Can customary land tenure facilitate agricultural productivity growth? Evidence from the West African Sahel

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Abstract

In the West African Sahel, land is managed through systems of customary tenure, which discourage land rentals and sales. Yet these systems permit the transaction of land through an institution called borrowing. This study examines the traditional rules surrounding land and investigates whether the borrowed status of land affects the seasonal and longer-term investments made on it. Results from a nationally-representative farm household panel dataset from Burkina Faso suggest that borrowed land is more intensely farmed in terms of cropping and inputs. We do not find evidence of fewer erosion-preventing investments, or of reduced fallows on borrowed plots.

1. Introduction

In recent years, governments of many Sub-Saharan African countries have focused their attention toward the delineation and fortification of land rights. They are motivated by the idea that clear and secure land rights may i) increase the incentive of land owners to make productive investments, ii) facilitate owner's access to credit, and iii) allow for the exchange of land (Place, 2009). All of these mechanisms should, in theory, increase investments in land, thereby increasing its productivity. However, in West Africa, the empirical link between land tenure and land investments--and productivity generally--has been found to be weak. Fenske (2011) puts forth multiple explanations which can be categorized as i) difficulties in both the measurement and identification of 'tenure security,' ii) the (in)effectiveness of titling programs, iii) thin credit markets, and iv) characteristics of local institutions surrounding land ownership and use.

In this paper, we examine local land institutions in three countries in the West African Sahel: Burkina Faso, Mali, and Niger. A distinct feature of many West African Sahelian farming systems is the coexistence of legislation and customary norms surrounding land ownership and use. Recent findings from qualitative studies suggest that customary norms continue to prevail despite legislative efforts to formalize land tenure (Hughes, 2014). We focus on characteristics shared across these customary systems and investigate their implications for land investments.

In particular, we are interested in a system of land exchange that resembles rental markets, but functions in a distinct way. The lands exchanged through these systems are oftentimes called loaned, lent, or borrowed lands. Land acquired through loaning / lending / borrowing (henceforth simply 'borrowing') has been common and widespread in many parts of Burkina Faso (e.g., Matlon (1994), de Zeeuw (1997), Gray and Kevane (2001) and Lentz (2013)), Mali (Skidmore et al., (2016)), and western Niger (Gavian and Fafchamps (1996); Sakuma, (2016)). Given how rare

formal tenure is in this region, acquisition mode is the rare objective metric of tenure status. Moreover, lands acquired through borrowing have been hypothesized as being associated with lower tenure security (e.g., Matlon (1994), Gray and Kevane (2001), Fenske (2011)).

The objective of this paper is to understand the role that customary systems may play in facilitating agricultural productivity in the West African Sahel. In the first half of this paper, we review the literature from Burkina Faso, Mali, and Niger in order to articulate a common set of rules surrounding customary tenure generally and borrowing specifically. Most of the empirical studies related to land have focused on southern and eastern African countries such as Kenya (Jin and Jayne, 2013), Ethiopia (Benin et al., 2005; Deininger et al., 2008, Deininger et al. 2011), Malawi and Zambia (Chamberlin and Ricker-Gilbert, 2016). Given major regional differences in farming and land institutions, these existing studies may be of limited applicability in understanding land markets in West Africa (Place, 2009).

In the second half of the paper, we bring new empirical evidence about land access and farm investment in the context of Burkina Faso. Using a nationally-representative farm household panel dataset, we i) document the prevalence of different forms of land acquisition, including borrowing; ii) compare land-borrowing households to non-borrowers, and iii) analyze the effect of land borrowing on small-scale farm investments with short time horizons (mineral fertilizer, herbicides, and hired labor) and longer ones (soil and water conservation structures and fallowing). We employ a multivariate probit model combined with a control function approach and correlated random effects in order to account for the interdependence across farm investment and to deal with possible endogeneity issues.

We find that land is still commonly managed through systems of customary tenure in Burkina Faso. Although borrowed plots accounts for just over 10% of all plots, this percentage

can be as high as 20% in some provinces. Interestingly, borrowing households—those in which the head borrows at least one plot—do not appear so distinct from non-borrowing households, except that the former have far fewer landholdings otherwise (0.5 ha, compared to 2 ha) and are nearly three times as likely to be headed by a woman.

Our empirical results indicate that borrowed plots are more likely to be treated with herbicide. We also find that borrowed plots have a higher probability of being mono-cropped with maize, and conditional on a maize crop, a higher tendency to have mineral fertilizer applied. Combined, these results suggest that borrowed plots are farmed more intensely, using newer production technologies. This narrative is intuitive, as borrowing households are those that must make do with limited land; moreover, in many parts of Burkina Faso, a borrower who continually cultivates a plot may then pass on the right to his son, at which point access is considered permanent. We find no discernible effect of borrowed-plot status on the likelihood of fallowing, nor on erosion-control investments.

It is important to understand the institution of borrowing and to know if farmers treat borrowed lands differently from non-borrowed lands because, in the West African Sahel, it is still the dominant mechanism for transacting land between households. Our finding that farmers invest more inputs in borrowed land suggests that systems of customary tenure may not be as incompatible with agricultural intensification as previously feared.

2. Land Tenure in Burkina Faso, Mali, and Niger

2.1 A review of the ethnographic literature

In Burkina Faso, Mali, and Niger, where *de jure* rules applying to land transactions do not largely coincide with the *de facto* rules, articulating a model of land transaction is a challenging

task. Although legal statutes exist, there are typically superseded by local customs—which differ by regions and ethnic groups, oftentimes reflecting complex overlays of both pre-colonial and colonial traditions (Hughes, 2014; Skidmore et al., 2016; Elbow, 2013). In this section, we review the literature on norms surrounding land in Burkina Faso, Mali, and western Niger. We find that, despite the wide geographic range covered by the studies, it is possible to identify a single constellation of features commonly found among the many customary regimes. We believe that these features can serve to articulate an important set of considerations—if not a basic description—of *de facto* systems of land tenure covering most regions of the West African Sahel.

Autochthonous[1] lineages, or clans, are thought to have a special tie to the land upon which their community resides. This tie may be managed through an earth priest, or a person designated with the task of maintaining a state of harmony between the community and the land, which includes farmland, wood, minerals, grazing areas, and even wild animals. An important part of this role entails allocating, to the heads of the autochthonous lineages, rights of i) direct use and ii) concession of usufruct rights to others (Lentz, 2013, in Burkina Faso). Thus, while the earth priest remains the ultimate authority over all natural resources within the boundaries of the village, the task of allocating and adjudicating use rights among villagers and newcomers often rests with the lineage chiefs (Turner and Moumouni, 2018, in Niger; Lentz, 2013, in Burkina Faso).

It is useful to distinguish between three kinds of land rights: ownership, use, and transfer (of use rights). Traditionally, no single person or household may own land, as it belongs to the lineage. Autochthonous household heads in a village typically inherit rights of both use and transfer for specific plots within that village. In most West African Sahelian countries, a

patrilineal system prevails, meaning land rights are typically transmitted through male kin (Konate, 2006, in Burkina Faso; Gavian and Fafchamps, 1996, in Niger). Being in control of the land, the patriarch can decide to temporarily lend use rights to family members with insufficient or no inherited plots (e.g., wives and sons) and/or to other households, including newcomer households (Sawadogo and Stamm, 2000, Etongo et al., 2015, in Burkina Faso; Benjaminsen and Sjaastad, 2002, in Mali).

Rules surrounding such inherited lands resemble *de facto* proprietary rights; however, outright sales are either prohibited by law (e.g., Burkina Faso and Mali) or traditionally discouraged (e.g., Niger). Even the renting out of land for cash is frowned upon (Gavian and Fafchamps, 1996, Turner and Moumouni, 2018, in Niger; Gray, 2002, Wily, 2018, in Burkina Faso). And, so, despite inherited lands appearing to be as 'as good as owned' by their users, other members of the lineage, particularly lineage chiefs, maintain some say in their use. For example, Breusers (2001) observed in Burkina Faso that a single plot typically fell under a hierarchy of authorities that included earth priests, lineage elders, and household heads, with the tiller's tenure security depending on not only his or her place in the community, but that of the person having granted or lent the land.

Customary tenure systems permit the temporary ceding of use rights to both autochthonous (same-lineage) members of the community and to those considered newcomers, provided that land use is granted for the purpose of basic sustenance. As noted above, an autochthonous household typically inherits use and transfer rights associated with specific plots of land. However, if this land is considered insufficient to support a household; the household head, in theory, has a right to access more land within his lineage's lands[2] (Benjaminsen and Sjaastad, 2002, in Mali; Gavian and Fafchamps, 1996, in Niger; Reyna, 1997, Sawadogo and

Stamm, 2000, and Brasselle et al., 2002, in Burkina Faso). The use of borrowed land alongside inherited land has been described by Reyna as "icing the cake," by "gaining access to a desired soil type or a field close to home" (p. 537). Such transactions are typically voluntary, but can be influenced by imbalances in power, particularly within extended families. And while not all transactions require the direct approval of the lineage chief, all must be socially acceptable, since what is being transacted is access to *communal* land. In Burkina Faso, Sawadogo and Stamm (2000) report autochthons increasingly needing to borrow such supplementary land, due to larger numbers of people being supported on the families' fields and declines in soil fertility.

Newcomers to a village typically access land exclusively through borrowing. In most cases, lineage chiefs are tasked with the job of accommodating both autochthonous borrowers and any newcomers wishing to settle on the lineage's land (Mathieu et al., 2003, and de Zeeuw, 1997, in Burkina Faso; Turner and Moumouni, 2018, in Niger). In Mali, where the population density is relatively low, newcomers can expect to access land as a matter of course (Benjaminsen and Sjaastad, 2002). When a newcomer petitions for land access, a village chief may allocate plots from within his pool of communal lands, permit the clearing of land in the peripheries of the village, or may put pressure on those having inherited 'excess' land to lend from among their plots. Such requests can be refused only if the inheritor can demonstrate that he has no excess land, or if the petitioner is known to be of bad character (Sawadogo and Stamm, 2002, in Burkina Faso).

When petitioners are lent land, they are expected to show gratitude and social loyalty. Sawadogo and Stamm (2000) note that the 'land lenders' that they interviewed were quick to emphasize that they are motivated to lend land on a social—not material—basis. Nonetheless, social allegiance is typically accompanied with periodic, symbolic gifts such as a chicken, tins of

rice, and food or drink that may be used in ceremonies (Brasselle et al., 2002, and Sawadogo and Stamm, 2000, in Burkina Faso). In Niger, Turner and Moumouni (2018) report an expectation for borrowers to pay a tithe ('zakat') to the lineage chiefs who, in their study context, are typically the ones brokering the land. The authors, note, however, that the tithe is meant to be symbolic, rarely amounting, in practice, to the customary one-tenth of the harvest. On the other hand, subletting the field, planting trees or making long-term investments (e.g., fences and wells) universally represent a breach of protocol and grounds for termination of borrowing arrangements (Gavian and Fafchamps, 1996, in Niger; Gray, 2002, Ouédraogo, 2002, Paré, 2001, Raebild et al., 2007, in Burkina Faso).

Within borrowed lands, the security of access differs by i) the petitioner of use rights, ii) the broker (sometimes called the 'patron' or 'tuteur'), iii) the use to which the land is put, and iv) the behavior of the petitioner toward the broker and the community generally. Land borrowed by an autochthonous petitioner tends to be more secure than that borrowed by a newcomer. For example, if the petitioner is of the autochthonous lineage and resides in the village, he/she has a strong claim and is more likely to be granted land on a longer-term basis (Gray, 2002, and Sawadogo and Stamm, 2000, in Burkina Faso). The security of the land arrangement also depends on the broker—or the one holding the transfer rights. Matlon's (1994) research in Burkina Faso establishes a widely agreed-upon hierarchy of factors determining the security of usufruct rights. The rights considered the most secure were those that were inherited, on lands belonging to someone of the same lineage, and granted by someone in the same lineage.

Lastly, if a borrowed plot is continually used for subsistence purposes, the borrowing arrangement is less likely to be discontinued or contested. Both improper use (strictly commercial use, subletting, and making longer-term investments such as tree planting), and

underuse are likely to result in the termination of the arrangement. With respect to the latter, if a household were to fallow a borrowed plot, this could signal inadequate need, justifying the patron's rescinding of usufruct rights in some cases (de Zeeuw (1997) in Burkina Faso). In fact, reports arise of even autochthonous households avoid fallowing their *inherited* lands, for fear that others will demand to borrow that land (Gray (2002) in Burkina Faso).

Borrowing agreements can be short-term, long-term, and—at least in Burkina Faso—inheritable (Matlon, 1994, de Zeeuw, 1997, Mathieu et al., 2003, Gray, 2002, Sawadogo and Stamm, 2000, Etongo et al., 2015). Inheritance of use rights appears to be the norm when borrowers are autochthonous households; however, it may not be universal when use rights are borrowed by newcomers (de Zeeuw, 1997; Gray, 2002). Breusers (2001) observes in the Burkinabe context that when a newcomer family is permitted to borrow land and therefore settle in a village, it is entitled to tillage rights on adequate farmland, but not necessarily on the same plots. Thus, newcomer households may periodically be bumped off of specific plots and asked to farm different plots. And, in the Malian context, a borrower may acquire land by clearing and—over the course of several years—improving a plot, only to be moved to another marginal area to repeat the process (Benjaminsen and Sjaastad, 2002). In Western Niger, Gavian and Fafchamps (1996) note that borrowed fields are considered secure until the harvest, after which they can be reclaimed by the brokering entity. Tellingly, they find that manure—a scarce resource—is typically applied on the plots considered most secure within a household's holdings. Thus, we see that security of land access is influenced by immutable factors such as the identity of the petitioner, the identity of the broker, and general land availability in the village; at the same time, this security can be strengthened or weakened based on the actions of the borrowing household.

2.2 A stylized model of land borrowing

Historically, borrowing has been the most common mechanism for temporarily accessing land in the West African Sahel. Borrowing is distinct from renting. To highlight the differences between the two, we briefly summarize characteristics of borrowing vis-à-vis renting.

Households, both autochthonous and newcomers, can request tillage rights to land, as long as it is deemed by the community as necessary for the household's sustenance. Recent newcomers present strong cases, as they have no land to cultivate otherwise. Tillage rights are generally granted by those who manage usufruct rights over more land than they use. Historically, the most common brokers of land access have been lineage chiefs, who granted usufruct rights on un-cleared or unused areas within the lineage's lands. As land becomes scarcer, lineage chiefs may pressure households to lend their inherited lands and petitioners may directly approach households appearing to manage 'excess' land.

As long as there is underexploited land in the villages, the opportunity cost of letting petitioners borrow land is low. However, as villages near their carrying capacity, for a lineage chief, the opportunity cost of lending land to a non-lineage petitioner is the ability to do so to someone of his own lineage. If someone other than a village chief lends land, part of the opportunity cost to the broker is the risk of the borrowing arrangement becoming permanent. As land increases in value, anecdotes arise of conflicting claims on land, and of extended family members refusing to return borrowed land—effectively expropriating the land—and passing on the usufruct rights to their children (Ouédraogo, 2002, in Burkina Faso).

Under customary tenure, the primary reward to the person granting usufruct rights is the borrower's deference and social allegiance, and this is typically accompanied with periodic,

symbolic gifts. The social aspect of lending means that lending arrangements can be used to strengthen ties between households and even lineages. We thus assume that those able to grant usufruct rights on land will do so as long as the potential increase in influence and clout within a community or lineage exceeds the opportunity cost, which is the foregone food production for one's own household or extended family.

Conceptually, borrowing systems lie somewhere between a rental market model and a 'social planner' model. Under customary tenure, the allocation of the majority of a community's land is overseen by just a few entities (e.g., the lineage chiefs) who are tasked with allocating land in a way that is acceptable to the community—they are literally 'social planners.' And even those lending out their own inherited lands are likely to consider the needs of the borrowers and operate within the expectations of the community. In borrowing systems, the outcomes will reflect the community's desire for equity and/or power differentials between households. And we speculate that the 'equilibrium price' of land access under these systems to be sluggish, if not completely static, because the value of social allegiance cannot change as quickly as the marginal value of land.[3] In contrast, in commercial land markets, the allocation of ownership and usufruct rights is dictated by a dynamic market price, which reflects i) the risk, to lenders, of their land being expropriated and ii) the expected benefit/opportunity cost of the land (Besley and Ghatak, 2010). Those with higher marginal land productivity are more likely to demand land and those with lower marginal productivity are likely to offer it.

3. Borrowing and land investments in Burkina Faso

In the remainder of this paper, we use a nationally-representative panel dataset of farm households in Burkina Faso to i) document the prevalence of different forms of land acquisition, including borrowing; ii) compare land-borrowing households to non-borrowers, and iii) analyze

the effect of land borrowing on small-scale farm investments with short time horizons (chemical fertilizer, herbicide) and longer ones (fallowing and soil and water conservation structures).

3.1 Data: The Continuous Farm Household Survey

The data used for this analysis come from the Continuous Farm Household Survey (known in French as Enquête Permanente Agricole—or EPA), implemented by the General Research and Sectoral Statistics Department (Direction Générale des Études et des Statistiques Sectorielles) of the Ministry of Agriculture and Food Security (Ministère de l'Agriculture et de la Sécurité Alimentaire) of Burkina Faso. The EPA sampling frame is based on the 2006 Population Census. It is a nationally representative sample of farm households located in 826 villages across all 45 provinces.

The EPA provides information on production, area and yield for rainfed crops, along with information on land acquisition, input use, livestock holdings, as well as income and expenditures of farm households. We utilize the data covering the three-year period from 2009/10 through 2011/12. The unit of observation is the plot-year. We use a subset of the full dataset in order to obtain a consistent sample of households engaged in staple crop production. Therefore, our criteria for inclusion are i) the plot is sown in one of the four main dryland cereals (maize, millet, white sorghum and red sorghum) ii) the household was surveyed in all three survey years, and iii) the plot is managed by the household head, something which we explain below. Our effective sample is 20,375 plot-year observations, cultivated by 1,926 households in 44 provinces.[4]

In many West African Sahelian countries, farm households are comprised of multiple generations and several nuclear families which farm together under the supervision of the household head, who is predominantly an elder patriarch (Thériault et al., 2017). A combination

of individually- and collectively-managed plots are farmed. The household head is responsible for allocating land for collective and individual purposes. Proceeds from collective plots, which are managed by the household head, serve to meet the basic food needs of the entire household, whereas proceeds from individually managed plots can be retained by the managing member to meet his/her personal needs. Typically, a wife will tend to her own plot in addition to working on the head's plot, and an adult son may allocate his labor between up to three kinds of plots—his father's, his mother's, and his own.

It is because of this unique, corporate structure, that our analysis relies exclusively on plots managed by household heads. First, because head-managed plots are considered the most important plots, they are typically larger and collectively worked, meaning that the head can command the labor of all household members, unlike plots managed by sons or wives. It is well-documented that these plots are farmed with different levels of intensity and with differential access to inputs such as labor and fertilizer (Thériault et al., 2017; Haider et al. 2018). Second, a household head who borrows land is almost certainly likely to be borrowing it from someone outside of the household.[5] By contrast, had we included the plots of wives and sons (as in Bambio and Agha, 2018), borrowed plots would have likely included those having been borrowed from the head (from the pool of the *household's* lands), and not necessarily borrowed from outside of the household. Head-managed plots comprise 72 percent of all plots.

3.2 The prevalence of different forms of land access

In the survey questionnaire, plot managers were asked about the mode of acquisition of each of their plots. The choice of responses included: purchased (achat), borrowed (emprunté), rented (location), granted (don/legs), inherited (heritage), or other. Consistent with earlier ethnographic accounts, household heads most commonly acquire land through inheritance. In our sample of

head-managed plots, 13,358 plots (65%) are acquired through *inheritance*, 4,510 (22%) have been *granted*, and 2,244 (11%) are *borrowed.*[6] In contrast, only 94 plots have been *purchased*, and *rented* plots number only 64. This study compares borrowed plots to inherited, granted, and purchased plots, with the latter three being combined into a category that we refer to as 'non-borrowed.' We ignore rented plots by dropping the 25 households associated with the rented (head-managed) plots.[7]

Figure 1 shows the fraction of head-managed plots comprised of borrowed plots, by province. The prevalence of borrowing varies by province, but not in any obvious systematic way—for example, by agro-ecological zones or population density. We conclude that, although levels of borrowing vary, the many customary tenure systems across Burkina Faso all likely *allow* for borrowing.

3.3 Identifying the effect of land borrowing on crop inputs and plot investments

Here, we estimate systematic differences between borrowed and non-borrowed plots in terms of short-term investments and longer-term investments. Our explanatory variable of interest is the borrowed status of the plot. This choice is primarily motivated by the fact that borrowed status is objective and easily verified and, in light of the literature above, a signal regarding the household's tenure security with respect to land. Indeed, in the Ghanaian context, Besley (1995) uses an IV approach in which tenure security is instrumented with acquisition mode and length of tenure.

Our choice to examine borrowing status is also motivated by the inconsistency and apparent confusion on the part of respondents when answering a question related to the tenure security (sécurisation foncière) of their plots. The choices offered were none (aucun), lease (bail), title (titre foncier), permission to cultivate (permis dexploiter), surveyed (bornage), locally

registered (procès-verbal de palabre), and owned (propriétaire terrien). Cross tabulation of these categories with the acquisition mode variable generated inconsistent and often-times impossible combinations, suggesting that notions of security may defy categorization, at least in these terms.

Previous studies in the Burkinabe context have estimated the effects of tenure security itself (e.g., Matlon, 1994; Brasselle et al., 2002; Fenske, 2011; Linkow, 2016; and Bambio and Agha, 2018), with some using acquisition mode as a control variable (Matlon, 1994 and Fenske, 2011). In these studies, tenure security is measured by asking respondents about specific rights that they feel they can exercise on their land. However, as Brasselle et al. (2002) and Bambio and Agha (2018) both note, using such measures can complicate analysis. For example, tenure security is typically elicited using multiple binary variables. Having multiple explanatory variables requires multiple instruments in IV-type analysis (Fenske, 2011); on the other hand, forcing these multiple variables into a single ordinal variable is also complicated (e.g., Brasselle et al., 2002).

Previous studies consider an array of investment outcomes. The majority consider longer-term, soil-and-water-conserving investments, including manuring, planting trees, constructing hedgerows, fallowing, constructing stone cordons (to control soil and water run-off), and constructing micro-catchments (small holes in which the seeds and fertilizer are placed) (e.g., Gray and Kevane, 2001; Brasselle, 2002; Kazianga and Masters, 2002; Fenske, 2011; Bambio and Agha, 2018). However, shorter-term inputs, such as mineral fertilizer and labor use have also been considered by Matlon (1994), Gray and Kevane (2001), and Fenske (2011). This study simultaneously considers shorter-term, seasonal inputs (mineral fertilizer, herbicide, and hired labor) alongside longer-term, land-improving investments (fallowing and soil/water conserving investments). In terms of the research questions, our study is most similar to Fenske (2011),

which estimates the effects of acquisition mode (alongside perceived tenure security) on fertilizer, seed, hired labor, fallow, and land-improving investments. Compared to Fenske, who uses ICRISAT data from 1984/85, our data are more recent and nationally representative (the ICRISAT data cover only three provinces), and we address the potential endogeneity arising from borrowing land.

Earlier studies have concluded that neither tenure security nor acquisition mode significantly affect seasonal inputs (e.g., Matlon, 1994; Gray and Kevane, 2001; Fenske, 2011) or land investments (e.g., Gray and Kevane, 2001; Brasselle et al., 2002; Fenske, 2011). The explanations put forth are both contextual and technical. For example, *absolute* levels of tenure security may be high enough for investments, despite variation in the *relative* levels experienced by land managers, and—particularly relevant under systems of customary tenure—certain investments may strengthen managers' claims to land. Further, identifying the effect of tenure is difficult, given that tenure security (and/or acquisition mode) are likely to be correlated with oft-unobserved variables such as social standing, family alliances, access to resources, and entrepreneurial aptitude.

However, as noted by Bambio and Agha (2018), the past decades have seen a changing institutional environment, evolving farming technologies, and increasing population pressure. Indeed, the findings of two recent studies suggest that tenure security matters: Linkow (2016) finds that a significant percentage of farm managers perceive threats to tenure security, and that these threats reduce land productivity by almost ten percent. Bambio and Agha (2018)'s study, also based on a recent, nationally-representative dataset, concludes that tenure security incentivizes longer-term plot investments.

We deal with the potentially endogenous nature of the borrowed status of a plot by using the control function approach (CFA) combined with correlated with random effects (CRE). The CREs control for unobserved, time-invariant household effects, and the CFA reduces estimation bias arising from correlation between the explanatory variable and time-variant unobserved factors (Wooldridge 2015). Moreover, our estimation controls for crop choice, something that is likely to be determined simultaneously with the choice of plot and inputs.

To the best of our knowledge, Brasselle et al. (2002), Linkow (2016), and Bambio and Agha (2018) are the only other studies from Burkina Faso that addresses the potentially endogenous nature of tenure security. Our approach hews closest to those of Brasselle et al. (2002) and Bambio and Agha (2018). Brasselle et al. (2002) investigate the relationship between tenure security, investments, and migrant status. Their study is unique in that it explicitly considers the newcomer status of households, an important consideration given that newcomers—by definition—borrow most of their land. In their sample from the Houet (formerly Tui) province, over half of the study participants were self-described newcomers. The tenure security that households associated with their plots was measured with an ordinal scale, with the highest level entailing rights to bequeath, lend, and even charge money for (access to) land, and the lowest level providing only the right to grow and appropriate the harvested products. Investments were captured using indicator variables for each type (i.e., did the household make improvement X in the past five years), and immigrant status was self-reported by the survey participants.

Both tenure security and the household head's migrant status were treated as potentially endogenous. They employed a two-stage conditional maximum likelihood method (2SCML), a CFA, as well as an instrumental variables probit model to simultaneously identify i) the effect of

tenure security (and migrant status) on investment, and ii) the effect of investment on tenure security. Notably, two of their six excluded variables are dummies indicating acquisition mode.[8] They find no evidence of tenure security influencing investments on land; however, they do find that investments enhance tenure security. Bambio and Agha (2018) estimate the same model as Brasselle et al. (2002), but using a plot-level, nationally representative, two-year (2010-2012) panel dataset. Their results indicate that causality runs both ways: investments strengthen land rights, and that land rights induce longer-term investments.

Before turning to the details of our empirical approach, it is worth differentiating our approach from that of the two abovementioned studies: First, because our explanatory variable is the plot's borrowing status, it makes no sense to estimate the (reverse-) causal effect of investments on borrowing status; acquisition mode is pre-determined. Second, we consider seasonal inputs in addition to longer-term inputs, which necessitates the modeling of crop choice as well. Third, we do not control for immigrant status because our data do not identify these households. However, heavy reliance on borrowed land is likely to be a strong correlate of immigrant status, and our summary statistics show that 23% of households borrow at least 75% of their cultivated cereal area (Figure 2).[9] Lastly, we examine head-managed plots only, which means that our borrowed-plot effect is estimated using only inter-household variation.

3.3.1 Specification: Crop inputs

The fact that we deal with seasonal crop inputs, in addition to longer-term inputs, raises two issues: First, the choice of crop must also be treated as an endogenous variable, since it is likely that the choices of crop, inputs, and plot are decided simultaneously each season. Second, the use of certain inputs is likely to be correlated. For example, the use of mineral fertilizer and herbicide may be correlated, as the use of the former may necessitate using the latter and /or cash-abundant

household may be more likely to purchase both. A specification that does not acknowledge such tendencies would risk producing inefficient estimates.

To deal with the potential correlation between crop inputs, we specify a multivariate probit model, in which each input equation takes the form of equation 1.

$$y^*_{pti} = \alpha_i c_{pt} + \beta_i b_{pt} + X'_{pt}\gamma_i + \varepsilon_{pti} \quad (1)$$

$$y_{pti} = \begin{cases} 1 \text{ if } y^*_{pti} > 0, \\ 0 \text{ otherwise.} \end{cases}$$

$$i \in \{\text{fertilizer, herbicide, hired labor}\}$$

Our unit of observation is a plot-year. y^*_{pti} is the unobservable perceived net benefit to the household of investing in input *i,* (herbicide, mineral fertilizer, hired labor) on plot *p* in year *t*. What we observe is y_{pti}, which takes the unit value if the perceived net benefit of using the input is positive, and is zero otherwise. The likelihood of a particular input being applied is a function of the borrowed status of the plot (*b*), the crop (*c*) grown on that plot, and the observable covariates in the vector *X*.

We now turn to issue of endogeneity. In estimating the system of equations above, we employ a control function approach with correlated random effects (CFA-CRE). The CFA is an instrumental variables (IV)-type approach, where the generalized residuals from a set of first-stage regressions (specified below) are included in the main, second-stage regression (system of equations 1, above) along with the endogenous explanatory variables (Rivers and Vuong, 1988; Vella, 1993; Wooldridge, 2015). These residuals simultaneously correct for and permit the testing of the endogenous nature of the explanatory variables (Wooldridge, 2015). As in other IV-type approaches, the consistency of the CFA estimates depends on the strength of the IVs and their valid exclusion from the main, second-stage regression.

Our first-stage regressions are probit specifications—one for the borrowed status (*b*) of a plot and a second one for the crop (*c*) sown on that plot—specified as functions of at least as many IVs (the vector *Z*), plus the set of exogenous covariates from the main, second-stage regression (*X*).

$$b_{pt}^{*} = X_{pt}'\tilde{\delta} + Z_{pt}'\tilde{\kappa} + u_{pt}$$
$$b_{pt} = \begin{cases} 1 \text{ if } b_{pt}^{*} > 0, \\ 0 \text{ otherwise.} \end{cases} \quad (2)$$

$$c_{pt}^{*} = X_{pt}'\hat{\delta} + Z_{pt}'\hat{\kappa} + \mu_{pt}$$
$$c_{pt} = \begin{cases} 1 \text{ if } c_{pt}^{*} > 0, \\ 0 \text{ otherwise.} \end{cases} \quad (3)$$

Our instrumental variables are *children-per-woman*, *landless,* and *livestock*. *Children-per-woman* is the average number of children borne by each wife. *Landless* takes the unit value if a household head cultivates less than 0.5 hectares of land, excluding the borrowed ones. And *livestock* is the number of animals, in tropical livestock units (TLUs), owned by the household. The choice of the first two instruments is based on our survey of the ethnographic literature, which suggests that only petitioners deemed truly deserving of land succeed in borrowing it. In including *livestock*, we follow previous studies based in Burkina Faso. We use the same set of variables to instrument the choice of growing maize on a plot.

Exogenous covariates (comprising the vector *X*) are those pertaining to the household head (age, education, gender, credit access, membership in an agricultural cooperative), household (total land, household size, and off-farm income), plot (topography, area, location, years in management), village (the number of agro-dealers and rainfall), and province (population density). Given the two-stage estimation process, all standard errors on the coefficients are bootstrapped.

3.3.2 Specification: Longer-term investments

We also estimate the effect of borrowed status on longer-term investments: whether a plot was fallowed within the past ten years[10] and whether the plot features any soil/water-conserving (SWC) investments: stone cordon (cordon pierreux), microcatchment (digue filtrante), half moon (demi lune), planting pits (zaï), earth bank (bourrelet de terre), vegetative buffer strip (bande enherbée), and/or hedgerow (haie morte/vive). As above, we contend with the potentially endogenous nature of the plot's borrowed status. We estimate CFA-CRE probit equations in which the investment outcome y_{ptj} $j \in \{\text{fallow}, \text{SWC investment}\}$ is a function of the borrowed status of the plot but not the crop currently cultivated, assuming that the presence of investments is independent of the crop planted. Lastly, there is no reason to expect fallowing and SWC investments to be correlated with each other or with the seasonal inputs. Therefore, each specification is estimated individually.

3.4 Results

3.4.1 Borrowing v. non-borrowing households

In Table 1, the characteristics of borrowing households are compared to those of non-borrowing households. A household is considered to be a borrower if at least one of the head-managed plots was acquired by borrowing. Here, the unit of observation is the household-year.

As expected, borrowing households are those who would have little land otherwise; for these households, the average area of non-borrowed land is .45 hectares. For non-borrowers, the average landholding is 1.97 hectares. In fact, 66% of borrowing households would otherwise have less than 0.5 hectares; contrast this to 14% of non-borrowing households. Borrowing households are slightly younger, nearly three times more likely to be headed by a woman, and their household members cultivate plots that are, on average, 0.8 hectares smaller.

3.4.2 Borrowed v. non-borrowed plots

In table 2, the characteristics of borrowed plots are compared to those of non-borrowed plots (those acquired through inheritance, grant, or purchase). Here, the unit of observation is the plot-year. Unsurprisingly, borrowed plots have been managed by the responding household head for less time (an average difference of nearly 8 years) and are more likely to be located farther away from the household. Borrowed plots have a higher probability of having herbicides applied, something that may be correlated with the higher incidence of maize mono-cropping.[11] Finally, borrowed plots are less likely to have any SWC investments.

3.4.3 Estimated effects

Table 3 presents coefficient estimates from the CFA-CRE multivariate probit specifications that simultaneously predict fertilizer, herbicide, and hired labor use. We estimate the effect of borrowed-plot status using three sets of data: the full data (columns denoted by 1), plots belonging to borrowing households (2), and plots in which maize is the primary crop (3). When we restrict the analysis to borrowing households only, we control for any bias-inducing unobserved heterogeneity between borrowing and non-borrowing households that remains uncaptured by the CREs. And testing over maize plots only represents an alternative way to control for any bias that may arise from the 'maize effect.'[12]

Results across all three specifications suggest that borrowed plots are more likely to be treated with herbicide. And, with respect to herbicide use, we can soundly reject the exogeneity of both maize planting and borrowed-plot status. All three specifications suggest that borrowed plots are less likely to be worked by non-familial labor. This is likely because a household head who successfully borrows land is someone who has demonstrated that his land endowment is otherwise insufficient to support his household. In this regional context where household

members represent not just mouths to feed, but also working hands, the hiring of labor could therefore signal an excess of land, which could jeopardize the borrowing arrangement. We also reject the exogeneity of borrowed-plot status with respect to hired labor.

Turning to the fertilizer results, first we find that maize plots are more likely to receive fertilizer (column 1)—an unsurprising result. Restricting the analysis to borrowing households (column 2) attenuates this relationship, suggesting that borrowing households may tend to use more fertilizer for all of their crops. Second, among maize plots, borrowed ones are more likely to receive fertilizer (column 3). When we interpret these results in combination with i) the summary statistics in table 2 which suggest that borrowed plots are more likely to be sown in mono-cropped maize, and ii) the first-stage regression results which show that being landless strongly predicts growing maize (A1 in the Appendix), the following narrative emerges: Borrowing households have a higher tendency to grow mono-crop maize, and because successfully growing maize requires more soil amendments, borrowed households are more likely to use mineral fertilizer.

To check the robustness of these results, we specify a variant of system-of-equations 1 using crop-year fixed effects in lieu of the maize dummy and year dummies. This is estimated using the same CFA-CRE approach (where the one endogenous variable is *borrowed*) over all plots and again over plots cultivated by borrowing households. The estimated borrowed-plot effects (not shown) are similar in magnitude and significance to those in the columns marked (1) and (2).

Table 4 presents average marginal effect estimates of borrowed-plot status on SWC investments and fallowing. Although borrowed plots—among plots cultivated by households borrowing at least one plot (specification b)—appear to be less likely to have any SWC

investments, this result does not hold for among all plots (specification a). These results contrast with the findings of Bambio and Agha (2018), who find that tenure insecurity decreases the likelihood of managers making longer-term plot investments. But are consistent with Braselle et al. (2002) who find no systematic difference in land investment with regard to land tenure security. Recall that Bambio and Agha's study sample includes plots managed by the wives and children of a household, which means that their results are subject to both within- and between-household heterogeneity.

Finally, we cannot reject that plots acquired via borrowing are no less likely to have been fallowed in the past ten years, a finding that is seemingly contradictory to ethnographic accounts of households avoiding fallowing plots for fear that they will be taken back (e.g., de Zeeuw, 1997). However, our findings are not necessarily inconsistent if managers of *non*-borrowed plots are also increasingly hesitant to fallow their plots, for fear that their access might be appropriated to others (Gray, 2002). This would reduce the expected borrowed-plot effect. Second, because of the construction of our outcome variable—fallowed within the past ten years—our sample is necessarily restricted to plots managed for at least ten years.[13] Borrowed plots managed for this long may have a high level of associated security, and may not be representative of the average borrowed plot.

The validity of these results rests on the strength of the instruments in predicting our endogenous variables in the first-stage regressions, and on the successful exclusion of the instruments from the main (second-stage) regressions. We are able to test the former. Table A1 in the appendix shows the test statistics for the various first-stage regressions, as well as those from the tests of joint significance of the three instrumental variables.

4. Conclusions and implications for approaching land tenure policy in the West African Sahel

In the West African Sahel, little rural land is titled and formal land markets are rare. Rather, the majority is managed through systems of customary tenure, which discourage rentals and sales. However, these systems permit the temporary exchange of (access to) land through arrangements that outwardly resemble renting. Given that land is thusly exchanged on a non-trivial scale, this begs the question: can these systems facilitate the much-needed growth in agricultural productivity?

It is not apparent if and how agricultural productivity can increase under such systems. Relatively few empirical studies have dealt with customary land tenure in the West African Sahel, perhaps because i) it is unclear if customary tenure regimes share common features across various regions, complicating national-level analyses and ii) because of the difficulty of defining and measuring tenure security.

The question of whether customary land tenure can facilitate increased agricultural productivity is both relevant and timely because Burkina Faso recently codified new land tenure legislation: Loi No 034- 2009/AN Portant Régime Foncier Rural du 16 juin 2009. Among other things, this new law recognizes and formalizes local, informal, systems of governance and cedes many management and conflict resolution roles to village-level officials, marking a departure from the preceding 1984 law, which sought to make all rural lands officially the property of the state (Elbow 2013).

There is also the question of whether customary land tenure institutions can survive increased population pressure, fluctuating agro-climatic conditions, and greater movements of people. Reports emerge of local systems of customary tenure being strained and/or modified, particularly in the western provinces. Mathieu et al. (2003) document cases of long-term

borrowing rights being contested by the kin of the lineage chief. de Zeeuw (1997) notes a trend from long-term- to short-term borrowing arrangements. Lentz (2013) documents cases of plots of those in one community 'bumping up' against those in a neighboring community in the Black Volta region. And in the cotton zone—also in the western part of the country—Koussoubé (2015) documents the emergence of land rental markets,[14] something that has been documented in countries with relatively higher population density (e.g., Chamberlin and Ricker-Gilbert, 2016).

The first part of this study reviewed the ethnographic literature from Burkina Faso, Mali, and Western Niger to investigate modes of land access, focusing on the above-described system of land 'borrowing.' This literature tells us that borrowing is distinct in a few important ways. First, the institution of borrowing exists, in theory, to provide land access to those needing it for subsistence (e.g., newcomers to a village or households, returning migrants, widows, and autochthonous households having inherited insufficient households). Second, those who broker access to these lands rarely demand monetary or physical remuneration; rather, land exchanges precipitate and strengthen social alliances. And third, while the granted usufruct rights are understood to be temporary, in many contexts, borrowed usufruct rights can become permanent and inheritable by the borrower's children, provided that the borrower manages to farm it continually—a form of sweat equity.

Our model of land acquisition predicts that increased land pressure would increase the incentive of all households, but particularly borrowers, to continually use their land, to reduce the risk of expropriation. To the extent that households have the resources to continually restore soil nutrients--increasingly in the form of fertilizer, rather than fallows—this could incentivize sustainable intensification.

The second part of the study empirically tested whether borrowed land is treated differently than non-borrowed land. Given the temporary nature of borrowing arrangements, it has been widely hypothesized that borrowed plots would be associated with lower levels of tenure security, thereby deterring longer-term investments. Using borrowed status as a measure of tenure security, we test for differences in seasonal crop input use and in longer-term productivity investments. We find that borrowed plots are more likely to be treated with herbicide. We also find that borrowed plots have a higher probability of being mono-cropped with maize, and conditional on a maize crop, a higher tendency to have mineral fertilizer applied. Combined, these results suggest that borrowed plots may be farmed more intensely, using newer production technologies.

What does this mean in terms of facilitating much-needed increases in agricultural productivity? Given that formal land titling may be infeasible and/or undesirable in many regions, it is important understand how customary tenure systems can perform, vis-à-vis more formal systems. Due to their traditional emphases on equity, customary systems—compared to land markets—are less likely to facilitate the consolidation of land under those with greater means and/or ability. However, if customary forms of tenure become widely recognized, these could facilitate access to credit. And—as this research shows—systems of customary tenure appear to provide incentive for investment and perhaps even sustainable use among both borrowing and non-borrowing households alike. We conclude that customary systems may not necessarily be a hindrance as regions strive to increase agricultural productivity.

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Tables

Table 1. Summary statistics: Borrowing v. non-borrowing households

		Borrowing households n=882		Non-borrowing households n=4,891		z- or t-stat.
Household-level	head age (years)	48.498		49.881		2.727
		(13.440)		(13.942)		
	head attended primary school (0=no;1=yes	0.171		0.146		-1.950
		(0.377)		-0.353		
	head female (0=no;1=yes)	0.086		0.033		-7.413
		(0.281)		(0.178)		
	non-borrowed land (ha)*	0.449		1.974		18.005
		(1.081)		(2.473)		
	total cultivated land (ha)	2.242		2.362		1.327
		(2.067)		(2.507)		
	landless (0=no; 1=yes)†	0.667		0.141		-14.379
		(0.472)		(0.348)		
	household size (members)	9.653		10.071		1.836
		(6.265)		(6.209)		
	head experienced w/ credit (0=no;1=yes)	0.149		0.129		-0.532
		(0.356)		(0.335)		
	head member of veg. coop. (0=no; 1=yes)	0.154		0.140		-0.372
		(0.192)		(0.201)		
	household's non-farm income (logged CFA	7.314		7.018		-1.428
		(5.628)		(5.673)		
	household's livestock (TLU)†	1.479		1.481		0.042
		(0.913)		(0.920)		
	plots managed by household*	4.389		4.389		-0.002
		(2.867)		(2.797)		
	average size of plot (ha)*	0.681		0.759		2.607
		(0.641)		(0.852)		
	children per woman†	2.713		2.624		-1.607
		(1.544)		(1.511)		
Village-level	number of agro-dealers	33.179		29.717		-2.964
		(32.723)		(31.786)		
	rainfall (mm/year)	862.580		866.167		0.498
		(193.757)		(197.374)		
Province-level	population density (person/ha)	88.175		80.426		-1.720
		(139.804)		(119.923)		
Dummy variables	Northern region*	0.031		0.054		0.633
		(0.172)		(0.226)		
	Eastern region*	0.085		0.145		1.627
		(0.279)		(0.352)		
	South-central region*	0.297		0.279		-0.486
		(0.457)		(0.449)		
	North-central region*	0.163		0.134		-0.802
		(0.370)		(0.341)		
	Southwestern region*	0.424		0.388		-0.972
		(0.494)		(0.487)		
Source: Authors' calculations based on EPA dataset						
* Variables not used in the estimating specifications						
†Used as instrumental variables						

Table 2. Summary statistics: Borrowed v. non-borrowed plots

		Borrowed plots n=2,244	Non-borrowed plots n=18,058	z- or t-stat.
Seasonal inputs	herbicide applied (0=no; 1=yes)	0.222	0.129	-4.138
		(0.416)	(0.336)	
	min. fertilizer applied (0=no; 1=yes)	0.241	0.202	-1.758
		(0.428)	(0.401)	
	hired labor used (0=no; 1=yes)	0.111	0.083	-1.242
		(0.314)	(0.275)	
Longer-term investments	any SWC investments (0=no; 1=yes)	0.292	0.435	6.383
		(1.048)	(1.334)	
	fallowed in last 10 years (0=no; 1=yes)*	0.030	0.050	0.567
		(0.0335)	(0.009)	
Plot characteristics	years under management (years)	15.004	21.726	19.577
		(12.518)	(15.657)	
	collectively farmed (0=no; 1=yes)	0.944	0.953	0.395
		(0.230)	(0.212)	
	sloped (0=no; 1=yes)	0.084	0.071	-0.575
		(0.277)	(0.257)	
	located away from house (0=no; 1=yes)	0.588	0.454	-5.978
		(0.492)	(0.498)	
	lowland (0=no; 1=yes)	0.078	0.057	-0.903
		(0.268)	(0.233)	
	area (ha)	0.667	0.662	-0.265
		(0.884)	(0.977)	
*Current crop mix***	maize monocrop (0=no; 1=yes)	0.322	0.273	-2.185
		(0.467)	(0.445)	
	sorghum monocrop (0=no; 1=yes)	0.215	0.183	-1.439
		(0.411)	(0.387)	
	sorghum with legume (0=no; 1=yes)	0.178	0.186	0.349
		(0.383)	(0.389)	
	millet with legume (0=no; 1=yes)	0.090	0.113	1.065
		(0.286)	(0.317)	
	millet monocrop (0=no; 1=yes)	0.099	0.100	0.016
		(0.299)	(0.300)	
	maize with other grain (0=no; 1=yes)	0.027	0.047	0.923
		(0.161)	(0.213)	
Source: Authors' calculations based on EPA dataset.				
* Statistics over plots managed for at least 15 years; this subsample has 889 borrowed and				
10,321 non-borrowed plot observations.				
** These variables are not used in the estimation.				

Table 3. CFA-CRE multivariate probit coefficients: the effect of borrowed status (and maize cultivation) on seasonal inputs

Outcome:	*Fertilizer application*			*Herbicide application*			*Hired labor*		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Plots:	all	borrowers'	maize	all	borrowers'	maize	all	borrowers'	maize
borrowed	0.111	0.013	0.374	0.836	1.076	0.128	-0.280	-0.696	-0.444
	[0.82]	[0.06]	[5.08]	[4.54]	[3.31]	[5.07]	[1.74]	[-2.52]	[-3.24]
maize	1.931	1.22		-0.750	-1.955		0.721	1.118	
	[3.37]	[0.98]		[-1.12]	[-1.53]		[0.95]	[0.76]	
generalized resid., borrowed	-0.055	-0.099	-0.153	-0.386	-0.416	-0.297	0.279	0.373	0.376
	[-0.74]	[-0.71]	[-2.30]	[-3.41]	[-1.88]	[-4.51]	[3.62]	[2.36]	[4.34]
generalized resid., maize	-0.417	0.134		0.781	1.539		-0.394	-0.709	
	[0.343]	[0.18]		[1.96]	[2.00]		[-0.86]	[-0.78]	
head attended prim. school	++		++	++		++			
head female									
head age			++			++			--
head experienced with credit		+		--					
head member of veg. coop.	--	-					++		++
all cultivated land (natural log)							--	-	
non-farm income (natural log)	++	++	++	++	+	++			
household size									
plot is collective farmed	++			++			+		-
years under management			--	--	--	--		--	
sloped			++			++			
located far from house	++		++			++	++		++
lowland	+								
plot area	++		++			++	++	++	++
rainfall			--	--		--			
number of agro-dealers	--		++	++	++	++			++
population density							+		

Source: Authors' calculations based on EPA dataset

Notes: z-statistics are in brackets below coefficients. All three inputs are estimated simultaneously using multivariate probit.

Specification 1 is estimated using all observations (n=19,825).

Specification 2 is estimated using plot-year observations managed by households that borrow at least one plot (n=3,044).

Specification 3 is estimated using plot-year observations planted in maize (n=2,969).

Year fixed effects and time averages of time-variant household characteristics included; results not shown here.

Standard errors calculated using 100 bootstrap replications.

++ (+) and -- (-) signs indicate p-values smaller than 0.05 (0.10).

Table 4. CFA-CRE probit average marginal effects: the effect of borrowed status on longer-term inputs

Outcome:	*SWC investments*		*Recent fallow*	
	(a)	(b)	(a)	(b)
Plots:	all	borrowers'	all	borrowers'
Observations:	19,823	3,044	10,682	1,340
borrowed	-0.039	-0.111	-0.037	-0.017
	[-1.30]	[-2.18]	[-1.68]	[-0.40]
generalized resid, borrowed	0.016	0.051	0.018	-0.004
	[0.92]	[1.65]	[1.56]	-[-0.20]
head attended prim. school				
head female	--		++	
head age				
head experienced with credit		++		
head member of veg. coop.			--	
total cultivated land (natural log)		-		
non-farm income (natural log)				
household size				
livestock owned				
plot is collective farmed	++			
years under management	+	++	++	
sloped	++	++		
located far from house	--	-	++	++
lowland	++			
plot area	++	+		
rainfall		++		
number of agro-dealers	--			
population density	--			

Source: Authors' calculations based on EPA dataset

Notes: z-statistics are in brackets below average marginal effects.

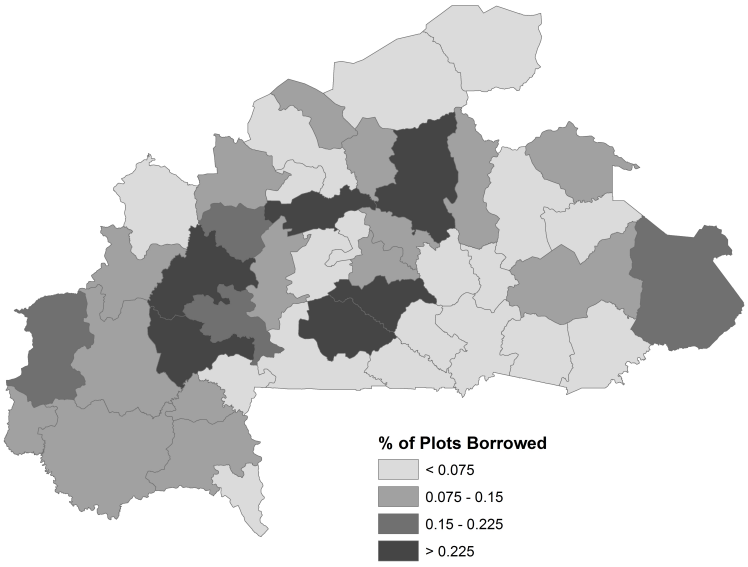
Standard errors calculated using 100 bootstrap replications.

++ (+) and -- (-) signs indicate p-values smaller than 0.05 (0.10).

Year fixed effects and time averages of time-variant household characteristics included; these results not shown here.

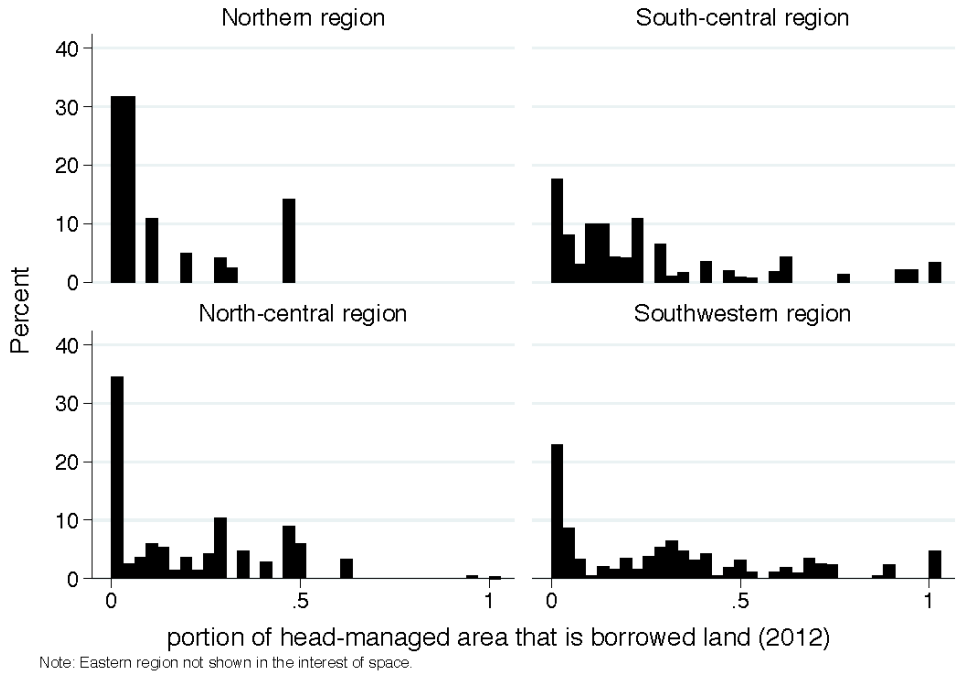
Figures

Figure 1. Prevalence of borrowed plots among head-managed plots, average percentage over all study years



Source: authors' calculations based on the EPA dataset

Figure 2. Histogram: Percentage of household's borrowed area, by region



Source: authors' calculations based on the EPA dataset

Appendix

Table A1. Summary of first-stage probit regression results

Outcome variable	borrowing					maize	
Endogenous variable:	*borrowed*					*maize*	
Plots:	all	16+ yrs.	maize	borrowers'	orrowers', 16+	all	borrowers'
Second-stage specification:	(1), SWC (a)	fallow (a)	(3)	(2), SWC (b)	fallow (b)	(1)	(2)
Observations:	19,374	10,461	6,621	2,969	1,312	19,374	2,969
children per woman	0.016	0.037	-0.007	-0.002	-0.038	-0.009	-0.025
	[0.91]	[1.31]	[-0.32]	[-0.08]	[-0.74]	[-1.06]	[-1.43]
landless	1.796	1.933	1.808	1.617	1.74	0.149	0.150
	[26.96]	[16.75]	[20.30]	[18.09]	[11.69]	[5.24]	[2.35]
livestock	0.023	0.027	0.021	0.101	0.032	0.064	0.025
	[0.62]	[0.45]	[0.47]	[1.72]	[0.28]	[3.31]	[0.63]
head attended prim. school	+	+				++	
head female	++	++	+			--	--
head age					--		
head experienced with credit							
head member of veg. coop.							
total cultivated land	++	++	++				
non-farm income		--		--		-	
household size			--	--			
plot is collective farmed		--		--	-		
years under management	--	--	--	--	--	--	
sloped					+	--	--
located far from house	++		-	++	++	--	--
lowland	++		++				
plot area	--	--	--			--	--
rainfall							
number of agro-dealers	-			++	++	++	++
population density							
Regression Wald Chi-sq.	1027.81	440.54	585.8	527.59	256.76	1245.31	326.11
IV joint significance Chi-sq.	736.65	292.5	412.92	336.33	137.71	44.05	8.54
Source: Authors' calculations based on EPA dataset							
Notes: z-statistics are in brackets below average marginal effects.							
++ (+) and -- (-) signs indicate p-values smaller than 0.05 (0.10).							
Year fixed effects and time averages of time-variant household characteristics included; these results not shown.							

Endnotes

[1] By *autochthon* or *autochthonous*, we refer to those belonging to the same ethnic group as the 'original' settlers of a community.

[2] We will henceforth refer to the heads of households as *he*, given that the vast majority of household heads are male.

[3] Interestingly, the gifts themselves, however symbolic, appear to be growing in market value. For example, Gray and Kevane (2001) note that the symbolic gift of grain can range from approximately 10kg to 30kg in their study area in southwestern Burkina Faso. The amount depends on the brokering entity, but the authors note a general trend toward greater gifts.

[4] The 2006 sample frame included 4,130 households. Of these, 2,700 are interviewed over all three panel years. We are left with 1,926 households after restricting this sample to just those growing at least one of the main staple crops.

[5] For the purposes of the survey, a household is defined as "a group of individuals generally joined by ties of blood or marriage, who share shelter, who generate income together, and who operate under the financial authority (at least, in theory) of a single person, recognized by all as the head of household."

[6] Bambio and Agha (2018) find that borrowing accounts for only 2% of plots, based on a different, nationally-representative survey of Burkina Faso implemented through the Rural Land Governance Project. However, their percentages for the other categories are comparable: 67% inheritance, 22% gift, suggesting that what we call 'borrowing' may be a combination of what the authors call 'Public allocation (5%)' and 'Traditional borrowing (2%).'

[7] These households are located in the provinces of Banwa (7 households), Balé, (2) Houet (4), Komandjoa (2), Bougourib, Kénédougou, Mouhoun, Passoré, Soum, Sourou, Ioba, Kompienga, and Loroum (1 each).

[8] Their six excluded variables are a region dummy, whether the land was gifted, whether it was borrowed, the original area belonging to the respondent, whether the respondent was the first to clear the land, and whether the respondent is a herder.

[9] Bambio and Agha (2018) estimate that 15.5% of households are immigrants. One source of this discrepancy is likely to be autochthonous households led by women. We find that 20% of the households borrowing 100% of their lands are women-headed households. It is possible that these are widows, whose ties to (their husbands') inherited plots were cut upon the death of their husbands (e.g., Reyna, 1987).

[10] This analysis is done only over plots that have been under the head's management for more than 15 years.

[11] In recent years, the importance of maize has increased, both in terms of caloric intake and income (Thériault et al., 2018). Moreover, the production of maize is distinct from that of millet and sorghum—the traditional crops, in that maize has been traditionally considered as a cash crop and is more responsive to fertilizer.

[12] In estimating this last specification, we drop the maize dummy from equation 1.

[13] We use a cut-off of 15 years, in case a pre-cleared state is mistakenly recognized as a fallow state in the data.

[14] Based on a sample of 454 villages sampled by the government's Enquête Fichier des Localités, Koussoubé find that 19% of the sampled villages in the western provinces of Houet, Tuy, and Kénédougou, reported having an active land rental market. It is not clear, however, how a 'rental market' is defined, though Koussoubé notes that this designation was made by focus groups of local leaders and officials in each village.