



GENDER
INNOVATION
LAB



DESIGN REPORT:

**Impact Evaluation of *Plans Fonciers Ruraux* in
Benin**

AUGUST 2016

Glossary

ATL Access-to-Land project. 5

ETF Enquete Topo-Foncière. 6, 8

MCA-Benin Millennium Challenge Account-Benin. 5, 6, 8, 10–12, 17, 21, 23

MCC Millennium Challenge Corporation. 5

PFR Plan Foncier Rural. 5–17, 19–21, 23

PFR Programme de Gestion des Ressources Naturelles. 6, 12

Contents

Glossary	2
1 Introduction and Background	5
1.1 Country context	5
1.2 Objectives of this report	5
2 Overview of the Compact and the Intervention Evaluated	6
2.1 Overview of the project and implementation plan	6
2.1.1 Project description	6
2.1.2 Description of implementation to date	7
2.2 Theory of change	10
2.3 Cost benefit analysis & beneficiary analysis	10
2.4 Literature review	11
2.4.1 Summary of the existing evidence	11
2.4.2 Policy relevance of the evaluation	12
3 Evaluation Design	12
3.1 Evaluation design overview	12
3.2 Evaluation questions	13
3.2.1 Effect of the PFR on perceived and de facto tenure security	14
3.2.2 Effect of the PFR on investment decisions and agricultural production	14
3.2.3 Additional issues: off-farm activities and gender differentiated impacts	15
3.3 Econometric approach	15
3.4 Data	17
3.5 Survey instruments	20
3.6 Challenges	21
4 Administrative	22

4.1	Summary of IRB requirements and clearances	22
4.2	Data protection	22
4.3	Preparing data files for access, privacy and documentation	22
4.4	Dissemination Plan	23
4.5	Evaluation Team Roles and Responsibilities	23
4.6	Evaluation Timeline and Reporting Schedule	23
	References	24
	Appendix	26
A-1	Figures	26
A-2	Power analysis	27

1 Introduction and Background

1.1 Country context

Benin is one of the countries in West Africa where the design and implementation of policies to consolidate rural land rights is furthest advanced. The key policy experiment in this respect is the *Plans Fonciers Ruraux* (PFR), first tried in Ivory Coast in 1989, piloted in Benin between 1993 and 2003, and being scaled up nationwide since 2006.

The shift in the focus of the PFR from experimentation to scaling up was made possible through a sizable grant provided by the Millennium Challenge Corporation (MCC) over a five-year period between 2006 and 2011. Recognizing land security as a priority, the first MCC Compact between the United States and Benin allocated USD \$33.7 million of a total of USD \$307 million grant to its land component. The Access to Land (ATL) project aimed to create secure land tenure and to build effective and transparent land governance institutions through policy and legal reform. It was based on two stylized facts: (i) that title registry in Benin was expensive, slow and complex with only 1 percent of urban households holding a formal title to their land, and the vast majority of the rural population relying solely on oral records to justify their access to land; and (ii) that land disputes in the country were frequent.

The ATL project, led by the Millennium Challenge Account-Benin (MCA-Benin), included a series of interventions to improve land tenure and reduce the number of conflicts. In urban areas, the project aimed to upgrade land occupancy certificates to full civil law titles, modernize the geodetic network, and establish new systems for managing documents and training agency officials. In rural areas, the *Plans Fonciers Ruraux* (PFR) component aimed to provide the recognition and certification of land held under customary tenure. The project also collected information on both primary and secondary rights to land to mitigate the risk of disenfranchisement of vulnerable groups, including women and non-sedentary livestock herders. The stated objective of the ATL was to formally document land rights in 300 rural villages (across 40 communes) with certificates, benefiting 85,000 households, and to convert 30,000 occupancy permits to land titles in urban areas. The remainder of the report focuses exclusively on the PFR project in rural areas.

1.2 Objectives of this report

This document presents the methodological approach to assess the short- and medium-run effects of the PFR intervention in rural Benin. The impact evaluation, led by the World Bank in collaboration with the MCC, employs a randomized controlled trial design. In fact, the PFR in Benin is the first land formalization program to provide an experimental setting for measuring impact, by virtue of the fact that the selection of program villages was conducted through commune-level lotteries. The results are expected to contribute to the scarce but growing literature on the effects of property rights on a range of outcomes related to investment and agricultural production.

The report is structured as follows. The next section provides a detailed description of the PFR intervention and its implementation to date. Section 3 outlines the experimental design and data sources used to measure program impact. Finally, section 4 presents the administrative aspects of the impact evaluation.

2 Overview of the Compact and the Intervention Evaluated

2.1 Overview of the project and implementation plan

2.1.1 Project description

At its inception in Benin, the PFR was conceived to demarcate landholdings held by households in rural areas and protect forests and natural resources from further colonization by farmers. It was implemented under the aegis of PFR, a program of the Ministry of Agriculture for the conservation and management of natural resources, with the technical assistance of GTZ and AfD and initial support from the World Bank and UNDP. Between 1993 and 2003, the PFR was piloted in 41 villages neighboring watersheds and other natural resources. The PFR pilots were therefore limited in scope and, given the absence of an appropriate legislative instrument, unable to provide land use certificates to beneficiaries.

With technical and financial support from the MCC, the PFR moved towards a land policy intervention that enabled smallholders to formalize land rights obtained under customary arrangements in rural areas. Benin's PFR exemplified a paradigm shift in land formalization programs as it embedded the recognition of land rights within existing customary practices. The main objective behind the PFR was to improve tenure security and stimulate agricultural investment in rural areas. Indeed, analyses regarding land tenure in Benin pointed to (i) unequal access to land (for instance, in some areas, women cannot inherit land although they may purchase it), and (ii) low investment in land (as tenant farmers and herders have more limited rights to plant trees or make other land investments). In this context, the originality of the PFR was to allow for an improvement in tenure security and investment while recognizing the source of existing tenure rights in customary practices.

In practice, the activities under the PFR program fell under two key steps: first, each community identified and demarcated all parcels, with the mapping of customary ownership in the form of a full land survey, and the laying of cornerstones to explicitly secure parcel boundaries; second, customary land ownership was formally and legally documented in the form of land use certificates. The first step aimed to increase tenure security, while the second step aimed to confer transferable property rights.

Land demarcation activities represented the first step of the PFR, aiming to accurately record the rights and obligations of the villagers from their point of view. Specifically, land demarcation was marked by a series of sub-interventions at the village level, where the parcel (i.e., the landholding) was the primary unit of treatment. The demarcation process was led, with support from the MCA-Benin PFR program, by local land management commissions (or SVGF, *Sections Villageoises de Gestion Foncière*). In each community, these commissions conducted with program implementers the following four main activities: first, an awareness raising campaign to draw interest to the intervention and select beneficiary villages; second, a socio-legal study to take stock of all land claims of the population; third, a systematic topographic surveying (or ETF, *Enquête Topo-Foncière*) to produce a full land registry and lay down cornerstones marking the parcel boundaries; lastly, from the ETF and the socio-legal inquiry, each identified parcel was associated with its respective owners and users, in the terms stated by the owners/users themselves (Hounkpodote, 2007).

The demarcation process culminated with the creation of village landholding plans (also referred to as PFRs), which are legally defined as registries of all rural landholdings and their owners within

the boundaries of a village. The PFR is essentially a graphic document that maps the individual agricultural parcels in a village, including the name of their owners/users, mode of acquisition, and types of rights associated with each of the surveyed parcels (see Figure A-1 for an example of a finalized PFR). Until the village landholding plans (PFRs) are finalized and validated, and land certificates are issued for each parcel in the land registry, cornerstones serve as immediate, long-lasting benchmarks to detect and resolve future land encroachment disputes. Moreover, they represent a more standardized substitute to traditional methods used by landholders to mark the frontier of their parcels. As such, land demarcation provides an opportunity for the community to resolve disputes and overlapping claims on the land, and set the stage for the second key step of the formalization process – the delivery of a transferable land certificate.

The second and final step of the PFR intervention is the ongoing delivery of a legally valid and transferable land use certificate (*Certificat Foncier Rural*, CFR) to individual landholders, which results in a formal recognition of existing customary land rights. This was made possible after the adoption of a landmark law in February 2007, establishing the PFR as the official government approach to land tenure management in rural areas. After a long political process, the 2007 Law on Rural Landholding finally provided a legal backing to the PFR process by legalizing the delivery of land use certificates in the final stage of a PFR. Land use certificate holders will have the option of upgrading to a fully-fledged title, the land ownership certificate (*Certificat de Propriété Foncière*), under the recently adopted land code.

As described in more detail in Figure 1, the implementation of this second step of the PFR has been the responsibility of village- and commune-level land management units. The following activities would have to be completed in order for landholders whose parcels have been demarcated and included in the village PFR to receive their land certificates: (i) landholders submit a written request to their local land management unit (SVGF); (ii) an SVGF member transfers the request to the commune-level town hall; (iii) the land management unit in the town hall processes the request and issues a land use certificate; (iv) the mayor of the commune signs the land use certificate; and (v) the land use certificate is delivered to the landholder, who has to travel to the town hall and pay a fee in order to withdraw it.

2.1.2 Description of implementation to date

Under the MCC Compact, the geographic coverage of the PFR became expansive. It spans the entire range of Benin's agro-climatic zones including nine of Benin's twelve regions (*départements*): Alibori, Atlantique, Borgou, Collines, Couffo, Mono, Ouémé, Plateau, and Zou. Within these départements, the PFR has been implemented in 300 villages, belonging to 40 out of the 77 *communes*, or sub-regional units equivalent to districts, nationwide.

The PFR intervention was designed *ex ante* to be subjected to a randomized impact evaluation to allow for the rigorous measurement of the program's effects and to generate lessons for policy. As such, the selection of treatment and control villages were selected randomly as follows. First, villages in each of the 40 PFR communes received an information campaign. The intention was to inform villages about the program and invite them to apply for a chance to receive one of the 300 PFRs. Second, proposals were reviewed against pre-established selection criteria, such as high levels of poverty, a general acceptance for the rights of women and girls in the village (particularly for their right to inherit land), existence of land conflicts or disputes, and significant agricultural production (NORC, 2012). From this review a list of eligible villages was produced. Third, each commune organized lotteries to randomly select villages within the eligible pool into the program. Overall, 1,235 villages applied for the program, out of the 1,543 that were targeted. Of these 1,235

Figure 1: List of main PFR activities

STEP 1: Land Demarcation
<ul style="list-style-type: none"> • Awareness rising campaign and selection of PFR villages • Socio-legal study • Topographic survey (ETF) and laying of cornerstones • Mapping of parcels and owners • Creation of village landholding plans (PFRs)
STEP 2: Delivery of Certificates
<ul style="list-style-type: none"> • Submission of request by landholder • Transfer of request to town hall • Issuance of certificate • Signing of certificate • Delivery of land use certificate (CFR) to landholder

villages, 576 met the eligibility criteria. To select the 300 beneficiary villages, 80 public lotteries were organized, two in each commune. Commune-level lotteries to select PFR villages were carried out over the course of three years, from 2007 to 2009 (NORC, 2012).

The implementation of the PFR intervention itself began in earnest in mid-2009, and was launched in all the targeted communes over the course of the following three years. By the end of the MCC compact in 2011, the project completed topographic land surveys (or ETFs, Enquêtes Topo-Foncières) covering a total of 72,413 parcels (Elbow *et al.*, 2012), and initiated PFRs in 294 villages, providing written records of land rights for approximately 68,700 landholders (MCC, 2012).

Before transferring direct responsibility for PFR implementation to the Government of Benin in 2011, MCA-Benin Benin oversaw the completion of the following PFR activities:

- Community sensitization about the PFR project;
- Implementation of micro-regional and land diagnostics in beneficiary areas;
- Creation of land lexicons in the main languages spoken in PFR-covered areas (e.g., Fongbé, Goungbé, Baatonu, Fulfulbé, Dendi, Tchaabè, Adja, Guingbé);
- Establishment of 40 Land Management Community Commissions (or CoGeF, Commissions communales de Gestion Foncière), 300 Land Management Village Sections (or SVGF, Sections Villageoises de Gestion Foncière), and 166 Land Management Structures at the arrondissementlevel;
- Capacity building for members of these structures to enable them to participate in and to take charge of their responsibilities in the formalization process;

- Administration of topographic land surveys (or ETFs, Enquêtes Topo-Foncières) in 294 villages through a participatory process involving the landowners and local land management structures;
- Development of Land Information Systems (or SIF, Systeme d'Information Foncière) in the 40 PFR communes.

A key output of the first step of the PFR intervention, the SIFs are GIS databases that include complete scans of the information collected during the detailed topographic land surveys (ETFs) for all the PFR villages in each commune. The main purpose of the SIFs is to enable commune-level land management structures to issue and deliver the land use certificates. However, as (Elbow *et al.*, 2012) point out, the fact that the transfer of the SIFs to the communes took place relatively late in the MCC project has undermined the commune-level officials' ability to appropriate the new databases and to achieve the intended use of the SIF for the delivery and subsequent tracking and updating of land certificates. Activities directly associated with the delivery of land certificates were launched shortly before the closeout of the MCC Compact in 2011, and have been carried out by local governmental structures since then. While land demarcation – and the subsequent development of PFRs – was conducted at the village-level, the town hall (mairie) in each commune has been responsible for delivering land use certificates (CFRs).

The 40 communes covered by the PFR include between 28 and 113 villages each, with 56 villages on average. The number of PFR villages in each commune varies between 4 and 14, with an average of 8 PFR villages per commune. Total PFR coverage rates, defined as the share of villages in a commune selected for the PFR program, range from 5.31 percent to 42.42 percent.⁹ By determining fees and other key aspects associated with obtaining a certificate, the communes play a critical role in the implementation of the second step of the PFR intervention.

The delivery of land use certificates consists of five main activities: (i) request submitted by landholder to SVGF, (ii) transfer of request to town hall, (iii) issuance of the land use certificate, (iv) signing of certificate by mayor, and (v) delivery of the certificate to landholder. First, each landholder whose parcel has been demarcated and listed in the PFR must formally apply for a land use certificate by filling in a form available at the SVGF (chaired by village leaders). Submitting a request for a land use certificate is free of charge in most communes, although commune survey data suggests there are some exceptions. In the communes where landholders have to pay a fee to submit a request, costs vary between FCFA 500 and FCFA 2,000. Once the request has been submitted by the landholder, the SVGF takes the form to the commune's town hall in order to trigger the process for the delivery of the land use certificate.

The land management unit in charge of the PFR within each commune is then responsible for processing the request and issuing the land use certificate. The commune's mayor then has to approve and sign the certificate. Data from the commune survey shows that the time required by the town hall to issue a land use certificate once it receives the request from the SVGF varies between 1 and 90 days, with an average processing time of 10 days. Finally, the land use certificate is made available to the landholder, who has to withdraw the certificate in person. The delivery of the certificate is also contingent on another set of fees imposed on the landholder. The price grid varies significantly across communes, with the most common fees being FCFA 2,000 for an area of less than 0.5 hectare, FCFA 3,000 for an area between 0.5 and 1 hectare, FCFA 4,000 for areas between 1 and 2 hectares, and FCFA 5,000 for areas larger than 2 hectares.

Four years after the end of the MCC 2006-2011 compact, the process of delivering land use cer-

tificates is still ongoing. According to administrative data, out of the 72,742 land use certificates expected based on the village PFRs, only 652 have been issued and delivered to landholders (ITCA, 2015). Nevertheless, data collected during our commune survey suggests this is an underestimate. In the 35 out of 40 communes covered by the commune survey, the certificate delivery rate (defined as the share of expected certificates which have been delivered) was 22 percent on average.¹⁴ Out of 65,175 land use certificates expected following UCF/MCA-Benin's 2014 mission, only 14,558 certificates had been delivered in 2015. Another 6,144 certificates had been requested but not yet processed, and 33,956 certificates had been issued but not delivered. Data collected from commune land officials in 2015 points to a number of possible explanations for the relatively low take-up, including capacity constraints and limited incentives of local land management structures, cost constraints for take-up, distance to travel to obtain the certificate, and a lack of awareness of the document and its benefits.

2.2 Theory of change

The 2006-2011 Compact aims to increase economic growth and reduce poverty in Benin by removing constraints to investment in key sectors of the economy. The Compact also seeks to increase investment and private sector activity by improving key institutional and physical infrastructures through the four Projects: "Access to Land," "Access to Financial Services," "Access to Justice," and "Access to Markets" (MCA, 2009).

The Program logic relies on two main approaches: (i) Improved institutional infrastructure, and (ii) Improved physical infrastructure. Each of the four components contribute to the overall goal as follows:

- **Land Objective:** strengthen property rights and investment, as measured by the value of investment in urban and rural land;
- **Financial Services Objective:** expand access to financial services, measured by the value of new financial services extended by financial institutions;
- **Justice Objective:** improve ability of the justice system to enforce contracts and reconcile claims, measured by the time needed to enforce a contract and the confidence in the judicial system;
- **Markets Objective:** improve access to markets through improvements to the Port of Cotonou, measured by the volume of goods and port surcharges.

In particular, the Access to Land component is expected to assist households in improving tenure security and to stimulate agricultural investment in rural areas. Ultimately, the PFR intervention aims to lead to long-term income benefits for households in treated areas as a result of increased agricultural productivity. Formal land registration documents are also expected to facilitate land transaction, reduce costs of such transactions, and lead to increases in land value (MCA, 2009). Finally, the project also intends to promote key policy reforms and strengthen women's land rights under the new policy framework.

2.3 Cost benefit analysis & beneficiary analysis

In accordance with the MCC Guidelines for Economic and Beneficiary Analysis beneficiaries are defined as individuals that are expected to experience an income increase due to Compact activi-

ties. Each project's economic rate of return analysis details benefit streams through which beneficiaries should experience increased income.

Based on the assumption that overall increases in private sector activity as a result of the Compact will translate in income gains at the individual-level, the MCC-MCA-Benin M&E Manual (MCA, 2009) provides ex-ante estimates of the economic and poverty impact its 2006-2011 Benin Compact. The economic rate of return, or the comparison of the costs and benefits of MCC's investment, was estimated to reach 23.7% for the entire project and 23% for the Access to Land component. The rate of return for the other components was only marginally higher, at 25.8% for Access to Financial Services, 24% for Access to Justice, and 23.6% for Access to Markets.

2.4 Literature review

2.4.1 Summary of the existing evidence

Throughout rural Sub-Saharan Africa, the allocation and enforcement of land rights involve a diverse and complex set of customary arrangements made and upheld by local stakeholders such as village chiefs, councils of elders, and land chiefs (Le Bris *et al.*, 1982). Customary land tenure systems often coexist with formal land administration systems, where proof of ownership or of use rights is documented with registered titles or deeds. Yet only a small proportion of the population holds formal land titles for the land they *de facto* own. The structures that support these systems may lead to under-investment and sub-optimal yields (Goldstein and Udry, 2008). Codification of private property rights should in theory increase agricultural investment and productivity and spur economic development (Besley, 1995; Besley and Ghatak, 2010). Yet, while land titling programs have met with relative success in rural (Deininger and Feder, 2009; Feder *et al.*, 1988) and urban settings (Field, 2007; Galiani and Schargrodsky, 2010), the evidence from Africa is less positive (Lawry *et al.*, 2014). This contrast is perhaps due to oversimplified interventions that neglect the complexity of customary land relations in rural areas, the limited capacity of central land administrations for the delivery of titles, or the difficulties in establishing decentralized institutions (Teysier and Selod, 2012).

Formalizing land rights is typically modeled as affecting investment behavior through an improvement in tenure security and the issuance of formal rights that can be transferred or used as a collateral (Banerjee *et al.*, 2002; Besley, 1995). The PFR program consists of two key steps: first, each community identifies and demarcates all parcels, with the mapping of customary ownership in the form of a full land survey, and the laying of cornerstones to explicitly secure parcel boundaries; second, customary land ownership is formally and legally documented in the form of transferable certificates. The first step increases tenure security, while the second step confers transferable property rights. Akin to the case of barbed wire fencing studied by Hornbeck (2010) in the Great Plains of North America, laying cornerstones clarifies frontiers and protects farmers from encroachment. The process that surrounds demarcation additionally establishes property rights, as each community works to unify competing and overlapping conceptions of land rights.

As land demarcation clarifies uncertainty over land claims, the risk of expropriation should decrease, reinforcing tenure security and incentives to invest (Banerjee *et al.*, 2002; Besley, 1995; Feder and Feeny, 1991). Some of these investments may involve reallocation from land-guarding practices to more productive activities (Besley and Ghatak, 2010; Goldstein and Udry, 2008). Given pre-existing gender differences in customary land rights in Benin, the extent of these effects may

also differ for men and women (Ali *et al.*, 2014).¹

2.4.2 Policy relevance of the evaluation

PFR pilots had been carried out in 41 villages between 1993 and 2003 under the aegis of PFR, a Beninese programme of the Ministry of Agriculture (MAEP) for the conservation and management of natural resources. These 41 pilot PFRs were implemented with the technical assistance of the German Agency for Technical Cooperation (GTZ) and the Agence Française de Développement (AFD) and initial support of the World Bank and UNDP. These pilots were not granted a certificate since these could not be delivered before the 2007 law was passed and before its decrees were promulgated.

When the impact evaluation started, PFRs were being carried out by the Programme pour la Conservation et la Gestion des Ressources Naturelles (ProCGRN) for 66 PFRs in the North-West of Benin (regions of Attacora and Donga), and under the MCA-Benin Benin program for 300 planned PFRs in the remaining nine regions (with the exception of the Cotonou urban area). The PFR process was implemented but the PFRs under the ProCGRN were also coupled with complementary interventions for sustainable natural resource management.

There had been several attempts in the past to evaluate the impact of the PFRs although in no village had the final step (i.e. issuance of certificates) been implemented when the impact evaluation was undertaken. A 2006 Poverty and Social Impact Analysis focusing on land reform impacts in Benin provided a first insight into the effects of the PFR process focusing on the original pilots. The results suggested that PFRs diminish disputes among neighbors and increase investments. However, these results were limited to initial stages of the PFR as the impact after completion of the entire process could not be assessed at that time.

This evaluation will contribute to the discussion about the scaling-up of the formalization of land rights to all rural villages in Benin and elsewhere in Sub-Saharan Africa.

3 Evaluation Design

3.1 Evaluation design overview

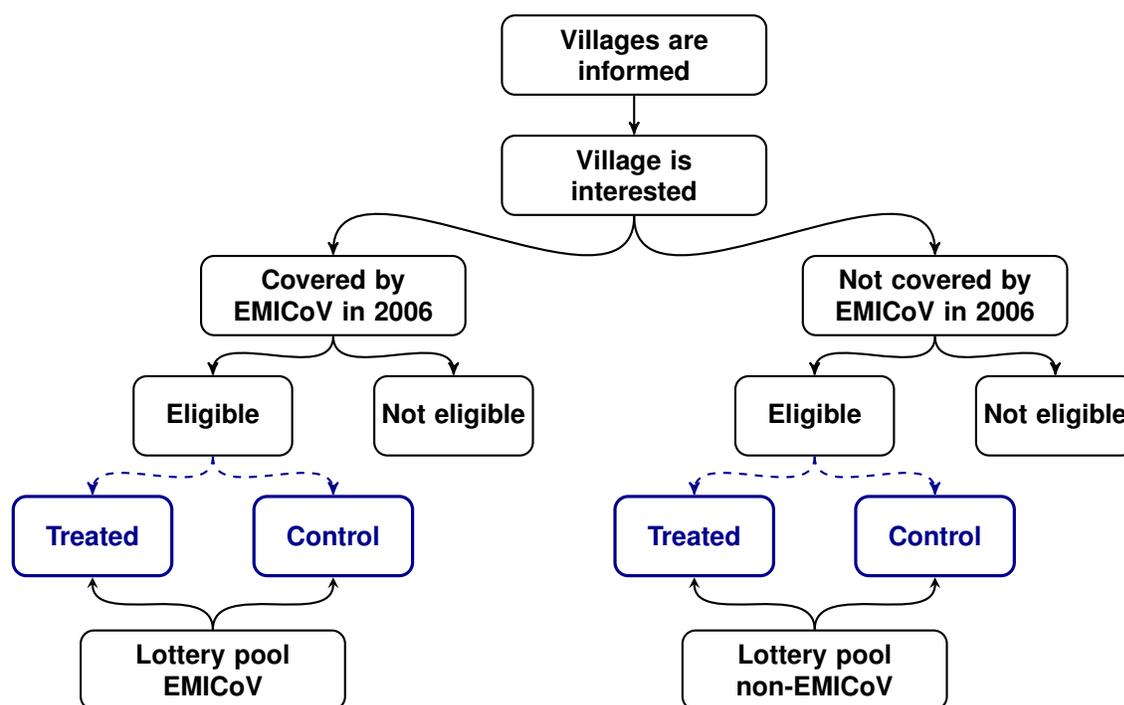
The impact evaluation employs a randomized controlled trial design. Specifically, the identification of causal impact of land registration relies on the random assignment of the PFR program at the village level by program implementers, allowing us to circumvent issues of reverse causality commonly faced in the literature. Typically, changes in land rights are endogenous to parcel and household characteristics, as some latent variables can plausibly predict individual land registration, tenure security, investment and productivity simultaneously (Besley, 1995; Brasselle *et al.*, 2002). For instance, the expectation of land loss or encroachment on a given parcel can prompt a household to invest in land registration strategies. Households may also seek to obtain a land certificate for their higher quality plots (Besley, 1995; Brasselle *et al.*, 2002). As a result of these methodological challenges, very few studies provide a credible counterfactual analysis of the impact of land formalization.

The sample of villages included in this impact evaluation represents the subset of PFR villages which were covered by the 2006 and 2010 EMICoV (*Enquête Modulaire Intégrée sur les Conditions de*

¹In Benin, women primarily obtain secondary land use rights through a male spouse or relative.

Vie de Ménages) surveys. The EMICoV is a nationally-representative household survey, administered by the Benin National Statistics Institute (INSAE). The 2010 EMICoV provided the village-level sampling frame for the study's first round of data collection in 2011: 160 randomly-selected treatment and control villages from the 2006 EMICoV sample were revisited in 2010, and an additional 129 villages were added in 2010 to complement the 2006 sample. Our experimental sample therefore covers 291 villages, 193 treated and 98 control. The selection of villages for the PFR intervention was done randomly and stratified by commune and EMICoV 2006 coverage, with on average 7 villages surveyed per commune. Figure 2 below illustrates the selection of treatment and control villages.

Figure 2: Selection of treated villages within commune



Source: Information collected by authors.

The impact evaluation aims at estimating the impact of the PFR on land tenure security, investment, and agricultural productivity. To isolate the effect of the delivery of the land certificate from that of land demarcation, we will rely on a unique data set on landholdings held by the same households across two periods of time: in 2011, just after the completion of land demarcation activities, and again in 2015, several years after demarcation and the commencement of certificate delivery. We can therefore compare outcomes of landholdings with and without the PFR in the short-run and medium-run, while also shedding light on the impact of land certification itself.

3.2 Evaluation questions

This study seeks to examine three main channels of effects of rural land interventions that are usually addressed in the literature: improvements in land tenure security, improvements in land transfer, and increased investment in land. Additional, though related, research questions will attempt to shed light on plot-level agricultural outcomes and gender-differentiated effects of PFRs.

The analysis of the data collected will focus on the research questions presented below.

3.2.1 Effect of the PFR on perceived and de facto tenure security

Tenure security and its perception may vary throughout the PFR implementation process, with the delivery of the certificate marking the conclusive step. Moreover, households may be differently affected in terms of tenure security depending on the rights they hold on land (without overlooking the fact that it can not be ruled out that some households may lose while others may gain rights).

An initial indicator of program impact will be the effect of the PFR on beneficiaries' perceptions of tenure security. Measurement of tenure security will be based on self-reported assessments regarding the risk of losing land rights.

Another indicator will be tenure security itself as proxied by the level of land-related conflicts (including conflicts that lead to the loss of rights on a parcel). In Benin, rural land conflicts occur between farmers, villagers, and pastoralists, and within and across farmer and herder groups (Hounkpodote, 2007). These conflicts are particularly frequent in the more densely populated areas of southern Benin, where land pressures are more acute. It should be acknowledged that while a clear demarcation of borders and participatory conferral of land rights may lead to a longer-term reduction in land conflicts, it is possible that verification of land boundaries and their documentation may also result in a short-term spike in previously simmering land disputes. A detailed focus on conflicts is also particularly justified given that conflicts raise land market transaction costs, generate administrative costs for adjudication, and have considerable implications for the productivity of land use.

3.2.2 Effect of the PFR on investment decisions and agricultural production

One of the main objectives of the PFR is to stimulate investment. To date, qualitative and quantitative evidence from previous PFR studies suggests that the intervention has induced farmers to deepen investments in their land even before the receipt of a land certificate. The identification strategy used in our evaluation will allow us to identify the causal impact of the PFR on land investment (including repairs and conservation measures). We will measure possible PFR effects on land practices such as destumping, fallowing, terracing, tree and perennial planting, and brush clearing.

Further along the results chain, one might expect to see an increase in agricultural yields if productivity-enhancing investments are stimulated by the PFR. The impact evaluation will consider these effects by estimating changes in plot-level agricultural output and productivity (as measured by output per hectare). Possible effects on crop choice (e.g., cash vs. staple crops) and plot-level input intensity (e.g., labor, fertilizer) will also be examined. This could shed light on the potential of PFRs regarding specialization/diversification effects.

Since the literature points out that investments may be fostered by increased tenure security and/or improved access to credit, the evaluation will also estimate the effect of the PFR on the value and volume of loans (from formal and informal loan sources) held by certificate holders. Despite the theoretical advantages of formal documentation for the collateralization of land, there is a relatively small body of evidence on the credit effects of rural land interventions in Africa – and the findings for Africa are at best inconclusive (Deininger and Feder, 2009). As credit and land markets (for the resale of foreclosed land) are relatively thin in much of rural Benin, it is possible that

the PFR will not immediately lead to improved credit access.

3.2.3 Additional issues: off-farm activities and gender differentiated impacts

In addition to the three above effects, the evaluation will look for possible effects of PFRs on off-farm enterprise creation and the decision to work off-farm. Findings from urban land evaluations suggest that enhancing tenure security can increase labor force participation (Field, 2007), yet these links have not been established in the rural context where formal labor markets are not as developed as in urban areas. It is nevertheless possible that the PFR may lead rural households to diversify their income sources. The evaluation may also permit us to detect if migration behaviors are affected by PFR implementation.

Throughout Sub-Saharan Africa, men and women face different sets of constraints with respect to land, with women often disproportionately limited in their ownership and transfer rights (Joireman, 2008). This pattern holds with respect to rural Benin as well (MCA, 2008). There is mounting evidence to suggest that rural land interventions have differential effects on women and men (Deininger *et al.*, 2008; Goldstein and Udry, 2008; Holden *et al.*, 2009). The evaluation will thus look at program effects by gender of the household head to offer a deeper understanding of PFR impact. The analysis may also assess possible gender-differentiated effects on household bargaining power.

Table 1: Evaluation questions

Evaluation question	Key outcomes	Data	
		Source	Type
Effect of PFR on land tenure security	land demarcation land certificate land conflicts	parcel and household level observations	quantitative survey
Effect of PFR on agricultural investment	land fallowing tree planting perennial crops	parcel and household level observations	quantitative survey
Effect of PFR on agricultural production	land size cultivated labor supply fertilizer use total value of output yield	parcel and household level observations	quantitative survey
Effect of PFR on off-farm activities	Off-farm paid work Farm paid work Non-ag. self employment	household level observations	quantitative survey

3.3 Econometric approach

To estimate the impact of the PFR on measures of tenure security, cultivation and investment decisions, and agricultural production we consider the following model:

$$y_{ijk} = \alpha + \beta \cdot \mathbf{d}_{jk} + \phi \cdot \mathbf{x}_{ijk} + \gamma_k + \varepsilon_{ijk} \quad (1)$$

where y_{ijk} is the outcome of parcel i in village j that took part in lottery pool k , d_{jk} is a variable equal to 1 if village j of lottery k is selected for a PFR and 0 otherwise. x_{ijk} is a vector of exogenous controls (at the household and parcel levels), γ_k are lottery fixed-effects and ϵ_{tijk} is the error component.

The random assignment of the program at the village level establishes our identification, and we exploit within-lottery variation to recover the intention-to-treat (ITT) using data collected in 2011 and 2015. To the extent that the demarcation activities and the issuance of land certificates have a lasting effects on household decisions, we test if $\beta \neq 0$ in 2011 and 2015. All standard errors are clustered at the unit of randomization (village) to account for intra-village correlation in the outcomes of interest (Duflo *et al.*, 2008).

To test for the impact of land certification in 2015 we consider the following framework:

$$y_{ijk} = \kappa + \delta \cdot \mathbf{cfr}_{ijk} + \phi \cdot \mathbf{x}_{ijk} + \epsilon_{ijk} \quad (2)$$

$$\mathbf{cfr}_{ijk} = a + b \cdot \mathbf{d}_{jk} + \phi \cdot \mathbf{x}_{ijk} + \gamma_k + v_{ijk} \quad (3)$$

where \mathbf{cfr}_{ijk} takes a value of 1 if parcel i in village j has a rural land certificate and 0 otherwise. Since, households are likely to obtain a documentary evidence of their land rights for many reasons which may also be correlated with decisions to invest and agricultural output, the ordinary least square (OLS) estimates of δ produces a biased estimate of the effect of documentary evidence of land rights on household decisions.

To address that issue, we use the selection into PFR as an instrumental variable for the award of a documentary evidence of land rights. This strategy rests on the fact that several households in the PFR villages have had access to a documentary evidence of their land rights that they would not have received in absence of the PFR. This allows us to estimate a local average treatment effect (LATE) of the CFR on those households. However, this approach, is mostly valid only if selection into a PFR can only affect household decisions through the issuance of the land certificate. This is not the case as the PFR process includes many steps which may increase land security even in absence of the delivery of the land certificates. To that extent, the LATE estimate obtained through the instrumental approach may underestimate the true causal impact of the documentary evidence of land rights on household decisions.

Using a two-stage least square (2SLS) procedure, we estimate and report the coefficient δ , on our outcomes of interest (tenure security; cultivation and investment decisions; and agricultural production) in 2011 and 2015.

To test for heterogeneity of impact by gender of the parcel manager, we augment the previous equation as follows:

$$y_{ijk} = \alpha + \beta \cdot \mathbf{d}_{jk} + \psi \cdot \mathbf{gender}_{ijk} + \lambda \cdot \mathbf{d}_{jk} \cdot \mathbf{gender}_{ijk} + \phi \cdot \mathbf{x}_{ijk} + \gamma_k + \epsilon_{ijk} \quad (4)$$

where \mathbf{gender}_{ijk} takes a value of 1 if parcel i is operated by a female-headed household. We report the coefficients β , ψ and λ on our outcomes of interest (tenure security; cultivation and investment decisions; and agricultural production) in 2011 and 2015. Relative to the existing gender gap (i.e., the gender gap observed within control villages), a significant coefficient for λ indicates that the program led to a narrowing (or widening) of the gender gap within treated communities for that

specific outcome in year t . We also report the total program effect on female-headed households $\beta + \lambda$ in a bottom row, with the corresponding standard error and significance level.

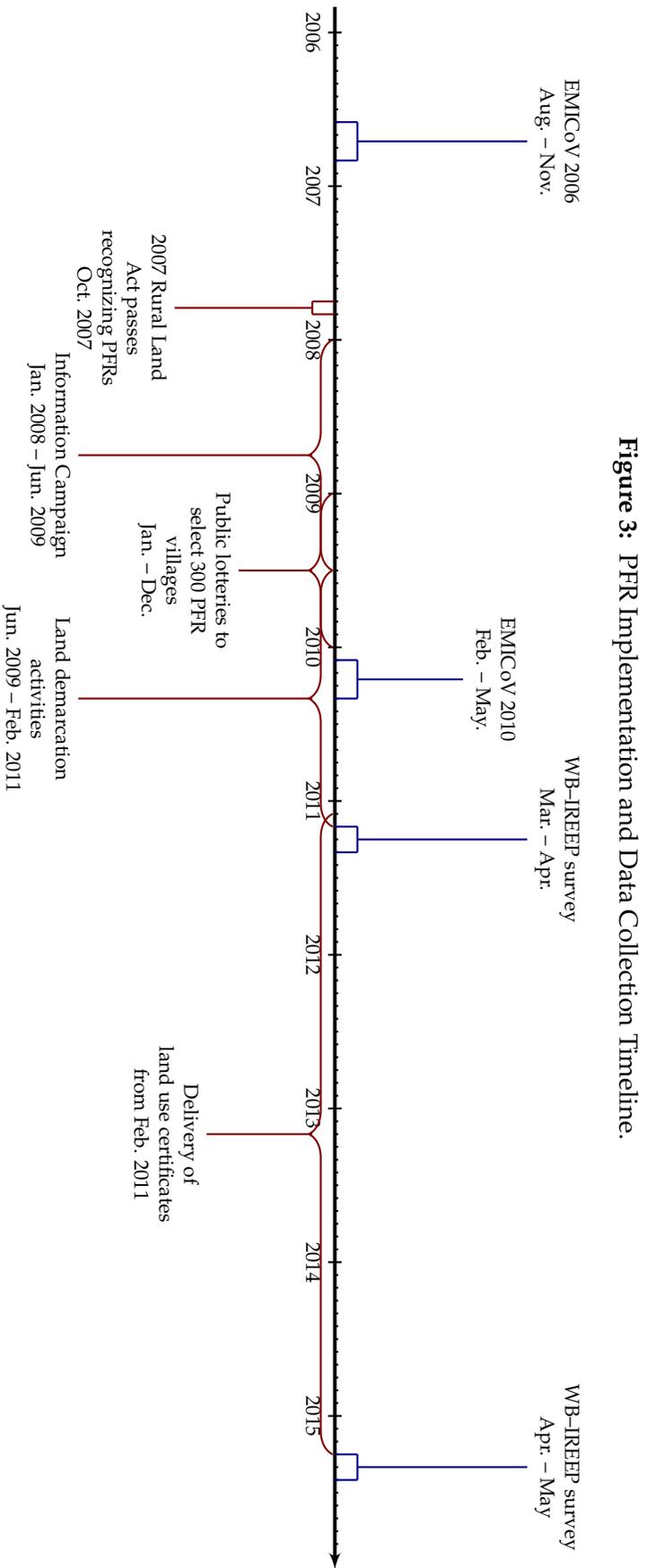
3.4 Data

We exploit five sources of data to analyze the impact of the PFR in Benin: (i) secondary national household survey data provide pre-intervention balance checks; (ii) administrative data compiled from the PFR implementation units help us establish the intervention road-map and verify the delivery of land use certificates to landholders; (iii) commune-level survey data provides additional information about PFR implementation and certificate delivery status; (iv) two rounds of primary household survey data formally document impact; and (v) qualitative research data. Figure 3 provides a timeline of implementation and data collection activities.

First, we exploit the 2006 national EMICoV survey data to establish pre-intervention balance on a set of outcome variables between treatment and control communities. Nevertheless, since the PFR implementation at the village level had been scheduled to begin in mid-2007, the 2006 EMICoV data was instrumental in validating the comparability of treatment and control village characteristics before the intervention. Table 1 below presents differences in means across treatment and control households in the 2006 EMICoV sample. While this balance check does not refer to our study sample, it helps further validate the lottery across the outcome space. We confirm balance across treatment and control communities on a range of key observable characteristics prior to program implementation. The average household head is, however, significantly older by 1.59 years and has 0.22 fewer years of education in the treatment group relative to the control. Although these differences vanish in our full 2011 sample, we control for these observables in all impact regression models.

Second, we use administrative monitoring and evaluation data from the MCC and MCA-Benin to document the village-level eligibility for the PFR, the outcome of the program assignment lottery, and the implementation schedule across treated villages. We further use data and reports from the UCF MCA-Benin (Unité de Coordination de la Formulation du 2eme Programme et du Suivi des Reformes de MCA-Benin) to document the land certificate delivery by town halls in the 40 PFR communes. The database shared by UCF in October 2015 provides commune- and village-level information on a number of indicators, including status of IT devices and SIF database, functioning of local land management structures (CoGeFs, SCGFAs, SVGFs), status of land certificate delivery (i.e. number certificates expected, number of requests received, number of certificates issued, number of certificates signed by the mayor, number of certificates delivered), support provided to communities for the delivery of land certificates (i.e. support to submit requests, village gatherings, radio communication), and breakdown of land certificate delivery fees by land area.

Third, we triangulate information on PFR implementation and land certificate delivery with data obtained through a brief commune-level survey. Data collection activities were conducted by the World Bank field coordinator, who administered the survey to a group of up to five town hall officers, such as the head of the SADF (*Service des Affaires Domaniales ou Juridiques*) or another person who is familiar with land management issues. The commune survey covered the following topics: commune characteristics (population, size, number of villages, number of PFR villages), start date of different PFR activities (PFR sensitization campaign, land certificate delivery), land certificate delivery status (number of land certificates delivered, number of land certificates requested, fee amounts for the request and delivery of land certificates, duration of processing requests), transfer of land certificates, reasons for low delivery rate of land certificates.



Source: Author's illustration based on data collected during the field survey.

Table 2: Household Characteristics across Treatment Groups in 2006

	Treated		Control		Diff.	
	Mean	Std. Dev.	Mean	Std. Dev.	coeff.	s.e.
Female headed hh [†]	0.19	0.39	0.20	0.40	-0.00	(0.02)
Age of hh head (years)	45.30	16.56	43.35	15.55	1.59	(0.64)**
Education (years)	1.31	2.61	1.52	2.80	-0.22	(0.13)*
Household size	5.26	3.12	5.28	3.21	-0.01	(0.14)
Household has a landholding [†]	0.85	0.36	0.85	0.36	0.02	(0.02)
HH sold a land in last 3 years [†]	0.02	0.15	0.03	0.16	-0.00	(0.01)
Landholder cultivated a plot [†]	0.88	0.33	0.88	0.33	0.02	(0.02)
Number of landholdings	1.82	1.37	1.85	1.41	0.10	(0.12)
Landholder can sell land [†]	0.44	0.50	0.45	0.50	-0.01	(0.04)
Household has a female landholder [†]	0.31	0.46	0.39	0.49	-0.04	(0.03)
- Number of landholdings	1.39	0.76	1.45	0.87	-0.03	(0.08)
Household with female land tiller [†]	0.66	0.47	0.67	0.47	0.03	(0.03)
- cultivated her plot	0.26	0.44	0.32	0.46	-0.02	(0.03)
- helped a fellow member	0.53	0.50	0.52	0.50	0.04	(0.04)
Daily consumption per cap. (2005 \$)	1.04	0.93	1.08	0.80	-0.02	(0.06)
Own food production (2005 \$)	0.10	0.13	0.10	0.17	-0.00	(0.01)
Number of of households	1,394		1,137		2,531	

Note: The table compares household characteristics across *treated* and *control* villages that were pre-selected for a rural land use plan by program implementers. The sample used for this table is restricted to the households in treated and control villages which were covered by the EMICoV in 2006. The statistics reported under the heading "Treated" refer to the sub-sample of households located in one of the villages selected for a PFR. Under the heading "Control" we report the statistics about households living in villages that took part in and lost the lotteries. Column "diff." describe the variation of household characteristics across treatment groups in 2006.

Standard errors are in parentheses and are clustered at the primary sampling unit level. The coefficients reported in column "coeff." are obtained from regressing each variable on the treatment variable controlling for the lottery pool fixed effects. Significance levels for coefficients in are reported for t-tests of the equality of the means across treatment groups.

[†] Indicates dummy variables. Significance levels are reported as follows: * p<0.10, ** p<0.05, *** p<0.01.

Fourth, we conducted two primary household surveys to measure the effects of the PFR intervention. The first quantitative data collection round was administered in March/April 2011, providing data on the impacts of the first step of the PFR intervention – the mapping and demarcation of parcels within villages. Overall 3,507 households were interviewed (12 per village), with detailed information on 6,572 parcels used by these households. The same sample of households was re-surveyed during the second data collection round in April/May 2015, which was aimed at estimating the longer-term impacts of land demarcation in addition to the effects of land certification itself.

Fifth, from January to March 2015, a qualitative study was conducted in two of the treated PFR communes to capture effects of the PFR intervention from the perspective of land-holders who had participated in the program. The communes of Aplahoué and Banikoara were selected for data collection to maximize variation on important socio-economic characteristics of the qualitative study participants and agroclimatic considerations for agriculture. Aplahoué is in the southern part of Benin where there are two harvest seasons, land is relatively more scarce, and land-holdings are relatively small and individualized. In contrast, Banikoara is in the northern part of the country,

Table 3: Design overview

Round	Timing	Sample unit/ respondent	Sample size	Relevant instrument /module	Exposure period (months)
1	3/2011 – 4/2011	Households and commu- nities	3,507 house- holds/291 villages	Basic demograph- ics, parcel land use, intra-household control of re- sources, and agricultural pro- duction	11 months after de- marcation (on avg.)
2	4/2015 – 5/2015	Households, communes, and commu- nities	3,338 house- holds / 291 villages / 35 communes	Basic demograph- ics, parcel land use, intra-household control of re- sources, and agricultural pro- duction	59 months after de- marcation (on avg.)

where harvests occur once per year and where large land-holdings are often managed by the elders of a family lineage. Also, in Aplahoué almost none of the land use certificates for demarcated parcels had been issued by the time of this study, whereas nearly all certificates had been delivered in Banikoara. The study took place in six villages divided evenly between the communes and included a total of 36 in-depth interviews with women, 31 in-depth interviews with men, 12 key-informant interviews with officials who have knowledge of the PFR implementation process, and 12 focus group discussions. Households were selected for participation in the in-depth interviews using the 2011 quantitative survey data as a sampling frame.

3.5 Survey instruments

The 2011 and 2015 multi-topic household survey instruments cover a detailed set of questions related to basic demographics, parcel land use, intra-household control of resources, and agricultural production. The land modules elicit a rich set of information on perceived tenure security, perceived land rights, market participation, and investment at the parcel level, while the agricultural modules allow for productivity estimates (log of value harvested per hectare) at the agricultural plot level. Gender-informed modules also collect information from individual spouses on the access to and control over land resources, as well as decision-making and bargaining power within the household. In addition to the household survey, a community questionnaire was administered in both rounds to a set of key respondents with diverse responsibilities in each village. It includes information on village-level demographics, infrastructure, social services, economic activities, and mode of land acquisition, land market activity, and conflicts.

Four types of questionnaires were used during the 2015 survey:

- Household questionnaire: main survey instrument, slightly adapted from the 2011 version (see below). This instrument was administered by the enumerators to the sample of households surveyed in 2011.
- Migrant household questionnaire: an abridged version of the main household questionnaire, to be administered to households which had moved to another commune since the 2011 survey and were successfully tracked by the enumerators.
- Community questionnaire: this survey instrument was used to collect data at the village-level and was administered by the controllers, occasionally assisted by 1 or 2 enumerators.
- Commune questionnaire: this instrument was used to collect data at the commune level on topics such as commune characteristics and PFR implementation status, including on the delivery of land certificates. It was administered by the World Bank field coordinator to a group of up to 5 town hall officers knowledgeable about land management issues.

3.6 Challenges

This section outlines the anticipated risks involved in the proposed impact evaluation and the steps foreseen to avoid or mitigate these risks.

- **Compliance with treatment assignment:** A common risk in randomized controlled trials is non-adherence to experimental design. This occurs when communities assigned to a treatment arm do not receive all of the services at the time they are meant to, or when control communities do receive some interventions even when they are not supposed to. Non-adherence to experimental design most often occurs when implementers and community leaders have not been properly sensitized to the evaluation; when district- or community-level staff are not aware of which communities have been assigned to which treatment arm; when staff turnover occurs and new staff do not fully understand or buy in to the impact evaluation; when researchers or Government fail to monitor activities on the ground thoroughly; when communication between evaluation stakeholders (communities, Government, and researchers) breaks down; or when political support for the impact evaluation wanes. In the case of the PFR impact evaluation, these risks will be mitigated through close coordination between the research team, the MCC/MCA-Benin project team, and the local and regional implementing structures; and by hiring a Cotonou-based field coordinator to serve as liaison between all evaluation stakeholders.
- **Contamination:** Another type of contamination is when the control group gains access to other development or relief interventions unrelated to the intervention being evaluated, while the treatment group does not. In these cases, the evaluation will find improvements in the control group's economic status as a result of these other interventions and will tend to underestimate the impact of the program being evaluated. The risk of contamination in this evaluation will be mitigated by coordinating with development partners and other Government agencies working in the study communities (to avoid others specifically targeting the control group for interventions); and by ensuring that treatment and control communities

are not directly adjacent (or creating “buffer zones” if needed between treatment and control areas).

- **Delays:** Delays in both the implementation and the research can cause frictions in the course of conducting an impact evaluation. The impact evaluation surveys need to be carefully timed and planned for in the implementation timeline. Implementation delays can cause unnecessary costs and delays, since the research team needs adequate time to hire and train field survey teams and to conduct the survey. These risks are best mitigated through careful integration of the research and implementation teams.
- **Attrition:** Attrition is the absence of data because the researchers are unable to collect some or all of the outcome measures from some people in the sample across survey rounds. This is particularly an issue when it reduces the comparability of the treatment and control groups. Attrition may also lower statistical power, which depends on sample size. To address this risk, we will collect a detailed set of contact information from respondent households during the first survey. We will also closely monitor the extent to which sample attrition affects our follow-up survey response rates and – resources permitting – track a sub-set of those households who moved (particularly if attrition is found to be correlated with treatment).
- **Linking to an existing panel survey** The initial vision for this evaluation was to build a panel dataset using the 2006 and 2010 EMICoV (*Enquête modulaire intégrée sur les conditions de vie*) rounds along with the 2011 and 2015 World Bank-IREEP surveys. There were two sets of challenges with this undertaking: survey fieldwork issues and analytical limitations. From a fieldwork standpoint, the tracking information from the 2006 EMICoV was insufficient to verify household-to-household or parcel-to-parcel matching. This problem persisted in the 2010 EMICoV survey, and the replacement rate was too high to take advantage of the panel. In addition, the EMICoV questionnaire did not ask about outcomes which are critical for our analysis. Given these challenges, we were forced to rely on the 2011 and 2015 rounds for measurements of program impact.

4 Administrative

4.1 Summary of IRB requirements and clearances

Institutional review board (IRBs) ensure that the welfare and interests of research subjects are protected, and that best practices towards these ends are followed. For this study, host country review board clearances were obtained, including approval from the *Conseil National de la Statistique*.

4.2 Data protection

The research team will ensure, in collaboration with its data collection partners, that all standard protocols for respecting the privacy of respondents will be followed. Informed consent will be obtained from all study participants prior to the start of any survey. All data collected as part of this study will be stored on encrypted servers and no personal identifying information or other attributable characteristics will be shared with any third parties.

4.3 Preparing data files for access, privacy and documentation

In accordance with the World Bank Open Data policy, the research team will make all datasets available for free download and use. The data will be de-identified and anonymized prior to pub-

lic release. All dataset releases will be accompanied by a release of relevant data documentation, including a study description, metadata summary document, data dictionary, and survey questionnaires. These data will be available for download via the World Bank Microdata Catalog, as well as via links from the MCC website.

4.4 Dissemination Plan

The activity shall lead to the following outputs: final follow-up dataset for analysis; long-run impact evaluation paper (for publication in a peer-reviewed journal); policy briefs; workshop presentations and blog posts for dissemination. The results of this impact evaluation will be disseminated widely via a range of channels, including in-country workshops with policy experts (for example, Benin's *Groupe Sectoriel Foncier*). The primary audiences are the Government and other entities in Benin and other developing countries working on property rights and land administration program. This work will also aim to inform World Bank operational teams, academics, and other development partners.

4.5 Evaluation Team Roles and Responsibilities

The impact evaluation is carried out as a collaboration between the World Bank, the MCC/MCA-Benin Benin, PFR stakeholders in Benin (MAEP and GTZ) and the African School of Economics. The budget is provided by the Millennium Challenge Corporation. The results will undoubtedly contribute to the scarce but growing literature on the effects of property rights, especially the distributional effects of land rights formalization within households. This will contribute to the discussion about the scaling-up of the formalization of land rights to all rural villages in Benin and elsewhere in Sub-Saharan Africa.

The activities on the ground require hiring a local firm (IREEP) in order to perform the testing of the survey, hiring and training of enumerators, and data collection. Two field coordinators were also hired to oversee fieldwork activities (e.g., supervise survey teams, liaise with Government counterparts and implementers), ensure the overall quality of data.

The team members for this activity include Markus Goldstein (Africa Gender Innovation Lab, The World Bank), Kenneth Hounbedji (Paris School of Economics), Florence Kondylis (Development Research Group, The World Bank), Michael O'Sullivan (Africa Gender Innovation Lab, The World Bank) and Harris Selod (Development Research Group, The World Bank).

4.6 Evaluation Timeline and Reporting Schedule

The following table provides a timeline for the evaluation reports generated as part of this study.

Table 4: Summary table

Round	Data collection	Data cleaning & analysis	Draft report expected	
			First	Final
1	3/2011 – 4/2011	7/2011 – 10/2015	6/2014	10/2015
2	4/2015 – 5/2015	7/2015 – present	7/2016	9/2016

References

- Ali, D. A., Deininger, K., and Goldstein, M.,** 2014. "Environmental and Gender Impacts of Land Tenure Regularization in Africa: Pilot Evidence from Rwanda." *Journal of Development Economics* 110(C), 262–275.
- Banerjee, A. V., Gertler, P. J., and Ghatak, M.,** 2002. "Empowerment and Efficiency: Tenancy Reform in West Bengal." *Journal of Political Economy* 110(2), 239–280.
- Besley, T.,** 1995. "Property Rights and Investment Incentives: Theory and Evidence from Ghana." *Journal of Political Economy* 103(5), 903–37.
- Besley, T. and Ghatak, M.,** 2010. *Property Rights and Economic Development*, vol. 5 of *Handbook of Development Economics*, chap. 68. Elsevier, pages 4525–4595.
- Brasselle, A.-S., Gaspart, F., and Platteau, J.-P.,** 2002. "Land Tenure Security and Investment Incentives: Puzzling Evidence from Burkina Faso." *Journal of Development Economics* 67(2), 373–418.
- Deininger, K. and Feder, G.,** 2009. "Land Registration, Governance, and Development: Evidence and Implications for Policy." *The World Bank Research Observer* 24(2), 233–266.
- Deininger, K., Jin, S., and Nagarajan, H. K.,** 2008. "Efficiency and equity impacts of rural land rental restrictions: Evidence from India." *European Economic Review* 52(5), 892–918.
- Duflo, E., Glennerster, R., and Kremer, M.,** 2008. *Using Randomization in Development Economics Research: A Toolkit*, vol. 4 of *Handbook of Development Economics*, chap. 61. Elsevier, pages 3895–3962.
- Elbow, K., Zogo, A., Zongo, K., and Diouf, A.,** 2012. "Emerging Lessons from MCC/MCA-Sponsored Initiatives to Formalize Customary Land Rights and Local Land Management Practices in Benin, Burkina Faso and Senegal." Paper for presentation at the Annual World Bank Conference on Land and Poverty.
- Feder, G. and Feeny, D. H.,** 1991. "Land Tenure and Property Rights: Theory and Implications for Development Policy." *World Bank Economic Review* 5(1), 135–53.
- Feder, G., Tongroj, O., Yongyuth, C., and Chira, H.,** 1988. *Land Policies and Farm Productivity in Thailand*. No. 32 in World Bank Occasional Paper New Series, Baltimore: Johns Hopkins University Press.
- Field, E.,** 2007. "Entitled to Work: Urban Property Rights and Labor Supply in Peru." *The Quarterly Journal of Economics* 122(4), 1561–1602.

- Galiani, S. and Schargrodsky, E.**, 2010. "Property Rights for the Poor: Effects of Land Titling." *Journal of Public Economics* 94(9-10), 700–729.
- Goldstein, M. and Udry, C.**, 2008. "The Profits of Power: Land Rights and Agricultural Investment in Ghana." *Journal of Political Economy* 116(6), 981–1022.
- Holden, S. T., Deininger, K., and Ghebru, H.**, 2009. "Impacts of Low-Cost Land Certification on Investment and Productivity." *American Journal of Agricultural Economics* 91(2), 359–373.
- Hornbeck, R.**, 2010. "Barbed Wire: Property Rights and Agricultural Development." *The Quarterly Journal of Economics* 125(2), 767–810.
- Hounkpodote, R. M.**, 2007. "Manuel de Procédure pour l'Établissement du Plan Foncier Rural." Tech. Rep., MCA-Benin/GTZ, Cotonou.
- Joireman, S.**, 2008. "The Mystery of Capital Formation in Sub-Saharan Africa: Women, Property Rights and Customary Law." *World Development* 36(7), 1233–1246.
- Lawry, S., Samii, C., Hall, R., Leopold, A., Hornby, D., and Mtero, F.**, 2014. "The Impact of Land Property Rights Interventions on Investment and Agricultural Productivity in Developing Countries: A Systematic Review." *Campbell Systematic Reviews* (1).
- Le Bris, E., Le Roy, E., and Leimdorfer, F.**, 1982. *Enjeux fonciers en Afrique noire*. Karthala.
- MCA**, 2008. "Étude 4 sur la Politique et les Réformes Foncières: Elaboration de Stratégies pour Accroître l'Accès des Femmes à la Terre, Analyses et Recommandations." Tech. Rep., MCA and Stewart International., Cotonou.
- , 2009. "Rapport de Campagne d'Information Rapprochée sur le Plan Foncier Rural dans les Villages de la Commune de Zè Département de l'Atlantique." Tech. Rep., Millennium Challenge Account (MCA).
- Teyssier, A. and Selod, H.**, 2012. "Can Land Policies be Reformed without Transforming Land Institutions? The Cases of Madagascar and Benin." In "2012 Annual World Bank Conference on Land and Poverty," .

A-2 Power analysis

Statistical power calculations were conducted on key parcel-level variables using *Optimal Design* and *Stata*. The scenarios were calculated using a multi-site cluster randomized trials. We used the first wave of data collected in 2011 to form priors about key parameters of the simulations. To account for possible similarities on observable dimensions within village clusters, intra-cluster correlations (ρ) were calculated for each outcome variables. The mean number of villages (clusters) per strata was 6. The mean number of households per village was estimated at 10 and the mean number of parcels was estimated at 18. Calculations were made with the margin of 5% chance to detect an effect when it doesn't exist (α).

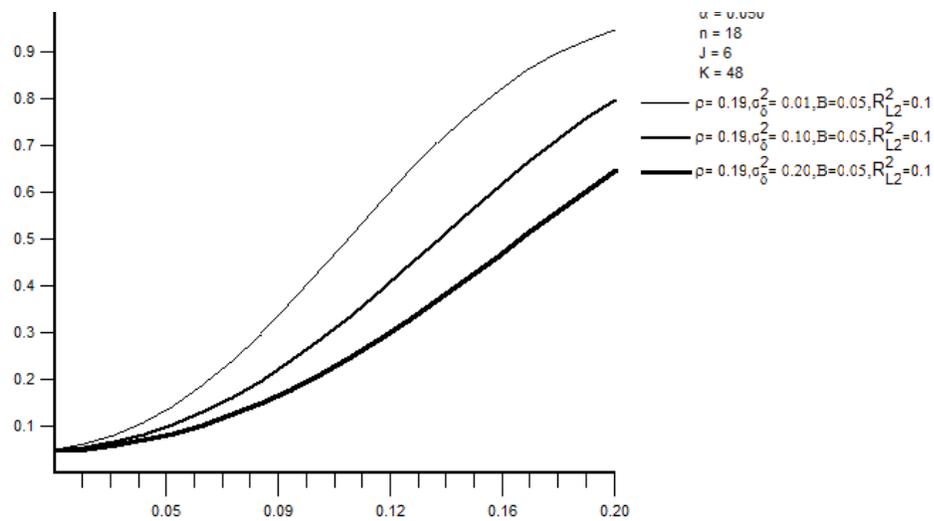
The results below illustrate the range of power and effect size for a given intra-cluster correlation, number of parcels and households per villages, proportion of variance explained by the strata and the clustering. We focus on three outcome variables (land conflict, investment projects and agricultural productivity), using existing information from the baseline survey. These simulation are run based on the variability of the treatment effect across sites (strata).

Table A-1: Distribution of the main outcome variables in 2011

	Control		Treated		diff.		ICC		R ²	
	mean	s.e	mean	s.e	coeff.	s.e	coeff.	s.e	strata	cluster
Conflict	0.06	0.23	0.05	0.22	-0.01	0.01	0.19	0.02	0.05	0.13
Investment	0.12	0.32	0.13	0.34	0.01	0.01	0.13	0.02	0.08	0.07
Fallow	0.01	0.11	0.01	0.12	0	0.00	0.04	0.01	0.02	0.03
land rentals	0.05	0.21	0.03	0.17	-0.01	0.01	0.05	0.01	0.01	0.06
Productivity (log USD/ha)	6.38	1.06	6.4	1.07	-0.01	0.06	0.16	0.02	0.07	0.1
Number of parcels	1,703		2,741		4,444		4,444		4,444	

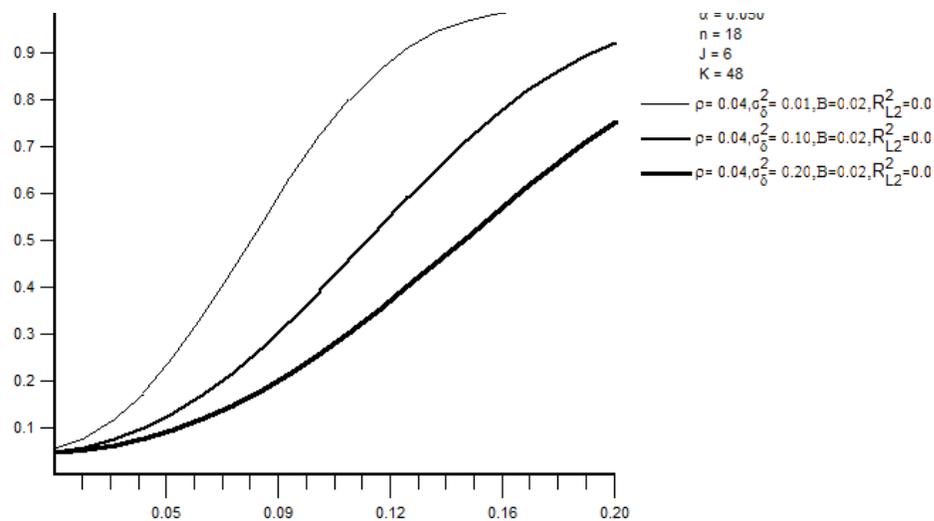
Overall, a survey of approximately 4,356 parcels (approximately 200 clusters) should be sufficient to detect standardized effects (δ) of reasonable magnitude on conflicts and investments in land (both of which are key variables of interest for the impact evaluation).

Figure A-2: Power calculation focusing on land conflict as the outcome variable.



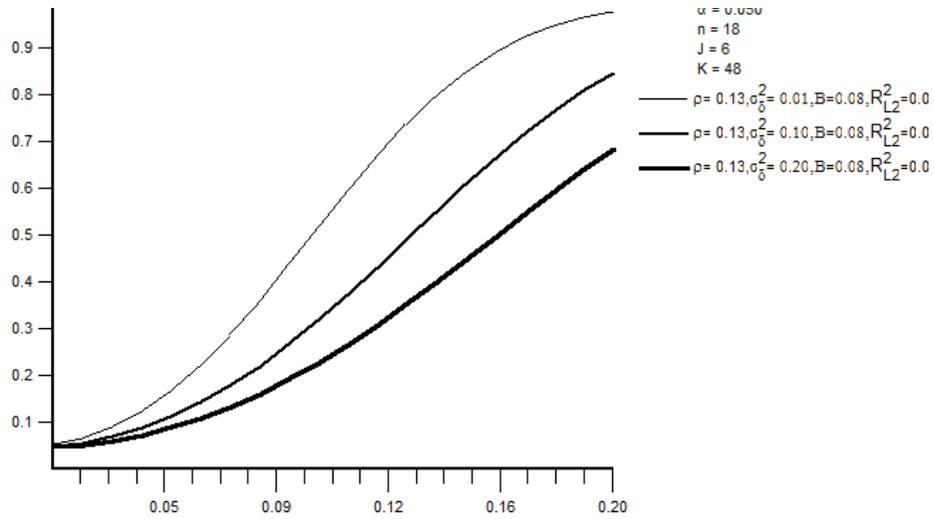
Source: Author's illustration based on survey data collected in information from [Table A-1](#) and using the software *Optimal Design*.

Figure A-3: Power calculation focusing on fallow as the outcome variable.



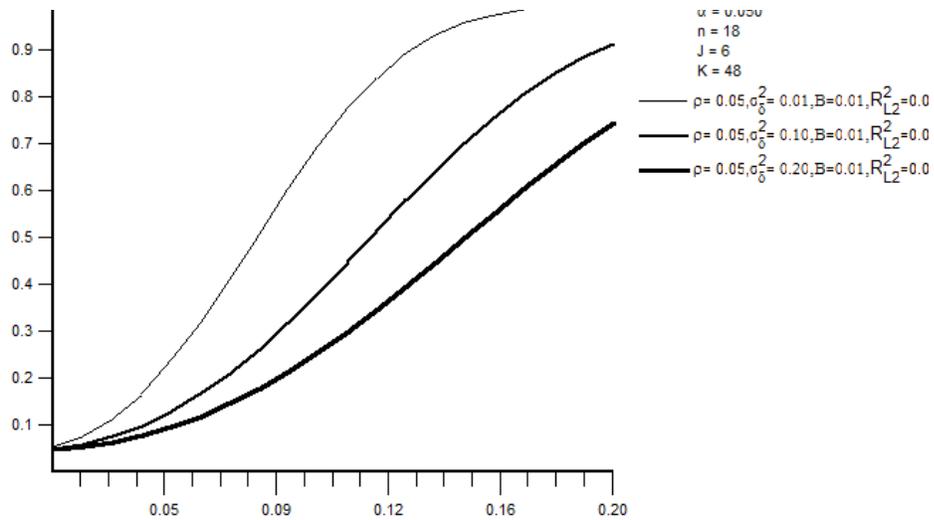
Source: Author's illustration based on survey data collected in information from [Table A-1](#) and using the software *Optimal Design*.

Figure A-4: Power calculation focusing on land conflict as the outcome variable.



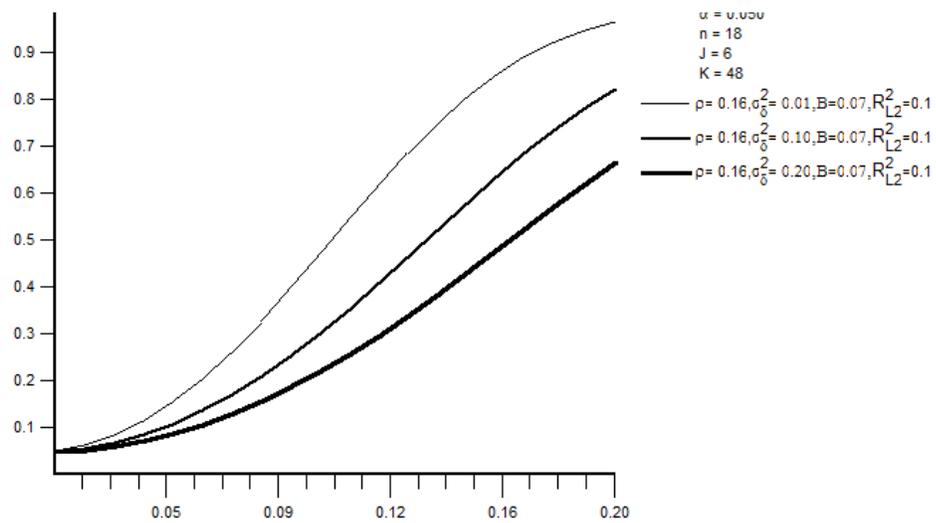
Source: Author's illustration based on survey data collected in information from [Table A-1](#) and using the software *Optimal Design*.

Figure A-5: Power calculation focusing on land related investment as the outcome variable.



Source: Author's illustration based on survey data collected in information from [Table A-1](#) and using the software *Optimal Design*.

Figure A-6: Power calculation focusing on parcel productivity as the outcome variable.



Source: Author's illustration based on survey data collected in information from [Table A-1](#) and using the software *Optimal Design*.