endline data collection, the study team will implement a short village-level survey with key aggregate indicators across the control villages, in order to effectively track outcomes that are not regularly collected by the M&E teams in the treatment areas. At baseline and endline, the village-level data will be collected through the headperson survey and key informant interviews. Depending on what information can be collected as part of the regular or an augmented M&E data collection effort, the short village-level survey may also need to collect M&E data in villages where the relevant interventions are not implemented (i.e. tenure M&E data in agroforestry villages and control villages; and agroforestry M&E data in tenure and control villages).

The endline data will be collected after the program has been in effect for three years. We expect this timing to provide a sufficient amount of exposure time for proximate (short-term) outcomes. Given the relatively short, three-year period of the TGCC program, however, the evaluation team does not expect that that the study will be able to detect longer-term resilience and livelihood effects, although variables to measure such outcomes will be included in survey instruments.

Our survey tools will also collect basic social, economic, demographic and related characteristics of 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 from farmers, and
- Perceived risk and uncertainty (Pattanayak et al 2003; Mercer 2004).

Table 8.2 summarizes the data requirements.

Table 8.2. Table Summary of Data Requirements

Survey Instrument	Who	Level	Type	Frequency	Description of Data
Household	Households	Household	Quantitative	Baseline and Endline	Demographics, landholdings, land use, tenure perceptions, socio economic, socio political, agricultural production, agroforestry
Headperson	Headperson/ Woman	Village	Quantitative and qualitative	Baseline and Endline	Demographics, land registry, land use plans, tenure rules and regs, tenure perceptions, socio economic, socio political
Focus Group	Members selected from key groups	Village	Qualitative	Baseline and Endline	Demographics, socio political, tenure perceptions, socio economic,
Village Key Informant	YGL, Member Village land committee, induna	Ward, Village	Quantitative and qualitative	Baseline, Endline, and yearly	Demographics, socio political, tenure perceptions, socio economic, supplemental M&E data from non-program villages (i.e. control)
Chief [1]	Chief, indunas	Chiefdom	Qualitative	Baseline and Endline	Land management, rules and regs, tenure perceptions, socio economic perceptions, etc.
TGCC program M&E	Program	Village	Quantitative	Yearly +	M&E data from program implementers

HOUSEHOLD SURVEY

Type of Data: Quantitative

Frequency: Baseline and endline

The household survey will cover representative samples of the treatment and control groups for up to 300 villages in the program. In order to maximize the IE team's capacity to detect heterogeneous effects

[1] This survey is being administered by TGCC.

for women headed households and poor households, the proposed sample size for the baseline survey is between 3600 and 4500 respondents in total; this will require surveying an average of 15 households per village. The HH survey is stratified by female vs. male headed, wealth and HHs that belong to a different tribe than the headperson.

In addition to standard socio-economic and demographic information, the survey will focus on measuring tenure security outcomes, uptake of sustainable agricultural practices, and the mechanisms through which property rights changes influence farmer expectations and sustainable agriculture behavior. The processes of interest include biophysical factors, risk and uncertainty, preferences, resources and assets, as well as market pressures. We propose modeling some aspects of the survey on several elements of Zambia's 2001-2012 Rural Agriculture Livelihood Survey, which contains land tenure and agricultural components that are consistent with variables of interest for this study.

HEADPERSON SURVEY

Type of Data: Quantitative

Frequency: Baseline and endline

The headperson survey will be administered to each village headperson, and its context will largely mirror that of the household survey. It will contain a mixture of closed and open-ended questions. We propose drawing some questions and modules for the headperson survey from Zambia's 2008 Headperson Survey.

FOCUS GROUP DISCUSSIONS

Type of Data: Qualitative

Frequency: Baseline and endline

The evaluation will rely on rich contextual data from focus group discussions with female-headed households, cash croppers versus subsistence only households, matrilineal versus patrilineal households, land-constrained households and/or poor households. We will hold two focus groups per village in a subset of villages in each treatment arm.

VILLAGE KEY INFORMANT INTERVIEWS

Type of Data: Quantitative and qualitative

Frequency: Baseline and endline (yearly for select information)

The study will collect village-level data from 55-75 control villages (exact number TBD). Semi-structured interviews with three key informants will be conducted in a subset of villages in each of the treatment arms. These will be interviews with a YGL representative, an *induna*, and a member of the village land committee. In addition to the baseline and endline, a short structured data collection tool will be developed that captures the key village-level outcomes with greater frequency. This tool will be administered to 1-2 key informants in the treatment and control villages. In TGCC treatment villages some of this data is expected to be collected as part of the routine program M&E performance and monitoring. However, this may require some additional data collection on the part of the key informants as well as tracking M&E indicators for non-program villages. The intention is to have the key informants help with data collection during the M&E process to avoid the IE field team conducting a HH-level data

collection. For example, if we are tracking the number of HH with land certificates and/or land conflicts that might require some extra effort from the key informants. Depending on the budget and indicators, we should collect 2-4 rounds of this village-level data in the control villages in between the baseline and endline data collection.

CHIEF SURVEY

Type of Data: Qualitative

Frequency: Baseline and endline

The chief survey will be administered to the chief or representative (i.e. induna). The chief survey will be used to provide additional context on how policies are administered at the chiefdom level and to help assess the extent to which high-level policies are targeted to villages within the chiefdom. The semi-structured survey will cover issues such as land management, rules and practices for land administration, and administering policies, including geographic targeting. TGCC will conduct the chief survey and ERC will provide a set of questions of interest for the evaluation.

ELECTRONIC DATA COLLECTION

The baseline and endline data collection will be carried out throughan electronic data collection effort. While there is additional up-front effort required to program the questionnaire, train staff and enumerators on the use of tablets, and manage the tablets and hardware to limit complications in the field, there are a number of clear benefits. In general, a tablet-based approach reduces data entry errors and improves the quality of the data (Caeyers, Chalmers, & De Weerdt, 2010). The electronic approach will incorporate the built-in functionality of the software to reduce errors in data entry (i.e. validation checks) and build in routing capabilities to improve efficiency of the data collection and reduce the potential for errors. Following the initial adaptation of the questionnaire to the survey software, the local survey firm will ensure the questionnaire is translated into the local language. Testing and revising of the software will be carried out on an ongoing basis, and it will be important that the survey firm build sufficient capacity in the use of electronic devices to allow for trouble shooting of potential problems as they arise in training exercises, as well as when being implemented in the field.

SELECTION OF PRIMARY DATA COLLECTION/SURVEY FIRMS

A competitive and open bid process will be implemented to select the data collection firm. The evaluation team will develop a detailed description of the work required and solicit bids. The request for proposals will be posted publically through a suitable media outlet in Zambia as well as sent to prospective firms identified during the evaluation scoping trip (January 2014). When all bids have been received, proposals will be reviewed and scored based on the technical and cost components. The technical and cost components of the proposal will be reviewed independently. The details of the data collection will be covered in detail in the request for proposals and will favor firms with experience conducting large surveys in Zambia and working with development partners and will give preference to those firms having experience with electronic data collection.

ERC COUNTRY COORDINATOR

Given the short time frame for research preparation and complexity of the data collection, the evaluation team recommends hiring an in country Research Field Manager with the necessary skills and

qualifications to oversee and manage the IRB application process and the technical and field logistics for a large scale and complex RCT. Additionally, because the evaluation team identified electronic data collection as a weakness in data collection partners, the ERC Country Coordinator should also have survey programming skills and the ability to set-up an electronic data collection effort.

SECONDARY DATA SOURCES

Depending on access and availability, the evaluation team will also collect the secondary data outlined below. This data will be used to better understand the background and context and help generate more precise parameter estimates for the power calculations, randomization and survey sampling plan. However, based on the team's current understanding of the scope of the data, we do not believe that it can be used to assess the outcomes of interest for this IE, because it is not representative of the treatment and control areas comprising this study.

- Zambia Census 2010 (Central Statistics Office)
- Headperson survey 2008 (IAPRI)
- Rural Agricultural Livelihoods Survey 2012 (IAPRI)
- Farm and crop census data from the Ministry of Agriculture
- Spatial data
  - Village point file for villages that USAID is working in
  - Integrated Land Use Assessment (Forest Department)
  - Census Standardized Enumeration Areas (SEAs)
  - US Forest Service forest change data
  - Administrative boundaries, all units that are available (e.g., constituencies, wards, districts, provinces)

IRB PROCESS

The research team will submit the proposed impact evaluation to Zambia's Institutional Review Board. The IRB in Zambia approves and monitors research activities involving human subjects. According to Zambian researchers, the process of receiving IRB approval will take approximately one full month.

The IRB's main role is to ensure that research procedures do not pose more than negligible risk to the participant subjects, and to assess the adequacy of safeguards to protect subjects' rights, welfare and dignity. Researchers are required by the IRB to: (1) inform the subjects about the purpose, risks and benefits of the study so that they can make an informed decision about whether or not to participate in the research and (2) protect the anonymity of subjects and the confidentiality of the data.

The research team will provide training to all enumerators and qualitative researchers to ensure they understand these principles. Upon completion of research activities in the field, the data will be maintained in a way that adheres to IRB principles. All analyses and publications will respect the anonymity of respondents; no identifying information will be used in reports or presentations. The mode of analysis will follow econometric standards for survey research, the aim of which is to make general claims about the participant and non-participant populations, not specific claims about identifiable individuals.

9.0 DELIVERABLES

All reports, data, survey instruments are subject to review by LTD and the USAID Zambia Mission prior to release. When cleared for public release, documents and data will be available on the LTPR portal (http://usaidlandtenure.net/) and will also be submitted appropriately to the USAID Development Experience Clearinghouse (DEC).

DISSEMINATION PLAN

We plan to share the results via presentations to a variety of stakeholders, including development partners and academic audiences. Given approval from USAID Mission and LTD, the results of the evaluation will be presented to local stakeholders. To ensure results of the baseline and endline are reported back to the communities in a culturally appropriate manner, the IE team will consult with the USAID Mission and the TGCC implementers. Results will be shared with development experts in the US, including a presentation at USAID in Washington, D.C. In addition, we will present the results at academic and policy conferences, as well as publish at least two peer-reviewed journal articles based on the research.

BASELINE REPORT

A baseline report will be completed approximately six weeks following the receipt of cleaned baseline data. The report will provide contextual data on villages in the study area, and — when combined with data on the treatment assignment — will flag any potential imbalances across treatment groups. The baseline report will also include a data analysis plan for the impact evaluation (created after examining the distribution of variables in the baseline survey).

IMPACT EVALUATION REPORT

We will prepare an impact evaluation report within six weeks of the receipt of the cleaned end-line survey data. The impact evaluation report will report the effects of each of the treatment arms on the outcomes of interest. In addition to investigating average treatment effects, the report will also investigate differential effects for the specific subgroups of interest to the study, including: female-headed households, cash croppers versus subsistence only households, matrilineal versus patrilineal households, land-constrained households and/or poor households.

To the extent possible, heterogeneous treatment effects will be rigorously assessed with the quantitative data. Given the importance of studying women-headed households, the evaluation has prioritized ensuring sufficient power to analyze the treatment effects for this group. However, for other groups that may represent a small part of the population — such as land-constrained households or cash croppers — the study may need to rely on qualitative data to analyze subgroup differences.

POLICY BRIEF

We will prepare a policy brief of approximately 10 pages that highlights the most policy relevant findings from the evaluation. This brief will be completed after the end-line analysis.

POLICY BLOG

The evaluation team will publish at least one blog on the LTPR Portal based on the evaluation research.

FULLY DOCUMENTED DATA SETS

We will deposit a fully documented baseline data set with USAID by January 2015. We will deposit a fully documented final data set with USAID by early 2018. Prior to public release all household identifiers or other personally identifiable information (i.e. latitude and longitude coordinates) will be removed. To provide an appropriate level of spatial detail while preserving individual anonymity, some administrative level data will be preserved as appropriate and latitude and longitude coordinates may be 'scrambled' so that they do not identify individual households but are (i.e. adjusting coordinates by a normally distributed random correction so that the publically reported coordinates have an accuracy of +/- 200 meters of the original location). These data sets will be submitted to both the LTPR Portal and the DEC.

JOURNAL ARTICLES

The evaluation team aims to publish two peer reviewed journal articles following receipt of the end-line data.

PRESENTATIONS

The evaluation team will draft at least two presentations for different audiences (e.g. USAID technical staff, economists, etc.) based on the evaluation research.

10.0 IMPACT EVALUATION TIME LINE

The timing of the roll-out of the intervention and the surveys is detailed in Table 10.1 below. To avoid seasonal effects, the baseline and endline surveys should be conducted at the same times each year, if feasible. The field team will conduct the baseline household survey in summer 2014 and the endline household survey in summer 2017. During these two periods, data from focus groups and interviews will also be collected. Table 10.1 provides a detailed timeline.

TABLE 10.1. TGCC IMPACT EVALUATION ACTIVITY TIMELINE

Activity	2014											2015				2016				2017							
	F	M	A	M	J	J	A	S	O	N	D	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	A	M	J	J	A	S	O
Develop TOR for research field manager																											
Prepare RFP for data collection firm																											
IE Design Report																											
Survey instrument development																											
Send RFP out for data collection																											
Contract Research Field Manager																											
Contract data collection firm																											
IRB application process																											
Survey translation and tablet adaptation																											
Develop sampling methodology																											
Survey programming																											
Pre-testing/Finalize survey instrument																											
Enumerator training																											
BASELINE DATA COLLECTION																											
Data management, cleaning, translation																											
Baseline data report																											
M&E data collection (TBD)																											
Contract data collection firm																											
IRB application process																											
Enumerator training																											
ENDLINE DATA COLLECTION																											
Data management, cleaning, translation																											
Endline data report																											

11.0 REFERENCES

Acheson, J. M. (2011). Ostrom for anthropologists. *International Journal of the Commons*, *5*(2), 319–339.

Ajayi, O. C. (2007). User Acceptability of Sustainable Soil Fertility Technologies: Lessons from Farmers' Knowledge, Attitude and Practice in Southern Africa. *Journal of Sustainable Agriculture*, *30*(3), 21–40. doi:10.1300/J064v30n03_04

Angrist, J., Pischke, J., & Angrist, Joshua D., and J.-S. P. (2010). "The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics." *Journal of Economic Perspectives*, *24*(2), 3–30. Retrieved from http://www.nber.org/papers/w15794

Banerjee, Abijit, and E. D. (2008). *"The Experimental Approach to Development Economics."*

Deaton, A. (2010). Instruments, Randomization, and Learning about Development. *Journal of Economic Literature*. doi:10.1257/jel.48.2.424

Deininger, K., Ali, D. A., & Alemu, T. (2011). Impacts of Land Certification on Tenure Security, Investment, and Land Market Participation: Evidence from Ethiopia. *Land Economics* , *87* (2), 312–334. Retrieved from http://le.uwpress.org/content/87/2/312.abstract

Deininger, K., & Jin, S. (2006). Tenure security and land-related investment: Evidence from Ethiopia. *European Economic Review*, *50*, 1245–1277. doi:10.1016/j.euroecorev.2005.02.001

Duflo, E., & Kremer, M. (2008). Using Randomization in Development Economics: A Toolkit. In *Handbook of Development Economics* (p. 68). doi:10.1016/S1573-4471(07)04061-2

Franzel, S., Coe, R., Cooper, P., Place, F., & Scherr, S. J. (2001). Assessing the adoption potential of agroforestry practices in sub-Saharan Africa. *Agricultural Systems*, *69*, 37–62. doi:10.1016/S0308-521X(01)00017-8

Jayne, T.S., B. Zulu, G. Kajoba, M. T. W. (2009). *Access to land and poverty reduction in rural Zambia: Connecting the policy issues*. Retrieved from http://purl.umn.edu/55054

Kabwe, G., Bigsby, H., & Cullen, R. (2009). Factors influencing adoption of agroforestry among smallholder farmers in Zambia - Paper presented at the 2009 NZARES Conference. Nelson. Retrieved from http://ageconsearch.umn.edu/bitstream/97135/2/2009_9_Zambian Agroforestry Adoption_KabweG.pdf

Kiptot, E., Franzel, S., & Degrande, A. (2014). Gender, agroforestry and food security in Africa. *Science Direct: Current Opinion in Environmental Sustainability*, *6*, 104–109. doi:10.1016/j.cosust.2013.10.019

Leamer, E. E. (2010). Tantalus on the Road to Asymptopia. *Journal of Economic Perspectives*. doi:10.1257/jep.24.2.31

Mbow, C., Smith, P., Skole, D., Duguma, L., & Bustamante, M. (2014). Achieving mitigation and adaptation to climate change through sustainable agroforestry practices in Africa. *Scioence Direct: Current Opinion in Environmental Sustainability*, *6*, 8–14. doi:10.1016/j.cosust.2013.09.002

Mbow, C., Van Noordwijk, M., Luedeling, E., Neufeldt, H., Minang, P. a, & Kowero, G. (2014). Agroforestry solutions to address food security and climate change challenges in Africa. *Science Direct: Current Opinion in Environmental Sustainability*, *6*, 61–67. doi:10.1016/j.cosust.2013.10.014

Mercer, D. E. (2004). Adoption of agroforestry innovations in the tropics: A review. *Agroforestry Systems*. doi:10.1023/B:AGFO.0000029007.85754.70

Pattanayak, S. K., Mercer, D. E., Sills, E., & Yang, J. (2003). Taking stock of agroforestry adoption studies. *Agroforestry Systems*, *57*, 173–186. doi:10.1200/JCO.2003.11.022

Phiri, D., Franzel, S., Mafongoya, P., Jere, I., Katanga, R., & Phiri, S. (2004). Who is using the new technology? the association of wealth status and gender with the planting of improved tree fallows in Eastern Province, Zambia. *Agricultural Systems*, *79*, 131–144. doi:10.1016/S0308-521X(03)00055-6

Place, F. (2009). Land Tenure and Agricultural Productivity in Africa: A Comparative Analysis of the Economics Literature and Recent Policy Strategies and Reforms. *World Development*, *37*, 1326–1336. doi:10.1016/j.worlddev.2008.08.020

Place, F., & Otsuka, K. (2001). Tenure, Agricultural Investment, and Productivity in the Customary Tenure Sector of Malawi. *Economic Development and Cultural Change*. doi:10.1086/321918

Raudenbush, S. W., Spybrook, J., Congdon, R., Liu, X., Martinez, A., Bloom, H., & Hill, C. (2011). Optimal Design Plus Empirical Evidence (Version 3.0). Retrieved from http://www.wtgrantfoundation.org/resources/optimal-design

Sirrine, D., Shennan, C., & Sirrine, J. R. (2010). Comparing agroforestry systems' ex ante adoption potential and ex post adoption: on-farm participatory research from southern Malawi. *Agroforestry Systems*. doi:10.1007/s10457-010-9304-0

Smith, R. E. (2004). Land tenure, fixed investment, and farm productivity: Evidence from Zambia's southern province. *World Development*, *32*, 1641–1661. doi:10.1016/j.worlddev.2004.05.006

Spybrook, J., Bloom, H., Congdon, R., Hill, C., Martinez, A., & Raudenbush, S. (2011). *Optimal Design Plus Empirical Evidence: Documentation for the "Optimal Design" Software* (pp. 0–215). Retrieved from http://www.wtgrantfoundation.org/File Library/Resources/OD-Documentation-V3-0-10-17-11x--2-.pdf

Tetra Tech. (2014). *Zambia Tenure and Climate Change Scoping Report: Opportunities for land tenure and agroforestry intervention*.

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