

# Formalizing Rural Land Rights: Long-Run Evidence from a Policy Experiment in Benin<sup>\*</sup>

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## Abstract

We present evidence from the first large-scale randomized-controlled trial of a land formalization program. We draw on two rounds of data to assess the short-run and medium-run effects of the program. Improved land security following land demarcation in 2011 led to an increase in long-term agricultural investment in tree planting and perennial crops. Female-headed households further responded to demarcation by closing the gender gap in fallowing, a key soil fertility investment. Four years later, treated households continued to report significantly higher rates of perennial crop cultivation. Despite the observed increases in investment, no average effects on output or farm yields were observed in either 2011 or 2015.

**Keywords:** property rights, agricultural investment, land administration, gender, natural resources

**JEL Classification:** O12, O17, P48, Q15, J16

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## Introduction

This document serves as the final report for the impact evaluation of the Establishment of Rural Landholding Plans (or PFR, *Plans Fonciers Ruraux*)<sup>1</sup> activity under the Access to Land (ATL) project in Benin. The project, which was funded by the Millennium Challenge Corporation (MCC) under its 2006-2011 Compact between the governments of Benin and the United States of America, was carried out by the Millennium Challenge Account-Benin (MCA-Benin) and its implementing partners. The impact evaluation, which was led by the World Bank with funding from the MCC, employs a randomized controlled trial design to document the causal impact of establishing rural landholdings plans.

This report draws on two rounds of quantitative household survey data from 2011 and 2015, as well as a range of administrative and qualitative data sources, to present estimates of the short- and medium-run impacts of establishing rural landholding plans on a range of outcomes related to investment and agricultural production. The selection of program villages through commune-level lotteries allows for a rigorous estimate of the impact using a randomized-controlled trial approach. The report also provides detailed summary statistics on implementation and treatment and control households in the sample.

The report is structured as follows. [Section 1](#) provides background information for this evaluation, while [Section 2](#) describes the Establishment of Rural Landholding Plans (or PFR) intervention in more detail. [Section 3](#) outlines the experimental design and data sources used to measure program impact, while [Section 4](#) presents the status of program implementation activities and summary statistics from the two rounds of quantitative survey data. Following a description of the impact evaluation's econometric approach in [Section 5](#), we present estimates of the PFR's impact along a range of dimensions.

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<sup>1</sup>Throughout the report, we use the abbreviation of the project title in French: PFR, or *Plans Fonciers Ruraux*.

## 1 Background

Across much of rural Sub-Saharan Africa, the allocation of land and the enforcement of land rights often involve a diverse and complex set of customary arrangements made and upheld by customary stakeholders such as village chiefs, councils of elders, and land chiefs (Le Bris *et al.*, 1982).<sup>2</sup> At the same time, customary land tenure systems often coexist with formal, or so-called “modern” land administration systems, where proof of ownership or of use rights is given by formal documents such as titles or deeds. But only a small proportion of the population holds land formally registered whereas most landholders do not have any formal documentary evidence of their land rights. In this context, land conflicts over inheritance, as well as disputes within and across villages are common. As a result it is argued that tenure insecurity could considerably dampen incentives for investment and maintain a low agricultural productivity. Land tenure insecurity and conflicts over land rights are also likely to have distributional implications, as women and other groups vie for secondary land rights in a context where ownership and control over land is circumscribed to those who have the power to enforce their claims.

In many parts of the world, such as Latin America, the policy response to undocumented property rights has often been the “formalization” of land tenure (i.e. the incorporation of “informal” or undocumented tenure claims into the formal system of property rights) often through the provision of fully-fledged formal titles, a procedure known as “land titling” (Durand-Lasserve and Selod, 2009), the different types of and different contexts for land tenure formalization). These programs have met with relative success in both rural settings (Deininger and Feder, 2009; Feder *et al.*, 1988) and urban settings (Field, 2007; Galiani and Schargrotsky, 2010). However, the available evidence suggests that impacts may not be as positive in Sub-Saharan Africa (Jacoby and Minten, 2007), perhaps due to approaches that neglected the complexity of customary land relations in rural areas as well as the limited capacity of central land administrations to establish and maintain titling systems (Teyssier and Selod, 2012).

It has also been argued that these land formalization programs have actually resulted in exacerbating, rather than diminishing existing gender inequalities in access to land in Africa (Lastarria-Cornhiel, 1997). In response to these challenges, (Udry, 2012) observes the shift that has emerged in policy advice “from direct provision of individual title to support for better integration of customary tenure with the formal legal system” might prove more effective in

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<sup>2</sup>The discussion in this section is drawn from (Goldstein *et al.*, 2015).

improving tenure security and promoting rural development in Africa.

Despite the importance of these policy questions, there remains a dearth of rigorous evidence on the impact of land formalization programs in Sub-Saharan Africa. With the exception of recent work from Rwanda ([Ali \*et al.\*, 2014](#)) and the short-run results from this same study in Benin ([Goldstein \*et al.\*, 2015](#)), there are no rigorous evaluations of land formalization interventions on the investment and welfare of households in Africa. This study aims to contribute to that knowledge gap.

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## 2 The Establishment of Rural Land Holding Plans (PFR) Intervention

### 2.1 Intervention 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 Rural Land Holding Plans, or *Plans Fonciers Ruraux* (PFR), first tried in Ivory Coast in 1989, piloted in Benin between 1993 and 2003, and scaled up as part of the MCC-funded ATL project nationwide since 2006.<sup>3</sup>

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 PGRN, 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.

The shift in the focus of the PFR from experimentation to scaling up was made possible through a sizeable 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 Land 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 remarkably frequent, comprising more than 70 percent of all civil court cases (MCC, 2012).

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<sup>3</sup>Not part of the MCC/Benin Compact were aspects of PFR and rural land management work that the government of Benin has carried out itself or with other donors: (i) Linkage of PFR to natural resource and environmental management, (ii) Linkage of PFR to agricultural improvement activities, and (iii) Linkage of PFR to microcredit.

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. As outlined in the Compact Closeout brief (MCC, 2012), the Access to Land (ATL) Project consisted of the following main activities:

- **Decentralization of Land Registry Services:** Provide more convenient and faster services for obtaining legally sufficient proof of landholding rights and for carrying out transactions.
- **Establishment of Rural Landholding Plans:** Provide maps of landholdings and lists of landholders for intra-village transactions and mediation disputes. Allow landholders to receive certificates of proof of rights for extra-village actions in courts and administration and in property and credit transactions.
- **Urban Land Titles:** Replace obsolete, slow and expensive administrative procedures to obtain urban land title.
- **Technological Improvements in Land Management Systems:** Adopt modern technologies and improved procedures for land management agencies and regulations to better guard against corrupt practices.

While recognizing that several other components of the ATL Project were also carried out to support the Establishment of Rural Landholding Plans (PFR) activity,<sup>4</sup> the remainder of the report uses the term PFR to refer to the specific intervention under evaluation.

## 2.2 Intervention Description

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 ethnic groups, women cannot inherit land although

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<sup>4</sup>Other activities included initial outreach and public education leading to the selection of communes and villages for treatment, on-going public education and institutional capacity building, and other technical capacity building and support to decentralize the land administration authority from the state to *commune* administrations.

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. At the household level, 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<sup>5</sup> 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 2 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

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<sup>5</sup>According to Law No. 2013-01 August 14, 2013

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 (see [Figure 3](#) for a CFR example). 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.<sup>6</sup> 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 MCC-funded project did not assist individual landholders in a systematic way to apply for and obtain their land certificates, and only provided the necessary administrative tools to enable commune office staff and SVGF officers to conduct this work themselves.<sup>7</sup> 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

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<sup>6</sup>This paved the way for the implementation of the current PFR programs and their extension as planned in Benin's strategic plan for agriculture development (*Programme National d'Investissement Agricole*). Benin also engaged into the formulation of a land policy through several documents. These include a *Lettre de Cadrage* (2009), a White Paper (2009), and a Land Code (2015), which consolidate laws in the rural and urban sectors.

<sup>7</sup>The MCC-funded project provided every village administration with a small office with furniture and storage space to keep the village copies of the maps and landholder lists safe. Each village SVGF also received a motor bike to periodically ride to the commune town hall to bring map changes, certificate application forms, blank certificates, etc.



**Figure 1:** List of main PFR activities

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

town hall and pay a fee in order to withdraw it.

### 2.3 Village Selection and Implementation of the PFR

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 project 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 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. At the end of the MCC Compact in 2011, only 652 out of the 72,742 land use certificates expected had been issued and delivered to landholders (UCF, 2015). Significant progress has been made during the following four years, but the share of land certificates delivered to landholders remains low. As of March 2015, only 19 percent of expected certificates had been delivered: out of 65,175\* land use certificates expected following UCF/MCA-Benin's 2014 mission, only 14,558 had been delivered. Another 6,144 certificates had been requested but not yet processed, and 33,956 certificates had been issued but not delivered.

Before transferring direct responsibility for PFR implementation to the Government of Benin in 2011, MCA-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 *arrondissement*-level<sup>8</sup>;
- 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 (ETFs) in 294 villages through a participatory process involving the landowners and local land management structures;
- Development of Land Information Systems (or SIF, *Système 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 sur-

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<sup>8</sup>A few villages and communes added a small budget item to their annual expenditures to cover the costs of the Land Commissions. In most places, the certificate issuance is funded by charging a small fee.

veys (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.<sup>9</sup> 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

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<sup>9</sup>Based on 2015 data collected by World Bank field coordinator through a commune-level survey conducted in 35 out of the 40 PFR communes.

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.<sup>10</sup>

Data collection activities carried out in 2015 included a commune survey, in which land management officers were interviewed about the status of land certificate delivery in their town halls. Asked about what they perceived as the main reasons behind the low rates of certificate delivery, respondents provided the following types of explanations:

- **Poor performance of local land management structures:** Both SVGF members and SIF operators had limited incentives to carry out their work, according to the interviewed commune officials;
- **High costs associated with obtaining a land use certificate:** Depending on the commune, landholders had to pay fees to request a land certificate, fees for the delivery of the certificate, as well as transportation costs for travelling to the town hall to withdraw the certificate. Given the low income levels of most small-scale landholders in rural areas, the costs associated with obtaining a certificate may have limited their take-up;
- **Long distances between villages and town halls:** To withdraw their land use certificates, some landholders have to travel long distances to reach the issuing town hall. Moreover, in the absence of a meeting with the CSADE, beneficiaries sometimes have to make repeated journeys;
- **Lack of knowledge:** Landholders may be unaware of the benefits of having a certificate or simply consider that the land demarcation process is enough to secure their rights to a particular parcel.

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<sup>10</sup>With a few exceptions, the tariff grid corresponds with the figures presented in the final report of the *Bureau d'Etudes Inter Topographie Cartographie et Aménagement* (UCF, 2015). The reported cost for obtaining a certificate was the highest in Ouèssè, where land owners were reportedly charged FCFA 10,000 regardless of the size of the parcel.

- **Device failures:** Some CSADE members reported that device failures, such as defective printers or power outages, have created disruptions and delays in issuing land use certificates.
- **Duration of issuing a land use certificate:** The long period of time required for a certificate to be issued by the town hall has acted as disincentive for landholders to request one.
- **Refusal to recognize the certificate by some institutions:** Some microfinance institutions as well as the DGID (*Direction Générale des Impôts et de Domaines*) may be unaware of the existence of land use certificates and do not accept the document as valid for loan applications. In many areas, loans continue to be offered based solely on sales agreements or a guarantee of morality for the applicant.
- **Lack of public awareness:** According to some interviewed officials, the sensitization campaign carried out during the PFR program implementation was not sufficiently robust.
- **Other reasons:** Other reasons cited by CSADE members include the lack of adequate funding for SIF operators, confusion between the land use certificate and the land title (*titre foncier*) which is considered expensive and difficult to obtain, the relatively high levels of tenure security in certain villages and communes, the fear among potential beneficiaries that they would have to pay taxes based on the certificate, and the lack of necessary identification cards.

### 3 Experimental Design and Data

#### 3.1 Experimental Design

We rely on the random assignment of Benin's *Plans Fonciers Ruraux* (PFR) program at the village level to identify the program impacts. As described in [Section 2](#), treatment and control villages were selected among those interested and eligible for the PFR through public lotteries carried out in each of the 40 communes.

The sample of villages included in this impact evaluation represents the subset of PFR villages which were covered by the 2006 and 2010 national EMICoV (*Enquête Modulaire Intégrée sur les Conditions de 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.<sup>11</sup> 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 illustrates the selection of treatment and control villages. The geographic coverage of our survey is expansive, spanning the entire range of Benin's agro-climatic zones with data in nine of Benin's twelve regions (*départements*).

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.<sup>12</sup> 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. To address concerns of endogeneity of land delimitation and certification – some unobserved variables can indeed simultaneously determine land demarcation or certi-

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<sup>11</sup>By 2015, the PFR had been implemented in two control villages – one of which is in our study sample.

<sup>12</sup>The 2011 survey took place on average 11 months after the completion of demarcation activities in PFR villages, with another follow-up survey four years later.

fication and tenure security, investment and productivity and the expectation of land loss or encroachment can even prompt land delimitation or certification – we exploit the random selection of beneficiary villages through public lotteries. Since our sample covers households from both beneficiary and non-beneficiary villages, we use the random assignment to separate out the causal impact of land demarcation from possible confounders that plague much of the existing empirical literature on property rights.

### 3.2 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; and (iv) two rounds of primary household survey data formally document impact. [Figure 4](#) 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.<sup>13</sup> 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

<sup>13</sup>The initial vision for the evaluation was to build a panel dataset using the 2006 and 2010 EMICoV data, combined with experimental survey data. However, 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, even in the 2010 EMICoV survey, and the replacement rate was too high to take advantage of the panel.

**Table 1:** Household Characteristics across Treatment Groups in 2006

|  | Treated |           | Control |           | Diff.  |          |
|--|---------|-----------|---------|-----------|--------|----------|
|  | Mean    | Std. Dev. | Mean    | Std. Dev. | coeff. | s.e.     |
| Female headed hh <sup>†</sup>                  | 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 <sup>†</sup>       | 0.85    | 0.36      | 0.85    | 0.36      | 0.02   | (0.02)   |
| HH sold a land in last 3 years <sup>†</sup>    | 0.02    | 0.15      | 0.03    | 0.16      | -0.00  | (0.01)   |
| Landholder cultivated a plot <sup>†</sup>      | 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 <sup>†</sup>          | 0.44    | 0.50      | 0.45    | 0.50      | -0.01  | (0.04)   |
| Household has a female landholder <sup>†</sup> | 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 <sup>†</sup> | 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 preselected 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.

<sup>†</sup> Indicates dummy variables. Significance levels are reported as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

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



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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.

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 agro-climatic 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, 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.

### 3.3 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.

For the 2015 survey, a number of changes were made to the 2011 household questionnaire, including:

- A section on durable goods was added to Module C on dwelling characteristics, which was expanded to include a series of questions on the use of energy sources;
- An entire new module (Module J) was added to gather information on loans and use of financial services;
- An additional set of questions on land tenure security were added, including on the perceived risk of losing a landholding, and on the potential beneficiaries of any landholdings lost by the household;
- Several questions were dropped, including questions on out-grower schemes (Module F-I) and crop storage (Module F-VI), as well as a variety of questions from Module G, such as the year of marriage, number of children with each wife, value of each wife's dowry.

### 3.4 Fieldwork

As in 2011, data collection activities in 2015 were carried out by the Institute for Empirical Research in Political Economy (IREEP), at the African School of Economics (ASE), based in Cotonou. The second follow-up survey took place between April 7th and May 25th 2015, in 291 villages spread across 40 communes and 9 regions. The local survey staff was organized into 10 field teams, including 53 enumerators, 10 controllers, 10 supervisors, and 10 data entry clerks. The 83 field agents were selected among the 96 participants to the enumerator training which took place between 16 and 22 March 2015.<sup>14</sup>

Each team covered a region,<sup>15</sup> which includes between two and five communes. Enumerators were in charge of administering the household surveys, with a quota of two household questionnaires per day. Controllers and supervisors were responsible for planning and coordinating on site activities as well as ensuring that data collection protocols are respected. Controllers were also responsible for traveling to the next village a day in advance of the rest of the team in order to mobilize the community and prepare for the survey. Finally, data entry clerks also

<sup>14</sup>The first 5 days of the training were classroom-based and consisted of the presentation and learning of the different data collection instruments. The last 2 days of the training consisted of a pre-test in Ze commune, as well as a subsequent classroom debriefing. Data entry clerks were trained separately in how to use CPro and how to use the data entry shell.

<sup>15</sup>With the exception of Collines, which required two teams.

accompanied the field teams in order to digitize collected data as soon as possible. Each data entry clerk had a laptop with the CSPro data entry shell installed and set up a “data entry center” with a fixed location in each village. The fact that the first data entry was conducted in the field not only reduced the time needed to obtain the final dataset once the fieldwork was completed, but also enabled IREEP’s data manager to conduct frequent data quality checks on the incoming data.

IREEP completed 2015 complete follow-up surveys with 3,338 households, representing approximately 95 percent of the 2011 sample of 3,507 households. Among the remaining 169 households, there are 43 relocated/migrant households (who were administered a shorter “migrant” survey) and 126 attrited (“lost”) households. Table 2 reports 2011 household characteristics by 2015 survey attrition status. Although survey attrition is not significantly correlated with treatment status, the Table does reveal a pattern: attrited households were significantly more likely to be landless or to own fewer parcels and agricultural plots in 2011, relative to non-attrited households. This finding holds when including relocated/migrant households in the attrited category.

**Table 2:** Household survey attrition across two survey waves (2011 & 2015)

|  | Obs.  | Sample | Non-attrited | Attrited | <i>p</i> -value |
|--|-------|--------|--------------|----------|-----------------|
| In treated village                             | 3,507 | 0.67   | 0.67         | 0.61     | 0.18            |
| Female headed HH                               | 3,507 | 0.19   | 0.18**       | 0.27     | 0.03            |
| Age of HH head (years)                         | 3,507 | 46.87  | 46.86        | 47.10    | 0.89            |
| Household size                                 | 3,507 | 6.15   | 6.22***      | 4.33     | 0.00            |
| Household has a landholding                    | 3,507 | 0.94   | 0.94***      | 0.85     | 0.00            |
| Household landholding size (ha)                | 3,277 | 6.25   | 6.35***      | 3.01     | 0.00            |
| Number of parcels held by household            | 3,492 | 2.06   | 2.09***      | 1.25     | 0.00            |
| Number of ag plots controlled by household     | 3,507 | 1.87   | 1.90***      | 1.21     | 0.00            |
| Household sold land in last 5 years            | 3,507 | 0.03   | 0.03         | 0.04     | 0.45            |
| Household sold at least some of its harvest    | 3,507 | 0.65   | 0.65***      | 0.50     | 0.00            |
| Household planted perennial crops              | 3,507 | 0.15   | 0.15**       | 0.10     | 0.04            |
| Household has a formal evidence of land rights | 3,301 | 0.2    | 0.20         | 0.16     | 0.22            |
| Household has at least 1 female farmer         | 3,507 | 0.16   | 0.16         | 0.16     | 0.95            |

Note: This table reports 2011 household-level survey means by 2015 survey attrition status.

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## 4 Descriptive Evidence

### 4.1 Program Implementation

The status of village-level PFR implementation is presented in [Table 3](#). Implementation status is reported for all PFR villages (Panel A) and for the sub-set of PFR villages included in the World Bank study sample (Panel B).

Overall, the PFR successfully completed demarcation activities in the large majority of program villages. As of March 2015, nearly all (97%) of PFR villages had a completed village landholding plan ([Table 3](#), Panel A), while respondents from 92% of villages in the sample reported having at least one demarcated parcel (Panel B). Moreover, the process of land certification was at least initiated in three-quarters of PFR villages (Panel A). However, the issuance and delivery of Rural Landholding Certificates (CFR), a process led by local governments and village land committees, was carried out at a far slower pace. According to the most recently available administrative data, only 19% of the demarcated parcels have a CFR [Table 3](#), Panel A & Panel B). Only 6 treated villages in the study sample (all 5 treated villages from the commune of Banikoara and 1 of the 3 treated villages of the commune of Kandi) have achieved full CFR delivery for demarcated parcels. Qualitative research conducted in Banikoara indicates that the high level of CFR delivery in that commune was facilitated by a committed official who employed a service to deliver certificates to the population.

Although, according to the administrative data, demarcation and certification activities in the villages covered by the study sample have progressed similarly to the pace in the whole sample of all demarcated villages, the World Bank survey data aggregated at the village-level reflects a lower rate of CFR delivery. The land certificate delivery rate is the same (19%) in all 294 PFR villages as it is in the 185 PFR villages included in the study sample. However, only 7% of parcels owned by *surveyed* households were accompanied by land certificates (Panel B in [Table 3](#)). The differential rate can be attributed to the sampling methodology used for the study. While demarcation activities had been conducted in 175 out of the 191 (92%) surveyed PFR villages, only 55% of these 175 villages had any respondents reporting having land certificates on demarcated parcels.

In the process of CFR delivery, the landholder having a demarcated parcel candidate for CFR

**Table 3: Status of land certification in the treatment villages as of March 2015**

|  | Obs. | Mean |
|--|------|------|
| <b>Panel A: All PFR villages<sup>a</sup></b>                       |      |      |
| Village is selected for a PFR                                      | 300  | 1.00 |
| Village is demarcated  | 300  | 0.97 |
| CFR delivery (as of March 2015)                                    |      |      |
| - Started  | 292  | 0.74 |
| - CFR delivery rate  | 292  | 0.19 |
| <b>Panel B: PFR villages in the impact evaluation study sample</b> |      |      |
| <i>2015 MCA-Benin UCF administrative data:</i>                     |      |      |
| Village is demarcated  | 191  | 0.97 |
| CFR delivery (as of March 2015)                                    |      |      |
| - Started  | 185  | 0.75 |
| - CFR delivery rate  | 185  | 0.19 |
| <i>World Bank survey data:</i>                                     |      |      |
| Village is selected for a PFR                                      | 191  | 1.00 |
| Household with a demarcated plot                                   | 191  | 0.92 |
| CFR delivery (as of March-April 2015)                              |      |      |
| - At least one parcel with a CFR                                   | 175  | 0.55 |
| - CFR delivery rate in the sample                                  | 175  | 0.07 |

<sup>a</sup> Source: 2015 MCA-Benin UCF administrative data.

delivery first submits a CFR request form to the leader of the local land management committee (SVGF) in the village; then, the request heads towards the administrative commune for CFR issuance by the mayor and delivery to the landholder. While, according to 77% of commune-level land affairs officers, requesting a CFR is free of charge, 63% of the surveyed villages report some cost associated with submission (Table 4). Adding to the amount likely to be paid for the CFR request submission at the village-level, landholders have to pay for CFR delivery, an amount set at the commune-level which usually varies with the parcel area (Table 5). According to the administrative data, the cost for CFR delivery is between 300 and 2,000 FCFA for a parcel area less than 0.5 Ha, and can rise up to 50,000 FCFA for larger parcel areas. Overall, 8% of the households in our sample had a least one CFR in 2015. A further look at the characteristics of the households with a CFR in 2015, shows that members of land committees and village advisers – both of whom are well educated about the steps to acquire a CFR – were more likely to have a CFR in 2015. Interestingly, the take up rate is not correlated to potential barriers such as fees and distance to the city town where the CFR requests are processed (see Table ??).

**Table 4: Cost of submitting a CFR request**

| Cost in FCFA    | Commune survey respondents <sup>a</sup> |            |       | Village survey respondents <sup>b</sup> |            |       |
|-----------------|---|------------|-------|---|------------|-------|
|                 | Freq.                                   | Percent    | Cum.  | Freq.                                   | Percent    | Cum.  |
| None            | 27                                      | 77.14      | 77.14 | 48                                      | 36.64      | 36.64 |
| ]0 – 500]       | 2                                       | 5.71       | 82.86 | 14                                      | 10.69      | 47.33 |
| ]500 – 1,000]   | 3                                       | 8.57       | 91.43 | 14                                      | 10.69      | 58.02 |
| ]1,000 – 2,000] | 3                                       | 8.57       | 100   | 12                                      | 9.16       | 67.18 |
| ]2,000 – 5,000] |   |            |       | 31                                      | 23.66      | 90.84 |
| >5,000          |   |            |       | 12                                      | 9.16       | 100   |
| <b>Total</b>    | <b>35</b>                               | <b>100</b> |       | <b>131</b>                              | <b>100</b> |       |

*Note:* This table compares responses to the same question asked to respondents from both the commune- and village-level surveys. Land affairs officers representing 35 surveyed communes provided the cost, if any, for submitting a CFR request (representatives

<sup>a</sup> *Source:* 2015 World Bank commune survey data.

<sup>b</sup> *Source:* 2015 World Bank village survey data.

**Table 5: CFR delivery cost (FCFA) by parcel size**

| Land size (ha) | Obs. | Cost in FCFA |       |
|----------------|------|--------------|-------|
|                |      | Min          | Max   |
| Lump sum fee   | 5    | 500          | 10000 |
| ]0 – 0.5]      | 14   | 2000         | 2000  |
| ]0.5 – 1]      | 14   | 3000         | 4000  |
| ]0 – 1]        | 11   | 1000         | 3000  |
| ]1 – 2]        | 12   | 2000         | 4000  |
| ]0 – 2]        | 1    | 2000         | 2000  |
| ]1 – 3]        | 1    | 3000         | 3000  |
| ]2 – 3]        | 3    | 3000         | 5000  |
| ]2 – 4]        | 1    | 4000         | 4000  |
| ]3 – 4]        | 1    | 4000         | 4000  |
| ]3 – 5]        | 1    | 4000         | 4000  |
| ]4 – 5]        | 1    | 4500         | 4500  |
| ]0 – 5]        | 3    | 2500         | 4500  |
| ]1 – 5]        | 1    | 3000         | 3000  |
| ]0 – 9]        | 1    | 4500         | 4500  |
| ]0 – 10]       | 1    | 2000         | 2000  |
| ]1 – 10]       | 1    | 3000         | 3000  |
| ]5 – 10]       | 1    | 4000         | 4000  |
| ≥ 1            | 11   | 4000         | 5000  |
| ≥ 2            | 9    | 5000         | 5000  |
| ≥ 3            | 2    | 5000         | 6000  |
| ≥ 4            | 1    | 5000         | 5000  |
| ≥ 5            | 5    | 5000         | 5000  |
| ≥ 9            | 1    | 5000         | 5000  |
| ≥ 10           | 3    | 5000         | 5000  |

*Note:* This table presents the variation in CFR delivery cost in FCFA across the 40 PFR communes. Each commune applies its own CFR cost structure. Two communes have unclear cost data and were not included in this table. One commune sets 5,000 FCFA for a parcel under 1,000 square meters and a price range of 10,000 to 50,000 FCFA for all other parcel areas. The other commune applies between a range of 2,000 to 10,000 FCFA, with no corresponding parcel area range specified. “ha” = hectares.

*Source:* 2015 MCA-Benin UCF administrative data.

## 4.2 Sample Characteristics

Table 6 presents the household sample by landholding location. For the purposes of this study and in line with PFR program coverage, the household study sample is limited to those households with at least one parcel landholding in their village of residence. The sample from 2011 is made up of 2,972 households with at least one parcel in their village, while the corresponding figure for 2015 is 3,132 households (Table 6).<sup>16</sup>

**Table 6:** Locations of household landholdings

| Location        | Survey year 2011   |         |       | Survey year 2015 |         |       |
|-----------------|--------------------|---------|-------|------------------|---------|-------|
|                 | Freq.              | Percent | Cum.  | Freq.            | Percent | Cum.  |
| In village      | 2,972              | 84.74   | 84.74 | 3,132            | 93.83   | 93.83 |
| Outside village | 304                | 8.67    | 93.41 | 83               | 2.49    | 96.32 |
| No landholding  | 231                | 6.59    | 100   | 123              | 3.68    | 100   |
| Total           | 3,507 <sup>a</sup> | 100     |       | 3,338            | 100     |       |

<sup>a</sup> Note: During the 2015 follow-up survey, 3,338 households were re-surveyed; 43 households migrated/relocated to another area; and 126 households were not found. Source: 2011 & 2015 World Bank survey data.

Table 6 presents household and parcel characteristics, disaggregated by treatment status, for both the 2011 and 2015 samples. All mean differences are adjusted to account for the way in which villages were randomly selected for the PFR via commune-level lotteries. Average household and parcel characteristics across treatment groups in each survey year indicate that the treated sub-sample is similar to the control sub-sample along a range of observed characteristics, except that the control group is composed of more female-headed households in 2015 and control households are slightly larger in 2011. Approximately one-fifth of the sample households across both years are female-headed and a quarter of household heads report being able to read and write. These households have 6.2 members on average. Parcel level means in control areas for the key outcome areas of interest are reported in Section 5. The aggregate number of parcels for the 2015 survey (7,736), meanwhile, is greater than that of 2011 (6,094). This increase is likely due to at least two factors: i) the increased share of households with at least one parcel in the village and ii) the observed decrease in average parcel size between the two survey waves.

<sup>16</sup>The increase in the number of households with at least one parcel in the village may be linked to population increases within study areas and expanded boundaries within study villages. This finding may also be consistent with a shift toward more household landholdings within a given village. As a robustness check, the 2015 impact analysis will be conducted with both the full within-village 2015 sample and the restricted sample of households who had at least one parcel within the village in 2011. Nevertheless, parcel location is not correlated with treatment status in the 2015 sample.



Table 7: Household and parcel characteristics across treatment groups

|  | Survey year 2011 |       |       |         |        |        | Survey year 2015 |       |       |         |        |        |
|--|------------------|-------|-------|---------|--------|--------|------------------|-------|-------|---------|--------|--------|
|  | Treated          |       |       | Control |        |        | Treated          |       |       | Control |        |        |
|  | Mean             | S.D.  |       | Mean    | S.D.   | Diff   | Mean             | S.D.  |       | Mean    | S.D.   | Diff   |
| <b>Panel A: Household characteristics</b>  |                  |       |       |         |        |        |                  |       |       |         |        |        |
| Female-headed household <sup>†</sup>       | 0.17             | 0.37  | 0.16  | 0.37    | 0.01   | (0.02) | 0.21             | 0.41  | 0.18  | 0.39    | 0.03** | (0.02) |
| Age of HH head (years)                     | 46.78            | 15.21 | 47.12 | 15.38   | -0.32  | (0.64) | 49.61            | 14.68 | 49.67 | 14.98   | 0.18   | (0.63) |
| Household head can read/write <sup>†</sup> | 0.24             | 0.43  | 0.23  | 0.42    | 0.03   | (0.02) | 0.24             | 0.43  | 0.26  | 0.44    | -0.02  | (0.02) |
| Household size                             | 6.28             | 3.27  | 6.5   | 0.37    | -0.22* | (0.13) | 6.1              | 3.28  | 6.2   | 3.37    | -0.14  | (0.13) |
| Number of households                       | 2,002            |       | 970   |         | 2,972  |        | 2,094            |       | 1,038 |         | 3,132  |        |
| <b>Panel B: Parcel characteristics</b>     |                  |       |       |         |        |        |                  |       |       |         |        |        |
| Type of soil:                              |                  |       |       |         |        |        |                  |       |       |         |        |        |
| - sandy                                    | 0.19             | 0.39  | 0.14  | 0.35    | 0.03   | (0.02) | 0.3              | 0.46  | 0.29  | 0.45    | -0.02  | (0.02) |
| - lateritic                                | 0.32             | 0.47  | 0.3   | 0.46    | 0.01   | (0.03) | 0.33             | 0.47  | 0.37  | 0.48    | -0.03  | (0.02) |
| - hydromorphic                             | 0.18             | 0.38  | 0.16  | 0.36    | 0.01   | (0.03) | 0.11             | 0.31  | 0.09  | 0.29    | 0.04   | (0.02) |
| - ferrallitic                              | 0.26             | 0.44  | 0.35  | 0.48    | -0.04  | (0.03) | 0.21             | 0.4   | 0.17  | 0.37    | 0.01   | (0.02) |
| - other                                    | 0.05             | 0.22  | 0.05  | 0.22    | -0.01  | (0.01) | 0.06             | 0.23  | 0.08  | 0.27    | 0.01   | (0.01) |
| Walking time from homestead:               |                  |       |       |         |        |        |                  |       |       |         |        |        |
| - 00-05 minutes                            | 0.14             | 0.35  | 0.13  | 0.34    | -0.02  | (0.01) | 0.26             | 0.44  | 0.27  | 0.45    | -0.01  | (0.01) |
| - 06-15 minutes                            | 0.13             | 0.34  | 0.11  | 0.31    | 0.01   | (0.01) | 0.14             | 0.35  | 0.13  | 0.34    | 0.01   | (0.01) |
| - 16-30 minutes                            | 0.16             | 0.36  | 0.16  | 0.37    | 0      | (0.01) | 0.16             | 0.37  | 0.16  | 0.36    | 0.01   | (0.01) |
| - 31-45 minutes                            | 0.13             | 0.33  | 0.14  | 0.35    | -0.01  | (0.01) | 0.1              | 0.3   | 0.1   | 0.3     | 0      | (0.01) |
| - 46-60 minutes                            | 0.11             | 0.32  | 0.12  | 0.32    | 0.01   | (0.01) | 0.09             | 0.29  | 0.09  | 0.29    | 0.01   | (0.01) |
| - > 1 hour                                 | 0.33             | 0.47  | 0.34  | 0.47    | 0      | (0.02) | 0.24             | 0.43  | 0.25  | 0.43    | -0.02  | (0.02) |
| Number of parcels                          | 4,071            |       | 2,023 |         | 6,094  |        | 5,159            |       | 2,577 |         | 7,736  |        |

Note: The table compares household and parcel characteristics across treated and control villages. Standard errors (s.e.) are reported in parentheses and are clustered at the village 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 are reported as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

<sup>†</sup> Indicates dummy variables.

## 5 Econometric Approach and Impact Estimates

This Section presents estimates of the PFR's impact in the short-run (approximately one year after demarcation) and medium-run (four years later). We first estimate the impact of the PFR on measures of tenure security, cultivation and investment decisions, agricultural production, and labor market participation using 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  $k$ ,  $\mathbf{d}_{jk}$  is a variable equal to 1 if village  $j$  of lottery  $k$  is selected for a PFR and 0 otherwise.  $\mathbf{x}_{ijk}$  is a vector of exogenous controls (at the household and parcel levels),  $\gamma_k$  are lottery fixed-effects and  $\varepsilon_{ijk}$  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).

### 5.1 Average Impact of the PFR

The four panels of [Table 8](#) and [Table 9](#) report regression results using [Equation 1](#) for the following categories of outcomes: tenure security (Panel A); cultivation and investment decisions (Panel B); agricultural production (Panel C) and labor market participation (Panel D) in 2011 and 2015. For each outcome, we report the mean of the control group, as well as the standard deviations of non-binary outcomes, to assign a relative magnitude to our point estimates. These results allow us to test how the selection into a PFR affects household decisions through the land demarcation activities ([Table 8](#)) complemented later on with the delivery of land certificates ([Table 9](#)).

We first estimate the effect of the PFR process on key measures of land tenure security: presence of clear borders, existence of a formal documentary evidence of land rights (a land certificate

is a particular case of such document) and occurrence of land conflict<sup>17</sup> during the previous twelve months in 2011 and 2015 (Table 8 and Table 9, Panel A). In 2011, we observe that the program increased the likelihood of having borders by 27 p.p. relative to control parcels, representing around five-fold increase relative to control mean (6%). Though smaller, relative to 2011, the effect remains visible 4 years later. In 2015, parcels held by residents of treated villages were 23 percentage points (p.p.) more likely to be demarcated, compared to control mean of 7%. At the same time, in 2015, tenure security was also 3 p.p. more likely to be enforced through a documentary evidence of land rights; a 23% increase compared to the control mean of 13%. This effect is mostly driven by the issuance of land certificates which increased by 6 p.p. compared to a control mean of 0.4%. However, the implantation of cornerstones and the delivery of land certificates were not accompanied by a reduction of land conflicts.

Next, we assess the impact of the PFR on cultivation and investment decisions over the parcel (Table 8 and Table 9, Panel B). In 2011, we find no evidence that that the land demarcation activities in 2001, prompted a change in the decision to cultivate land or leave it fallow. However, we find evidence of a shift toward long-term crop investment. Treated parcels are 2.4 p.p. more likely than control parcels to be used primarily for perennial crops, and they are 1.7 p.p. more likely to have a newly-planted tree—an effect that is nearly half the size of the control mean (4%). The observed increase in tree investment is similar in magnitude to other tree-planting effects found in the literature (e.g., [Bandiera, 2007](#)). In 2015, we uncover evidence that the proportion of parcels left fallow decreased by .5 p.p. compared to a control mean of 1.4%. We find no evidence that investment in tree planting has reacted in response to the delivery of land certificates in the PFR villages. However, the proportion of parcels used primarily for perennial crops, increased by 3.2 p.p. — about half the size of the control mean (7.5%).

Third, we estimate the effect of the PFR process on agricultural production (Table 8 and Table 9, Panel C). Despite the observed increase in long-run investment observed in 2011 agricultural, we find no evidence that output and farm yields (measured as the log of the value harvested per hectare) have uniformly increased neither in 2011, nor in 2015. However, in 2015, there is evidence, statistically significant at 10%, that households in the PFR villages use non-household member farm labor more intensively on their plots. We also note a null result on parcel size.

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<sup>17</sup>Conflict is self-reported. The variable used in the analysis was constructed based on a series of Yes/No questions: "Have you encountered the following problems on your land? Dispute over boundaries; Argument between farmers and livestock breeders; Inheritance dispute; Fraudulent sale; Non-consensual breach of contract; Other types of dispute.

Turning our attention to participation to labor market (Table 8 and Table 9 , Panel C), we find mixed results. In 2015, we find no evidence that selection into PFR has affected household members decision to work as paid worker or as self-employed in off-farm income generating activities. In 2011, following the land demarcation activities, there is evidence that household members in the PFR villages were less likely to work as paid worker (for off-farm and on-farm activities) and more

## 5.2 Effect of delivery of land certificates

To test for the impact of documentary evidence of land rights we consider the following framework:

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

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

where  $\mathbf{doc}_{ijk}$  takes a value of 1 if parcel  $i$  in village  $j$  has a documentary evidence of the landholder rights 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  $\delta$  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  $\delta$ , on our outcomes of interest (tenure security; cultivation and investment decisions; and agricul-

tural production) in 2011 and 2015 (Table 10a, Table 10b).<sup>18</sup>

Overall, the 2-SLS estimates of Table 10a, Table 10b do not confirm any of the correlation between documentary evidence of land rights and increased likelihood to plant tree and perennial crops, increased land size and agricultural output and increased participation to off-farm income generating activities found in Table 11a, Table 11b.

### 5.3 Gender

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

the

$$y_{ijk} = \alpha + \beta \cdot d_{jk} + \psi \cdot \text{gender}_{ijk} + \lambda \cdot d_{jk} \cdot \text{gender}_{ijk} + \phi \cdot x_{ijk} + \gamma_k + \varepsilon_{ijk} \quad (4)$$

where  $\text{gender}_{ijk}$  takes a value of 1 if parcel  $i$  is operated by a female-headed household. We report the coefficients  $\beta$ ,  $\psi$  and  $\lambda$  on our outcomes of interest (tenure security; cultivation and investment decisions; and agricultural production) in 2011 and 2015 (Table 12a, Table 12b and Table 13a, Table 13b). Relative to the existing gender gap (i.e., the gender gap observed within control villages), a significant coefficient for  $\lambda_t$  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.

First, we note that the PFR caused a 21 p.p. increase of the proportion of parcels with clear borders and we observe no statistically significant difference between parcels managed by female and male headed households (col. 1 Table 13a).<sup>19</sup> Likewise, the proportion of parcels with a land certificate increased by 6 p.p. (col. 2, Table 13a). This effect was not observable in 2011 as the issuance of land certificates had just started (col. 2, Table 12a). However, we observe no impact of the PFR on land conflicts neither in 2011, nor in 2015 across parcels of female and male-headed households (col. 3, Table 12a and Table 13a).

<sup>18</sup>These estimates can be compared to the OLS estimates of the effect of the documentary evidence of land rights reported in Table 11a, Table 11b.

<sup>19</sup>Initially, in 2011, selection into PFR caused a 28 p.p. increase in the proportion of parcels with clear borders among male-headed households (col. 1, Table 12a). In contrast, the effect on parcels managed by female-headed households was 8.5 p.p. lower (difference significant at the 10% level). However, this difference was smaller and not statistically significant in 2015 as the land demarcation activities were completed in all the treated villages.

Second, we investigate gender differences in the impact of land demarcation on cultivation and investment decisions (cols. 4-6, [Table 12a](#) and [Table 13a](#)). Our estimates suggest that assignment to the PFR increases the likelihood of fallowing land exclusively among women-headed households in 2011. This was a large effect. As fallowing increased by 1.5 p.p. for female-headed households in PFR villages, relative to 1% of households that practice fallowing in the control group (significant at the 5% level). In 2015, following the completion of the land demarcation activities and the issuance of the land certificates, the effect of the PFR on fallowing decision was different. Parcels of male-headed households were 0.6 p.p. ((p-value < 0.1) less likely to be left fallow in the treated villages. In comparison, parcels managed by female-headed were no more likely to be left fallow compared to practices observed in control villages.

Regarding other aspects of investments, we find that the significant effects of the program on both perennial crops and tree investments documented in [Table 8](#) hold equally for male- and female-headed households (p-value < 0.1 and p-value < 0.05, respectively). In 2015, only the positive effects of the PFR on planting of perennial crops holds equally true for female- and male-headed households. The positive effect of the PFR on tree planting (2 p.p. increase) is only observed for parcels managed by female headed households.

Third, we test for gender differences in the effects of the PFR process on agricultural production ([Table 12b](#) and [Table 13b](#)). We observe no significant difference in impact (nor any overall impact) on self-reported land size, cultivation use, farm labor intensity, or fertilizer/improved seed use. Yet, selection into the PFR increased the gender gap in agricultural yields. In 2011 and 2015, parcels held by female-headed households have yields that are 20% lower (significant at the 5% level) than yields found on parcels held by male-headed households in treated villages. Adding up the treatment effect with its gender interaction produces negative point estimates on both total revenue and yield.

In [Table 12c](#) and [Table 13c](#), we test for gender differences in the effects of the PFR process on participation to off-farm activities either as wage-earner or self-employed. In 2011, we observe that we observe no significant difference in impact (nor any overall impact) on self-reported land size, cultivation use, farm labor intensity, or fertilizer/improved seed use. Yet, selection into the PFR increased the gender gap in agricultural yields. In 2011 and 2015, parcels held by female-headed households have yields that are 20% lower (significant at the 5% level) than yields found on parcels held by male-headed households in treated villages. Adding up the

treatment effect with its gender interaction produces negative point estimates on both total revenue and yield. Furthermore, the results from [Table 12b](#) and [Table 13b](#) show that the widening of the gender gap in yields was not accompanied by gender differences in impact on farm labor input intensity or on the use of fertilizer and high yield seeds.

## Conclusion

The *Plans Fonciers Ruraux* (PFR) in Benin is an innovative policy experiment that aims to improve tenure security and stimulate agricultural investment through the formalization of customary land rights in rural areas. It was successfully scaled up to 40 communes nationwide starting in 2008/2009, with financial and technical support from the MCC. Administrative data suggests that land demarcation activities and the creation of village landholding plans (PFRs) were completed in 97 percent (292 out of 300) of the initially selected PFR villages. However, four years after the end of MCC's direct support in 2011, progress with respect to the delivery of land use certificates (CFRs) to landholders has been slow. As of March 2015, only 19 percent of demarcated land parcels were accompanied by land use certificates. The land certification step of the PFR is centralized at the town hall (*mairie*) and depends on a range of factors, including the capacity of local- and commune-level land management units to process landholders' requests and issue certificates, as well as the ability of the landholder to travel and pay fees to request and receive certificates.

The progress made in PFR implementation is reflected in the World Bank impact evaluation survey data. In 2011, households in treatment villages were significantly more likely to report having parcels with clear borders. The positive effect persisted in 2015, when treated households were also relatively more likely to report having documentary evidence of land rights as a result of the PFR. Improved land security following land demarcation in 2011 led to an increase in long-term agricultural investment in tree planting and perennial crops. Female-headed households further responded to demarcation by closing the gender gap in fallowing, a key soil fertility investment. Four years later, treated households continued to report significantly higher rates of perennial crop cultivation. In 2015, we also find evidence that households in PFR villages increase their demand for hired labor to support their agricultural production.

Despite the observed increases in investment, no average effects on output or farm yields were observed in either 2011 or 2015. Selection into the PFR does nevertheless widen the gender gap

in agricultural yields: in 2011 and 2015, parcels held by female-headed households have yields that are 19 to 20 percent lower than yields found on parcels held by male-headed households in treated villages. On the other hand, there is no significant gender difference in impact on self-reported land size, cultivation use, farm labor input intensity, or fertilizer/improved seed use in either year. While the differential gender impact on farm yields was driven by female-controlled parcels held outside of the village boundaries, further work needs to be done to understand this result in 2015.

The effects on labor market outcomes are mixed. While in 2011, household members in PFR villages were less likely to work as a paid worker and more likely to be engaged in non-agricultural self-employment, these effects dissipate four years later. The 2011 results indicate that the PFR induced a short-run drop in off-farm wage work among female-headed households on both extensive and intensive margins. No impacts on labor market participation are detected among female- or male-headed households in 2015.



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**Table 8:** Average effects of the PFR on key outcomes in 2011

|   | Obs.  | Control |           | ITT      |        |
|---|-------|---------|-----------|----------|--------|
|   |       | Mean    | Std. dev. | Coeff.   | s.e.   |
| <b>Panel A: Tenure security</b>                                 |       |         |           |          |        |
| Parcel has clear borders <sup>†</sup>                           | 6,094 | 0.061   |           | 0.270*** | (0.02) |
| Parcel has a formal document <sup>†</sup>                       | 6,094 | 0.097   |           | 0.001    | (0.01) |
| - Parcel has a CFR <sup>†</sup>                                 | 6,094 | 0.000   |           | 0.000    | (0.00) |
| Parcel with land conflict <sup>†</sup>                          | 6,094 | 0.052   |           | -0.009   | (0.01) |
| <b>Panel B: Cultivation and investment</b>                      |       |         |           |          |        |
| Started following parcel <sup>a†</sup>                          | 6,094 | 0.010   |           | 0.004    | (0.00) |
| Investment in tree planting <sup>a†</sup>                       | 6,094 | 0.040   |           | 0.017**  | (0.01) |
| Perennial crops <sup>†</sup>                                    | 6,094 | 0.103   |           | 0.024**  | (0.01) |
| <b>Panel C: Agricultural production<sup>b</sup></b>             |       |         |           |          |        |
| Parcel size (ha)  | 6,094 | 2.908   | 8.903     | 0.047    | (0.29) |
| Inputs  |       |         |           |          |        |
| - HH members labor supply (person-days/ha)                      | 3,994 | 108.170 | 168.578   | 4.532    | (6.94) |
| - non-HH members labor supply (person-days/ha)                  | 3,994 | 94.684  | 182.618   | -2.814   | (6.98) |
| - fertilizer/high-yield seeds <sup>†</sup>                      | 3,994 | 0.272   |           | 0.018    | (0.02) |
| Output  |       |         |           |          |        |
| - total value of output (Log USD)                               | 3,677 | 6.135   | 1.358     | -0.044   | (0.06) |
| - yield (Log USD/ha)  | 3,677 | 6.379   | 1.064     | 0.022    | (0.05) |
| <b>Panel D: Labour market participation<sup>c</sup></b>         |       |         |           |          |        |
| Off-farm paid work  |       |         |           |          |        |
| - at least one HH member  | 2,972 | 0.094   |           | -0.020*  | (0.01) |
| - # of HH members   | 2,972 | 0.102   | 0.332     | -0.023*  | (0.01) |
| Farm paid work  |       |         |           |          |        |
| - at least one HH member  | 2,972 | 0.073   |           | -0.018*  | (0.01) |
| - # of HH members   | 2,972 | 0.100   | 0.400     | -0.023   | (0.02) |
| Non-ag self employed  |       |         |           |          |        |
| - at least one HH member  | 2,972 | 0.615   |           | 0.022    | (0.02) |
| - # of HH members   | 2,972 | 0.970   | 0.969     | 0.071*   | (0.04) |
| <b>Panel E: Women position within the household<sup>d</sup></b> |       |         |           |          |        |
| Involved in HH's land decisions                                 | 2,757 | 0.381   |           | 0.029    | (0.02) |
| Woman has private ownership of assets <sup>†</sup>              | 2,757 | 0.717   |           | -0.028   | (0.02) |
| Woman receives some ag. revenue <sup>†</sup>                    | 2,972 | 0.233   |           | 0.000    | (0.02) |
| Woman had no physical violence with spouse <sup>†</sup>         | 2,972 | 0.388   |           | 0.011    | (0.02) |

**Note:** The table shows estimates of village-wide land demarcation activities on several variables. Each row corresponds to an estimation where the dependent variable (reported in the first column) is regressed on a dummy variable equal to 1 when the household lives in a village randomly selected for a land demarcation activities (see Equation 1). The column "Obs." reports the number of households and the column "Control mean" shows the average level of the dependent variable in the control villages. Column "Coeff. ITT" shows the effect of being in a PFR village.

The standard errors are clustered at the village level and are reported in parentheses. Each estimation includes the lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

<sup>a</sup> The reference period is the previous twelve months.

<sup>b</sup> Yield and inputs are reported for the agricultural season that starts with the main rainy season.

<sup>c</sup> The reference period is the previous seven days.

<sup>d</sup> Information is recorded for the primary woman of the household and the reference period is the previous twelve months.

<sup>†</sup> Indicates dummy variables.

**Table 9:** Average effects of the PFR on key outcomes in 2015

|   | Obs.  | Control |           | ITT      |        |
|---|-------|---------|-----------|----------|--------|
|   |       | Mean    | Std. dev. | Coeff.   | s.e.   |
| <b>Panel A: Tenure security</b>                                 |       |         |           |          |        |
| Parcel has clear borders <sup>†</sup>                           | 7,736 | 0.069   |           | 0.214*** | (0.02) |
| Parcel has a formal document <sup>†</sup>                       | 7,736 | 0.130   |           | 0.030**  | (0.01) |
| - Parcel has a CFR <sup>†</sup>                                 | 7,736 | 0.004   |           | 0.059*** | (0.01) |
| Parcel with land conflict <sup>†</sup>                          | 7,736 | 0.013   |           | -0.001   | (0.00) |
| <b>Panel B: Cultivation and investment</b>                      |       |         |           |          |        |
| Started following parcel <sup>a†</sup>                          | 7,736 | 0.014   |           | -0.005*  | (0.00) |
| Investment in tree planting <sup>a†</sup>                       | 7,736 | 0.048   |           | -0.001   | (0.01) |
| Perennial crops <sup>†</sup>                                    | 7,736 | 0.075   |           | 0.032*** | (0.01) |
| <b>Panel C: Agricultural production<sup>b</sup></b>             |       |         |           |          |        |
| Parcel size (ha)  | 7,736 | 1.964   | 4.318     | 0.208    | (0.14) |
| Inputs  |       |         |           |          |        |
| - HH members labor supply (person-days/ha)                      | 4,495 | 90.376  | 146.496   | -1.994   | (7.14) |
| - non-HH members labor supply (person-days/ha)                  | 4,495 | 35.975  | 73.829    | 6.139*   | (3.53) |
| - fertilizer/high-yield seeds <sup>†</sup>                      | 4,495 | 0.363   |           | 0.010    | (0.02) |
| Output  |       |         |           |          |        |
| - total value of output (Log USD)                               | 4,367 | 6.264   | 1.463     | -0.066   | (0.05) |
| - yield (Log USD/ha)  | 4,367 | 6.419   | 1.054     | -0.058   | (0.04) |
| <b>Panel D: Labour market participation<sup>c</sup></b>         |       |         |           |          |        |
| Off-farm paid work  |       |         |           |          |        |
| - at least one HH member  | 3,132 | 0.080   |           | -0.006   | (0.01) |
| - # of HH members   | 3,132 | 0.092   | 0.342     | -0.007   | (0.01) |
| Farm paid work  |       |         |           |          |        |
| - at least one HH member  | 3,132 | 0.090   |           | -0.011   | (0.01) |
| - # of HH members   | 3,132 | 0.127   | 0.463     | -0.024   | (0.02) |
| Non-ag self employed  |       |         |           |          |        |
| - at least one HH member  | 3,132 | 0.681   |           | 0.002    | (0.02) |
| - # of HH members   | 3,132 | 1.075   | 0.961     | -0.006   | (0.03) |
| <b>Panel E: Women position within the household<sup>d</sup></b> |       |         |           |          |        |
| Involved in HH's land decisions                                 | 2,951 | 0.505   |           | -0.003   | (0.02) |
| Woman has private ownership of assets <sup>†</sup>              | 2,951 | 0.578   |           | 0.006    | (0.02) |
| Woman receives some ag. revenue <sup>†</sup>                    | 3,132 | 0.341   |           | -0.011   | (0.02) |
| Woman had no physical violence with spouse <sup>†</sup>         | 3,132 | 0.306   |           | -0.005   | (0.01) |

**Note:** The table shows estimates of village-wide land demarcation activities on several variables. Each row corresponds to an estimation where the dependent variable (reported in the first column) is regressed on a dummy variable equal to 1 when the household lives in a village randomly selected for a land demarcation activities (see Equation 1). The column "Obs." reports the number of households and the column "Control mean" shows the average level of the dependent variable in the control villages. Column "Coeff. ITT" shows the effect of being in a PFR village.

The standard errors are clustered at the village level and are reported in parentheses. Each estimation includes the lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

<sup>a</sup> The reference period is the previous twelve months.

<sup>b</sup> Yield and inputs are reported for the agricultural season that starts with the main rainy season.

<sup>c</sup> The reference period is the previous seven days.

<sup>d</sup> Information is recorded for the primary woman of the household and the reference period is the previous twelve months.

<sup>†</sup> Indicates dummy variables.

**Table 10a:** Effects of documentary evidence of land rights on key outcomes in 2011

|   | Obs.  | Control |           | LATE    |          |
|---|-------|---------|-----------|---------|----------|
|   |       | Mean    | Std. dev. | Coeff.  | s.e.     |
| <b>Panel A: Tenure security</b>                         |       |         |           |         |          |
| Parcel with land conflict <sup>†</sup>                  | 6,094 | 0.047   |           | -0.073  | (0.09)   |
| <b>Panel B: Cultivation and investment</b>              |       |         |           |         |          |
| Started fallowing parcel <sup>a†</sup>                  | 6,094 | 0.013   |           | -0.068  | (0.03)   |
| Investment in tree planting <sup>a†</sup>               | 6,094 | 0.043   |           | 0.023   | (0.05)   |
| Perennial crops <sup>†</sup>                            | 6,094 | 0.111   |           | 0.292   | (0.11)   |
| <b>Panel C: Agricultural production<sup>b</sup></b>     |       |         |           |         |          |
| Parcel size (ha)  | 6,094 | 3.252   | 11.638    | -2.832  | (1.12)   |
| Inputs  |       |         |           |         |          |
| - HH members labor supply (person-days/ha)              | 3,994 | 117.465 | 188.939   | 21.766  | (70.24)  |
| - non-HH members labor supply (person-days/ha)          | 3,994 | 90.975  | 180.614   | 237.532 | (101.21) |
| - fertilizer/high-yield seeds <sup>†</sup>              | 3,994 | 0.293   |           | 0.306   | (0.18)   |
| Output  |       |         |           |         |          |
| - total value of output (Log USD)                       | 3,677 | 6.154   | 1.374     | -0.687  | (0.19)   |
| - yield (Log USD/ha)                                    | 3,677 | 6.388   | 1.070     | 0.023   | (0.43)   |
| F-test – parcel level                                   |       |         |           | 30.385  |          |
| - p-value   |       |         |           | 0.000   |          |
| <b>Panel D: Labour market participation<sup>c</sup></b> |       |         |           |         |          |
| Off-farm paid work                                      |       |         |           |         |          |
| - at least one HH member                                | 2,972 | 0.082   |           | 0.242   | (0.10)   |
| - # of HH members                                       | 2,972 | 0.088   | 0.308     | 0.290   | (0.11)   |
| Farm paid work  |       |         |           |         |          |
| - at least one HH member                                | 2,972 | 0.061   |           | 0.163   | (0.07)   |
| - # of HH members                                       | 2,972 | 0.087   | 0.399     | 0.212   | (0.11)   |
| Non-ag self employed                                    |       |         |           |         |          |
| - at least one HH member                                | 2,972 | 0.618   |           | 0.135   | (0.14)   |
| - # of HH members                                       | 2,972 | 0.961   | 0.967     | 0.336   | (0.27)   |
| F-test – HH level                                       |       |         |           | 146.580 |          |
| - p-value   |       |         |           | 0.000   |          |

**Note:** The table shows estimates of presence of documentary evidence of land rights on several variables. Each row corresponds to an estimation where the dependent variable (reported in the first column) is regressed on a dummy variable equal to 1 when the parcel has a documentary evidence of land rights and 0 otherwise. To account for the possible endogeneity of that variable, we use as instrument the random selection of the village where the household lives for a land demarcation activities. The column "Obs." reports the number of households and the column "Control mean" shows the average level of the dependent variable in the control villages. Column "Coeff. LATE" shows the effect of documentary evidence of land rights.

The standard errors are clustered at the village level and are reported in parentheses. Each estimation includes the lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

<sup>a</sup> The reference period is the previous twelve months.

<sup>b</sup> Yield and inputs are reported for the agricultural season that starts with the main rainy season.

<sup>c</sup> The reference period is the previous seven days.

<sup>†</sup> Indicates dummy variables.

**Table 10b:** Effects of documentary evidence of land rights on key outcomes in 2015

|   | Obs.  | Control |           | LATE   |         |
|---|-------|---------|-----------|--------|---------|
|   |       | Mean    | Std. dev. | Coeff. | s.e.    |
| <b>Panel A: Tenure security</b>                         |       |         |           |        |         |
| Parcel with land conflict <sup>†</sup>                  | 6,817 | 0.013   |           | -0.016 | (0.02)  |
| <b>Panel B: Cultivation and investment</b>              |       |         |           |        |         |
| Started fallowing parcel <sup>a†</sup>                  | 6,817 | 0.012   |           | -0.002 | (0.01)  |
| Investment in tree planting <sup>a†</sup>               | 6,817 | 0.049   |           | 0.008  | (0.03)  |
| Perennial crops <sup>†</sup>                            | 6,817 | 0.084   |           | 0.265  | (0.08)  |
| <b>Panel C: Agricultural production<sup>b</sup></b>     |       |         |           |        |         |
| Parcel size (ha)  | 6,817 | 2.234   | 5.196     | -0.180 | (0.56)  |
| Inputs  |       |         |           |        |         |
| - HH members labor supply (person-days/ha)              | 4,041 | 87.836  | 139.504   | 1.271  | (48.86) |
| - non-HH members labor supply (person-days/ha)          | 4,041 | 37.406  | 77.258    | 8.052  | (35.95) |
| - fertilizer/high-yield seeds <sup>†</sup>              | 4,041 | 0.384   |           | 0.138  | (0.13)  |
| Output  |       |         |           |        |         |
| - total value of output (Log USD)                       | 3,936 | 6.208   | 1.522     | -0.437 | (0.24)  |
| - yield (Log USD/ha)                                    | 3,936 | 6.347   | 1.054     | 0.153  | (0.50)  |
| F-test – parcel level                                   |       |         |           | 48.831 |         |
| - p-value   |       |         |           | 0.000  |         |
| <b>Panel D: Labour market participation<sup>c</sup></b> |       |         |           |        |         |
| Off-farm paid work                                      |       |         |           |        |         |
| - at least one HH member                                | 2,716 | 0.074   |           | 0.012  | (0.06)  |
| - # of HH members                                       | 2,716 | 0.086   | 0.328     | -0.002 | (0.07)  |
| Farm paid work  |       |         |           |        |         |
| - at least one HH member                                | 2,716 | 0.084   |           | -0.029 | (0.06)  |
| - # of HH members                                       | 2,716 | 0.117   | 0.439     | -0.075 | (0.10)  |
| Non-ag self employed                                    |       |         |           |        |         |
| - at least one HH member                                | 2,716 | 0.652   |           | -0.058 | (0.10)  |
| - # of HH members                                       | 2,716 | 0.992   | 0.945     | 0.197  | (0.19)  |
| F-test – HH level                                       |       |         |           | 54.724 |         |
| - p-value   |       |         |           | 0.000  |         |

**Note:** The table shows estimates of presence of documentary evidence of land rights on several variables. Each row corresponds to an estimation where the dependent variable (reported in the first column) is regressed on a dummy variable equal to 1 when the parcel has a documentary evidence of land rights and 0 otherwise. To account for the possible endogeneity of that variable, we use as instrument the random selection of the village where the household lives for a land demarcation activities. The column “Obs.” reports the number of households and the column “Control mean” shows the average level of the dependent variable in the control villages. Column “Coeff. LATE” shows the effect of documentary evidence of land rights.

The standard errors are clustered at the village level and are reported in parentheses. Each estimation includes the lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

<sup>a</sup> The reference period is the previous twelve months.

<sup>b</sup> Yield and inputs are reported for the agricultural season that starts with the main rainy season.

<sup>c</sup> The reference period is the previous seven days.

<sup>†</sup> Indicates dummy variables.

**Table 11a:** OLS estimate of the correlation between documentary evidence of land rights and key outcomes in 2011

|   | Obs.  | Control |           | OLS       |         |
|---|-------|---------|-----------|-----------|---------|
|   |       | Mean    | Std. dev. | Coeff.    | s.e.    |
| <b>Panel A: Tenure security</b>                         |       |         |           |           |         |
| Parcel with land conflict <sup>†</sup>                  | 6,094 | 0.047   |           | -0.001    | (0.02)  |
| <b>Panel B: Cultivation and investment</b>              |       |         |           |           |         |
| Started fallowing parcel <sup>a†</sup>                  | 6,094 | 0.013   |           | -0.007    | (0.01)  |
| Investment in tree planting <sup>a†</sup>               | 6,094 | 0.043   |           | 0.017*    | (0.01)  |
| Perennial crops <sup>†</sup>                            | 6,094 | 0.111   |           | 0.046**   | (0.02)  |
| <b>Panel C: Agricultural production<sup>b</sup></b>     |       |         |           |           |         |
| Parcel size (ha)  | 6,094 | 3.252   | 11.638    | -0.061    | (0.29)  |
| Inputs  |       |         |           |           |         |
| - HH members labor supply (person-days/ha)              | 3,994 | 117.465 | 188.939   | -23.477** | (10.00) |
| - non-HH members labor supply (person-days/ha)          | 3,994 | 90.975  | 180.614   | 5.595     | (12.10) |
| - fertilizer/high-yield seeds <sup>†</sup>              | 3,994 | 0.293   |           | -0.020    | (0.04)  |
| Output  |       |         |           |           |         |
| - total value of output (Log USD)                       | 3,677 | 6.154   | 1.374     | 0.142     | (0.09)  |
| - yield (Log USD/ha)                                    | 3,677 | 6.388   | 1.070     | 0.033     | (0.08)  |
| <b>Panel D: Labour market participation<sup>c</sup></b> |       |         |           |           |         |
| Off-farm paid work                                      |       |         |           |           |         |
| - at least one HH member                                | 2,972 | 0.082   |           | 0.004     | (0.02)  |
| - # of HH members                                       | 2,972 | 0.088   | 0.308     | 0.016     | (0.03)  |
| Farm paid work  |       |         |           |           |         |
| - at least one HH member                                | 2,972 | 0.061   |           | 0.005     | (0.02)  |
| - # of HH members                                       | 2,972 | 0.087   | 0.399     | 0.007     | (0.03)  |
| Non-ag self employed                                    |       |         |           |           |         |
| - at least one HH member                                | 2,972 | 0.618   |           | 0.043*    | (0.02)  |
| - # of HH members                                       | 2,972 | 0.961   | 0.967     | 0.130**   | (0.05)  |

**Note:** The table shows OLS estimates of effects of the presence of documentary evidence of land rights on several variables. Each row corresponds to an estimation where the dependent variable (reported in the first column) is regressed on a dummy variable equal to 1 when the parcel has a documentary evidence of land rights and 0 otherwise. The column "Obs." reports the number of households and the column "Control mean" shows the average level of the dependent variable in the control villages. Column "Coeff. OLS" shows the raw partial correlation between documentary evidence of land rights and the outcome of interest.

The standard errors are clustered at the village level and are reported in parentheses. Each estimation includes the lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

<sup>a</sup> The reference period is the previous twelve months.

<sup>b</sup> Yield and inputs are reported for the agricultural season that starts with the main rainy season.

<sup>c</sup> The reference period is the previous seven days.

<sup>†</sup> Indicates dummy variables.

**Table 11b:** OLS estimate of the correlation between documentary evidence of land rights and key outcomes in 2015

|   | Obs.  | Control |           | OLS       |        |
|---|-------|---------|-----------|-----------|--------|
|   |       | Mean    | Std. dev. | Coeff.    | s.e.   |
| <b>Panel A: Tenure security</b>                         |       |         |           |           |        |
| Parcel with land conflict <sup>†</sup>                  | 6,817 | 0.013   |           | -0.005    | (0.00) |
| <b>Panel B: Cultivation and investment</b>              |       |         |           |           |        |
| Started fallowing parcel <sup>a†</sup>                  | 6,817 | 0.012   |           | 0.001     | (0.00) |
| Investment in tree planting <sup>a†</sup>               | 6,817 | 0.049   |           | -0.002    | (0.01) |
| Perennial crops <sup>†</sup>                            | 6,817 | 0.084   |           | 0.086***  | (0.02) |
| <b>Panel C: Agricultural production<sup>b</sup></b>     |       |         |           |           |        |
| Parcel size (ha)  | 6,817 | 2.234   | 5.196     | 0.246     | (0.16) |
| Inputs  |       |         |           |           |        |
| - HH members labor supply (person-days/ha)              | 4,041 | 87.836  | 139.504   | -6.288    | (6.72) |
| - non-HH members labor supply (person-days/ha)          | 4,041 | 37.406  | 77.258    | 6.738     | (4.62) |
| - fertilizer/high-yield seeds <sup>†</sup>              | 4,041 | 0.384   |           | 0.031     | (0.02) |
| Output  |       |         |           |           |        |
| - total value of output (Log USD)                       | 3,936 | 6.208   | 1.522     | 0.193***  | (0.07) |
| - yield (Log USD/ha)                                    | 3,936 | 6.347   | 1.054     | 0.098     | (0.06) |
| <b>Panel D: Labour market participation<sup>c</sup></b> |       |         |           |           |        |
| Off-farm paid work                                      |       |         |           |           |        |
| - at least one HH member                                | 2,716 | 0.074   |           | -0.006    | (0.01) |
| - # of HH members                                       | 2,716 | 0.086   | 0.328     | -0.018    | (0.01) |
| Farm paid work  |       |         |           |           |        |
| - at least one HH member                                | 2,716 | 0.084   |           | -0.033*** | (0.01) |
| - # of HH members                                       | 2,716 | 0.117   | 0.439     | -0.055*** | (0.02) |
| Non-ag self employed                                    |       |         |           |           |        |
| - at least one HH member                                | 2,716 | 0.652   |           | 0.034     | (0.02) |
| - # of HH members                                       | 2,716 | 0.992   | 0.945     | 0.093**   | (0.04) |

**Note:** The table shows OLS estimates of effects of the presence of documentary evidence of land rights on several variables. Each row corresponds to an estimation where the dependent variable (reported in the first column) is regressed on a dummy variable equal to 1 when the parcel has a documentary evidence of land rights and 0 otherwise. The column "Obs." reports the number of households and the column "Control mean" shows the average level of the dependent variable in the control villages. Column "Coeff. OLS" shows the raw partial correlation between documentary evidence of land rights and the outcome of interest.

The standard errors are clustered at the village level and are reported in parentheses. Each estimation includes the lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

<sup>a</sup> The reference period is the previous twelve months.

<sup>b</sup> Yield and inputs are reported for the agricultural season that starts with the main rainy season.

<sup>c</sup> The reference period is the previous seven days.

<sup>†</sup> Indicates dummy variables.



**Table 12a:** Gender differentiated effects of land demarcation activities on tenure security and investment in 2011

|   | Border               | Land certificate   | Land conflict      | Fallow              | Tree planting        | Perennial crops     |
|---|----------------------|--------------------|--------------------|---------------------|----------------------|---------------------|
| Female-headed HH ( $\psi$ )             | 0.0441*<br>(0.024)   | -0.0001<br>(0.001) | 0.0018<br>(0.017)  | -0.0077<br>(0.005)  | -0.0332**<br>(0.014) | -0.0376*<br>(0.020) |
| Treated village ( $\beta$ )             | 0.2822***<br>(0.023) | 0.0004<br>(0.001)  | -0.0103<br>(0.015) | 0.0025<br>(0.003)   | 0.0159**<br>(0.008)  | 0.0215*<br>(0.011)  |
| $\times$ Female-headed HH ( $\lambda$ ) | -0.0845**<br>(0.037) | 0.0002<br>(0.001)  | 0.0055<br>(0.019)  | 0.0125*<br>(0.007)  | 0.0078<br>(0.016)    | 0.0196<br>(0.023)   |
| Number of parcels                       | 6,094                | 6,094              | 6,094              | 6,094               | 6,094                | 6,094               |
| $\beta + \lambda$                       | 0.1977***<br>(0.039) | 0.0006<br>(0.000)  | -0.0047<br>(0.019) | 0.0150**<br>(0.006) | 0.0237*<br>(0.014)   | 0.0411*<br>(0.023)  |

Note: Robust standard errors are reported in parentheses. They are clustered at the village level and all regressions include household and landholding control variables, enumerator fixed effects, and lottery pool fixed effects. Significance levels are denoted as follows: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

**Table 12b:** Gender differentiated effects of land demarcation activities on agricultural activities in 2011

|   | Parcel size (ha)      | Labor supply        |                      | Fertilizer         | Output                |                      |
|---|-----------------------|---------------------|----------------------|--------------------|-----------------------|----------------------|
|   |                       | HH                  | non HH               |                    | total                 | per ha               |
| Female-headed HH ( $\psi$ )             | -0.9130***<br>(0.328) | 3.7754<br>(13.043)  | 7.1600<br>(14.232)   | -0.0277<br>(0.041) | -0.3858***<br>(0.076) | -0.0204<br>(0.099)   |
| Treated village ( $\beta$ )             | 0.1575<br>(0.331)     | 3.2151<br>(7.634)   | -0.8450<br>(7.515)   | 0.0103<br>(0.021)  | -0.0321<br>(0.063)    | 0.0544<br>(0.055)    |
| $\times$ Female-headed HH ( $\lambda$ ) | -0.7671<br>(0.571)    | 11.9162<br>(19.529) | -12.6880<br>(17.384) | 0.0528<br>(0.049)  | -0.0922<br>(0.133)    | -0.2002**<br>(0.098) |
| Number of parcels                       | 6,094                 | 3,994               | 3,994                | 3,994              | 3,677                 | 3,677                |
| $\beta + \lambda$                       | -0.6096<br>(0.464)    | 15.1313<br>(17.914) | -13.5330<br>(15.795) | 0.0631<br>(0.049)  | -0.1189<br>(0.124)    | -0.1553<br>(0.102)   |

Note: Robust standard errors are reported in parentheses. They are clustered at the village level and all regressions include household and landholding control variables, enumerator fixed effects, and lottery pool fixed effects. Significance levels are denoted as follows: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

**Table 12c:** Gender differentiated effects of land demarcation activities on labor market participation in 2011

|                                  | Off-farm worker       |                       | Farm worker           |                       | Non-ag self employed |                    |
|----------------------------------|-----------------------|-----------------------|-----------------------|-----------------------|----------------------|--------------------|
|                                  | ≥ 1 worker            | # workers             | ≥ 1 worker            | # workers             | ≥ 1 worker           | # workers          |
| Female-headed HH ( $\psi$ )      | 0.0341<br>(0.029)     | 0.0375<br>(0.031)     | -0.0590***<br>(0.018) | -0.0754***<br>(0.027) | 0.0711*<br>(0.042)   | -0.1101<br>(0.070) |
| Treated village ( $\beta$ )      | -0.0078<br>(0.013)    | -0.0100<br>(0.015)    | -0.0227**<br>(0.011)  | -0.0293*<br>(0.017)   | 0.0259<br>(0.020)    | 0.0741*<br>(0.044) |
| × Female-headed HH ( $\lambda$ ) | -0.0732**<br>(0.032)  | -0.0791**<br>(0.035)  | 0.0295<br>(0.021)     | 0.0451<br>(0.034)     | -0.0417<br>(0.050)   | -0.0293<br>(0.085) |
| Number of households             | 2,972                 | 2,972                 | 2,972                 | 2,972                 | 2,972                | 2,972              |
| $\beta + \lambda$                | -0.0810***<br>(0.029) | -0.0891***<br>(0.031) | 0.0067<br>(0.019)     | 0.0159<br>(0.030)     | -0.0158<br>(0.045)   | 0.0448<br>(0.075)  |

Note: Robust standard errors are reported in parentheses. They are clustered at the village level and all regressions include household and landholding control variables, enumerator fixed effects, and lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

**Table 13a:** Gender differentiated effects of land demarcation activities on tenure security and investment in 2015

|                                  | Border               | Land certificate     | Land conflict      | Fallow              | Tree planting         | Perennial crops     |
|----------------------------------|----------------------|----------------------|--------------------|---------------------|-----------------------|---------------------|
| Female-headed HH ( $\psi$ )      | -0.0202<br>(0.022)   | 0.0149<br>(0.010)    | 0.0016<br>(0.007)  | -0.0089<br>(0.006)  | -0.0434***<br>(0.011) | -0.0113<br>(0.022)  |
| Treated village ( $\beta$ )      | 0.2208***<br>(0.019) | 0.0639***<br>(0.009) | -0.0021<br>(0.004) | -0.0058*<br>(0.004) | -0.0068<br>(0.007)    | 0.0293**<br>(0.012) |
| × Female-headed HH ( $\lambda$ ) | 0.0106<br>(0.034)    | -0.0046<br>(0.017)   | -0.0064<br>(0.007) | 0.0059<br>(0.006)   | 0.0318**<br>(0.013)   | 0.0096<br>(0.026)   |
| Number of parcels                | 6,817                | 6,817                | 6,817              | 6,817               | 6,817                 | 6,817               |
| $\beta + \lambda$                | 0.2314***<br>(0.035) | 0.0593***<br>(0.017) | -0.0085<br>(0.007) | 0.0001<br>(0.006)   | 0.0250**<br>(0.011)   | 0.0388<br>(0.025)   |

Note: Robust standard errors are reported in parentheses. They are clustered at the village level and all regressions include household and landholding control variables, enumerator fixed effects, and lottery pool fixed effects. Significance levels are denoted as follows: \* p<0.10, \*\* p<0.05, \*\*\* p<0.01.

**Table 13b:** Gender differentiated effects of land demarcation activities on agricultural activities in 2015

|   | Parcel size (ha)     | Labor supply       |                     | Fertilizer            | Output                |                      |
|---|----------------------|--------------------|---------------------|-----------------------|-----------------------|----------------------|
|   |                      | HH                 | non HH              |                       | total                 | per ha               |
| Female-headed HH ( $\psi$ )             | -0.4387**<br>(0.198) | 1.3158<br>(10.083) | 7.7686<br>(6.076)   | -0.1022***<br>(0.037) | -0.2717***<br>(0.082) | 0.0124<br>(0.084)    |
| Treated village ( $\beta$ )             | 0.2517<br>(0.174)    | -0.9963<br>(8.393) | 7.6977**<br>(3.646) | -0.0025<br>(0.025)    | -0.0599<br>(0.059)    | -0.0208<br>(0.051)   |
| $\times$ Female-headed HH ( $\lambda$ ) | -0.3921<br>(0.272)   | 2.4847<br>(11.581) | 3.7246<br>(8.316)   | 0.0651<br>(0.043)     | -0.1254<br>(0.116)    | -0.1734**<br>(0.081) |
| Number of parcels                       | 6,817                | 4,041              | 4,041               | 4,041                 | 3,936                 | 3,936                |
| $\beta + \lambda$                       | -0.1404<br>(0.253)   | 1.4885<br>(9.950)  | 11.4223<br>(7.779)  | 0.0626<br>(0.042)     | -0.1749*<br>(0.099)   | -0.1893**<br>(0.077) |

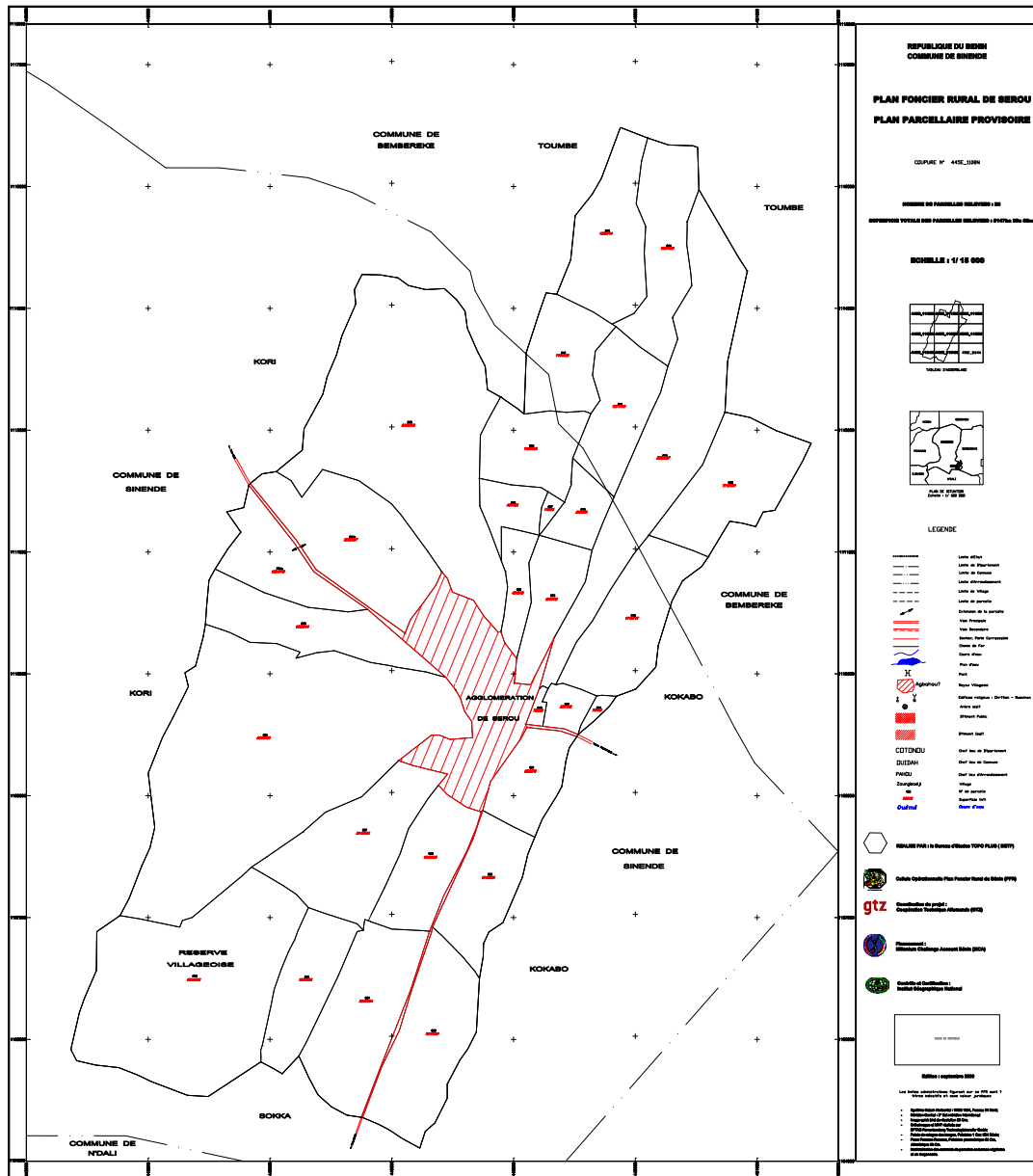
*Note:* Robust standard errors are reported in parentheses. They are clustered at the village level and all regressions include household and landholding control variables, enumerator fixed effects, and lottery pool fixed effects. Significance levels are denoted as follows: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

**Table 13c:** Gender differentiated effects of land demarcation activities on labor market participation in 2015

|   | Off-farm worker       |                       | Farm worker        |                     | Non-ag self employed |                    |
|---|-----------------------|-----------------------|--------------------|---------------------|----------------------|--------------------|
|   | $\geq 1$ worker       | # workers             | $\geq 1$ worker    | # workers           | $\geq 1$ worker      | # workers          |
| Female-headed HH ( $\psi$ )             | -0.0483***<br>(0.017) | -0.0599***<br>(0.019) | -0.0191<br>(0.023) | -0.0240<br>(0.034)  | 0.0732*<br>(0.044)   | -0.0361<br>(0.070) |
| Treated village ( $\beta$ )             | -0.0044<br>(0.012)    | -0.0089<br>(0.015)    | -0.0181<br>(0.013) | -0.0406*<br>(0.022) | 0.0112<br>(0.022)    | 0.0045<br>(0.040)  |
| $\times$ Female-headed HH ( $\lambda$ ) | 0.0150<br>(0.021)     | 0.0326<br>(0.026)     | 0.0162<br>(0.028)  | 0.0152<br>(0.041)   | -0.0292<br>(0.051)   | -0.0292<br>(0.083) |
| Number of households                    | 2,716                 | 2,716                 | 2,716              | 2,716               | 2,716                | 2,716              |
| $\beta + \lambda$                       | 0.0106<br>(0.019)     | 0.0236<br>(0.024)     | -0.0019<br>(0.029) | -0.0254<br>(0.040)  | -0.0179<br>(0.047)   | -0.0247<br>(0.071) |

*Note:* Robust standard errors are reported in parentheses. They are clustered at the village level and all regressions include household and landholding control variables, enumerator fixed effects, and lottery pool fixed effects. Significance levels are denoted as follows: \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Figure 2: Example of a village's PFR

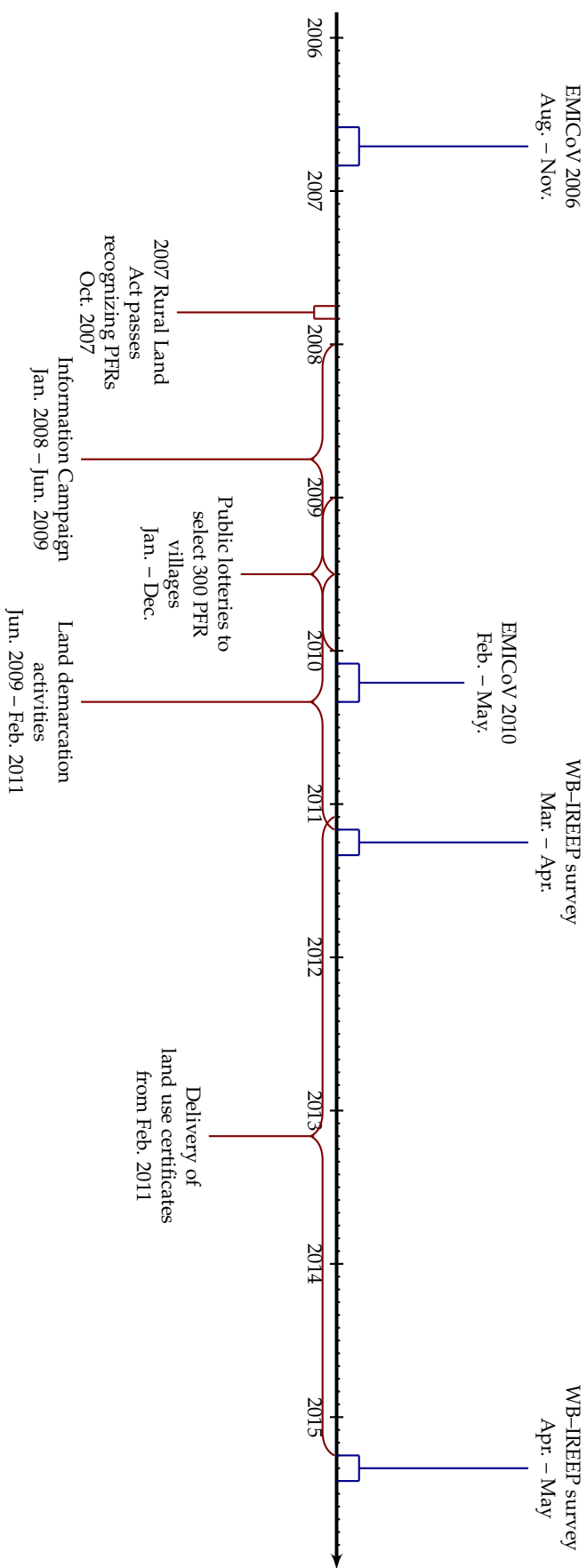


Source: Designed and drawn by the *Institut Géographique National*.

Figure 3: Example of a land use certificate (CFR)

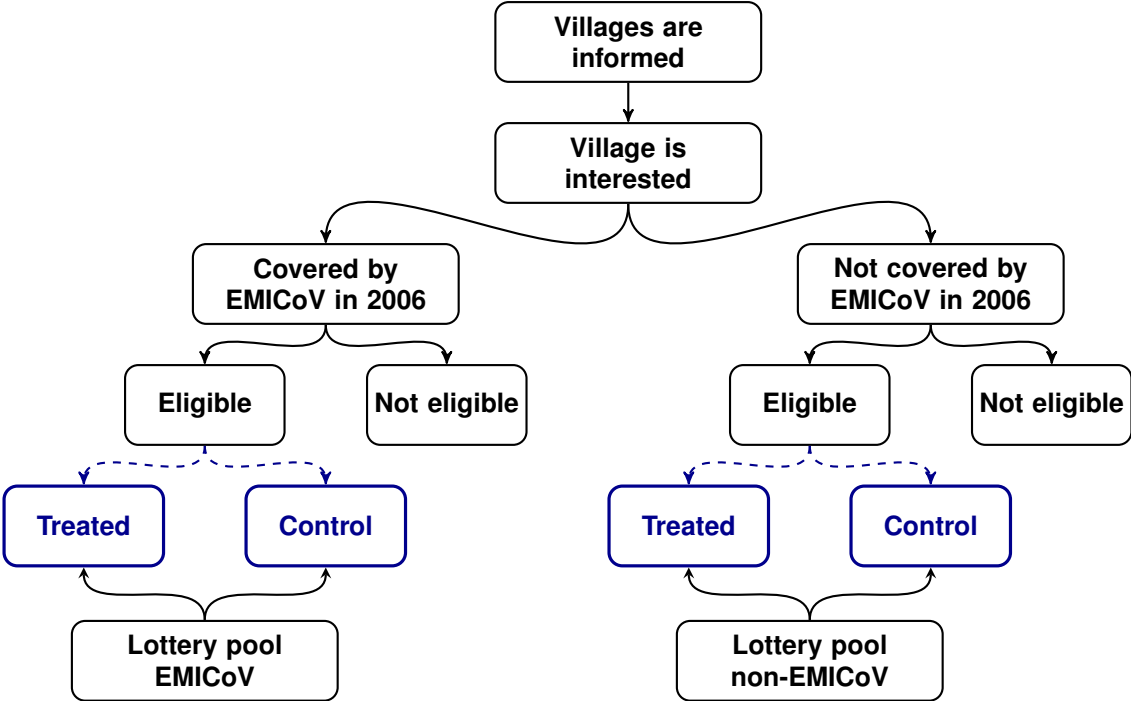


Figure 4: PFR Implementation and Data Collection Timeline.



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

Figure 5: Selection of treated villages within commune



Source: Information collected by authors.