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Evaluating the transformational impact of a forest carbon offsetting programme in Uganda: Lessons from a ten-year investigation into the Trees for Global Benefits programme

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Evaluating the transformational impact of a forest carbon offsetting programme in Uganda: Lessons from a ten-year investigation into the Trees for Global Benefits programme

Abstract

In this working paper we consider the transformational impacts of transnational climate governance initiatives by investigating the Trees for Global Benefits (TFGB) programme, a forest carbon offset programme in Uganda operating on the "voluntary" carbon market under the Plan Vivo standard. Importantly, we take a comparative, quasi-experimental and longitudinal approach by comparing results from a 2019 field effort with data first collected in 2009. Such an approach offers us a unique perspective from which to evaluate the effectiveness of the TFGB programme in catalyzing transformational change and to compare with other theoretical frameworks that have been used to investigate the TFGB programme. Overall, our findings suggest that, while the programme has delivered benefits, it has not been as transformative as expected. We find the programme to be delivering positive but declining returns for TFGB participants while generating limited positive feedbacks and spillovers with non-participants. While such dynamics are associated with two theoretical frameworks previously used to interpret the TFGB programme (skewed benefits and discount theory), they also highlight the gap between the completion of upfront carbon payments by the 10^{th} year of participation and anticipated timber harvest by its completion at the $20^{th}/25^{th}$ year. A number of recommendations are made that may allow for the transformational impact of the TFGB programme to be more fully realized.

Keywords

Carbon offsetting, forestry, transformational change, livelihoods, quasi-experimental methods, longitudinal research, Uganda

Évaluation de l’impact transformationnel d’un programme de compensation du carbone forestier en Ouganda : Leçons tirées d’une enquête de dix ans sur le programme « Trees for Global Benefits »

Résumé

Dans ce document de travail, nous examinons les impacts transformationnels des initiatives transnationales de gouvernance climatique en étudiant le programme Trees for Global Benefits (TFGB), un programme de compensation du carbone forestier en Ouganda opérant sur le marché du carbone "volontaire" sous la norme Plan Vivo. Il est important de noter que nous adoptons une approche comparative, quasi-expérimentale et longitudinale en comparant les résultats d'un effort de terrain de 2019 avec des données collectées pour la première fois en 2009. Une telle approche nous offre une perspective unique pour évaluer l'efficacité du programme TFGB à catalyser le changement transformationnel et pour établir une comparaison avec d'autres cadres théoriques qui ont été utilisés pour étudier le programme TFGB. Dans l'ensemble, nos résultats suggèrent que, bien que le programme ait apporté des avantages, il n'a pas été aussi transformateur que prévu. Nous constatons que le programme produit des rendements positifs mais décroissants pour les participants au TFGB, tout en générant des rétroactions et des retombées positives limitées avec les non-participants. Bien que ces dynamiques soient associées à deux cadres théoriques précédemment utilisés pour interpréter le programme TFGB (bénéfices asymétriques et théorie de l'actualisation), elles mettent également en évidence l'écart entre l'achèvement des paiements initiaux de carbone à la 10e année de participation et la récolte de bois prévue à sa fin à la 20e/25e année. Des recommandations sont formulées afin de permettre une meilleure réalisation de l'impact transformationnel du programme TFGB.

Mots clés

Compensation carbone, foresterie, changement transformationnel, moyens de subsistance, méthodes quasi-expérimentales, recherche longitudinale, Ouganda

1. Introduction

In this paper we consider the transformational impacts of transnational climate governance initiatives by investigating the Trees for Global Benefits (TFGB) programme, a forest carbon offset programme in Uganda operating on the "voluntary" carbon market under the Plan Vivo standard.[1] Importantly, we take a comparative, quasi-experimental and longitudinal approach by comparing results from a 2019 field effort with data first collected in 2009. Longitudinal research is increasingly seen as crucial for development and sustainability studies (Caruana et al., 2015; Edwards, 2015; Faling, 2020) while a number of experts have called more rigorous comparative and quasi-experimental research methods (Blackman and Bluffstone, 2021; Ferraro and Pattanayak, 2006; Purdon, 2013). Such an approach offers us a unique perspective from which to evaluate the effectiveness of the TFGB programme in catalyzing transformational change.

Transformational change is increasingly viewed as important paradigm for interpreting the impact and sustainability of climate action. For example, the Sixth Assessment Report (AR6) of the IPCC highlights its role in meeting the Paris Agreement and Sustainable Development Goals (IPCC, 2022). However, important debates revolve around the relationship between transformational and incremental change as well as the relationship between transformation, sustainability, and global climate governance (Bernstein and Hoffmann, 2018; Feola, 2015; Levin et al., 2012; Mapfumo et al., 2017; Swilling et al., 2016; Termeer et al., 2017). Empirical research into these issues tends to be forward looking and ex-post evaluation is only beginning to attract attention (Hale et al., 2021).

Within Uganda, the debate on forest carbon offsetting has been particularly acute, given that a relatively large number of carbon offset programmes have been established in the country (Nel et al., 2018). Investigation of the TFGB programme is important since it adheres to the Plan Vivo carbon standard, a certification system of the voluntary carbon market for afforestation/reforestation projects in developing countries. Plan Vivo differs from other forest carbon standards, such as those under the Clean Development Mechanism (CDM) of the Kyoto Protocol, in terms of its emphasis on directly collaborating with smallholder farmers, offering upfront carbon payments and working with native tree species, amongst other governance innovations. First piloted in southwestern Uganda in 2003, by 2020 the TFGB programme has grown to involve 11,798 households (as well as 86 community groups) in 12 districts across the country involving 9,242 hectares of land and has paid out $3.4 million US dollars to participants for 1.95 million tonnes CO2e of emission removals (EcoTrust, 2021: 2). The scale and speed at which the TFGB programme has grown is suggestive of transformational change.

[1] See Kollmus et al. (2008) for an introduction to the voluntary carbon market and how it compares to regulated carbon markets like those formerly associated with the Kyoto Protocol.

Despite these innovations and growth, the TFGB programme is not without critique. Previous empirical, field-based research has raised concerns about the TFGB programme from different theoretical frameworks. We categorize existing research into (i) skewed benefits, (ii) discount theory, (iii) subsumption theory, and (iv) environmental justice. By considering empirical results from the vantage of transformational change and contrasting this with other theoretical frameworks, research presented in this paper allows us to provide new insights into the TFGB programme's impact.

The paper proceeds as follows. After this introduction, we provide a brief discussion of transformational change before next providing an overview of the TFGB programme. After this we elaborate on the theoretical frameworks that have previously been used to explain the local impacts of the TFGB programme and generate hypotheses about the direction and scope of change implicit in each. In a fourth section we present our research methodology, before next presenting results of regression analysis of household survey data as well as an analysis of changes in programme governance and management as elicited through key informant interviews. In the discussion, we consider the implications of our findings for transformational change and existing theoretical frameworks. We conclude with a reflection on improving research going forward.

2. Transformational Change

Transformational change has emerged as leading conceptual framework for understanding climate change mitigation and adaptation efforts. The IPCC defines transformation as a concept "embracing the idea of major fundamental changes in society or natural systems as opposed to changes that are minor, marginal or incremental" (IPCC, 2022: 1-65). While a comprehensive review of transformational change is beyond the scope this paper, we highlight key tensions that are important for understanding the transformational impact of the TFGB programme at the local level.

One line of debate is the relationship between transformational and incremental change. As suggested by Termeer et al. (2017), transformational change has often been characterized as change that is entrenched, large-scale and/or quick (also see Bernstein and Hoffmann, 2018). In contrast, incremental change has traditionally been viewed as change that is shallow, partial and slow. Scholars, however, are increasingly questioning this distinction. First, as Termeer et al. (2017) argues, realising change that meets all three characteristics of transformational change is difficult because of the trade-offs between them. For example, a change that is quickly achieved might be very shallow. Second, incremental changes might accumulate over time that move a social system beyond a social tipping point and result in transformational change. Such a phenomenon has been referred to as continuous transformational change (Termeer et al., 2017), progressive incrementalism (Levin et al., 2012), or social tipping processes (Winkelmann et al., 2022).

A second debate surrounds the relationship between transformational change and sustainability. The two are not one and the same. For example, Folke et al. (2010) make a distinction between deliberate and forced transformations, such as migration in response to climate change. Mersmann et al. (2014) make a useful distinction between transformational change and sustainable development. While the former is a descriptive concept delineating the process of change, the latter is normative concept identifying the goal of change. Not all transformational change is sustainable; indeed, some forms of change may be regressive.

A third tension relates to the measurement of transformational change. Of the characteristics of transformational change, we submit that entrenchment is more difficult to measure than the scale or speed of change. Arguably, it is something that can also be better measured through comparative, quasi-experimental and longitudinal research. One reason that entrenchment is difficult to measure is that it is associated with complex path-dependent processes that have only begun to attract empirical attention. Drawing on this literature, we identify five path-dependent processes of entrenchment in Table 1: lock-in (institutional/economic), self-reinforcing, increasing returns, positive feedback and, as a unique contribution of this paper, positive spillovers. A major empirical challenge involves measuring the impact of a policy intervention on those targeted by the intervention, those not targeted as well as the interaction between the two. Here we differentiate between policy feedbacks (where the direction of policy effects flow from untargeted to targeted participants) from policy spillovers (where effects flow from targeted to untargeted participants). However, path-dependent processes might also take trajectories that lead to attrition (opposite of entrenchment) and, ultimately, regressive transformational change.

After first providing an overview of the TFGB programme in the next section, we later draw attention to path-dependent processes in Table 1 that are implicit in previous research into the impact of the TFGB programme.

Table 1: Types of Path-Dependent Processes of Entrenchment

Positive Processes	Description	Negative Processes
Positive Lock-in (Institutional/Economic)	When policies and political decisions contain an institutional logic that gives them immediate durability / When the consequences of economic decisions are difficult to reverse.	Negative Lock-In
Self-Reinforcement	When the costs of reversing a change instigated by a policy or decision rise over time.	Self-Undermining
Increasing Returns	When the benefits to targeted population of a policy intervention increase over time.	Diminishing Returns
Positive Feedback	When the subsequent decision of an untargeted population to join an initiative benefits the initial target population and reinforces their initial decision to participate.	Negative Feedback
Positive Spillovers	When an initially untargeted population benefits from the participation of the targeted population.	Negative Spillovers

Adapted from Bernstein and Hoffmann (2018: 202).

3. Overview of the TFGB Programme

The TFGB programme has been implemented under the Plan Vivo standard by a Ugandan conservation NGO known as EcoTrust. As suggested earlier, the Plan Vivo standard is distinguished from other forest carbon standards in a number of ways. First, it seeks to minimize the risk of land tenure problems by working with smallholders directly on their household lands and undertaking a household land-use planning exercise known as a "Plan Vivo" (Kollmuss et al., 2010; Orrego, 2005). One reason why EcoTrust initiated the TFGB programme in southwestern Uganda is the prevailing, quasi-private customary form of land tenure in this region, like many areas of southwestern Uganda (Carswell, 2002; Hartter et al., 2015). What we describe as a quasi-private customary land tenure is also recognized in Uganda's national legal framework.[2] Tree-planting is generally recognized to be more successful where tenure rights are more individualized (Acemoglu et al., 2002; Otsuka and Place, 2001). Relatedly, the Plan Vivo standard also requires households to hold at least one hectare of land to be eligible to participate in order to reduce the risk of food insecurity.

Justification of Plan Vivo's approach can be found when looking at other forest carbon offsetting projects in Uganda. Some of the most powerful critiques are associated with large-scale afforestation projects under the CDM standard on national parks or Central Forest Reserves (CFRs)—though there is a range of reported impacts (for example, see Fischer et al., 2016; Lyons and Westoby, 2014; 2016). Conflicts can arise when developers of carbon offset projects plant trees on CFRs that are being used by local residents, often deemed "encroachers" by the central government because they are considered protected areas by legislation.

In order to produce household Plan Vivos, EcoTrust recruits local coordinators, typically staff of a community-based organization (CBO), to meet with individual farmers. The Plan Vivo itself is drawn on flipchart paper with the farmer to sketch different household land uses and designate where TFGB trees will be planted. Smallholder farmers retain a paper copy of the Plan Vivo for their household records while EcoTrust retains a digital photo which it shares with local government and the CBO. While the agreement forms are written in English, during recruitment they are orally presented in local languages. The large majority of smallholders are not literate and thus a written agreement in the local language is impractical. The local council leaders of the villages where these farmers are registered act as witnesses during the preparation of these Plan Vivos.

[2] Article 237 of the 1995 Constitution of Uganda is distinguished from that of others in sub-Saharan Africa by vesting land ownership rights in the citizens of Uganda. Customary tenure is defined in the 1998 Land Act as tenure which applies "local customary regulations and management to individual and household ownership, use, occupation of, and transactions in, of land in perpetuity (Land Act: s.4(1)(a)-(h)). Although smallholders and communities may choose to obtain formal proof of their customary lands by acquiring a certificate of customary ownership, customary land ownership is legally recognized without it (Knight et al., 2011: 18).

A second innovation of the Plan Vivo standard is to offer upfront carbon payments. It is generally considered best practice to offer smallholders upfront payments in order to offset the initial costs of woodlot establishment (Dougill et al., 2012), though most other forest carbon standards offer payment only after trees have been established. The TFGB programme delivers nearly 70% of total carbon payments to a participating household in the first three years of the project, with another at the project's 5th year and final payment offered in the 10th year (EcoTrust, 2011: 17, 31). However, smallholders remain contractually bound to maintain planted trees until they reach 20- to 25-years of age, depending on the type of tree species being planted (Plan Vivo-PDD, 2009: 18). After this age, trees are expected to be selectively harvested for timber used in construction and furniture and generate significantly more household income. EcoTrust estimates that felled TFGB trees will generate $7,750 per ha (Plan Vivo, No Date-a: 5; No Date-b: Table 3). Importantly, upfront carbon payments are only made to participants upon successfully meeting performance milestones, including the number of trees planted, their spacing and survival rates in early years and tree diameter later (Plan Vivo-PDD, 2016: 46).

Carbon prices that EcoTrust has obtained on the market initially ran at about $4 per ton of CO2 equivalent (tCO2e) and peaked at $6.5 in 2009 and plateaued at just under $6 by the time of 2019 fieldwork (EcoTrust, 2019: 16).[3] We note that these prices are considerably higher and stable than average prices on voluntary carbon markets, which averaged $3.07 in 2019 (Donofrio et al., 2021: 5). Furthermore, carbon contracts with TFGB participants are paid based on the current exchange rate of US dollars to Ugandan shillings.

Third, the TFGB programme has promoted the establishment of native tree species. Initially the programme promoted the establishment of only a single species: *Maesopsis eminii* Engl. Technical specifications for seedling spacing and tree growth were first developed specific for the establishment of woodlots comprised 80% by this species. Thus, while tree-planting consisted of a native species, it was not very diverse. Beginning in 2013, the programme began to transition to the use of a new technical specification for mixed native species and different planting configurations (boundary, woodlot and intercropping) (EcoTrust, 2013: 11-12; 2014: 5). One reason was that woodlots comprised largely of *Maesopsis eminii* were proving prone to pests and disease (EcoTrust, 2017: 5-6). It is well known that biodiversity enhances the resilience of ecosystems (Elmqvist et al., 2003). The new technical specification was first piloted in eastern districts in the Mt Elgon region in 2013 and finalized in 2016 (EcoTrust, 2014: 9; 2016: 27). All farmers recruited prior to 2015 would continue to use the original single species technical specification while new recruits would use the mixed one (EcoTrust, 2017: 7). However, prior to the new specifications being finalized, smallholders in some districts were encouraged to experiment with different planting configurations, including mixed woodlots, as problems with the single species woodlots (pure stands) emerged.

[3] Bitereko Subcounty, Interview UD13, 26 May 2009; Bitereko Subcounty, Interview U15, 27 May 2009; Bitereko Subcounty, Interview U16, 27 May 2009; Kampala, Interview U1, August 2019.

A final innovation of the TFGB programme has been the establishment of a Carbon Community Fund (CCF). Participating smallholders are required to contribute 10% of their carbon payments to the CCF to support both risks of participating farmers being unable to maintain planted trees as well as to support community development projects (Byakagaba et al., 2021). While the CCF was included in the initial project design document, its role was clarified in an update published in 2016. Currently, approximately 70% of CCF funds are intended to recruit substitute farmers in case of withdrawal or abandonment while the remaining 30% goes to community development projects such a s improving road infrastructure and schools in the areas where the farmers are recruited (Plan Vivo-PDD, 2016: 31-32). EcoTrust also sets aside an additional 10% of carbon credits generated in a risk buffer account as a precaution against natural disturbances (EcoTrust, 2021: 2).[4]

4. Previous Research into the TFGB Programme

In this section, we elaborate on theoretical frameworks deployed in previous research into the impacts of the TFGB programme and including fieldwork in districts the same as those investigated here. Our contribution is to generate a number of implicit hypotheses about how transformational impact of the TFGB programme would have been expected to unfold according to each (Table 2). This has been achieved by drawing attention to tacit path-dependent processes implicit within each theoretical framework. We justify this attribution in the section below.

A first theoretical framework that we describe as skewed benefits concerns the distribution of costs and benefits of the TFGB programme amongst participants and non-participants at the local level. Various studies of the TFGB programme have demonstrated that benefits accrue largely to local smallholders of relatively higher socio-economic status, including separate field efforts in 2008, 2009 and 2014 (Carter, 2009; Kiyingi et al., 2016; Purdon, 2015; 2018). One question has been whether participation in the programme has led to this outcome or whether, as researchers have suggested, relatively more wealthy villagers (with surplus land) self-select to participate in TFGB programme.

While there are positive returns for participants, these are currently modest as they are shaped by the price of carbon on the voluntary carbon market; benefits for non-participants are limited to modest spillover effects such as through the Carbon Community Fund (CCF). Transformational impact is muted as it is expected that benefits will continue to be concentrated amongst the relatively elite villagers unless additional mechanisms to broaden the distribution of local benefits to non-participants (untargeted populations) are introduced.

A second theoretical framework is based on the economic theory of discounting. Drawing on fieldwork in late 2008 and early 2009 in Mitooma district, Fisher (2012) cautioned that upfront

[4] Kampala, Interview U1, August 2019.

carbon payments might lead smallholders targeted through the TFGB programme to over-commit land and other resources in a manner that would prove unsustainable. Economic research in the developing world has consistently demonstrated that poorer households tend to more highly discount future costs and benefits (Cardenas and Carpenter, 2008; Lumley, 1997). This is important for forestry projects since the costs of establishing trees is incurred over the short-term and benefits accrue over the long-term (Hepburn and Koundouri, 2007). Relatedly, other authors have raised concerns about forest carbon offsetting exacerbating food insecurity because land is committed to tree-planting instead of food production (Foster and Neufeldt, 2014; Jindal et al., 2007).

A hypothesis about transformational change derived from this theoretical framework would suggest that the TFGB programme will deliver decreasing returns over the initial 10-year phase of the programme as upfront carbon payments decline while timber payments remain unavailable until at least the 20th year of the programme. Such negative impacts would be more salient amongst relatively poorer TFGB participants, whose discount rates are expected to be higher.

A third theoretical framework that has been applied to the TFGB programme is subsumption theory (Carton and Andersson, 2017; 2018). As initially applied to environmental issues by Boyd et al. (2001) and recently reviewed by Walsh (2021), subsumption theory is a Marxist theory seeking to explain "how capital takes over existing production processes and social arrangements and intervenes in both for its own purposes" (Walsh, 2021: p.7). Relying on 2015 fieldwork in Mitooma district, Carton and Andersson (2017; 2018) argued that a causal process indicative of subsumption cascades from capitalists at the global level (global firms pursuing low-cost carbon credits) to influence the behavior of EcoTrust which in turn subsumes individual smallholders through a range of disciplinary techniques, including training as well as monitoring campaigns by EcoTrust.

Carton and Andersson (2017) provide four key pieces of evidence to substantiate this causal process (pp. 7-10). The first two correspond to pressure from global capital on EcoTrust. First, the authors argue that EcoTrust has been induced to focus on the cultivation of a single albeit native species (*Maesopsis eminii*) in order to meet the global carbon market's need for standardization. Second, they argue that, particularly important at the time of their fieldwork, EcoTrust was under pressure to respond to correction requests following a 2013 third-party verification in order to continue to be eligible to receive carbon payments under the Plan Vivo standard. Another two empirical observations are interpreted as demonstrating the subsumption of smallholders by EcoTrust. First, Carton and Andersson argue that grievances elicited through qualitative interviews with participating smallholders indicate a struggle by EcoTrust to discipline the labor of participating farmers. Second, they point to declining rates of programme performance as measured by the ability of TFGB participants in Mitooma district to reach project milestones in 2013 and 2014.

Subsumption theory anticipates regressive transformational change: TFGB programme management will become increasingly stricter as the programme becomes more deeply subsumed into global capitalism, leading to greater levels of dissatisfaction as smallholders are unable to meet ever more rigorous rules. These processes might be described as a self-undermining process and decreasing returns as well as negative institutional lock-in. However, because the theory is oriented towards participants in the TFGB programme, path-dependent policy processes involving targeted and untargeted populations (including feedbacks and spillovers) remain unarticulated.

Finally, we turn to theories of environmental justice, which have evaluated the TFGB programme for both targeted and untargeted populations in terms of distributional issues but also, importantly, issues of recognitional and procedural justice (Fisher et al., 2018; Nel et al., 2018). In their evaluations of environmental justice, it is important to point out that researchers have relied on Fisher's original 2008/2009 fieldwork—meaning that nearly 10-years separates fieldwork and evaluation.

In terms of distributional justice, the TFGB programme has been deemed by researchers to be "weakly positive" because, while benefits are generated, these are skewed to relatively wealthy smallholders, while costs and benefits were claimed to be contested (Nel et al., 2018: 136). With regard to recognitional justice, researchers deemed the programme to have neutral impacts because it, at least, recognizes the customary quasi-private land tenure of participating smallholders. The lowest evaluation is accorded to procedural justice, which is assigned a "weak/limited" evaluation. Similar to arguments made for subsumption theory, EcoTrust is argued to be more accountable to credit buyers than local smallholders: "TFGB is offered to participants, to adopt or not, with little space for negotiation" (Fisher et al. 2018: 262).

The transformational impact of the TFGB programme is not explicitly hypothesized in research from an environmental justice perspective. But given the 10-year gap between fieldwork and published evaluations, the implication is that the original environmental justice evaluation of the TFGB programme remains unchanged, with the lowest evaluation given to elements of procedural justice. While there are modest increasing returns for participants, they are locked into an unjust institutional framework while positive spillovers with non-participants are negligible.

Table 2: Four theoretical frameworks applied to TFGB programme and implicit hypotheses about transformational change

Theoretical Framework	Literature	Year Field Effort	Main Conclusion	Implicit Hypothesis about Transformational Change	Path-Dependent Process	Populations Sampled
Skewed Benefits	(Carter, 2009; Kiyingi et al., 2016; Purdon, 2015; 2018)	2008, 2009 & 2014	TFGB programme is characterized by positive economic benefits but skewed towards smallholders of relatively higher socioeconomic status. Need for additional mechanism to broaden distribution of benefits to non-participants.	TFGB programme continues to produce skewed benefits unless new mechanisms to broaden the distribution of benefits are introduced. However, this does not lead participants to leave the programme.	Modest Increasing Returns; Modest Positive Spillovers	Targeted and Untargeted Populations
Discount Theory	(Fisher, 2012)	2008/2009	Upfront payment structure of TFGB may "lure" smallholders to allocate household land towards the project in an unsustainable manner.	As currently designed, the TFGB programme will become increasingly unsustainable, particularly amongst relatively poorer participants, leading participants to leave the programme.	Decreasing Returns	Targeted Populations
Subsumption Theory	(Carton and Andersson, 2017; 2018)	2015	Global capitalism is subsuming smallholders to become "carbon farmers" which results in smallholder grievances, creates obstacles to programme implementation and declining programme performance.	Programme governance becomes increasingly more rigorous and demanding, leading to disagreements with participants who will increasingly leave the programme.	Self-Undermining; Decreasing Returns; Negative Lock-In	Targeted Populations
Environmental Justice	(Fisher et al., 2018; Nel et al., 2018)	2008/2009	TFGB programme is characterized by "weakly positive" performance across three dimensions of environmental justice, particularly in terms of procedural justice.	"Weakly positive" environmental justice performance of the TFGB programme remains unchanged	Modest Increasing Returns; Negligible Positive Spillovers; Negative Lock-In;	Targeted and Untargeted Populations

5. Methodology

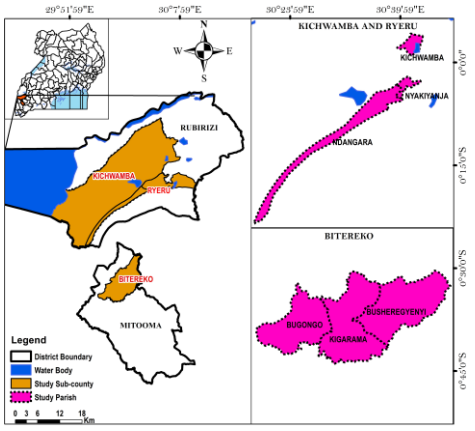
5.1. Study Area

We investigated the TFGB programme in three subcounties across two districts in southwestern Uganda: Bitereko subcounty in Mitooma district (visited in both 2009 and 2019) and Ryeru and Kichwamba subcounties in Rubirizi district (visited only in 2019). See Figure 1 for a map of the study area. Until 2010, both districts were part of Bushenyi district. The TFGB programme was piloted in Bitereko subcounty in 2003 though it reached subcounties Rubirizi district in 2006.

Both Mitooma and Rubirizi districts are in close proximity to Queen Elizabeth National Park (QENP), while Rubirizi is also host to the Kyambura Wildlife Reserve, Kasyoha-Kitomi CFR, Kalinzu CFR and Maramagambo CFR. Subcounties in Rubirizi have access to the Kasyoha-Kitomi CFR under a collaborative forest management arrangement (Raben et al., 2007).[5] The subcounty of Kichwamba is often associated with QENP, which is largely a grassland landscape (Plumptre et al., 2010), though the locations visited for this study are more similar to those in adjacent Ryeru subcounty, along an escarpment contiguous with parishes of Ndangara and Nyakiyanja. Consequently, in our statistical analysis (discussed below) we group results by district, combining results from Rubirizi district and comparing them with those from Mitooma.

We note that the population density of Mitooma district was 341 people per km^2 in 2014, with Bitereko registering the highest population among all the sub-counties in the district, while that of Rubirizi was 165 people per km^2 (UBOS, 2014). Bitereko subcounty of Mitooma is generally flatter and has been inhabited for a longer period of time. In contrast, the terrain in Rubirizi is characterized by undulating hills and valleys. The highland locations investigated in Rubirizi are also characterized by fertile volcanic soils (Wambede et al., 2016).

Figure 1: Map showing location of parishes investigated in Mitooma and Rubirizi districts



[5] The National Forestry Authority licensed 615 ha to the CBO for planting within the reserve of which members had planted 600 hectares by 2019 (Rubirizi district, Interview U11, August 2019).

5.2. Empirical Methods

We used a combination of qualitative and quantitative field research methods. Key were a total of 215 detailed household surveys with both those participating in the TFGB programme as well as local households that were not participating. In addition, key informant interviews were undertaken at the local, district and national levels and triangulated to validate survey findings and explore governance issues. In addition, we consulted relevant policy documents such TFGB annual reports and audit reports. The TFGB programme has been subject to three external third-party audits to verify it meets the requirements of the Plan Vivo standard: in 2009, 2013 and 2019 (ESI, 2019; Rainforest Alliance, 2009; 2013).

More specifically, in 2009, the first author and a field assistant from Makerere University, fluent in Runyankole-Rukiga, undertook a total of 61 household surveys in Bitereko subcounty of Mitooma district. Participants were randomly drawn from lists provided by local coordinators and local facilitators of the TFGB programme; neighbors who were not participating were selected as non-participants. The first author also conducted semi-structured interviews with 3 local key informants in Bitereko subcounty including the local coordinator, a subcounty official, and a local representative of the central government's forest agency as well as with 3 district government representatives in Bushenyi, then the district headquarters, including a district forest office, district land officer and district representative of the central government's forest agency.

In 2019, a larger team including two current authors as well as four graduate student field assistants from an East African university was assembled. All new members of the team assembled were fluent in Runyankole-Rukiga. The team use a strategy similar to that used in 2009 for identifying villagers to survey. Over the course of one week the team was able to undertake a total of 155 household surveys across the two districts. A total of 10 semi-structured interviews with local key informants (5 in each district) were also undertaken in addition to formal introductory meetings with district government representatives. Key informants were purposively selected based on their role in the community and expertise and included 3 TFGB participants, 2 non-participants, 3 local facilitators (who were also participants), 1 local coordinator, as well as 1 local representative of the central government's forest agency. Semi-structured interviews were led by the second author in Runyankole-Rukiga who translated responses into English. Towards the end of our visit, we also organized a meeting with EcoTrust to discuss aspects related to programme management.

The household survey itself was identical between sampling years, except as follows. In both 2009 and 2019, we collected data amongst TFGB participants and non-participants on a range of livelihood variables including household income, area of total household land, household land-use allocation, household crop cultivation as well as food security. In addition, we asked a number of questions only of TFGB participants in both sampling years. First, we asked them to evaluate the costs and benefits of their involvement in the programme on a 5-point scale (where a

5 indicated that benefits outweighed costs) in order to construct a cost-benefit index as well as to reconstruct more detailed costs and benefits of the programme over time in order to gauge how programme costs as a share of benefits evolved. Second, we asked participants whether they would retain trees standing after the final carbon payment was received at Year 10 through to the end of the contract with TFGB. A third question asked participants if they would like to continue planting more trees under the TFGB programme.

For the purposes of the current paper, the only difference between surveys administered between years was with regard to a question about household food security. In the initial survey, respondents were asked if their household had been short of food over the previous year. However, in 2019, we asked respondents to consider whether over the past year there was ever a worry that their household would run out of food. This difference in questions unfortunately precluded longitudinal analysis of food security responses.

5.3. Data Analysis

For quantitative analysis of household data, we undertook regression analysis with the goal of determining if there was an effect on livelihoods components of households participating in the TFGB programme over time. Our regression analysis included dummy variables for treatment, sampling year and district. For the majority of the analysis we used multiple regression and its estimation using ordinary least squares (OLS) while for logistic regression of binary dependent variables, we used the Firth procedure (Coveney, 2015), which is recommended for small sample sizes like those we investigated (Faghih et al., 2020). Given the small sample size (n=215), we use *P* values of 10%, 5% and 1% when reporting results. Interpretation of coefficients significant at the 10% level should be done cautiously as there might be a relationship that our small sample is not able to capture or the relationship itself might truly be weak (see Greenland et al., 2016).

To estimate the effect of the TFGB programme over time we used an interaction term to capture the relationship between involvement in the TFGB programme and time (treatment*year). In using an interaction term (treatment*year), our regression analysis is structurally similar to difference-in-differences (DiD) analysis (Fredriksson and de Oliveira, 2019). However, because we do not have household data from before the programme's start, DiD was not feasible.

We interpret results of regression analysis accordingly: a significant interaction term would suggest that TFGB participants evolved differently than non-participants over time with respect to the livelihood variable in question. However, if only a significant independent treatment effect was observed—and the interaction term not found significant—this would support the interpretation that participants of higher socioeconomic status have self-selected to participate in the TFGB programme, though for reasons unrelated to annual real income and total household land (which we have controlled for in our analysis).

A key feature of our regression analysis that renders it quasi-experimental is the use of control variables to isolate treatment effects. As suggested earlier, the socioeconomic profile of participants in the TFBG programme is known to be significantly different from non-participants. This means that non-participants cannot justifiably be considered a counterfactual representing participants if the opportunity to participate in the TFGB programme were unavailable. To address this, we controlled for these two contextual variables in our multiple regression analyses: annual real household incomes (adjusted for inflation and expressed in 2009 million Uganda shillings, $mUgSh_{2009}$) and total household landholdings.

6. Results

6.1. Descriptive Statistics

We present descriptive statistics in Table 3 for livelihood variables for all households sampled, including TFGB participants and non-participants, as well as measures of TFGB participant satisfaction in Table 4. These tables include means and standard deviations decomposed into sampling year, district and (in the case of livelihood variables) whether the household was participating in the TFGB programme or not.

We briefly describe livelihood variables between TFGB participants and non-participants. We find real income of TFGB participants to be double that of non-participants, at 4.2 million 2009 Ugandan shillings ($mUgSh_{2009}$) versus 2.1 $mUgSh_{2009}$, respectively. While the income of TFGB participants appears to be considerably greater, this should also be put in perspective. The real income of TFGB participants of 4.2 $mUgSh_{2009}$ is equal to \$2,019 USD_{2009} or \$5.5 USD per day per household. The international poverty line is currently estimated by the World Bank at \$1.9 per day per person.

The average total amount of household land held by TFGB participants was nearly three times greater than that of non-participants: 4.1 ha to 1.4 ha, respectively. Average measures of cultivated land, fallow land and planting of exotic tree species such as *Eucalyptus* were also higher amongst TFGB participants. The area of trees planted for TFGB averaged 0.81 ha amongst TFGB participants and was zero amongst non-participants. The average area of coffee cultivation amongst participants, at 0.57 ha, was about double that of non-participants.

Our last group of livelihood variables pertains to food security. In 2009, only 7% of TFGB participants reported that their household had been short of food over the previous year whereas 33% of non-participants indicated they were. While a similar pattern was observed with the regard to the 2019 food security question, the difference between groups was narrower.

Descriptive statistics for our three measures of participant satisfaction with the carbon offset programme are presented in Table 4. First were responses to our cost-benefit index. Across all households the index averaged 2.7—just below neutral. Between sampling years, the average

cost-benefit index increased from 2.2 to 3.1 while the index measured 2.4 in Mitooma and 3.2 in Rubirizi. Second were responses to the question about whether TFGB participants would be interested in continuing to participate in the carbon offsetting programme. In 2009, 87% of TFGB participants surveyed in Mitooma district indicated that they would be interested in continuing while this dropped to 50% in 2019. In Rubirizi, 61% of respondents interviewed in 2019 indicated they would like to plant more trees with the TFGB programme in the future.

Our final question was about whether TFGB participants would keep trees standing or harvest them after carbon payments ceased at the project's tenth year. In 2009 all respondents in Mitooma affirmed that they would keep trees if carbon payments stopped; by 2019, only 32% of Mitooma residents claimed they would do so. However, 58% of TFGB participants surveyed in Rubirizi in 2019 indicated that they would keep trees if carbon payments ceased.

Table 3: Mean Household Livelihood Variables, by Sampling Year, District and Participation in TFGB Programme

	All Households	Sampling Year		District		Participation in TFGB	
Variable	**(n=215)**	**2009 (n=60)**	**2019 (n=155)**	**Mitooma (n=134)**	**Rubirizi (n=81)**	**Participant (n=104)**	**Non-Participant (n=111)**
Annual Income, Real (mUgSh$_{2009}$)	3.1 (4.8)	3.9 (7.4)	2.9 (3.4)	3.4 (5.6)	2.7 (3.1)	4.2 (6.1)	2.1 (3.0)
Total Household Land (ha)	2.7 (4.3)	4.5 (5.8)	2.0 (3.3)	3.4 (5.2)	1.6 (1.3)	4.1 (5.4)	1.4 (2.1)
Cultivated Land (ha)	1.9 (2.6)	3.1 (4.2)	1.4 (1.3)	2.2 (3.1)	1.3 (1.1)	2.6 (3.0)	1.2 (1.8)
Fallow Land (ha)	0.25 (0.85)	0.54 (1.3)	0.12 (0.47)	0.34 (1.0)	0.07 (0.32)	0.49 (1.2)	0.06 (0.26)
TFGB Planting (ha)	0.39 (0.72)	0.42 (0.62)	0.38 (0.76)	0.37 (0.78)	0.43 (0.64)	0.81 (0.86)	0.00 (0.00)
Exotic Tree Planting (ha)	0.28 (0.58)	0.33 (0.47)	0.26 (0.62)	0.29 (0.61)	0.27 (0.54)	0.45 (0.73)	0.13 (0.33)
Banana (ha)	0.85 (1.1)	1.8 (1.1)	0.47 (0.74)	1.2 (1.2)	0.33 (0.34)	1.0 (1.2)	0.70 (0.87)
Coffee (ha)	0.41 (0.73)	0.70 (1.2)	0.30 (0.41)	0.45 (0.87)	0.35 (0.38)	0.57 (0.81)	0.26 (0.61)
2009 Food Security Question (Y = 100%)	20% (40%)	20% (40%)	NA	20% (40%	NA	7% (25%)	33% (48%)
2019 Food Security Question (Y = 100%)	63% (48%)	NA	63% (48%)	61% (49%)	65% (48%)	59% (50%)	67% (47%)

Note: Standard error reported in parentheses.

Table 4: Mean Household Measures of TFGB Participant Satisfaction, by Sampling Year and District

	All Households	Sampling Year		District	
Variable		2009	2019	Mitooma	Rubirizi
	(n=103)	(n=30)	(n=74)	(n=60)	(n=43)
Costs outweigh benefits? (1-5 Scale)	2.7 (1.6)	2.2 (1.7)	3.1 (1.4)	2.4 (1.6)	3.2 (1.3)
Would like to continue planting more TFGB trees? (Y = 100%)	66% (48%)	87% (35%)	57% (50%)	70% (46%)	61% (49%)
Would keep trees standing if carbon payments stop? (Y = 100%)	62% (49%)	100% (0%)	47% (50%)	65% (48%)	58% (50%)

Note: Standard error reported in parentheses.

6.2. Results from Regression Analysis of Livelihood Variables

Table 5 presents results from multiple regression of household income, household land holdings and various household land-uses, including TFGB planting. Results indicate that participation in the TFGB programme was significantly associated with greater real annual income and household land holdings, though the former only at significance level of *P* values of 10%. Importantly, while our descriptive statistics suggested a reduction in real household income over time, regression reveals that this was actually found to significantly increase between years, though only at *P* values of 10%. We note the high level of variation in household income in 2009. No significant relationship with the interaction term nor district was observed for either livelihood measures.

Participation in the TFGB programme was also significantly and positively associated with planting indigenous TFGB trees—a finding important in light of concerns about the additionality, or environmental integrity, of carbon offsetting. The lack of significant relationship between TFGB tree-planting and sampling year or district is supportive of the general effectiveness of the project to motivate smallholders to retain trees over time.

Relative to non-participants, smallholders participating in the TFGB programme were cultivating significantly larger areas of coffee than neighboring non-participants. Coffee is an important cash crop in the region and Uganda's leading foreign exchange earner. Both banana and coffee cultivation increased significantly with total household land holdings while real annual income was also associated with greater coffee cultivation.

The interaction term treatment*year yielded a significant and negative interaction coefficient for area left fallow and land under coffee cultivation but a positive one for planting of exotic tree species such as *Eucalyptus*. While the result was highly significant for coffee (*P* value of 1%), the relationship was only significant at *P* values of 10%. To explore these results, we present detailed descriptive statistics of crops and land-use between TFGB participants and non-participants between our two sampling years in Table 6. Coffee cultivation amongst TFGB

participants declined from 1.1 ha to 0.4 ha from 2009 to 2019, though remaining at 0.3 ha amongst non-participants over the same period (Table 6). Similarly, fallow land declined from 1.0 ha to 0.2 ha amongst TFGB participants, though only from 0.08 ha to 0.05 ha amongst non-participants. For the planting of exotic tree species, the area planted amongst TFGB participants remained generally constant, averaging 0.48 ha in 2009 and 0.44 ha in 2019, though a greater reduction was observed amongst non-participants from 0.18 to 0.10 ha. Overall, findings suggest that the TFGB programme has led participating smallholders to reduce the amount of area cultivated for coffee and fallow land while, as we have seen in the previous section, maintaining trees planted for TFGB. It is possible that planting indigenous TFGB trees has substituted for coffee and provided an alternative use for land that might otherwise have been left fallow. Such results indicate that carbon finance has been able to compete with traditional cash crops such as coffee.

Regression analysis did not show a significant relationship between participation in the TFGB programme and food security (Table 7). This is not surprising given our regression model has controlled for income and landholdings, which we demonstrated above were significantly higher amongst participants. Other studies have indicated that TFGB participants tended to actually be more food secure than non-participants (Kiyingi et al., 2016; Mbow et al., 2014).

Table 5: Multiple Regression of Livelihood Variables

Variable	Annual Income, Real ($mUgSh_{2009}$)	Total Household Land (ha)	Cultivated Land (ha)	Fallow Land (ha)	TFGB Planting (ha)	Exotic Tree Planting (ha)	Banana (ha)	Coffee (ha)
Treatment Dummy (TFGB = 1)	2.91*	3.69***	0.18	0.22	0.62***	-0.06	0.03	0.55***
	(1.60)	(1.27)	(0.65)	(0.21)	(0.15)	(0.11)	(0.28)	(0.20)
Year Dummy (2019 = 1)	1.18*	-0.84	-0.55*	0.08	0.04	-0.06	-0.90***	0.08
	(0.65)	(0.75)	(0.31)	(0.11)	(0.08)	(0.07)	(0.19)	(0.10)
Interaction Treatment*Year	-2.39	-1.95	-0.21	-0.37*	0.07	0.25*	0.01	-0.57***
	(1.74)	(1.40)	(0.61)	(0.22)	(0.18)	(0.14)	(0.29)	(0.20)
District Dummy (Mitooma =1)	0.16	0.89	-0.18	-0.02	-0.07	-0.06	0.21***	-0.15**
	(0.50)	(0.57)	(0.16)	(0.07)	(0.10)	(0.09)	(0.06)	(0.06)
Annual Income, Real (2009 M Ug shilling)	NA	0.24***	0.04	0.02	-0.01	0.02***	-0.01	0.02**
		(0.07)	(0.04)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)
Total Household Land (ha)	0.34**	NA	0.48***	0.13***	0.06*	0.06***	0.12**	0.05***
	(0.16)		(0.14)	(0.04)	(0.03)	(0.02)	(0.05)	(0.02)
Constant	0.67	0.93	0.92**	-0.21*	-0.05	0.08	1.04***	0.14
	(0.71)	(0.88)	(0.38)	(0.12)	(0.13)	(0.11)	(0.21)	(0.11)
N	210	210	207	187	210	210	209	209
F	3.62	9.32	43.02	10.15	41.4	7.09	20.64	6.21
Prob > F	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R2	0.154	0.265	0.753	0.581	0.424	0.297	0.576	0.329

*Note: Standard error reported in parentheses. All models estimated with robust standard errors. Two-tailed tests: *p<0.10, **p<0.05, ***p<0.01.*

Table 6: Mean measures of crop and land-use allocation amongst TFGB participants and non-participants between our two sampling years

Crop/Land-use	Participation in TFGB	2009	2019
Cultivated Land	Participant	4.5 (4.7)	1.9 (1.5)
	Non-Participant	1.8 (3.1)	0.90 (0.89)
Fallow Land	**Participant**	**1.0 (1.7)**	**0.22 (0.68)**
	Non-Participant	**0.08 (0.37)**	**0.05 (0.20)**
TFGB Planting	Participant	0.85 (0.65)	0.80 (0.94)
	Non-Participant	0.00 (0.00)	0.00 (0.00)
Exotic Tree Planting	**Participant**	**0.48 (0.46)**	**0.44 (0.82)**
	Non-Participant	**0.18 (0.45)**	**0.10 (0.28)**
Coffee	**Participant**	**1.1 (1.2)**	**0.36 (0.40)**
	Non-Participant	**0.29 (0.97)**	**0.25 (0.41)**
Banana	Participant	2.1 (1.1)	0.60 (0.98)
	Non-Participant	1.6 (1.1)	0.36 (0.39)

Note: Standard error reported in parentheses.

Table 7: Firth Logistic Regression of Food Security

Variable	2009 Food Security Question (Mitooma)	2019 Food Security Question (Mitooma & Rubirizi)
Treatment Dummy (TFGB = 1)	-1.20 (0.84)	0.15 (0.39)
Year Dummy (2019 = 1)	NA	NA
Interaction Treatment*Year	NA	NA
District Dummy (Mitooma =1)	NA	0.04 (0.36)
Annual Income, Real (2009 mUgSh)	0.00 (0.07)	-0.04 (0.06)
Total Household Land (ha)	-0.07 (0.13)	-0.33** (0.14)
Constant	-0.54 (0.46)	1.18*** (0.35)
N	57	147
Wald Chi2	4.19	10.20
Prob > Chi2	0.242	0.037
Pseudo R2 (Efron)	0.125	0.104

*Note: Firth logistic regression. Standard error reported in parentheses. Two-tailed tests: *p<0.10, **p<0.50, ***p<0.01.*

6.3. Regression Analysis of Measures of Participant Satisfaction

Regression analysis of our cost-benefit index indicated no significant differences between sampling year and district (Table 8). However, annual household income was found to be significantly and positively associated with an evaluation that benefits tended to exceed costs.

Firth logistic regression analysis revealed significant decreases in our two additional measures of participant satisfaction, with indications that those in Mitooma are significantly less satisfied than those in Rubirizi. First were responses to the question about whether TFGB participants would be interested in continuing to participate in the carbon offsetting programme. While no significant differences were observed between districts for this question, the reduction between sampling years was significant. Second, with regard to the question about whether TFGB participants would keep trees standing or harvest them after carbon payments ceased at the project's 10th year, we find both a significant decline over time but also significantly lower responses in Mitooma.

Table 8: Regression of Measures of Participant Satisfaction with the TFGB Programme

Variable	All Data		
	Cost-benefit Index$^{\beta}$ (5-point scale)	Continue planting more TFGB trees$^{\varphi}$ (Y = 1)	Keep trees standing if carbon payments stop$^{\varphi}$ (Y = 1)
Year Dummy (2019 = 1)	0.50 (0.51)	-1.87** (0.75)	-4.67*** (1.51)
District Dummy (Mitooma = 1)	-0.54 (0.48)	-0.60 (0.52)	-1.26** (0.51)
Annual Income, Real ($mUgSh_{2009}$)	0.05* (0.02)	-0.03 (0.04)	-0.07 (0.05)
Total Household Land (ha)	0.00 (0.03)	0.08 (0.10)	0.09 (0.08)
Constant	2.50*** (0.58)	2.26** (0.92)	5.04*** (1.65)
N	66	92	100
F	1.77	9.12	14.25
Prob > F	0.147	0.058	0.006
R2	0.125	0.144	0.327

Notes: $^{\beta}$Multiple regression using OLS; $^{\varphi}$Firth logistic regression. Standard error reported in parentheses. All models estimated with robust standard errors. *Two-tailed tests: *p<0.10, **p<0.05, ***p<0.01. For cost-benefit scale, 1 = cost outweigh benefits while 5 = benefits outweigh costs.*

Recall that another empirical strategy that we used to investigate costs and benefits of participating in the TFGB programme involved detailed survey questions about how costs as a share of benefits evolved over time. Results are presented in Table 9.

In 2009, it was estimated that households in Mitooma received payments averaged approximately $200 per hectare per year over the first three years of the project—slightly higher

than anticipated by EcoTrust. That is approximately 7% of annual income measured. The NGO claimed the TFGB programme would deliver approximately $761 USD per hectare of planted trees over the course of a 10-year financing period, with $532 USD per hectare delivered in the first three years (EcoTrust, 2011: 17, 31). However, our 2009 survey results estimated that establishment and maintenance costs for the first three years of the project were $238 per hectare or 31% of payments.

In 2019, in Rubirizi, where the average length of involvement in the TFGB programme was 5.8 years, total payments over the ten-year period averaged $714—about 48% of total household incomes amongst TFGB participants surveyed in the district that year. However, costs represented $282 or 39% of payments to date. Sampling that same year in Mitooma indicated that total average payments over the ten-year period from 2009 to 2019 amounted to $831 per ha—approximately equal to 46% of the total household income in 2019. However, average costs were $418 per ha in Mitooma, approximately 50% of total payments received.

Overall, a pattern appears whereby as a household progressed over the first 10-years in the TFGB programme, the relative importance of costs increased. However, we caution that our cost-benefit analysis above is insufficient to demonstrate the financial desirability of participating in the TFGB. First, our cost-benefit analysis covers, at most, the first 10-years of participation in the programme and does not include the potentially large benefits from timber harvesting at the 20^{th} or 25^{th} year. Second, our data is based on the recollections of smallholders surveyed, who are unlikely to have detailed records. Finally, detailed historical cost-benefit analyses of alternative land uses, such as coffee production, are not readily available.

Table 9: Carbon sequestration, carbon credit generation and carbon payment schedule (per hectare)

	Source	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y20	TOTAL/Total Period	
Carbon Sequestration															
Tonnes CO_2e Sequestration	(Plan Vivo, No Date-b: Figure 1 & Table 7)	/	1.4	2.9	4.5	6.2	8.0	9.8	11.8	13.8	15.9	18.1	45.0	414.0	20 Years
Tonnes Carbon Credit (tCO_2e)	(Plan Vivo, No Date-b: Figure 2)	/	0.6	1.3	2.0	2.8	3.6	4.4	5.3	6.2	7.2	8.2	20.2	186.5	20 Years
Benefits in terms of Carbon Payment															
% Total Carbon Payment		30%	20%	20%	/	/	10%	/	/	/	/	20%	/	100%	10 years
Planned Payment Instalment	(EcoTrust, 2011: 17, 31)	$228	$152	$152	/	/	$76	/	/	/	/	$152	/	$761	10 years
2009 Household Surveys (Mitooma)		$261	$166	$173	/	/	/	/	/	/	/	/	/	$600	3.2 years
2019 Household Surveys (Rubirizi)		-------- Payments Not Adhering to Payment Schedule ---------							/	/	/	/	/	$714	5.8 years
2019 Household Surveys (Mitooma)		---------- Payments Not Adhering to Payment Schedule ----------											/	$831	9.7years
Costs in terms of TFGB tree-planting establishment and maintenance															
2009 Household Surveys (Mitooma)		----- Avg Costs of 3 Years -----			/	/	/	/	/	/	/	/	/	$238	3.2 years
2019 Household Surveys (Rubirizi)		---------- Avg Costs of 6 Years ----------							/	/	/	/	/	$282	5.8 years
2019 Household Surveys (Mitooma)		---------- Average Costs of 10 Years ----------											/	$418	9.7 years
Costs as % Benefits															
2009 Household Surveys (Mitooma)														31%	3.2 years
2019 Household Surveys (Rubirizi)														39%	5.8 years
2019 Household Surveys (Mitooma)														50%	9.7 years

Note: In 2019 $1 US = 3701 Uganda shillings in 2019 and 2337 Uganda shillings in 2009.

6.5. Change in Programme Governance and Management Over Time

Interviews and policy document analysis indicated important changes to the governance and management of the TFGB programme over time. While some of the measures adopted by EcoTrust suggest a greater burden for smallholders, others have been to their benefit.

Amongst the most important governance and management arrangements is the monitoring regime for TFGB participants, as payments are only issued to smallholders upon successfully meeting performance milestones. Interviews undertaken in 2019 confirmed that monitoring visits are made two to three times per year by an EcoTrust district programme assistant.[6] This individual regularly visits a select number of households during each visit, during which time performance milestones are validated and the size of land per "Plan Vivo" is also remeasured. The EcoTrust district programme assistant also hires, on a short-term basis, local facilitators (typically different from the local coordinator discussed above) to help with the monitoring effort.[7] The results of monitoring exercises are discussed with local coordinators as well as the smallholders involved before being transferred to EcoTrust headquarters near Kampala, the capital city of Uganda. At the time of 2019 fieldwork, it would take a month for information collected during each monitoring visit to be entered into a database and also reviewed.[8]

A number of challenges facing the monitoring process have been flagged during recent third-party audits, governance issues to which EcoTrust has had to respond in a manner that has increased the administrative burden for participating smallholders. For example, the 2013 audit found smallholders planted the targeted number of trees but planted them over a smaller area, compromising growth rates as trees were planted too close (Rainforest Alliance, 2013: 7-8).[9] EcoTrust took corrective action by committing to remeasure land sizes with a handheld global position system (GPS), which had not been previously used. However, the 2019 third-party audit found that the measurement of planting area plots was still not consistent, which led EcoTrust to update the *TFGB Facilitator's Manual* (ESI, 2019: 8-9) to minimize the inconsistencies.

But other measures taken by EcoTrust in response to audits have been to the benefit of smallholders. For example, the 2013 audit also found that the programme lacked an internal audit procedure to allow EcoTrust to confirm that smallholders were able to retrieve payments from local banks and cooperatives, and thus detect local corruption. EcoTrust took corrective action by introducing a form requesting smallholders to acknowledge receipt of funds which was then compared with local records of local financial institutions that are used to effect payments.

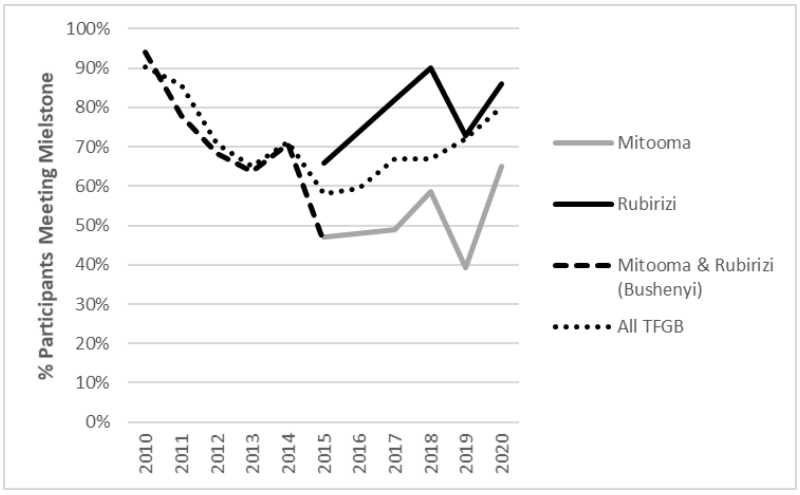
Another challenge for smallholders has been the poor survival of single species woodlots initially established under the original *Maesopsis eminii* technical specification. While the move towards more biodiverse mixed woodlots may be appropriate in light of efforts to improve the

[6] Kampala, Interview U1, August 2019; Bitereko subcounty, Interview U8, August 2019.
[7] Kampala, Interview U1, August 2019; Bitereko subcounty, Interview U10, August 2019.
[8] Kampala, Interview U1, August 2019.
[9] Bitereko subcounty, Interview U10, August 2019.

ecological resilience of planted trees, it has proven particularly challenging for participants in Mitooma district, where the programme has been established longest and most participants originally planted single species woodlots. Figure 2 indicates that programme performance in Mitooma district, where the programme was first launched, is lower than in Rubirizi and other districts where the TFGB programme is active. In 2019, only 39% of TFGB participants in Mitooma successfully reached performance milestones.

Given the situation in Mitooma, EcoTrust took the extraordinary step to suspend the contracts of some of the struggling smallholders in Mitooma and identified new farmers to compensate for lost carbon (EcoTrust, 2020: 20). However, EcoTrust has claimed to be supporting participants with trees that have attained at least Year 5 to keep them instead of changing planting methods to meet the new specifications (EcoTrust, 2019: 19). By 2020, performance in Mitooma district had recovered with 65% of participants meeting targets, which suggests that the reforms had a positive impact on performance.

Figure 2: Trends in TFGB participants in meeting programme milestones, 2010-2020



Note: Prior to 2015, data for Mitooma and Rubirizi were combined as they were both part of the former Bushenyi district. All data obtained from TFGB annual reports, which are available here: https://www.planvivo.org/trees-for-global-benefits-documents

Other evidence indicates that TFGB participants were able to win governance concessions from EcoTrust. As explained during field visits in 2019, the original EcoTrust district programme assistant was replaced in 2016 by one who was considerably stricter, uncompromising and with poor interpersonal relations. This account was offered independently by four key informants at the subcounty level in Mitooma and Rubirizi, and later confirmed during discussion with EcoTrust.[10] Participants in both districts voiced complaints to EcoTrust headquarters in 2015 and asked that the new, stricter district programme assistant be replaced; EcoTrust complied in 2016.

[10] Bitereko subcounty, Interview U10, August 2019; Bitereko subcounty, Interview U8, August 2019; Rubirizi district, Interview U11, August 2019; Rubirizi district, Interview U15, August 2019; Kampala, Interview U1, August 2019.

We note that this transition took place at the same period when the new technical specification was introduced. More recently, EcoTrust has developed a smartphone application to allow the EcoTrust district programme assistant to enter data while in the field and accelerate the data treatment process.[11] The application was set to be deployed in 2019 and was expected to improve on efficiency in paying smallholders.

7. Discussion

We discuss findings in each of the theoretical frameworks and path-dependent processes of transformational change implicit in previous research into the TFGB programme. We note that while there is an important discussion to be had about the role that transnational carbon offsetting and carbon markets more broadly should play in the global efforts towards decarbonization (Cullenward and Victor, 2020; McLaren et al., 2019; Paladino and Fiske, 2016; Purdon, 2014), our interest in this paper is on the transformational impacts of forest carbon offsetting at the local level in a developing country context.

7.1. Discount Theory and the Challenge of Sustainably Incentivizing Upfront Action for Long-Term Ecosystem Services

Amongst our most important findings is that, while there have been positive returns for smallholders participating in the TFGB programme, the perceived value of benefits has been declining over time. Indeed, our research also confirms rising dissatisfaction with the programme over time amongst an important number of TFGB participants. Our analysis suggests three factors explaining these results, which are consistent with discount theory but can also be attributed to gap between the cessation of carbon payments at the 10th year of participation and potential harvest by the completion of a household's Plan Vivo agreement. We refer to this path-dependent process as one of positive but declining returns, which we submit is different that of increasing/diminishing returns currently associated with theories of transformational change.

First, rising dissatisfaction, which was highest in Mitooma in 2019, appears to be associated with the completion of upfront carbon payments by the 10th-year of the programme. It is important to recall that carbon payments are staggered over the first 10-years of the programme though participants are required to maintain trees for an additional 10- to 15-years to honor Plan Vivo agreements with EcoTrust. This suggests that early in the TFGB programme, when cash was being more regularly received by participants, satisfaction amongst participants was high. But as upfront carbon payments decline, the costs of participating in the programme become increasingly salient to smallholders, thus affecting their satisfaction. It is important to point out that household land allocated to TFGB tree planting did not decrease over time, suggesting that rising dissatisfaction in Mitooma did not result in participants abandoning the programme but has affected their interest in continuing to participate.

[11] Kampala, Interview U1, August 2019.

Second, the deceleration of carbon finance payments was refracted through the different socio-economic conditions of TFGB participants. Our regression analysis demonstrated that participants with greater incomes had a more favorable evaluation of the costs and benefits of participating in the programme. This suggests that challenges facing the TFGB programme were more salient for poorer households who might reasonably be expected to be more reliant on carbon payments. This is also consistent with discount theory as poorer household are expected to discount future costs and benefits more significantly.

Finally, dissatisfaction might also be attributed to limited experience with timber harvesting and marketing in the districts investigated nor in the TFGB programme itself. The result is that TFGB participants view the benefits of the programme largely in terms of carbon finance, especially as they are contractually bound to retain trees for another 10- to 15-years after carbon payments cease.

While there are risks involved in using upfront payments, research into other forest carbon offset projects suggests they may be appropriate. A recent study by Aggarwal and Brockington (2020) using mixed methods to investigate a forest carbon offset project in India points to some of the benefits of their use. The authors observed that small farmers were particularly distressed because carbon payments were not set to begin until the project's 5th year, leading to foregone crop and fuelwood production. This suggests that upfront carbon payments address important dimension of the dilemma suggested by discount theory, but that additional solutions are still required.

7.2. Limited Positive Feedbacks and Spillovers

One powerful mechanism for catalyzing transformational change is to create synergies between those targeted through a governance intervention and those who are not. However, limited positive feedbacks and spillovers mean that benefits of the TFGB programme skew towards to relatively better-off local smallholders. An important challenge of the TFGB programme thus remains that of ensuring that benefits of the TFGB programme are visited upon those currently with insufficient landholdings to participate.

Consider the potential positive feedback mechanism of allowing poorer smallholders to be recruited into the TFGB programme. Currently impacts are limited as the programme struggles to recruit poorer household who lack sufficient land to meet the Plan Vivo food security criteria. Rather, supporting earlier research (Carter, 2009; Kiyingi et al., 2016; Purdon, 2018), our results indicated that smallholders with surplus land self-select to participate in forest carbon offsetting to diversify their livelihoods. The failure to identify a significant interaction effect between participation in the TFGB programme and time (treatment*year) for most livelihoods variables suggests that higher livelihood measures for participants relative to non-participants cannot be attributed to participation in the TFGB programme. Similarly, the significant association between household landholdings and food security in some of our results suggests that

households interested in pursuing tree-planting were already relatively food secure prior to the programme's arrival.

Similarly, mechanisms leading to spillovers from participants to non-participants in the TFGB programme such as the Carbon Community Fund (CCF), while positive, are relatively limited.

7.3. Policy Learning and Environmental Justice Over Time

Our longitudinal study suggests that the governance and management of the TFGB programme has changed over time in ways that are, on balance, beneficial to local participants in ways unanticipated by research undertaken from an environmental justice perspective. While both stricter enforcement of monitoring regimes and the shift to a new mixed woodlot technical specifications have proven problematic, particularly in Mitooma district given its initial experience with single species woodlot specifications, other management measures have been to their benefit. The most dramatic has been the replacement of the EcoTrust district programme assistant in 2015/2016. More recently, EcoTrust has sought to streamline management and payment systems, most notably through a new smartphone application.

While environmental justice research has suggested negative institutional lock-in, findings over time suggest policy learning. Policy learning might be defined as "the tendency for some policy decisions to be made on the basis of knowledge of past experiences and knowledge-based judgments as to future expectations" (Bennett and Howlett, 1992: 278). It is possible that, based on their frequent interactions with representatives of EcoTrust, TFGB participants were aware of the opportunity for improvement in programme governance and management.

The prospect of policy learning might explain the paradoxical finding about how the legitimacy of the TFGB programme was not compromised despite low evaluations in terms of environmental justice. For example, Fisher et al. (2018) report that local community members had few expectations about improving procedural justice. Similarly, issues that might be considered part of recognitional justice were "rarely raised" (p.266). Nor were community members concerned about how the concentration of benefits amongst smallholders with more land. Instead, smallholders were found to place emphasis on the distribution of costs and benefits of participation. Fisher et al. (2018) conclude that "these [distributive] concerns do not appear significant enough to compromise legitimacy and the project's functioning is largely unaffected" (p.267).

7.4. Challenging Subsumption Theory

Amongst the four theoretical frameworks considered, our research raises the most questions about critiques of the TFGB programme based on subsumption theory. Similar to critiques from an environmental justice, subsumption theory anticipated that the TFGB programme would lock smallholders into an unequal institutional relationship, though also suggesting diminishing returns and self-undermining impacts as the carbon offset programme became more deeply subsumed under global capitalism.

A first challenge to subsumption theory is that the governance improvements that TFGB participants have secured run counter to the causal process underpinning the theory: global capitalist pressure on EcoTrust results in stricter rules for TFGB participants and, ultimately, declining performance in terms of households reaching programme milestones. Instead, our results suggest the relaxing of monitoring requirements, though TFGB performance continued to decline in Mitooma until 2020. Milestone performance and satisfaction in Rubirizi were also higher in 2019 than in Mitooma, which aligns better with discount theory as the programme is more recently established and carbon payments are still ongoing.

Second, the account of the TFGB programme in Mitooma offered by subsumption theorists fails to note the transition in technical specifications from single species woodlots to mixed species woodlots in 2015. The timing of this transition coincides with 2015 fieldwork undertaken by Carton and Andersson (2017). This suggests that some of the grievances observed amongst TFGB participants at that time, while quite justifiable, might be better explained by the challenges facing the single species woodlots and the need to transition to the new technical specification. However, the proximate cause for moving from to the new mixed species technical specification was the poor ecological performance of single species woodlots and not the demands of global capitalism. While this shift does make the programme more amenable to carbon sequestration, it is one towards greater biodiversity rather than simplification as anticipated by subsumption theory.

Finally, while subsumption theory suggests that a market logic is imposed from the outside, our results indicate that smallholders were themselves knowledgeable about market dynamics and responded accordingly. Most importantly, we have demonstrated that the TFGB programme incentivized participating smallholders to plant indigenous TFGB trees instead of cash crops such as coffee. This might be a reasonable response to changing market prices for carbon and coffee. While TFGB carbon prices have remained stable if not slightly increasing, coffee prices have been declining in Uganda in recent years, from $2.22 USD per kilogram in 2012 to $1.58 USD per kilogram in 2019 (UCDA, 2012; 2019). Carbon payments are also fixed in US dollars, which may have proven attractive given the appreciation of the US dollar relative to the Uganda shilling over the 10-year period considered.[12]

7.5. Opportunities for Improving the TFGB Programme

Based on the findings from this study, we see ample opportunities to improve the transformative impact of the TFGB programme, both for participants and the broader communities in which they are situated. The current strategy of EcoTrust to deal with declining satisfaction appears to be to expand the programme into new areas of Uganda in order to compensate for the potential withdrawal of smallholders in areas where the programme has been established longer.[13] To be

[12] One USD was traded at 2,080 Uganda shillings in July 2009 and 3,700 Uganda shillings in July 2019. Source: https://tradingeconomics.com/uganda/currency.
[13] Kampala, Interview U1, August 2019.

more effective, EcoTrust should (i) respond to positive but declining returns associated with discount theory, (ii) consider compensating pioneer participants (concentrated particularly in Mitooma) who were unsuccessful under the single species planting system but unable or unwilling to o shift to the new technical specification, (iii) create greater policy positive spillovers for non-participants while also (iv) continuing to make the TFGB programme governance and management structure more accountable to local communities.

First, in order to address positive but declining returns over the first 10-years of participation identified in discount theory, one potential solution would be upfront payments for sustainable timber harvesting for the remaining 10- to 15-years remaining on carbon contracts. Similar to upfront carbon payments, upfront timber payments could be staggered over time and offer additional incentive to maintain trees after carbon payments have ceased. Sustainable timber harvesting is particularly important since Uganda has a chronic shortage of timber resources (Jacovelli, 2014; Lukumbuzya and Sianga, 2017; MWE, 2016: 64-65). While timber harvesting might appear contrary to the goals of carbon sequestration, if combined with continuous tree-planting in harvested areas, it is possible to maintain a relatively constant level of forest cover protection while selectively harvesting (Brown et al., 1996). The end use of harvested timber is also important: if used as fuelwood, emissions would be returned rapidly, whereas if transformed into durable production such as furniture and housing, the carbon benefits could be more long-term. Opportunities for payments for other ecosystems services such as biodiversity conservation and watershed protection might also be explored for the woodlots or trees where payment for carbon has ceased (Jose, 2009). A number of key informants suggested that EcoTrust should also consider additional interventions after upfront carbon payments cease such as distributing beehives and improved cookstoves.[14] This will require capacity building so that TGB participants are able to design viable investments that are linked to the trees they have planted and payments for carbon ceased.

A constraint on upfront payments for sustainable timber harvesting is that, as a conservation organization, EcoTrust likely has insufficient expertise for sustainable timber harvesting and associated business practices. But they might seek the expertise of other actors such as Uganda Timber Growers Association and the Uganda National Standards Development Group for Forest Stewardship Council to ensure sustainable forest management practices are upheld. Such experienced organizations can also support smallholders and their communities to acquire group forest certification for sustainable forest management.

Second, while the shift from the original single species technical specification to the new mixed species one appears appropriate, it is clear that this has been problematic in Mitooma. The district where the TFGB programme was pioneered, participants in Mitooma were originally encouraged to plant according to a technical specification that has proven result in woodlots more prone to disease and drought thus resulting in poor performance and participant

[14] Bitereko subcounty, Interview U9, August 2019; Rubirizi district, Interview U13, August 2019.

withdrawal. While participants who have trees that have survived to at least Year 5 appear to continue to be supported by EcoTrust, those that withdrew earlier appear to have been replaced by new recruits. It is important that EcoTrust continues to support those farmers whose trees failed but wish to continue with the TFGB programme to acquire seedlings for use under the new specification of mixed species. For those do not wish to continue, we recommend that they be given access to soft loans from the Carbon Community Fund (CCF) to engage in other businesses. Of course, it also necessary to consider how to offer such compensation while also avoiding to create a perverse incentive whereby underperforming participants appear to be seen to be being rewarded.

Third, to improve positive spillovers, EcoTrust should consider revising their eligibility requirements to enable greater participation while ensuring social safeguards such as food security. For example, EcoTrust could allow farmers that do not have adequate land to meet Plan Vivo's current requirements but are willing to combine agroforestry tree species with certain food crops to be recruited and managed collectively in groups(see Kalaba et al., 2010). EcoTrust could also intensify its support for communities to access land in Central Forest Reserves (CFRs) under collaborative forest management. The National Forestry and Tree Planting Act, 2003 provides for local community groups to enter into collaborative forest management agreements with the National Forestry Authority (GoU, 2003). Individuals who do not hold land that suits the Plan Vivo requirements will have an opportunity to plant in CFRs through participation in collaborative forest management.

Finally, positive spillovers from the TFGB programme might also be more broadly distributed if EcoTrust were to contribute directly to the Carbon Community Fund (CCF). Currently, only participating smallholders contribute to the CCF and only 30% of this is directed to community development efforts. Our results suggest that such funds are too small to have had a meaningful impact on community welfare. With TFGB participants already contributing to the fund, we suggest that EcoTrust directs an additional 10% sourced from their carbon revenues to this fund. Arguably, conditions for permitting EcoTrust to increase such community-level distributions have improved in recent years. While the voluntary carbon market has struggled over the past decade, observers have pointed to increasing volume of credit transactions in 2021 (Donofrio et al., 2021), a trend that will be further supported by decisions at COP26 in Glasgow to create a common rulebook for global carbon markets (Zwick, 2021).

Expanding opportunities for farmers with small amounts of land and increasing contributions to the community carbon fund will ensure that the TFGB programme is more inclusive of the members of the community with very small landholdings, thus contributing to Goal 8 of the Sustainable Development Goals (SDGs) and legitimacy of their operations. Additional research on the local socio-economic dynamics and conditions would help better steer such institutional and project design reforms.

8. Conclusion

This paper has presented findings from investigation into the TFGB programme over a 10-year period between 2009 and 2019, allowing us to contribute to debates about the impacts of forest carbon offsetting in developing countries. By situating our findings in light of transformational change, we have offered new theoretical perspective through which to interpret comparative, quasi-experimental and longitudinal research findings.

Our results suggest that initial carbon payments are appreciated by participants and that the TFGB programme has been effective in motivating relatively better-off smallholders to plant more indigenous trees on their land than would otherwise have been the case. This is important considering that most tree plantations in Uganda are of introduced species of Pine and Eucalyptus. TFGB has incentivized growing of indigenous tree species thus creating indigenous tree landscapes which are crucial considering that loss of natural forests on private land in Uganda continues to rise. TFGB participants were also found to have won significant improvements in the management and governance of the TFGB programme. However, the exhaustion of upfront carbon payments by the 10th-year of a household's participation in the programme suggests a pattern of declining returns amongst a significant portion of participants that is most consistent with discount theory. The finding of rising dissatisfaction with the programme amongst participants is important but something for which, when properly diagnosed, remedies exist. Most importantly, upfront payments for sustainable timber harvesting reverse declining returns amongst participants. This finding is complicated, however, by the poor performance of single species woodlots, which were concentrated in Mitooma region, and the challenge there of shifting to the new, more resilient mixed species woodlot technical specification.

Significantly, we have observed that TFGB participants have seen important improvements in the management and governance of the programme. These results are at odds with previous research into the TFGB programme from the perspective of subsumption theory and environmental justice, both of which anticipated negative institutional lock-in.

Overall, our findings suggest that, while the programme has delivered benefits, it has not been as transformative as expected. Benefits remain skewed as the programme favours the participation of smallholders of relatively higher socioeconomic status, with surplus landholdings, who self-select to participate in forest carbon offsetting. While these smallholders have benefited directly from carbon payments, their satisfaction has declined over time as discounted costs become apparent. We describe this dynamic as one of positive though declining returns for TFGB participants.

More limited is the transformational impact of the TFGB programme on non-participants, where the impact was positive though more negligible. Modest positive spillover mechanisms, including a smallholder-supported Carbon Community Fund (CCF) as well as minimum land/food security criteria for participation in the programme, limit the distribution of benefits to

broader communities in which the TFGB programmes are located. Other remedies are required to ensure that the transformational change also benefits those too poor to participate under current rules.

While we think that more could be done to expand programme benefits to groups not directly targeted by the TFGB programme, judging policy interventions by their potential spillover effects is a very high bar. A forest carbon programme cannot on its own be expected to be transformative for the poorest of the poor—often landless peasants. It also important to bear in mind that TFGB participants, while of relatively higher socioeconomic status at the local level, were still below the international poverty line in terms of their annual incomes.

Reflecting on the polarized debate on forest carbon offsetting in the developing world, we urge more comparative, quasi-experimental and longitudinal research methods in order to improve understanding of the conditions where forest carbon offsetting sustainably contributes to transformational change. There is, of course, room for improvement in methods we have used. For example, our study lacked household pre-treatment data, necessary for powerful DiD analysis. A potential solution here might be the collection of recall household data about socioeconomic conditions before the programme's start (Gelo, 2020). Another potential improvement might be to use a regression discontinuity design (Hahn et al., 2001), focusing on data from TFGB participants and non-participants just above and below the 1 hectare threshold for eligibility, though the trade-off would be losing observation. In addition, a larger sample size might improve the statistical power of our regression models. Finally, we would also value greater use of participant observation.

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