Land, Power, and Property Rights: The Political Economy of Land Titling in sub-Saharan Africa*

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Abstract

Only 15 percent of African households possess a formal title for their agricultural land, despite the widespread availability of titles and their documented benefits. Local politics combine with national land regimes to explain this empirical anomaly. I combine 170,216 household-level observations of titling across 22 African countries with a novel geospatial measure of land values and the returns to agricultural investment. Households in areas with high returns to potential agricultural investment title more. However, in countries with centralized land tenure regimes, strong customary institutions attenuate this relationship; in countries with decentralized land regimes, strong customary institutions reinforce it. I use a case study in Côte d'Ivoire, including an original survey of 801 households and 194 customary elites, to trace these mechanisms at work. This research documents granular variation in the uptake of land titles, illustrates how local politics explain this variation, and outlines conditions under which customary elites impede development.

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Insecure property rights pose barriers to economic activity and stifle growth across the developing world (Deininger and Goyal 2024). The agricultural sector in sub-Saharan Africa employs 52 percent of workers, but insecure land tenure constricts agricultural investments and reduces productivity.[1] To alleviate these concerns, governments and international donors devote sizable resources to land tenure formalization programs. Land titles are available on-demand to many African farmers as part of 'piecemeal' titling programs (Honig 2022). Despite households' incentives to title and the widespread availability of land titles, the uptake of formal property rights remains decidedly uneven. In Ethiopia, 79 percent of households possess such a title; in Burkina Faso, Burundi, and Malawi, only three percent possess a title.[2] Within countries, titling rates vary across every level of administrative division. What explains the uneven uptake of formal property rights?

The confluence of local politics and national land regimes constrains household decisions to acquire a formal land title.[3] In addition to administrative fees, mapping complex patterns of land use onto individual titles creates risk for households. As a result, households formalize their landholdings only when the value of their property, or the potential returns to agricultural investments enabled by titles, increases to the point that the benefits justify the costs. In countries with centralized land tenure regimes, titling erodes the authority of these intermediaries who then impede formalization when they are able. In countries which devolve responsibilities for land tenure administration to local governments, customary elites facilitate land titling because they can capture the process and maintain their authority.[4]

I illustrate this theory using 170,216 household observations from the Demographic and Health Surveys (DHS) and Living Standards Measurement Surveys (LSMS) across

[1] This figure comes from the World Bank's 'Employment in Agriculture' statistics for sub-Saharan Africa in 2022. A wide-ranging body of evidence demonstrates that formal property rights provide greater security than informal property rights (Higgins et al. 2018; Lawry et al. 2017).

[2] These statistics are from the data I introduce below.

[3] I define 'land titles' here very broadly to mean some kind of state-issued written documentation of a claim over a parcel of land. Many such documents lack some portion of the 'bundle of rights' associated with property deeds in a Western context (Deininger and Goyal 2024: 135–56). I use the terms land titling and land formalization interchangeably.

[4] This paper considers agricultural land. Urban land tenure encounters different constraints (Balán et al. 2022) and so it is outside of my scope conditions.

22 African countries. I introduce a geospatial measure of land values and the returns to agricultural investments which sidesteps measurement problems associated with informal and illegible property markets. These cross-national data document granular variation in the uptake of formal property rights and build a descriptive understanding of land tenure formalization across sub-Saharan Africa. These data also provide substantively and statistically significant evidence that the interaction between the strength of local customary institutions and national land regimes moderates this relationship. In centralized land regimes, strong customary authorities attenuate the relationship between land values and land tenure formalization: a 1,000 USD increase in the returns to long-term agricultural investment is associated with a 32 percent increase in the likelihood of possessing a land title where chiefs are strongest and a 66 percent increase where chiefs are weakest. In devolved land regimes, however, strong customary authorities strengthen the relationship between increased returns to agricultural investment and land tenure formalization. In such countries, the same increase in the returns to investment is associated with a 57 percent increase where chiefs are strongest, and no increase where they are weakest.[5]

I use an in-depth case study of Côte d'Ivoire to unpack the mechanisms by which chiefs capture land titles and to show how chiefs use titling to advance their own political agendas. The history of migration in Côte d'Ivoire combined with a village mapping procedure to create local variation in the strength of customary elites. I leverage this natural experiment through an original field survey of 801 household heads and 194 customary elites across the Ivoirian cocoa belt. I show evidence for a number of intermediate observable outcomes of my theory: villages with stronger chiefs have more land titles, chiefs capture the land titling process, and chiefs leverage this capture to advance their political agenda by discriminating against relative outsiders (allochthones).

These results add to a voluminous literature in political science and political economy which seeks to explain the presence or absence of strong property rights. Much of this research centers how states and elites manipulate property rights for political and economic advantages: it asks why and when states and elites supply property rights (Albertus 2020; Boone 2014; Nathan 2023). I nuance these theories by explicitly incorporating the household decision to seek a land title within my model and show that household demand for

[5]These results are taken from column six of table 3. All figures are in constant 2011 US dollars.

formal property rights varies significantly even within regions and districts. While much of the existing body of work treats property rights or institutions in abstract terms (Acemoglu, Johnson, and Robinson 2001; Libecap 1989; North and Weingast 1989), I open the "black box" of property rights by showing how households interact with concrete and tangible land titles. This paper also builds a descriptive understanding of the geographic variation in land tenure formalization across sub-Saharan Africa.

Informal institutions structure state-building efforts and economic development across the developing world (Acemoglu et al. 2020; Díaz-Cayeros, Magaloni, and Ruiz-Euler 2014). They often facilitate economic growth by serving as development intermediaries (Balán et al. 2022; Baldwin 2016). However, informal institutions do not always "add value" to development; they can serve as either compliments or substitutes to the state (Baldwin, Kao, and Lust 2023; Henn 2023; Honig 2022). Through the lens of property rights, this paper advances the study of informal institutions by enumerating conditions under which informal elites support or impede state-building.

The paper proceeds in seven parts. The first section establishes an empirical puzzle: few African households title their land despite the benefits to so doing and the availability of titles. The second section delves into a demand-driven theory of land tenure formalization to explain this discrepancy. The third section outlines the data sources I marshal to test this theory, as well as the paper's methodology. The fourth section presents the quantitative results of these tests and documents how the interaction between strong customary institutions and land regimes moderates the uptake of land titling. The fifth section traces the intermediate steps of this theory by showing how powerful chiefs in Côte d'Ivoire capture the land tenure formalization process in a devolved land regime. The sixth section concludes the paper.

1 Formal and informal land tenure in sub-Saharan Africa

The majority of land in sub-Saharan Africa is held via informal, or customary, land tenure regimes. Across the most recent waves of the DHS and LSMS data collection, only 15.2 percent of landholding households possess a title for at least one of their agricultural parcels. The remainder hold their land through customary or informal rights, which are

not registered and are rarely written. Customary land rights may be recognized by the state on a case-by-case basis, but are usually managed by customary authorities such as village chiefs.[6] In contrast, formal land rights are registered with state institutions, generally in the form of a written land title. Titles document a claim to the land (ownership, use rights, alienability, etc.) and carry legal weight.

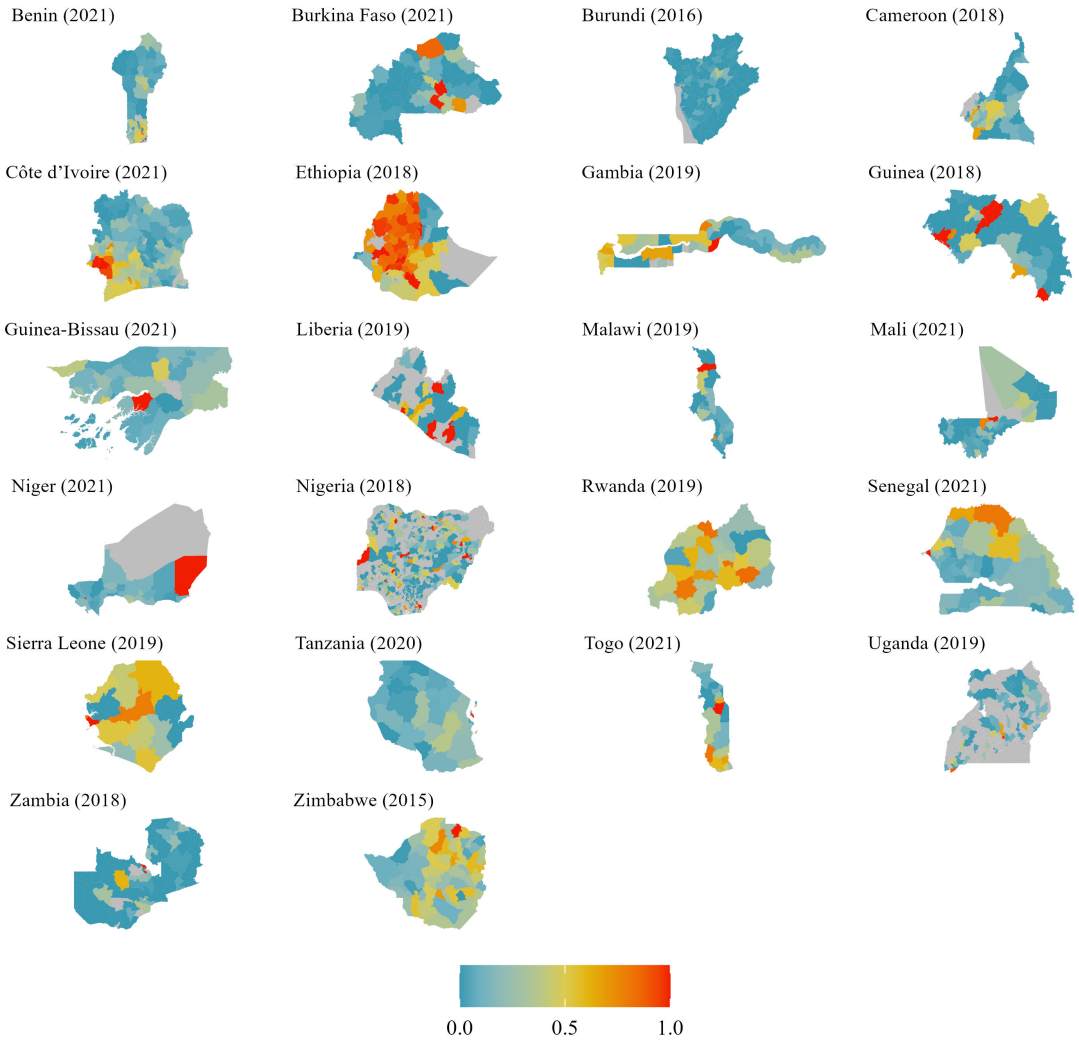
Secure property rights incentivize investment because one is more likely to receive the returns to one's investment (North and Weingast 1989). Acemoglu, Johnson, and Robinson (2001) famously show that countries with better institutions—defined as those with a smaller risk of property being expropriated—are richer than countries with worse institutions.[7] This mechanism also holds at the household level, where secure tenure incentivizes investments.

Abundant empirical research illustrates the linkages between land tenure security and agricultural investment. In Ghana, officers of local customary institutions feel more secure in leaving their plots fallow and have consequently higher level of soil fertility and agricultural profits compared to non office-holders (Goldstein and Udry 2008). In a randomized control trial in Benin, even land demarcation sans additional titling procedures led households to shift cultivation to crops which required a longer-term investment (Goldstein et al. 2018). Dillon and Voena (2018) show that households in Zambian villages where widows are unable to inherit land invest less in land quality. In India, households in areas with historically stronger landlords and weaker property rights have lower agricultural investments and productivity, even after independence (Banerjee and Iyer 2005). In the United States, uncertain title of railroads' land grants delayed the development and irrigation of frontier Montana and reduced land values by up to 21 percent (Alston and Smith 2022).

[6]The word "customary" need not imply these institutions are rooted in longstanding tradition. Many contemporary institutions date to the colonial period, when colonial regimes installed local intermediaries or expanded the powers of existing interlocutors (Nathan 2023).

[7]De Soto (2000) argued that secure property rights lead to economic growth by allowing households to mortgage their land but there is limited empirical evidence for this mechanism (Lawry et al. 2017)

Figure 1. Subnational variation in land titling across 22 African countries



This figure shows the fraction of landholding households with at least one formal title for an agricultural title at the district (2nd level administration division) level. Data are from the most recent round of the DHS and LSMS surveys. All calculations use the provided survey weights. Table A13 shows country-level averages.

The policies of African governments reflect the importance of land tenure security. Since the 2000s, 41 African countries have established piecemeal, or on-demand land titling procedures (Honig 2022: 2). In contrast to top-down land formalization programs,

demand-driven programs allow households to opt-in to land tenure formalization. Land titles are available, but households are not obligated to seek them.[8]

International donors also focus on land tenure security. The Land Portal Foundation, a consortium of international donor organizations, tracks 3,871 land governance projects around the world in its database. USAID alone has implemented land tenure projects in 23 separate countries. The World Bank and the Millennium Challenge Corporation (MCC) also heavily focuses on land tenure issues.

Titling remains rare across sub-Saharan Africa despite these efforts. Figure 1 documents extensive variation in the fraction of landholding households who possess a title, within both countries and regions. Areas with high rates of titling are not universally clustered around national capitals, or in resource producing areas. For example, there is a large concentration of formal land titles in the Fouta Djallon region of Guinea, a bastion of strong customary authority among the Peulh (Fulani) ethnicity. Mali's highest rate of titling is in the fertile Mopti region, but several communes within the arid region around Gao also have high rates of titling. Even within the districts shown in figure 1, the uptake of land tenure formalization varies dramatically across enumeration areas.

These facts pose a puzzle. Rural households benefit from land titles. Many African states have made land titles available, often with support from international donors. Nevertheless, land titles remain rare, although high levels of spatial variation persist even within regions. What explains this limited uptake of land tenure formalization?

2 A demand-driven theory of land titling

This section responds to the above puzzle by introducing a new theory of land tenure formalization in which household demand for land titles takes center stage. Households decide whether to acquire a formal land title. Pursuing a land title is costly: households pay an administrative fee but also incur a variety of risks when they title. Consequently, they only title when the benefits outweigh the costs. These benefits are increasing in

[8] Rwanda and Ethiopia are important exceptions: both mandated top-down, comprehensive titling drives. According to the most recent round of DHS collection, 69.4 percent of Rwandan households and 79.4 percent of Ethiopian households possess at least one formal land title.

the value of land and the returns to potential agricultural investments. Chiefs have an incentive to impede titling, because titling displaces their role in customary land administration and removes a long-term reservoir of political authority. On the other hand, when land administration is devolved, chiefs can capture local land administration regardless of titling. In these contexts, chiefs facilitate land titling because they can manipulate titling to advance their political agendas without ceding control over land.

2.1 Household balance costs and benefits

Land titling is costly. Generally households pay some kind of fee to title. In Sénégal, a land title costs around 5,000 CFA, or about 8 USD. In Côte d'Ivoire, Bassett (2020: 144) enumerates "over 20 steps to obtain a land certificate and another dozen to obtain a land title," many of which involve a fee. These steps involve multiple levels of government: the village land management committees (CVGFRs), the sous-prefectures, and the Agence Foncier Rurale (AFOR) in the capital. Such processes are common across the continent.[9]

However, the costs to titling go beyond monetary fees or time spent in the sous-prefect's office. Land tenure formalization is not a one-to-one mapping of existing land use onto paper; it creates winners and losers. In much of sub-Saharan Africa, agricultural parcels are subject to overlapping ownerships which exist in a state of strategic ambiguity (German 2022; Lund 2008). One person may have the right to farm in the dry season, another in the rainy season. A third person may have the right to graze their animals on the parcel. A fourth person may be the descendent of the original inhabitants of the area, who collects customary (but debatably ceremonial) rents. Which of these four owns the parcel? Land titling forces the issue of hierarchy between these partial owners. Formalization may carry a particular risk for "groups such as women, pastoralists, hunter-gatherers, casted people, former slaves and, and serfs, who have traditionally enjoyed subsidiary or derived (usufruct) rights to land" (Platteau 1996: 40). This risk forms an additional cost to titling.

[9]Tribal certificates in Liberia are issued by local communities, but they must be submitted to the Liberia Land Authority in Monrovia and published in both the official gazette and three other newspapers of national coverage.

If titling is expensive and risky, why do households pursue it? Land conflicts are an unfortunately common occurrence in much of Africa. In Côte d'Ivoire for example, settlement patterns by Burkinabé and Baoulé migrants led to large scale uprisings with as many as 4,000 casualties in the 1970s (Boone 2003: 220). In parts of Northern Ghana, the dispossession of historical elites led to conflicts between the village chiefs and the dispossessed earthpriests (Lund 2008). The fact that individuals who are more highly placed within customary institutions feel more secure in fallowing land likewise highlights the risk of expropriation (Goldstein and Udry 2008). Formal property rights can help alleviate such concerns. Titling one's land reduces the risk of losing it.[10]

Households will be more willing to title their land when the value is higher. Losing a valuable piece of land to a conflict is worse than losing an unproductive piece of land. Where an asset is more expensive, households will go to greater lengths to protect it—including undertaking a costly titling process (Besley and Ghatak 2010). These arguments echo those within political economy theories of endogenous institutions, which posit that property rights emerge when the individual benefits to organizing such a system become equal to the individual costs. Shifts in relative prices can shock prevailing equilibria and drive institutional change (Libecap 1989). Rosenthal (1992: 21) illustrates this dynamic clearly in Revolution-era France, where "it was not worthwhile to define property rights to unimproved land clearly, for enforcing such rights would have required monitoring unwarranted by the low value of the land." In the context of land formalization, a shift in the value of land or potential returns to investment should drive rural households to seek formal titles for their parcels.[11]

Land titling also incentivizes households to invest in their land. Households with more secure land are able to invest with comparatively greater surety that they will receive the returns to these investments (Dillon and Voena 2018; Goldstein and Udry 2008). These investment can be short term—such as fallowing one's land, or investing in fertilizer—or long term, such as planting tree crops which can take four to five years

[10] I focus on the legal weight of titles, but the legibility of titles—regardless of their legal weight—could also drive an increase in perceived land tenure security. (Ferree et al. 2023: 54; also Scott 1998).

[11] As part of his survey of the British colonies, Lord Hailey (1938: 830) wrote that "we are beginning to see new varieties of custom created by the growth of more intensive systems of cultivation, and by the fact that, in some areas at least, land is beginning to acquire a commercial value."

to become productive. The potential returns to investment in the parcel drive titling by incentivizing households to protect their future investments in the land.

Land tenure insecurity is not always the binding constraint to investing in one's agricultural parcels. Much land in sub-Saharan is arid or infertile (Herbst 2014). Many seemingly lush tropical areas suffer from poor soil. In such areas, the benefits to households from seeking a formal land title will be lesser—more secure land title will not unlock investment where the potential returns to such investments are too low. These dynamics suggest that households will formalize their land only when the value of the land or the returns to investment in agricultural parcels is high enough to justify the costs. More specifically, I hypothesize that:

H.1 Households in areas where the value of land is higher will be more likely to possess a title.

H.2 Households in areas where the returns to agricultural investment are higher will be more likely to possess a title.

2.2 Chiefs and precolonial institutions

Households do not title in a vacuum. The vast majority of villages in sub-Saharan Africa have some manner of customary leader—most often a village chief (Baldwin 2016). These chiefs have an incentive to prevent households from seeking land titles. However, chiefs do not always have the capacity to act on this incentive to prevent titling.

Customary authorities, most often chiefs, are important political actors across sub-Saharan Africa (Baldwin 2016). Chiefs' control over land reinforces their authority in other dimensions. Where property rights are insecure, chiefs can use control over land to sanction households who go against the chiefs in other ways (Acemoglu, Reed, and Robinson 2014). Even without such threats, the role chiefs play in resolving land disputes enhances their perceived authority to regulate conflicts. Chiefs are often the first step to resolve land disputes. When households bring their disputes to the chief, they implicitly recognize the chiefs' authority to arbitrate such disputes. Lund (2008: 10) summarizes this point, that "[r]ecognition of property rights by an institution simultaneously constitutes a process of recognizing the legitimacy of the institution." By keeping

land rights in the customary regime, chiefs maintain a long-term reservoir of political legitimacy. Baldwin and Ricart-Huguet (2023) illustrate this dynamic: households across sub-Saharan Africa perceive their chiefs to be more authoritative where land values are higher because of increased competition over land. If control over land held in the customary system enhances chiefs' political authority, then removing control of land to a centralized formal land regime will reduce their authority.

Chiefs also act as development intermediaries. Baldwin (2016) notes that much of chiefs' legitimacy as political actors comes from their performance on the job: constituents prefer a chief that delivers development goods, such as roads or clinics. Land titles are another form of development good. However, the extent to which chiefs can claim credit for such development goods depends on where decisions are made. Where land tenure administration is centralized, this kind of credit-claiming becomes more difficult, creating a second rationale for chiefs to impede titling.

Stronger chiefs are better able to act on their incentives to impede titling.[12] The strength of precolonial institutions is often measured in terms of the number of hierarchical layers of governance (Honig 2022; Neupert-Wentz and Müller-Crepon 2024). Chiefs who are situated in hierarchical institutions are better able to prevent the land titling process. Customary elites who are situated within these hierarchical institutions are more empowered to enforce their decrees. Within weakly hierarchical society, customary elites may not have the political capital to enforce judgements (Boone 2003). Increased within-village hierarchy may also help chiefs to hold households accountable because within-village elites such as lineage heads can convey grievances to or from the chief or act as the chiefs' lieutenant.[13]

A variety of literature explores how precolonial institutions affect contemporary outcomes. Honig (2022: 11), for example, notes that

> Customary institutions with hierarchical legacies trace their roots to powerful precolonial states with hierarchical authority structures that withstood the colonial conquest... producing variation in the contemporary strength of customary institutions within each country.

[12] Appendix D explores this claim.

[13] Greater levels of local hierarchy may also spread out the benefits of maintaining land in the customary system, decreasing incentives to title (Honig 2017).

Similarly, Wilfahrt (2022) notes how the overlap of precolonial institutions and contemporary state organs affects local redistributive politics in Sénégal. Neupert-Wentz and Müller-Crepon (2024) show that areas with hierarchical precolonial institutions have greater levels of contemporary political complexity. Precolonial hierarchy is especially pertinent when it comes to chiefly control over land, because much of the chief's authority over village life is predicated upon their control over land (Acemoglu, Reed, and Robinson 2014; Honig 2022). This political authority means that chiefs are better able to act on their incentives to prevent land titling.

Putting these factors together, chiefs in centralized land regimes have an incentive to impede land titling, and stronger chiefs are better able to prevent titling. As a result, I hypothesize that

H.3 Strong customary institutions will attenuate the relationship between land values/returns to titling in countries where land tenure formalization is centralized.

2.3 Devolved and Centralized Land Regimes

Titling reduces the power of chiefs when it removes land administration to a centralized authority. However, titling can buttress, rather than diminish, the power of chiefs in areas where chiefs can capture the process.

In countries with centralized land tenure regimes, decisions around land tenure formalization are made at the national level—which is more distant to customary elites. For example, the Liberian Land Authority presents itself as a "one-stop shop" for land tenure formalization. Land administration and titling occurs in Monrovia—far from customary institutions. Another strong example is Rwanda, where the country's comprehensive land tenure formalization drive was managed entirely by the state. Rwanda selected areas in which to title, household claims were mapped, and then the central land registry office published the information (Ali, Deininger, and Goldstein 2014).

Other countries devolve their land tenure regimes to local authorities. Land administration is a difficult task: agricultural land often exists in hinterlands where state capacity is comparatively limited (Herbst 2014). Where control of land is devolved, chiefs are able to capture the land tenure formalization process. For example, municipal councils

in Sénégal issue the rural land certificates (*délibérations foncières*), but in practice the municipal councils rely on chiefs to guide land titling procedures and resolve disputes. In a survey of 1,164 household heads across rural Sénégal, 92 percent of households said it would be necessary to inform the chief to acquire a *délibération foncière*, 47 percent said it would be necessary for the chief to investigate your claim, and 18 percent said it would be necessary to pay the chief (Ribar 2023). Similarly, village land management committees (*comitès villageois de gestion foncière rurale*, or CVGFRs) in Côte d'Ivoire investigate land claims, although titles (*certificats fonciers*) are formally distributed by the national land bureau. Village chiefs have no official position in CVGFRs, but they nevertheless almost always head the committee.[14]

Chiefs can capture land titling in both neocustomary and statist land regimes (2014: 24–5). In statist regimes, "governments administer the allocation and holding of rural property directly;" in the latter, land is governed indirectly through customary institutions.[15] However, local land tenure arrangements are complex, heterogenous, and often illegible to the state (Scott 1998). As a result, chiefs play a large role in adjudicating land claims even when land administration is officially in the hands of the state. The important factor in my analysis is chiefs' *de facto* control over titling, rather than their *de jure* control. Consequently, I measure devolution of tenure through the administrative level at which titling decisions are made—there is greater potential for chiefs to capture titling where decisions are made locally.

This capture of the titling process means that chiefs do not lose their power over land tenure, even when households seek title. Chiefs no longer have an incentive to impede titling—titling does not erode their power. As a result, chiefs can use titling to advance their own political agendas. For example, Onoma (2010: 81) shows how chiefs in Ghana used land tenure formalization to "purchase and ensure political support." Of course, different chiefs have different incentives. In Côte d'Ivoire, as I show in section 5,

[14]Chiefly capture of land tenure regimes opens the possibility of revoking a title. Onoma (2010) cites several extreme examples in Ghana. In many countries, including Sénégal, titles are actually long-term leaseholds which can be revoked if the land is not worked. Such examples are uncommon, but they suggest that titled land does not irrevocably exit the customary land regime where chiefs capture titling.

[15]Boone (2014: 25) specifically refers to these institutions as *neocustomary* to emphasize their often limited resemblance to historical precolonial institutions.

this agenda involves excluding outgroups from titling. Devolved land titling also opens space for chiefs to use land titles as a development good to increase their power (Baldwin 2016). Because land titling under devolved land regime lets chiefs advance their agendas without eroding their power, chiefs within a devolved land regime have an incentive to facilitate titling.

Strong chiefs are better able to act on these incentives—they have greater control over villagers and so can facilitate titling. Acemoglu, Reed, and Robinson (2014: 323), for instance, find that stronger chiefs "have more authority to influence whether or not people can farm or sell a piece of land." It may also be the case that stronger chiefs are more able to capture land titling institutions, but my Ivoirian case study suggests that even comparatively weak chiefs are able to control their village land committees.

Why do some African states devolve land tenure? Centralized land tenure administration was the default condition across colonial Africa, particularly in polities under French control. Centralized administration was necessary to alienate productive land from African populations (Hailey 1938: 1649). Starting in the 1990s, the World Bank promoted a number of decentralization proposals across the developing world (Deininger 2003). A number of MCC compacts, such as those in Benin and Niger, also promoted decentralization reforms. These reforms are largely donor-driven, rather than reflective of domestic politics. Decentralization programs are also a bad candidate for clientelist or targeted policies, because by nature they affect entire countries. German (2022) further notes that many of the structural reforms and other projects are more reflective of a World Bank-driven 'knowledge-regime' than of local circumstance.

In summary, land in the customary system enhances the power of chiefs. When households title land, it exits the customary system. Where the administration of land tenure is devolved, chiefs can retain some control over land tenure through their capture local land institutions, and so titling land does not eliminate the chiefs' authority. In devolved land regimes, chiefs have an incentive to facilitate land titling so they can use it to advance their political agendas and potentially claim credit for providing a development good. Where land tenure administration is devolved, chiefs have an incentive to facilitate formalization so they can claim credit for providing development goods, and so they can use titling to advance their political agendas. Where land tenure formaliza-

tion is centralized, titling cuts chiefs off from their reservoir of political authority, and so they have an incentive to oppose it. The incentive to impede or facilitate titling does not confer the ability: stronger chiefs—measured through the presence of hierarchical precolonial institutions—are better able to act on these incentives. In contrast to areas with centralized titling, I predict that:

H.4 Strong customary institutions will strengthen the relationship between land values/returns to titling in countries where land tenure formalization is devolved.

3 Data Sources and Methodology

This section overviews the sources of data I use in the cross-country portion of the paper, along with my methodology. For the outcome variable, I combine 66 waves of DHS and LSMS data across 22 African countries to extract 170,216 household-level observations of land titling.[16] Next, I combine geospatial measures of agricultural suitability with historical commodity pricing to measure both the value of agricultural land and the returns to agricultural investment. Third, I introduce my measure of chiefs' capacity to act on their incentives to impede or facilitate titling, measured through the hierarchy of local precolonial institutions. Finally, I introduce my original coding of country land regimes.

3.1 Outcome variable: household titling

The lack of accessible administrative data on land titling has hampered the ability of scholars to study the subject. To sidestep this problem, I combine data from the DHS and LSMS cross-national survey project. The DHS project collects comparable data on developing countries around the world. In its module on agriculture and landholding, the DHS asks "do you have a title deed or other government recognized document for any land you own?" Like the DHS, the World Bank's LSMS program is a large scale effort to collect comparable data across the developing world. The LSMS contains a

[16]There are 425,663 observations across the merged survey data; the difference (251,466) are dropped because they are either urban, or they do not own land.

parcel-level roster of agricultural land and asks "[d]oes your household currently have a title or ownership document for this parcel."

These similar questions allow me to construct the main outcome variable of the paper: a binary indicator for whether a household possesses a title for at least one parcel of agricultural land.[17] In addition, I include the age, sex, and education of the household head, which I include as demographic control variables. I also capture a binary indicator for whether the household has a title for their dwelling, which I use as a placebo outcome in section A.3.

These data provide observations for 22 countries across 62 survey waves. Six countries have only one survey wave; the remainder have at least two. Survey data come from the period between 2010 and 2021, with only three waves taking place earlier (Uganda in 2005 and 2009 and Tanzania in 2008). While the DHS data have been collected since the late 1980s, questions about land tenure only appeared in round seven of DHS, which started in the mid-2010s.

3.2 Land values and returns to investment

Illegible and informal land markets in most of Africa prevent researchers from directly measuring realized values of land.[18] To overcome these issues, I implement a novel measurement of 'attainable value:' the value for which the maximum attainable yield (per hectare) could sell for on the international commodity market. I combine geospatial crop suitability data with global commodity prices to obtain these land values at a 10km-by-10km grid cell level. Adjusting the underlying parameters of the crop suitability models creates two measures of the returns to agricultural investment: the marginal increase in attainable value from using fertilizer, and the marginal increase in attainable value from planting tree crops as opposed to perennials.

I use version four of the Food and Agriculture Organization (FAO)'s Global Agro

[17] The outcome variables are not identical across the two surveys—while the LSMS protocol asks if any parcel owned by a household is titled, the DHS protocol asks if any man has a title for their land. While the overwhelming majority of parcels are owned by men, these answers could give slightly different numbers. This difference is absorbed by fixed effects in all models.

[18] Differences in future discounting which could also feed into latent land values, but these cannot be addressed with current data.

Ecological Zone (GAEZ) model to obtain the 'attainable yield' of different crop types. The model takes into account climate, soil and terrain data, as well as phenology and crop calendars to calculate the attainable yield of crops for a 10km by 10km grid.[19] Potential total production is divided by total grid cell area. Prices come from the IMF's Primary Commodity Price System.[20] I set prices to constant 2011 USD. The commodities included in these data are: bananas, barley, chickpeas, canola oil, cocoa, coconuts, coffee, cotton, corn, groundnuts, oats, palm oil, rice, rubber, sunflower oil, soybeans, sorghum, sugar, tea, and wheat.

For each crop and grid cell, I multiply the maximum attainable yield (metric tons per hectare) by the commodity prices in a given year (USD per metric ton) to obtain the attainable price (USD per hectare) for each crop. I then take the maximum of this vector. More formally, the maximum attainable value π of grid cell g in year y is defined as:

$$\pi_{g,y} = \max_{c}(p_{c,y} \cdot s_{c,y,g})$$

where p indicates crop price, s indicates the attainable yield, and observations are indexed by g for grid cell, y for year, and c for crop. These data measure the maximum attainable value in dollars per hectare for a given 10km-by-10km grid cell on a yearly basis.

This measure calculates the attainable value of agricultural production per hectare; in other words, in captures the value of agricultural land. However, testing H2 also requires a measure of the returns to potential agricultural investment. To that end, I calculate two additional variables: the returns to using fertilizer (a short-term investment) and the returns to planting tree crops (a long term investment). The primary land value measure assumes that households do not fertilize their parcels. Fertilizer is not a consistent or linear multiplier for yields. In some locations and for some crops, fertilizer greatly increases yields. Elsewhere, the returns are minimal. By re-calculating the GAEZ attainable yield models assuming fertilizer use, I can take the difference to identify the

[19] Attainable yield here differs from "agro-climactic suitability" because the latter do not consider soil suitability and terrain factors. These data are based on the RCP4.5 climate projection.

[20] The FAO's producer price database provides more granular estimates of crop prices, but has too many missing data points to be useful. For example, in the target period it is missing cocoa and coffee prices in Côte d'Ivoire—the country's two primary export commodities.

returns to fertilization.

I also calculate the returns to cultivating tree crops over perennial crops. Tree crops require a high up-front investment: households must purchase saplings or wait for trees to become productive. Coffee trees, for example, take five to seven years to become commercially viable. As a result, tree crops represent a longer-term investment than purchasing fertilizer for the remaining year. Of the 20 crops for which I have price data, I classify bananas, coconuts, cocoa, coffee, rubber, and tea as tree crops. I calculate the maximum attainable value for these crops, and subtract the maximum attainable value for other crops. Where this difference is negative, I reset it to zero, in recognition that farmers would not make an unprofitable decision.

Farmers do not receive the global commodity prices. However, the validity of this measurement requires only that the prices farmers receive are positively correlated with global commodity pricing. In appendix B.2, I probe this requirement using a subset of data for which households' planting decisions are available. Households respond to this measure of attainable value: a one percent increase in the average attainable value per hectare of a crop is associated with a 0.13 to 0.16 percentage point increase in the amount of land that farmers dedicate to that crop. Similarly, an increase of one percent in the fraction of an administrative area in which a crop is the most profitable is associated with a 0.076-0.08 percentage point increase in the fraction of land that farmers dedicate to that crop. In other words, the elasticity of crop planting with regards to the crop's attainable value is positive, which supports this land value measure capturing the underlying phenomenon of agricultural production.

This metric superficially resembles a shift-share instrumental variables (SSIV), design. However, my measure is not an instrument—attainable yield operationalizes the latent land values directly. Second, the SSIV designs use the weighted exposure to shocks across sectors. In this paper, the land values metric takes the maximum of a vector (the highest multiplicative product of crop yield and commodity price vectors) rather than a weighted mean.

3.3 The strength of customary institutions

To measure the extent to which chiefs are able to act on their incentives to impede or facilitate titling, I use geo-referenced data from Murdock's Ethnographic Atlas (Moscona, Nunn, and Robinson 2020; Murdock 1967), a common reference for differences among pre-colonial institutions. The Murdock dataset includes 89 variables on 802 different ethnic groups around the world, of which 239 are located in sub-Saharan Africa. The specific variable from the Murdock dataset through which I operationalize chiefs' capacity is the precolonial institution's level of hierarchy, which Murdock measures in two numbers:

> the first indicates the number of levels up to and including the local community and the second those transcending the local community. Thus 20 represents the theoretical minimum, e.g., independent nuclear or polygynous families and autonomous bands or villages, whereas 44 represents the theoretical maximum, e.g., nuclear families, extended families, clan-barrios, villages, parishes, districts, provinces, and a complex state (Murdock 1967: 160).

This paper uses the first of these numbers: the number of administrative levels **within villages**.[21] This local hierarchy is more likely to reflect local norms, rather than constellations of power which were sedimented by colonial regimes (Chanock 1991). Acephalous societies, such as the independent villages of northern Ghana, would rank at the lowest level (Nathan 2023). In Sénégal the Imamate of Fouta Toto possessed a ruling council, regional chiefs, village chiefs, neighborhood chiefs, lineage heads, and household heads. Such a precolonial kingdom ranks at a four-four (the highest levels for both sets of hierarchy) on the Murdock scale.

Precolonial elites used the institutional discontinuity brought about by European rule to supplement their own authority (Berry 2001; Boone 2014; Lund 2008). In many cases, what today constitutes 'custom' reflects the powers that customary elites could convince the colonial state they possessed (Chanock 1991). In other cases, customary

[21] In contrast, most existing research on the role of precolonial hierarchy in determining contemporary outcomes uses hierarchy outside the village (Michalopoulos and Papaioannou 2013; Neupert-Wentz and Müller-Crepon 2024). Honig (2022) also uses precolonial hierarchy as an explanatory variable, although she does not draw on Murdock's data.

elites and chiefs were entirely invented by colonial powers (Nathan 2023). Nevertheless, what matters for my analysis is not the specific powers claimed by the village chief, but rather the extent to which the chief can act on their incentives to facilitate or impede land titling. Within-village precolonial hierarchy increases this ability because it provides the chiefs with more avenues to sanction households who act against the chief as well as subordinates—such as lineage heads—through which to administer the village.

There is undoubtedly noise in the relationship between precolonial hierarchy and contemporary institutions.[22] However, a variety of literature suggests that, on average, contemporary political institutions are stronger in areas where precolonial institutions were more hierarchical (Honig 2022; Neupert-Wentz and Müller-Crepon 2024; Wilfahrt 2022). Moreover, I believe this source of error to be uncorrelated with the independent or dependent variables, so this source of error would attenuate my results towards zero. As a result, one can consider this paper's results as a lower bound on the relationship between land values and titling.[23]

Ultimately, the hierarchy of precolonial institutions is an indirect measure of the strength of contemporary customary institutions. However, it has a crucial advantage over alternatives: it is comprehensive. This measures covers the universe of precolonial polities in Africa. These data are geospatial, so they produce variation at the levels where my other data sources vary. Appendix D provides additional evidence of the correlation between these Murdock data and the strength of current precolonial institutions.

3.4 Devolved and centralized land regimes

Finally, I code whether land regimes in a given country are centralized or devolved. This distinction matters because chiefs are better able to capture the land tenure process

[22] An alternative approach would be to use Afrobarometer data to directly examine the roles of contemporary chiefs (for example: see Henn 2023). While these samples are randomly selected, and thus provide an unbiased average result, the overlap is just too small for statistical analysis—any correlations are as likely to be noise as they are to be signal. I discuss these relations further in appendix D.

[23] Wilfahrt (2022) suggests chiefs are stronger where precolonial institutions and current administrative areas are geographically coterminous. My paper centers village chiefs, whose areas of geographic control are too small to be split across multiple precolonial institutions and nested within administrative areas. As such, I would expect the geographic overlap between administrative areas and precolonial institutions to be reasonably constant across my data.

where decision-making is devolved. I classify a land regime as devolved if decisions about whether a household can title a given parcel are made at the national level (centralized) or another level (devolved). This variable operationalizes the extent to which chiefs are able to capture land titling in a way that preserves my ability to make cross-national comparisons.

I specifically code this variable based on where the decision is made, rather than the location at which land titles are certified or recorded. For example, in Sénégal, *déliberations foncières* are adjudicated, issued, and recorded by municipal councils, a third level administrative devision. Côte d'Ivoire is a more complicated case: village-level CVGFRs decide who can obtain a *certificat foncier*, the sous-prefect verifies that correct procedures were followed, and the national land agency ultimately certifies the title. While administrative procedures take place at all three levels, this is a devolved land regime because villages make the decisions. The process is similar in Zambia: the Office of the Commissioner of Lands ratifies decisions made by chiefs. In contrast, the National Land Agency of Rwanda maps parcels, adjudicates titling, and issues certificates—a centralized land regime. Appendix E gives a complete list of countries and more detailed narratives which explains exactly how and why I classified these countries. No countries changed land regimes during the period of study.

3.5 Methodology

I analyze these variables using a series of linear probability models with fixed effects at the country-survey wave level. I also include a set of demographic controls, including the household head's education level, sex, age, marital status, and whether the household is urban or rural. My geographic controls are measured at the second-level administrative division, and include geographic area, population density of the district, an interaction of area and population density, average terrain ruggedness, caloric yield, average road density, and density of highways. I transform the road density variables using the inverse hyperbolic sine to improve normality.

I model the moderating effects of land regime and informal institutions on the relationship between land values and titling through a series of triple interaction models. The

triple interactions are necessary to capture the dependencies between land values/returns to investment, hierarchy, and land regimes. These regressions take the form:

$$y_{idnw} = \beta_1 V_d + \beta_2 H_d + \beta_3 V_d \cdot H_d + \beta_4 H_d \cdot C_n + \beta_5 V_d \cdot H_d \cdot C_n + X_i + Z_d + \psi_{nw}$$

Where V indicates the land value variable (I estimate separate equations for each of three land value/agricultural investment variables), H represents the fraction of the district covered by hierarchical precolonial institutions, and C is a binary indicator for whether the country devolved its land administration. X and Z are vectors of household-level and district level controls (respectively), i indexes observations by individual, d by district, n by country, and w by survey wave.[24] To facilitate interpretation, I also include marginal effects plots for all three land value variables. Tables 1, 2, and 3 all include these control variables; appendix tables A1, A3, and A2 replicate these analyses without controls, with similar results.

3.6 Threats to inference

I measure land values by interacting the attainable yield per hectare for a variety of different agricultural products with their commodity prices on the global market and taking the maximum. This estimation strategy is a form of weighted exposure to common shocks (Borusyak and Hull 2020): the crop prices are the shocks, and the total attainable yields per hectare are the weights. These shocks themselves are exogenous; no individual farmer or country can affect the a crops global commodity price. One potential threat to inference in this case is that observations' weights (i.e. their crop suitabilities) are likely not entirely exogenous to land titling. Soil quality may have other causal pathways to land titling rates; for example, Baldwin and Ricart-Huguet (2023) show that land quality affects the power of traditional leaders. In such cases, a non-random exposure to common shocks research design can lead to omitted variable bias (Borusyak and Hull 2020). When not otherwise controlled for by fixed effects, I include the average shock across all years for observation i to control for this bias.

[24] The devolved indicator by itself is absorbed by country-wave fixed effects.

A second threat to inference is that a country's land tenure regime, centralized or decentralized, is endogenous to other variables. Albertus (2020: 169), for example, points out that farmers who are "fixed geographically and lack property rights while facing obstacles to acquiring necessary agricultural inputs and credits are the stuff of clientelist party fantasy." As a result, states may centralize land regimes in order to withhold titling. Many African leaders are also large-scale landowners, which gives them economic incentives to promote or withhold titling (Onoma 2010). Countries may also make the decision to devolve land titling on the basis of geography: devolution would be especially useful in countries with large hinterlands which complicate governance (Herbst 2014). Mali and Niger, for instance, both have sparsely populated hinterlands and devolved land tenure. However, small countries such Ghana and Lesotho also devolved land tenure.[25] The decision to devolved tenure could also involve different social alliances and constellations of power: states are more likely to devolve power to rural elites who support their political regime (Boone 2003).

Many of these variables—politics, geography, and political coalitions—may co-vary with land tenure regimes.[26] I control for the direct effect of these variables through country-wave fixed effects. I also control indirectly for both population density, administrative area size, and their interaction in all regressions which should control for being in a hinterland. Devolved land rights is also a national variable, whereas local power blocs or hinterlands are sub-national. I am ultimately unable to eliminate the possibility that an endogenous variable drives these results, but

The concept of ownership is not constant across sub-Saharan Africa. Land ownership is often plural, in that multiple actors may have at least some claim over a particular parcel. Increased costs of titling due to plural ownership of land could reduce titling rates in certain areas and bias the results. The detailed subset of LSMS data collected as part of the EHCVM helps identify the extent of collective ownership. These surveys contain data on 148,885 separate parcels across 42,287 landholding households. Among these households, 70.6 percent individually own their parcels, 11 percent collectively own

[25]Population density is a reasonable proxy or these rural areas; in table A9 I show that population density does not predict titling.

[26]Though German 2022 notes that recent land tenure reform has largely reflected donor priorities and a global 'knowledge regime,' rather than conditions or preferences within Africa.

their parcels, and 18.4 percent own some parcels collectively and own some parcels individually.[27]

Because my outcome variable is whether a household possesses at least one land title, so this statistical bias would exist only for the 11 percent who only hold land collectively. None of these 11 percent of households report owning their collectively held land; instead, they report holding it through loans or sharecropping agreements. I exclude these households because I limit my analysis to landholding households. While the DHS data collection does not ask the mechanism through which a household holds land, I have no reason to believe that collective ownership is more common in countries where DHS data collection took place than in countries where LSMS data collection took place. I cannot entirely exclude the possibility that differing norms of collective ownership create bias in my results, but statistics from a subset of the data suggest that this problem applies only to a small percentage of respondents.

Finally, another potential threat to inference comes from the potential endogeneity of donor funded land tenure formalization programs. Donors may target programs to areas where land values are high; in turn, these programs will likely increase rates of land titling. As such, donor funded land tenure formalization programs are a mediator variable, rather than a confounding variable (Morgan and Winship 2015). It is possible that adding this variable into my analysis would attenuate my results. Unfortunately, there is no comprehensive database of land tenure formalization programs with sufficient geographic granularity to explore this mediator. However, donor-funded land programs would only mediate the direct relationship between land value variables and titling. Land tenure formalization programs often subsidize the administrative costs of titling, but they do not change chief's incentives to impede or facilitate land titling. As such, including donor-funded land programs would be unlikely to affect the overall marginal effects I display in figure 2.

[27]The administrative data I collected in Cote d'Ivoire provide a similar statistic: 17.6 percent of all land titles finalized between 2010 and 2022 were collective, rather than individual.

Table 1. Strong customary institutions moderate the relationship between land value and the uptake of land titles

	(1)	(2)	(3)	(4)	(5)	(6)
Land value	0.033		0.033	0.036	0.042**	0.064**
	(0.024)		(0.023)	(0.022)	(0.015)	(0.024)
Hierarchy		−0.006	−0.005	−0.075*	−0.005	0.044
		(0.028)	(0.029)	(0.034)	(0.028)	(0.069)
Hierarchy * Devolved				0.103*		−0.067
				(0.043)		(0.081)
Land value * Hierarchy						−0.031
						(0.023)
Land value * Devolved					−0.012	−0.043
					(0.022)	(0.032)
Land value * Hierarchy * Devolved						0.050
						(0.028)
Country-Wave Fixed Effects	X	X	X	X	X	X
Demographic Controls	X	X	X	X	X	X
Geographic Controls	X	X	X	X	X	X
Num.Obs.	168 156	168 156	168 156	168 156	168 156	168 156
R^2	0.251	0.251	0.251	0.253	0.251	0.253

Note: The dependent variable is whether a household possesses a land title. The independent variables are the maximum attainable value; the fraction of an administrative unit that is covered by a hierarchical pre-colonial institution; and whether the country devolved its land regime. The unit of analysis is the household. Land value data vary at the second level administrative division. Demographic controls include the age, sex, and education of the household head; geographic controls include area, population density, an urban/rural indicator, road density, highway density, and terrain ruggedness. Table A4 shows coefficients for these controls. Data are from the DHS and LSMS projects. All regressions use OLS with survey weights and country-wave fixed effects. Standard errors are clustered at the country-wave level.

4 Results

Previous theory suggests that both the value of land and the returns to agricultural investment should be positively associated with titling rates (H1 and H2). In countries with centralized land tenure regimes, strong customary institutions—measured by the hierarchy of precolonial institutions—will attenuate this relationship (H3). In countries with devolved land tenure regimes, strong customary institutions will strengthen it (H4).

Table 1 shows the results of regressing the household titling indicator on the maximum attainable value per hectare (in the previous year), in various combinations with the percent of the administrative division covered by a hierarchical pre-colonial institution and an indicator for whether the country has devolved its land regime. The maximum attainable yield per hectare has a qualitatively similar magnitude across specifications,

Table 2. Strong customary institutions moderate the relationship between returns to fertilizer and the uptake of land titles

	(1)	(2)	(3)	(4)	(5)	(6)
Difference (fertilizer)	0.848***		0.844***	0.896***	1.089***	1.666***
	(0.243)		(0.231)	(0.248)	(0.222)	(0.313)
Hierarchy		−0.006	−0.005	−0.076**	−0.005	0.069
		(0.028)	(0.027)	(0.029)	(0.027)	(0.046)
Hierarchy * Devolved				0.105**		−0.080
				(0.039)		(0.058)
Difference (fertilizer) * Hierarchy						−1.178**
						(0.417)
Difference (fertilizer) * Devolved					−0.442	−1.474*
					(0.474)	(0.693)
Difference (fertilizer) * Hierarchy * Devolved						1.745**
						(0.623)
Country-Wave Fixed Effects	X	X	X	X	X	X
Demographic Controls	X	X	X	X	X	X
Geographic Controls	X	X	X	X	X	X
Num.Obs.	168 156	168 156	168 156	168 156	168 156	168 156
R2	0.252	0.251	0.252	0.253	0.252	0.255

Note: The dependent variable is whether a household possesses a land title The independent variables are the increase in maximum attainable value from fertilizing a parcel; the fraction of an administrative unit that is covered by a hierarchical pre-colonial institution; and whether the country devolved its land regime. The unit of analysis is the household. Land value data vary at the second level administrative division. Demographic controls include the age, sex, and education of the household head; geographic controls include area, population density, an urban/rural indicator, road density, highway density, and terrain ruggedness. Table A5 shows coefficients for these controls. Data are from the DHS and LSMS projects. All regressions use OLS with survey weights and country-wave fixed effects. Standard errors are clustered at the country-wave level.

though it only reaches conventional statistical significance in columns 5 and 6. In these specifications, a one standard deviation increase in the maximum attainable value per hectare (1.2) is associated with 0.045 to 0.053 percentage point increase in the likelihood of a household possessing a formal land title, which translated to a 27 to 31 percent increase over the baseline probability of possessing a land title of 0.168. This table shows support for H1, but does not support H3 or H4: households title in response to higher land values, but the effect of the interaction between land regime and strong customary institutions is unclear.

Table 2 repeats these analyses, but using the returns to fertilizing the parcel, which measures the potential for short-term investment in a parcel. The directionality of these results is identical, but they are consistently statistically significant. Across different specifications, a one standard deviation increase in the returns to using fertilizer (0.046) is

Table 3. Strong customary institutions moderate the relationship between returns to planting tree crops and the uptake of land titles

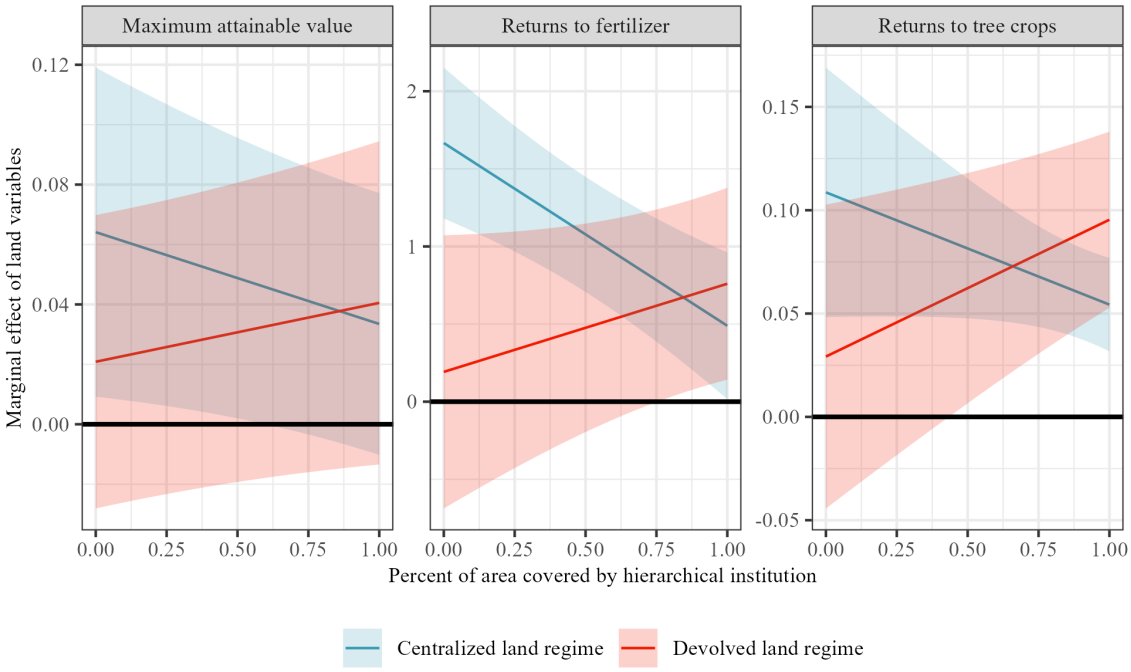
	(1)	(2)	(3)	(4)	(5)	(6)
Difference (trees)	0.082***		0.082***	0.080***	0.091***	0.109**
	(0.011)		(0.012)	(0.015)	(0.025)	(0.036)
Hierarchy		−0.006	−0.002	−0.066*	−0.001	−0.049
		(0.028)	(0.027)	(0.031)	(0.027)	(0.033)
Hierarchy * Devolved				0.095*		0.065
				(0.039)		(0.043)
Difference (trees) * Hierarchy						−0.054*
						(0.028)
Difference (trees) * Devolved					−0.012	−0.079*
					(0.030)	(0.033)
Difference (trees) * Hierarchy * Devolved						0.121***
						(0.031)
Country-Wave Fixed Effects	X	X	X	X	X	X
Demographic Controls	X	X	X	X	X	X
Geographic Controls	X	X	X	X	X	X
Num.Obs.	168 156	168 156	168 156	168 156	168 156	168 156
R^2	0.255	0.251	0.255	0.256	0.255	0.257

Note: The dependent variable is whether a household possesses a land title. The independent variables are the difference in maximum attainable value between planting tree crops and planting other crops; the fraction of an administrative unit that is covered by a hierarchical pre-colonial institution; and whether the country devolved its land regime. The unit of analysis is the household. Land value data vary at the second level administrative division. Demographic controls include the age, sex, and education of the household head; geographic controls include area, population density, an urban/rural indicator, road density, highway density, and terrain ruggedness. Table A6 shows coefficients for these controls. Data are from the DHS and LSMS projects. All regressions use OLS with survey weights and country-wave fixed effects. Standard errors are clustered at the country-wave level.

associated with a 0.036 to 0.041 percentage point marginal increase to the likelihood of possessing a title, which translates to a 21.7 to 22.6 percent increase over the mean titling rate of 0.168. These effects are both substantively and statistically significant—households who could make more money by using fertilizer are more likely to have a land title. Table 2 shows strong support for hypotheses H2, H3, and H4.

Finally, table 3 repeats these analyses using the returns to long-term investment in a parcel. This measure captures the marginal increase in maximum attainable value from planting tree crops rather than non-tree crops (and is equal to zero if that difference is negative). These results are statistically significant and support H2, H3, and H4. Across models, a one standard deviation increase in the returns to planting tree crops is associated with a 0.039 to 0.041 percentage point increase in the likelihood of a household possessing a land title, an increase of 23.3 to 24.6 percent over the baseline likelihood of

Figure 2. The marginal effect of land variables by the presence of precolonial institutions depends on the prevailing land regime



This figure shows the marginal effects of three land variables on the probability a household has a title, broken out by the percent of the administrative division covered by a title and whether the country has a devolved or centralized land regime. All equations are estimated separately using OLS, with country-wave fixed effects.

possessing a land title (0.168).

To make sense of these triple interaction models, figure 2 shows the marginal effect of the different measurement strategies for land value on titling rates by the strength of precolonial institutions, across both types of land regime. The vertical axes show the marginal effect of land value/returns to investment; the horizontal axes show the percentage of the district covered by hierarchical pre-colonial institutions (the measure of a chiefs' capacity to act on their incentives). In other words, the vertical axis shows the magnitude of the relationship between land values/returns to investment and land titling rates, conditional on other variables. For example, a value of 0.10 on the vertical axis

for a given level of pre-colonial strength and a given land regime implies that within this subgroup, a one unit increase in the land value variable is associated with a 0.10 point increase in the probability of land titling.

Figure 2 shows that across all specifications, the marginal effect of land values on land titling is weakly positive. Regardless of the country's land regime or the presence of hierarchical institutions, the relationship between land values and land titling is never negative—only statistically indistinguishable from zero or positive. However, the magnitude of the relationship between land values and titling varies dramatically and devolved land regimes invert the relationship between strong pre-colonial institutions and land values.

In countries with devolved land regimes, the relationship between land values and titling is weakly increasing in a district's coverage by hierarchical precolonial institutions. Within devolved regimes, a one unit increase in the returns to tree crops is associated with a (statistically insignificant) 0.029 percentage point increase in titling rates at the lowest rates of hierarchy, and a statistically significant increase of 0.095 percentage points at the highest levels of hierarchy. The slope of the marginal effects is similar for the maximum attainable value and the returns to fertilization, but at no point do they cross the threshold for statistical significance. In summary, within devolved land regimes, the presence of hierarchical customary institutions *increases* the strength of the relationship between land values and land titles.

Centralized land regimes tell a different story. Within these countries, the relationship between land values and titling is positive and significant at all but the highest levels of pre-colonial hierarchy. However, a one unit increase in the marginal returns to planting tree crops within centralized land regimes is associated with a 0.111 point increase in the likelihood of having a title among households at the lowest levels of hierarchy. Among households at the highest level of hierarchy, a one unit increase in the returns to tree crops is associated with only a 0.053 increase in the likelihood of having a land title. The magnitude and significance of these results is similar for the maximum attainable value of a parcel and the marginal returns to fertilization. Strong pre-colonial institutions *weaken* the relationship between land values and titling within centralized land regimes.

These results paint a nuanced portrait of the relationship between the value of land,

returns to agricultural investment, and the uptake of formal land titles. Across the board, households with more valuable land—as well as those with higher returns to agricultural investment—are more likely to have a formal title for at least one of their parcels. However, local politics, in the form of strong customary institutions interact with a country's land regime to moderate these relationships. In countries where land administration is centralized, households title less when chiefs are strong, consistent with H.3 and suggesting that chiefs impede titling. Households in countries where land regimes are devolved title more when their chief is strong, consistent with H.4.

One alternative mechanism that could explain these results is that households in areas with higher land values—or higher returns to agricultural investment—are simply wealthier. Higher levels of household wealth could alleviate monetary barriers to the uptake of titling, and therefore increase uptake. To test this mechanism, I conduct a series of placebo regressions using the same sets of explanatory variables, but with a binary indicator for whether the household has a formal title for their dwelling as the outcome. Titles for dwellings would be equally facilitated by increased wealth, but not by incentives to invest on agricultural land. These regressions (detailed in table A7) show null effects across the board, suggesting that higher household wealth is not a mechanism through which land values drives titling. Population density also does not predict land titling rates, suggesting it does not capture the underlying value of the land. Results are similar across British and non-British colonial powers.[28] Appendix A.4 shows that these results are robust to a variety of model specifications, including excluding Ethiopia and Rwanda, log-transforming the geospatial variables, and subsetting to only the most recent survey wave.

5 Côte d'Ivoire: customary elites in action

This section uses a case study in Côte d'Ivoire to show that chiefly authority increases land titling in a devolved regime, all else held constant, as well as to trace how chiefs use their capture of land titling to advance their political agenda. Côte d'Ivoire is a

[28] These results are in appendix A.3

particularly useful case because its unique history of migration and land use has led to high variation in the authority of customary chiefs. [29] The country is a devolved land regime, where village land committees (CVGFRs) adjudicate titling decisions. Holding the land regime and land values constant means this case study isolates the relationship between chiefly authority and the uptake of formal property rights. I unpack this case study through a field survey of 801 household heads and 194 customary elites in the Indénié-Djuablin regions.[30] Figure 3 highlights these areas, alongside two measures of household titling rates. Both regions cover the country's central forest belt, where similar ecological conditions allows households to grow coffee, cocoa, rubber, and oil palms as cash crops. [31]

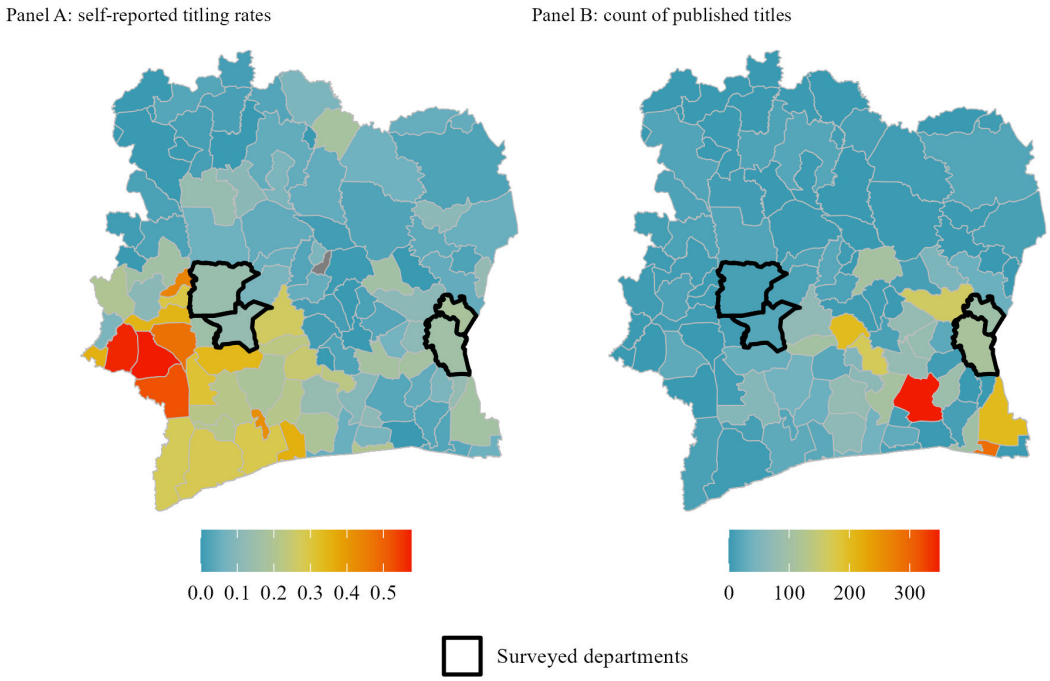
This case study also illustrates how chiefs use their control over land titling to further their political agenda. Land tenure in Côte d'Ivoire pits autochthones, or sons of the soil, against allochthones, or relative newcomers. Most areas have an autochthonous group, who are the descendants of the first inhabitants to 'clear the bush.' Village chiefs are almost always autochthones. Later arrivals are called 'allochthones,' or simply 'strangers.' These relative newcomers often give symbolic gifts to acknowledge the precedence of the autochthones, though in many cases the allochthones have lived in the village for decades. Burkinabè families are particularly prominent among the allochthones, because the long-serving first president Félix Houphouët-Boigny recruited wealthy planters from Burkina Faso to increase Ivoirian cocoa and coffee production (Zolberg 1964). Autochthony is orthogonal to ethnicity; any ethnicity would be autochthonous in their homeland and allochthonous elsewhere. Arriving families often established their fields and households at some distance from the original village. Over time, these settlements grew into hamlets and campements. These hamlets often rival the original village in population and eco-

[29] It is roughly average in both overall titling rates and the perceived authority of chiefs. These factors make it an "on-the-line" case, which is ideal as a nested case for testing the broader theory of land titling outlined above (Lieberman 2005). Appendix C.1 elaborates on the case selection.

[30] The survey covered 80 administrative villages in these regions. Within each village, I surveyed five households within the village itself, and another five in one to two randomly elected hamlets or campements. Within each location, I also surveyed the village chief/headman or their representative. Appendix C expands on the sampling and survey methodology.

[31] A pre-registration plan (PAP) for this survey is available at the Open Science Foundation Registry. However, this research deviates from the PAP such that it should be considered exploratory rather than confirmatory. Appendix C.6 details these deviations.

Figure 3. Spatial distribution of land titles across Côte d'Ivoire



The left panel shows self-reported titling rates by department from the 2021 LSMS survey. All averages use household weights. The right panel shows the count of land published in the Ivoirian national gazette (*Journal Officiel de la République de Côte d'Ivoire*) as of November 7, 2022. The lengthy publication process makes these administrative data a lagging indicator.

nomic prominence; near Daloa for example, allochthones now outnumber autochthones and hold most of the area's land (Boone et al. 2021).

Village chiefs discriminate against allochthones when they can because chiefs perceive the allochthone's land to be merely borrowed. The headman of an allochthonous hamlet near Abengourou to whom I spoke worried that the village chief would displace the hamlet in a few years when his cocoa trees became unproductive. An autochthonous farmer in the same region only permitted allochthones to farm land once he knew them personally, "to avoid them trying to claim the land." AFOR, in contrast, is agnostic as to customary versus use-based claims to land. As a result, chiefly capture of the land tenure formalization process in Côte d'Ivoire manifests as discrimination against allochthones.

5.1 Strong chiefs lead to more titles

Coôte d'Ivoire devolved land tenure to its CVGFR, so my theory would predict that villages with authoritative chiefs would have more titles. I measure chiefly authority using seven survey questions: "[f]or each of these activities [that chiefs in Côte d'Ivoire sometimes mandate], I would like you to tell me how much of the village you think would do what the chief asked them to do." The seven activities were: (1) Participate in village cleanup day; (2) Give up a piece of land for a school; (3) Spend a day repairing a road; (4) Spend a day planting trees; (5) Come to participate in a traditional dance; (6) Give money to support a traditional ceremony; and (7) Give up a piece of land for a mosque. For each activity, respondents answered: nobody, very few people, some people, most people, or everybody. I create two indices. One captures chiefs' political authority and includes items one to four. The other captures chiefs' authority in a more traditional sphere and includes items five to seven.[32] Chiefs' political power is the metric which aligns with my overall theory: strong chiefs are those with higher political power. I include traditional authority for a comparison.

Overall, approximately 38 percent of households possess at least one formal land title. Table 4 shows the relationship between the chiefly authority indices and household titling.[33] The outcome variable is a binary indicator for whether a household possesses a formal land title for at least one of their parcels. The independent variables are the two indices of chiefly authority. Columns 1-3 show no relationship between chiefly authority and titling. Columns 4-6, however, show that chiefs political power increases titling, but only for autochthones.[34] Among autochthones, a one standard deviation ($\sigma = 0.52$) increase in chiefs' political authority is associated with a 0.13 percentage point increase in titling, an increase of 34 percent over the baseline rate. In contrast, a one standard deviation in political authority is associated with a 0.09 percentage point *decrease* in

[32] Table C3 replicates these results using participation in the individual activities as independent variables.

[33] These regressions also control for the presence of PAMOFOR (Land Policy Improvement and Implementation Project for Côte d'Ivoire), an ongoing World Bank project which subsidizes land titling. Of the 80 administrative villages in which this research took place, 12 took part in PAMOFOR, which was randomly assigned at the commune level.

[34] 443 respondents were allochthones and 355 were autochthones.

Table 4. Chiefly authority increases titling for autochthones but not allochthones

	(1)	(2)	(3)	(4)	(5)	(6)
Chief's traditional power	−0.005	−0.003	−0.002	−0.032+	−0.027+	−0.027+
	(0.015)	(0.010)	(0.010)	(0.019)	(0.014)	(0.015)
Chiefs' political power	0.007	0.010	0.009	0.039*	0.038**	0.037*
	(0.012)	(0.011)	(0.011)	(0.015)	(0.014)	(0.014)
Allochthone	0.172*	0.155	0.153	0.668*	0.553*	0.528*
	(0.070)	(0.109)	(0.105)	(0.262)	(0.267)	(0.265)
Traditional power * Allochthone				0.055*	0.056**	0.057*
				(0.023)	(0.021)	(0.022)
Political power * Allochthone				−0.069**	−0.062**	−0.062**
				(0.021)	(0.018)	(0.019)
Hamlet/camp	−0.085	−0.077	−0.079	−0.071	−0.071	−0.071
	(0.087)	(0.083)	(0.081)	(0.073)	(0.075)	(0.074)
Department FEs	X	X	X	X	X	X
Demographic controls		X	X		X	X
Geographic controls			X			X
Num.Obs.	787	785	785	787	785	785
R2	0.075	0.243	0.250	0.120	0.275	0.282

Note: The dependent variable is whether a respondent has a formal land title for at least one agricultural parcel. The independent variables are indices of responses to: [f]or each of these activities [that chiefs in Côte d'Ivoire sometimes mandate], I would like you to tell me how much of the village you think would do what the chief asked them to do. Demographic controls include education, sex, age, ethnicity, the respondent's relationship to the household head, and wealth. Geographic controls include an indicator for PAMOFOR, distance to department capital, cocoa suitability, coffee suitability, and terrain ruggedness. Table C6 shows coefficients for these controls. All regressions use OLS with inverse sampling probability weights. Standard errors are clustered at the administrative village level.

titling among allochthones, a decrease of 22 percent relative to the baseline rate of titling. These results paint a clear picture: in this devolved land regime, strong chiefs lead to more titles for the in-group (autochthones). However, in the Ivoirian context, chiefly capture of land tenure administration means strong chiefs actually decrease titling rates among the outgroup (allochthones).

5.2 Chiefs capture land management and exclude allochthones

How do chiefs capture titling? One mechanism is that chiefs dominate the CVGFRs and fill them with co-ethnics. CVGFRs investigate land claims (Bassett 2020) and issue dossiers for potential *certificats fonciers* (CFs). The national land bureau (*Agence Foncier Rurale*—AFOR) ultimately records and issues CFs, but important decisions are made

Table 5. Allochthones and autochthones have different opinions about land titling

	CVGFR Composition			
Village	Entirely autochthonous	Mostly autochthonous.	Equally split	Mostly allochthonous
Mostly autochthonous	11	20	1	3
Equally split	6	16	15	1
Mostly allochthonous	2	2	0	1

Note:
Data from a 2024 survey of customary elites in the Haut-Sassandra and Indénié-Djuablin regions of Côte d'Ivoire.

locally. I asked the chiefs of each village (1) whether the village was mostly autochthonous or allochthonous and (2) whether the CVGFR was mostly autochthones or allochthones. Table 5 shows that even in villages which are equally split or mostly allochthonous, autochthones dominate the CVGFRs.

Chiefs may also unevenly enforce land titles. Table 6 shows whether respondents agree that: (1) having a title helps you **keep your land** if the government wants to take it; (2) having a title helps you **be compensated** if the government does take your land, and (3) having a title is useful in case of a **dispute** against your peers. A clear divide emerges between the in-group (autochthones) and the out-groups (allochthones). Across all three categories, allochthones think titles are more useful. The chiefs' authority has no relationship with the perception that titles are useful to be compensated for land expropriated by the government, which makes sense if households think such decisions are made at a higher political level. Across the remaining outcomes, a one standard deviation increase in chiefs' traditional authority is associated with a 0.17-0.26 standard deviation decrease in the perceived utility of titles among autochthones. Among allochthones, the same increase in chiefs authority is associated with a larger 0.50-0.53 standard deviation decrease in the perceived usefulness of titles.

If titles are less useful where chiefs are more powerful, it further suggests that chiefs can capture and control the titling process. All respondents think strong chiefs reduce the usefulness of titles, but this result is much stronger among allochthones, the outgroup. Unlike previous results, it is chiefs' customary authority, rather than their political authority that makes a difference. Land titles are less of a constraint on the behavior of more powerful chiefs which allows them to capture land management and discriminate

Table 6. Autochthones, but not allochthones, think strong chiefs make titles more useful

	Keep land		Be compensated		Win dispute	
	(1)	(2)	(3)	(4)	(5)	(6)
Chiefs' traditional power	−0.041*	−0.035	0.020	0.005	−0.067**	−0.069**
	(0.016)	(0.021)	(0.036)	(0.033)	(0.023)	(0.021)
Chiefs' political power	0.034	0.031	0.036	0.051	0.054*	0.054**
	(0.017)	(0.017)	(0.038)	(0.029)	(0.023)	(0.018)
Allochthone	0.908**	0.972**	1.313**	1.465**	0.922*	0.992**
	(0.305)	(0.350)	(0.430)	(0.450)	(0.390)	(0.371)
Traditional power * Allochthone	−0.087**	−0.101**	−0.054	−0.044	−0.061*	−0.059
	(0.027)	(0.036)	(0.042)	(0.043)	(0.027)	(0.035)
Political power * Allochthone	−0.015	−0.010	−0.062	−0.075*	−0.035	−0.040
	(0.019)	(0.023)	(0.033)	(0.029)	(0.021)	(0.025)
Hamlet/camp	0.070	−0.024	0.128	0.140	0.075	0.017
	(0.080)	(0.113)	(0.068)	(0.123)	(0.064)	(0.092)
Department FEs	X	X	X	X	X	X
Demographic controls		X		X		X
Geographic controls		X		X		X
Num.Obs.	798	796	798	796	798	796
R2	0.236	0.306	0.168	0.295	0.246	0.326

Note: Dependent variables are answers to '[d]o you think somebody with a certificat foncier would be (1-2) more likely to keep their land if the government attempted to take it; (3-4) to be compensated fairly for the land, were it taken' and (5-6) to succeed in a land dispute? All answers use a five-point likert scale. Demographic controls include education, sex, age, ethnicity, the respondent's relationship to the household head, and wealth. Geographic controls include an indicator for PAMOFOR, distance to department capital, cocoa suitability, coffee suitability, and terrain ruggedness. Table C7 shows coefficients for these control variables. All regressions use OLS with inverse sampling probability weights. Standard errors are clustered at the administrative village level.

against allochthones.

The chiefs' role in the titling process maintains their political authority. Chiefs are also able to extract rents from their control over titling. While chiefs have no official role in titling, 70 percent of the 801 respondents in my survey expected to have to pay chiefs in order to formalize a land title. Only 57 percent thought they would have to pay their CVGFR, which is actually empowered to title land.

An alternative explanation for the broader results is that households title less when they have confidence that the chief can protect their property rights. Such trust would decrease the marginal increase of perceived land tenure security from titling one's land,

and therefor would reduce uptake of land titling. In table C5, however, I show that trust in one's chief does not increase either household titling or the extent to which households perceive land titles as valuable. This result accords with other recent literature, which suggests that the legibility provided by land titles is a valuable resource regardless of title's legal weight (Ferree et al. 2023).

By holding land values and the national land regime constant while varying chiefs' power at a highly granular level, this case study sheds light into how customary authorities constrain the land titling process. Strong chiefs facilitate titling within their village—but only for the chiefs' in-group. Moreover, allochthones perceive titles to be less effective, suggesting that enforcement of land titles may be unequal. While the cross-national analysis reveals broad trends which are consistent with the theory, this case study shows that the observable implications of this theory in Côte d'Ivoire align with the intermediate steps of the broader theory.

6 Conclusion

Strong and secure property rights are a necessary condition for economic development. Land titles benefit households: titles reduce the risk of households losing their land and they make households feel more secure making profitable investments. These land titles are available on-demand in many African countries. So why are African farmers leaving these economic gains on the table?

Households whose land has higher attainable agricultural value and higher returns to agricultural investment are more likely to possess a title. However, the confluence of the strength of customary institutions and the country's land regime moderate this relationship. Where land tenure administration is devolved, an increase of 1,000 USD in the returns to long-term agricultural investment is associated with a (statistically insignificant) 14 percent increase in titling rates where customary institutions are weakest, and a statistically significant increase of 55 percent where customary institutions are strongest. Where land tenure administration remains centralized at the national level, the same increase in the returns to long-term investment is associated with a 63 percent increase in the likelihood of having a title among households with the weakest customary institu-

tions, and an increase of only 34 percent among households with the strongest customary institutions.

These results make two broad contributions to the existing literature. Much of the existing literature uses states and elites to explain the supply of property rights (Albertus 2020; Boone 2014). I document variation in the titling rates within states and within regions, suggesting that household demand plays an important role in the uptake of land titles. In establishing broad patterns in land tenure formalization across sub-Saharan Africa, I hope to open avenues for future research to test theories of property rights formalization against these empirical patterns. I also show that the interaction between national land regimes and customary institutions constrains household uptake of land titles. However, land tenure policy is one of many items in states' toolkits: export boards, tariff policies, and agricultural extension programs all play a role in rural politics. This research creates space for scholars to examine how other institutions which dominate rural life in Africa affect—and are affected by—household decisions to title their land.

Second, by showing how their cooperation with the state depends on their ability to maintain control over local processes, this paper advances the literature on informal institutions and elites in developing countries. This finding helps explain existing contradictory results on when the informal elites compliment or substitute for the state (Henn 2023). By unpacking the chiefs' incentives, this paper creates an opportunity for future research to examine how these incentives play out in alternative policy spaces.

Local politics affect how land tenure formalizations progress, which suggests a one-size fits all approach is unlikely to find consistent success. If chiefs facilitate land titling where they can capture the process, it also implies that African governments and donor organizations should consider the role of chiefs when designing land tenure formalization program. The Ivoirian case specifically suggests that interventions designed to reduce any bias through which chiefs and other village land institutions assign land titles could have strong effects on both equity and uptake.

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Appendices

Table of Contents

A Details for cross-country regressions

In the main regressions, land value and returns to agricultural investment data vary at the second level administrative division, with the exception of Côte d'Ivoire (third level) and Malawi (first level).

A.1 Controls and weights

The cross-national regressions in this paper use household-level sampling weights provided in the original DHS or LSMS data files. Both DHS and LSMS data use a complex, multi-level sampling strategy rather than a pure random sample. As a result, these surveys include sampling weights to account for both idiosyncrasies of sampling strategy and differential non-response. I make two modifications to these survey weights.

First, I winsorize all survey weights on a country-by-country basis. Weights above the 95th percentile for country i are set to the 95th percentile value; weights below the 5th percentile for country i are set to the 5th percentile value. This procedure is renders the estimates less sensitive to extreme outliers and reduces the variance of estimates.

Second, I rescale all survey weights so that the country i's fraction of total survey weight is equal to the fraction of total observations which belong to country i. For example, of the 425,663 total observations in the combined DHS/LSMS dataset, 28,991 observations come from Mali, or about 6.8 percent. After rescaling, the fraction of total survey weight which comes from observations in Mali is also 6.8 percent. This procedure ensures that results are not dominated by a single country due to different weighting procedures or base weights at the country level.

I include two sets of control variables for all regressions. The demographic set of controls include variables calculated from the LSMS/DHS surveys themselves. These data are necessarily constrained by the availability of data within the underlying survey. These controls include the education of the household head (don't know, no education, preschool, primary education, or secondary education/higher), the sex of the household head (male, female, didn't answer), and the household head's age.[35] Ethnicity questions

[35] When the household head's age is missing I replace it with the country-wave mean.

Table A1. Strong customary institutions moderate the relationship between land value and land titles (no controls)

	(1)	(2)	(3)	(4)	(5)	(6)
Land value	0.041		0.041	0.044	0.064*	0.087*
	(0.040)		(0.040)	(0.039)	(0.032)	(0.035)
Hierarchy		−0.002	−0.002	−0.082	0.000	0.064
		(0.033)	(0.033)	(0.044)	(0.031)	(0.063)
Hierarchy * Devolved				0.117*		−0.085
				(0.053)		(0.082)
Land value * Hierarchy						−0.037
						(0.023)
Land value * Devolved					−0.030	−0.064*
					(0.018)	(0.029)
Land value * Hierarchy * Devolved						0.059*
						(0.029)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	170 281	170 281	170 281	170 281	170 281	170 281
R2	0.240	0.239	0.240	0.242	0.241	0.244

Note: This table replicates table 1 in the main text, but without control variables. Regressions are otherwise identical.

were not included in approximately half of all DHS/LSMS surveys, so I cannot include it as a control. Household wealth questions were also administered inconsistently across countries, so I exclude them.

The second set of controls are geographic. They include the area of the 2nd level administrative division (in square kilometers), population density (CIESIN 2017), the interaction between district area and population density, average terrain density (Carter, Shaver, and Wright 2019), the distance between the district centroid and the country's capital, and caloric suitability (Galor and Özak 2016). With the exception of population density, these data are stationary over time. As alluded earlier, all regressions also include the average land value "shock" across all periods (Borusyak and Hull 2020). Boryusak and Hull (2020) note that the distribution of shocks must be stationary over time for a time-invariant counterfactual shock to eliminate this source of omitted variable bias. After controlling for inflation, the distribution of maximum possible values per observation is indeed stationary.

Tables A1, A2, and A3 repeat the regressions from section 4 without these control variables. All estimates are similar in magnitude. While most levels of education are

Table A2. Strong customary institutions moderate the relationship between returns to planting tree crops and the uptake of land titles (without controls)

	(1)	(2)	(3)	(4)	(5)	(6)
Difference (trees)	0.093***		0.094***	0.092***	0.119***	0.131***
	(0.006)		(0.008)	(0.011)	(0.016)	(0.028)
Hierarchy		−0.002	0.009	−0.067	0.010	−0.052
		(0.033)	(0.033)	(0.040)	(0.032)	(0.041)
Hierarchy * Devolved				0.110*		0.080
				(0.048)		(0.053)
Difference (trees) * Hierarchy						−0.048*
						(0.022)
Difference (trees) * Devolved					−0.033	−0.094***
					(0.021)	(0.024)
Difference (trees) * Hierarchy * Devolved						0.117**
						(0.045)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	170 281	170 281	170 281	170 281	170 281	170 281
R2	0.246	0.239	0.247	0.249	0.247	0.250

Note: This table replicates table 3 in the main text, but without control variables. Regressions are otherwise identical.

Table A3. Strong customary institutions moderate the relationship between returns to fertilizer and land titles (without controls)

	(1)	(2)	(3)	(4)	(5)	(6)
Difference (fertilizer)	0.715		0.715	0.806*	1.172***	1.776***
	(0.384)		(0.380)	(0.347)	(0.326)	(0.453)
Hierarchy		−0.002	−0.001	−0.084*	−0.001	0.067
		(0.033)	(0.033)	(0.040)	(0.031)	(0.049)
Hierarchy * Devolved				0.121*		−0.078
				(0.050)		(0.063)
Difference (fertilizer) * Hierarchy						−1.216*
						(0.504)
Difference (fertilizer) * Devolved					−0.782	−1.877**
					(0.488)	(0.726)
Difference (fertilizer) * Hierarchy * Devolved						1.888**
						(0.701)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	170 281	170 281	170 281	170 281	170 281	170 281
R2	0.240	0.239	0.240	0.243	0.241	0.245

Note: This table replicates table 2 in the main text, but without control variables. Regressions are otherwise identical.

not highly predictive of land titling, household heads with no education are less likely to possess a title. Female headed households are less likely to possess a title, as are households with younger heads. For geographic variables, the distance of the administrative unit's centroid to the national capital is negatively associated with titling—more remote areas have fewer titles. However, caloric suitability—a measure of how much food can be produced by an area—is also negatively associated with titling. This last result also suggests that my measures of land values and the returns to agricultural investment are capturing value, rather than pure productivity.

A.2 Coefficients for control variables

Table A4. Coefficient values for table 1

	(1)	(2)	(3)	(4)	(5)	(6)
Education: preschool	0.000	0.000	0.000	−0.001	0.000	−0.001
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
Education: primary	0.013	0.013	0.013	0.013	0.013	0.013
	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)
Education: secondary	0.026	0.026	0.026	0.025	0.026	0.025
	(0.020)	(0.020)	(0.020)	(0.019)	(0.020)	(0.019)
Education: higher	0.031	0.031	0.031	0.033	0.032	0.033
	(0.038)	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)
Female HH head	−0.029*	−0.029*	−0.029*	−0.028*	−0.029*	−0.029*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HH head age	0.009*	0.009*	0.009*	0.009*	0.009*	0.009*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HH head age squared	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	−0.001	0.000	−0.001	0.000	−0.001	0.000
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.003)
Urban	0.015	0.014	0.014	0.015	0.014	0.015
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Terrain ruggedness	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	−0.074	−0.072	−0.074	−0.063	−0.068	−0.056
	(0.068)	(0.069)	(0.069)	(0.062)	(0.066)	(0.064)
Density: all roads	0.017*	0.017	0.017	0.015	0.017*	0.014
	(0.008)	(0.009)	(0.009)	(0.008)	(0.008)	(0.008)
Density: highways	0.004	0.005	0.004	0.003	0.005	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Caloric suitability	−0.090*	−0.090*	−0.089*	−0.090*	−0.085	−0.082
	(0.042)	(0.044)	(0.041)	(0.042)	(0.048)	(0.047)
Area * population density	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	168 156	168 156	168 156	168 156	168 156	168 156
R_2	0.251	0.251	0.251	0.253	0.251	0.253

Note: This table shows coefficients or covariates from table 1. The dependent variable of this model is a binary indicator for whether a household possesses a land title. The independent variables are the maximum attainable value; the fraction of an administrative unit that is covered by a hierarchical pre-colonial institution; and a binary indicator for whether the country has devolved its land regime to local authorities. The unit of analysis is the household. Data are from the DHS and LSMS projects. All regressions use OLS with survey weights and country-wave fixed effects. Standard errors are clustered at the country-wave level.

Table A5. Coefficient values for table 2

	(1)	(2)	(3)	(4)	(5)	(6)
Education: preschool	0.001	0.000	0.001	0.000	0.001	0.000
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
Education: primary	0.013	0.013	0.013	0.013	0.013	0.013
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Education: secondary	0.026	0.026	0.026	0.025	0.026	0.025
	(0.020)	(0.020)	(0.019)	(0.019)	(0.020)	(0.019)
Education: higher	0.031	0.031	0.031	0.032	0.031	0.032
	(0.038)	(0.038)	(0.038)	(0.037)	(0.038)	(0.037)
Female HH head	−0.029**	−0.029**	−0.029**	−0.028*	−0.029**	−0.029**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HH head age	0.009*	0.009*	0.009*	0.009**	0.009*	0.009*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HH head age squared	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	−0.001	0.000	−0.001	0.000	−0.001	0.000
	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Urban	0.015	0.014	0.015	0.016	0.015	0.017
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
Terrain ruggedness	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	−0.088	−0.072	−0.088	−0.078	−0.080	−0.067
	(0.064)	(0.069)	(0.064)	(0.058)	(0.061)	(0.057)
Density: all roads	0.019*	0.017	0.019	0.016	0.019*	0.017
	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)
Density: highways	0.003	0.005	0.004	0.002	0.004	0.004
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
Caloric suitability	−0.090*	−0.090*	−0.089*	−0.090*	−0.085	−0.085
	(0.042)	(0.044)	(0.041)	(0.042)	(0.046)	(0.045)
Area * population density	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	168 156	168 156	168 156	168 156	168 156	168 156
R^2	0.252	0.251	0.252	0.253	0.252	0.255

Note: This table shows coefficients or covariates from table 2. The dependent variable of this model is a binary indicator for whether a household possesses a land title. The independent variables are the maximum attainable value; the fraction of an administrative unit that is covered by a hierarchical pre-colonial institution; and a binary indicator for whether the country has devolved its land regime to local authorities. The unit of analysis is the household. Data are from the DHS and LSMS projects. All regressions use OLS with survey weights and country-wave fixed effects. Standard errors are clustered at the country-wave level.

Table A6. Coefficient values for table 3

	(1)	(2)	(3)	(4)	(5)	(6)
Education: preschool	0.000	0.000	0.000	−0.001	0.000	−0.001
	(0.033)	(0.032)	(0.033)	(0.033)	(0.033)	(0.033)
Education: primary	0.010	0.013	0.010	0.010	0.010	0.010
	(0.013)	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)
Education: secondary	0.022	0.026	0.022	0.022	0.022	0.022
	(0.021)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Education: higher	0.027	0.031	0.027	0.028	0.027	0.029
	(0.037)	(0.038)	(0.037)	(0.036)	(0.037)	(0.036)
Female HH head	−0.029**	−0.029**	−0.029**	−0.028**	−0.029**	−0.028**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HH head age	0.009*	0.009*	0.009*	0.009*	0.009*	0.009*
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
HH head age squared	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000**	0.000*	0.000**	0.000**	0.000**	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	−0.001	0.000	−0.002	0.000	−0.001	−0.001
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)
Urban	0.015	0.014	0.015	0.016	0.015	0.015
	(0.023)	(0.024)	(0.023)	(0.023)	(0.023)	(0.023)
Terrain ruggedness	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	−0.062	−0.072	−0.062	−0.052	−0.061	−0.061
	(0.061)	(0.069)	(0.061)	(0.055)	(0.061)	(0.055)
Density: all roads	0.021**	0.017	0.021*	0.018*	0.020*	0.018*
	(0.007)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
Density: highways	0.005	0.005	0.005	0.004	0.005	0.004
	(0.005)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
Caloric suitability	−0.031	−0.090*	−0.030	−0.033	−0.030	−0.032
	(0.026)	(0.044)	(0.026)	(0.027)	(0.026)	(0.027)
Area * population density	0.000*	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	168 156	168 156	168 156	168 156	168 156	168 156
R2	0.255	0.251	0.255	0.256	0.255	0.257

Note: This table shows coefficients or covariates from table 3. The dependent variable of this model is a binary indicator for whether a household possesses a land title. The independent variables are the maximum attainable value; the fraction of an administrative unit that is covered by a hierarchical pre-colonial institution; and a binary indicator for whether the country has devolved its land regime to local authorities. The unit of analysis is the household. Data are from the DHS and LSMS projects. All regressions use OLS with survey weights and country-wave fixed effects. Standard errors are clustered at the country-wave level.

A.3 Robustness Checks and Placebo Regressions

This section shows additional robustness checks for the regressions in section4. First, table A7 shows results obtained by regressing a binary indicator for whether a household possesses a title for their dwelling on the explanatory variables. If households title their lands because of shifts to agricultural values, then the results of this regression should be null across the board. However, if households simply title because households with higher land values or in areas with profitable tree crops are richer, then we would also expect households to also title their dwellings more when these variables increase. As such, table A7 is a valuable placebo test for my main specifications. This table shows null results, which supports my interpretation of the main results.

Another concern may be different colonial experiences may be driving my results. The archetype of British approach to empire emphasized indirect rule through native interlocutors (Hailey 1938). In contrast, other powers (mostly the French) were more likely to disrupt pre-existing institutions to rule indirectly. In reality, policy towards native authority often differed as much within empires as between them (Boone 2003: 16). Nevertheless, table A8 shows that results of my primary specifications are relatively consistent in both former British colonies and other African states. The statistical significance switches on and off, but magnitudes are relatively similar.

Finally, table A9 replaces my measures of land values with population density. If land titling was bring driven by urban pressure, then population density should predict higher levels of titling. Table A9 shows that it does not.

Table A7. Land values do not affect titling for dwellings

	(1)	(2)	(3)	(4)	(5)	(6)
Max value	0.010	0.000				
	(0.015)	(0.017)				
Difference (fertilizer)			0.064	0.021		
			(0.404)	(0.422)		
Difference (trees)					0.025	0.012
					(0.032)	(0.033)
Hierarchy	−0.052	−0.090	−0.067	−0.093	−0.031	−0.028
	(0.075)	(0.076)	(0.062)	(0.062)	(0.027)	(0.025)
Hierarchy * Devolved	0.056	0.037	0.067	0.054	0.032	0.009
	(0.084)	(0.083)	(0.069)	(0.067)	(0.033)	(0.029)
Max value * Hierarchy	0.006	0.016				
	(0.021)	(0.022)				
Difference (fertilizer) * Hierarchy			0.323	0.551		
			(0.552)	(0.606)		
Difference (trees) * Hierarchy					0.011	−0.009
					(0.034)	(0.037)
Max value * Devolved	−0.005	−0.006				
	(0.018)	(0.020)				
Difference (fertilizer) * Devolved			0.005	−0.244		
			(0.501)	(0.543)		
Difference (trees) * Devolved					−0.004	−0.043
					(0.037)	(0.041)
Max value * Hierarchy * Devolved	−0.008	0.001				
	(0.025)	(0.025)				
Difference (fertilizer) * Hierarchy * Devolved			−0.344	−0.119		
			(0.652)	(0.691)		
Difference (trees) * Hierarchy * Devolved					−0.007	0.068
					(0.037)	(0.044)
Education: preschool		−0.013		−0.013		−0.013
		(0.017)		(0.017)		(0.017)
Education: primary		0.037***		0.037***		0.037***
		(0.008)		(0.008)		(0.008)
Education: secondary		0.058***		0.058***		0.057***
		(0.011)		(0.011)		(0.011)
Education: higher		0.074***		0.074***		0.075***
		(0.018)		(0.018)		(0.018)
Female HH head		−0.008		−0.008		−0.008
		(0.006)		(0.006)		(0.006)
HH head age		0.009***		0.009***		0.009***
		(0.001)		(0.001)		(0.001)
HH head age squared		0.000***		0.000***		0.000***
		(0.000)		(0.000)		(0.000)
Area		0.000*		0.000*		0.000*
		(0.000)		(0.000)		(0.000)
Population density		−0.007		−0.007		−0.007
		(0.004)		(0.004)		(0.004)
Urban		0.101***		0.100***		0.100***
		(0.012)		(0.012)		(0.012)
Terrain ruggedness		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)
Distance to capital		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)
Density: all roads		0.027**		0.027**		0.027**
		(0.009)		(0.009)		(0.009)
Density: highways		−0.001		−0.001		−0.001
		(0.006)		(0.006)		(0.006)
Caloric suitability		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)
Area * population density		0.000		0.000		0.000
		(0.000)		(0.000)		(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	254 772	251 233	254 772	251 233	254 772	251 233
R_2	0.070	0.106	0.069	0.106	0.070	0.106

Note: The dependent variable of this model whether a household possesses a title for their primary dwelling. Specifications are otherwise identical to the main text tables.

Table A8. Estimates are similar in British former colonies and other countries

	Former British colonies			All other countries		
	(1)	(2)	(3)	(4)	(5)	(6)
Max value	0.058*			0.013		
	(0.022)			(0.049)		
Difference (fertilizer)		1.803***			0.315	
		(0.164)			(0.959)	
Difference (trees)			0.104**			0.127***
			(0.035)			(0.030)
Hierarchy	0.098	0.114*	−0.050	−0.130	−0.067	0.083***
	(0.056)	(0.047)	(0.032)	(0.101)	(0.062)	(0.021)
Hierarchy * Devolved	−0.095	−0.141**	−0.026	0.106	0.058	−0.056
	(0.055)	(0.044)	(0.039)	(0.105)	(0.065)	(0.028)
Max value * Hierarchy	−0.046**			0.054		
	(0.016)			(0.038)		
Difference (fertilizer) * Hierarchy		−1.528***			1.172	
		(0.315)			(0.874)	
Difference (trees) * Hierarchy			−0.061			−0.082***
			(0.043)			(0.022)
Max value * Devolved	−0.023			0.006		
	(0.013)			(0.039)		
Difference (fertilizer) * Devolved		−0.917**			−0.273	
		(0.270)			(0.964)	
Difference (trees) * Devolved			−0.215***			−0.083
			(0.038)			(0.050)
Max value * Hierarchy * Devolved	0.022			−0.032		
	(0.013)			(0.040)		
Difference (fertilizer) * Hierarchy * Devolved		1.043***			−0.552	
		(0.259)			(0.931)	
Difference (trees) * Hierarchy * Devolved			0.180***			0.147***
			(0.042)			(0.030)
Education: preschool	0.112***	0.112***	0.110***	−0.013	−0.013	−0.016
	(0.027)	(0.028)	(0.027)	(0.037)	(0.037)	(0.038)
Education: primary	0.030**	0.031**	0.029**	0.009	0.010	0.007
	(0.010)	(0.010)	(0.010)	(0.015)	(0.015)	(0.015)
Education: secondary	0.058**	0.059**	0.059**	0.014	0.014	0.010
	(0.019)	(0.019)	(0.019)	(0.018)	(0.018)	(0.019)
Education: higher	0.142**	0.142***	0.141***	−0.006	−0.007	−0.009
	(0.038)	(0.037)	(0.037)	(0.023)	(0.023)	(0.023)
Female HH head	−0.026**	−0.026**	−0.026**	−0.027*	−0.027*	−0.026*
	(0.009)	(0.009)	(0.009)	(0.012)	(0.012)	(0.012)
HH head age	0.007*	0.007*	0.007*	0.010**	0.010**	0.010**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HH head age squared	0.000*	0.000*	0.000*	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	0.013	0.013	0.014	0.004	0.004	0.001
	(0.008)	(0.008)	(0.008)	(0.005)	(0.005)	(0.005)
Urban	0.012	0.016	0.012	0.023	0.023	0.021
	(0.032)	(0.030)	(0.030)	(0.026)	(0.026)	(0.026)
Terrain ruggedness	0.000	0.000	0.000	0.001**	0.001**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	0.000	0.000	0.000	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Density: all roads	0.013*	0.018**	0.017**	−0.009	−0.009	−0.001
	(0.005)	(0.006)	(0.005)	(0.010)	(0.010)	(0.009)
Density: highways	−0.007	−0.009	−0.005	0.008	0.008	0.012
	(0.007)	(0.006)	(0.007)	(0.014)	(0.014)	(0.015)
Caloric suitability	0.000*	0.000**	0.000	0.000*	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area * population density	0.000	0.000	0.000	0.000***	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	49 366	49 366	49 366	118 725	118 725	118 725
R2	0.068	0.073	0.067	0.333	0.333	0.338

Note: The dependent variable of these models is a binary indicator for whether a household possesses a title for at least one agricultural parcel. Specifications are otherwise identical to the main text tables.

Table A9. Population density does not predict the uptake of land titles

	(1)	(2)	(3)	(4)	(5)
Population density	0.000	0.000	0.001	0.018	−0.004
	(0.004)	(0.004)	(0.004)	(0.020)	(0.029)
Hierarchy		−0.006	−0.075**	−0.005	−0.087***
		(0.016)	(0.022)	(0.016)	(0.019)
Hierarchy * Devolved			0.101***		0.109***
			(0.028)		(0.026)
Population density * Hierarchy					0.045
					(0.028)
Population density * Devolved				−0.019	−0.004
				(0.020)	(0.029)
Population density * Hierarchy * Devolved					−0.036
					(0.029)
Education: preschool	0.000	0.000	−0.001	0.000	0.000
	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
Education: primary	0.013	0.012	0.013	0.013	0.013
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Education: secondary	0.026	0.026	0.025	0.026	0.025
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
Education: higher	0.032	0.032	0.033	0.032	0.033
	(0.032)	(0.033)	(0.032)	(0.032)	(0.031)
Female HH head	−0.029**	−0.029**	−0.029**	−0.029**	−0.028**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
HH head age	0.009***	0.009***	0.009***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HH head age squared	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000*	0.000*	0.000*	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban	0.015	0.014	0.015	0.014	0.016
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)
Terrain ruggedness	0.000*	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Density: all roads	0.016*	0.017*	0.014*	0.014*	0.012
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)
Density: highways	0.005	0.005	0.003	0.007	0.003
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Caloric suitability	0.000**	0.000**	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area * population density	0.000	0.000	0.000		
	(0.000)	(0.000)	(0.000)		
Country-Wave Fixed Effects	X	X	X	X	X
Num.Obs.	168 091	168 091	168 091	168 091	168 091
R2	0.251	0.251	0.252	0.251	0.253

Note: The dependent variable of this model whether a household possesses a title for at least one agricultural parcel. Specifications are otherwise identical to the main text tables.

A.4 Alternative specifications

This section shows that my results are robust to a variety of alternative specifications. Ethiopia and Rwanda are the two countries in sub-Saharan Africa with the highest titling rates, due to their top-down land titling drives. As a result, one might worry that any results are being driven by these two outliers, or that the underlying theory operates differently in these two countries. Table A10 shows that my results are identical—or even stronger—when excluding Ethiopia and Rwanda.

Alternatively, one might wish to log transform the different measurements of land values and the returns to agricultural investment, due to their non-normal (right skewed) distribution. Table A11 shows that my results are largely invariant to such a transformation.

Finally, we might be concerned that results are being driven by the fact that the underlying panel data is unbalanced. Certain countries (Tanzania and Uganda) have multiple waves; others have only one. Table A12 shows that coefficients are largely similar when restricting the data to only the most recent waves. However, the standard errors are inflated by the smaller sample size, so the statistical significance is inconsistent.

Table A10. Results are robust to excluding Ethiopia and Rwanda

	(1)	(2)	(3)	(4)	(5)	(6)
Max value	0.052*	0.066**				
	(0.023)	(0.024)				
Difference (fertilizer)			0.955***	1.546***		
			(0.197)	(0.222)		
Difference (trees)					0.092***	0.115***
					(0.018)	(0.029)
Hierarchy		0.060		0.086*		−0.047
		(0.056)		(0.043)		(0.027)
Hierarchy * Devolved		−0.113		−0.109*		0.041
		(0.060)		(0.047)		(0.032)
Max value * Hierarchy		−0.034*				
		(0.017)				
Difference (fertilizer) * Hierarchy				−1.288***		
				(0.301)		
Difference (trees) * Hierarchy						−0.050
						(0.031)
Max value * Devolved		−0.026				
		(0.022)				
Difference (fertilizer) * Devolved				−1.016		
				(0.561)		
Difference (trees) * Devolved						−0.081
						(0.049)
Max value * Hierarchy * Devolved		0.056**				
		(0.021)				
Difference (fertilizer) * Hierarchy * Devolved				1.733**		
				(0.500)		
Difference (trees) * Hierarchy * Devolved						0.119**
						(0.039)
Education: preschool	−0.022	−0.024	−0.022	−0.023	−0.017	−0.019
	(0.049)	(0.047)	(0.049)	(0.048)	(0.048)	(0.047)
Education: primary	−0.016	−0.016	−0.016	−0.016	−0.014	−0.014
	(0.040)	(0.040)	(0.040)	(0.040)	(0.039)	(0.039)
Education: secondary	−0.003	−0.004	−0.002	−0.003	−0.002	−0.003
	(0.040)	(0.040)	(0.040)	(0.040)	(0.039)	(0.039)
Education: higher	0.014	0.015	0.013	0.014	0.014	0.016
	(0.048)	(0.047)	(0.047)	(0.047)	(0.046)	(0.046)
Female HH head	0.010	0.009	0.009	0.008	0.008	0.006
	(0.006)	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
HH head age	0.005***	0.005***	0.005***	0.005***	0.005***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
HH head age squared	0.000***	0.000**	0.000***	0.000**	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000*	0.000*	0.000	0.000	0.000**	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	0.001	0.002	0.001	0.001	0.001	0.000
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)
Urban	0.016	0.016	0.017	0.017	0.017	0.017
	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)	(0.021)
Terrain ruggedness	0.000	0.000	0.000	0.000	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	−0.058	−0.054	−0.074	−0.061	−0.043	−0.046
	(0.043)	(0.040)	(0.041)	(0.038)	(0.037)	(0.034)
Density: all roads	0.019**	0.019**	0.021**	0.021***	0.024***	0.022***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Density: highways	−0.001	−0.001	−0.002	−0.001	0.000	0.001
	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.013)
Caloric suitability	−0.104**	−0.101**	−0.106**	−0.102**	−0.032	−0.033
	(0.033)	(0.037)	(0.033)	(0.037)	(0.019)	(0.019)
Area * population density	0.000*	0.000**	0.000*	0.000**	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	150 756	150 756	150 756	150 756	150 756	150 756
R_2	0.075	0.078	0.076	0.080	0.081	0.084

Note: These regressions exclude Ethiopia and Rwanda, which have top-down land titling programs. Specifications are otherwise identical to the main text tables.

Table A11. Results are invariant to log-transforming the land value variables

	(1)	(2)	(3)	(4)	(5)	(6)
Max value	−0.039*	0.006				
	(0.017)	(0.064)				
Difference (fertilizer)			0.000	0.133**		
			(0.029)	(0.042)		
Difference (trees)					0.022**	0.026**
					(0.006)	(0.007)
Hierarchy		0.014		−0.353***		−0.116***
		(0.060)		(0.091)		(0.028)
Hierarchy * Devolved		−0.003		0.486***		0.224***
		(0.062)		(0.109)		(0.042)
Max value * Hierarchy		−0.069				
		(0.055)				
Difference (fertilizer) * Hierarchy				−0.132**		
				(0.042)		
Difference (trees) * Hierarchy						−0.018*
						(0.008)
Max value * Devolved		−0.058				
		(0.065)				
Difference (fertilizer) * Devolved				−0.156**		
				(0.049)		
Difference (trees) * Devolved						−0.018
						(0.013)
Max value * Hierarchy * Devolved		0.092				
		(0.056)				
Difference (fertilizer) * Hierarchy * Devolved				0.171***		
				(0.046)		
Difference (trees) * Hierarchy * Devolved						0.039***
						(0.010)
Education: preschool	−0.023	−0.023	−0.022	−0.023	−0.020	−0.021
	(0.044)	(0.043)	(0.045)	(0.043)	(0.043)	(0.043)
Education: primary	−0.011	−0.009	−0.010	−0.009	−0.009	−0.008
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.037)
Education: secondary	0.002	0.002	0.003	0.004	0.003	0.004
	(0.038)	(0.038)	(0.038)	(0.038)	(0.038)	(0.037)
Education: higher	0.008	0.011	0.009	0.011	0.009	0.012
	(0.044)	(0.043)	(0.044)	(0.043)	(0.043)	(0.042)
Female HH head	−0.015	−0.018	−0.016	−0.021	−0.014	−0.016
	(0.032)	(0.032)	(0.033)	(0.033)	(0.033)	(0.033)
HH head age	0.009***	0.009***	0.009***	0.009***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
HH head age squared	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000	0.000	0.000*	0.000	0.000**	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	0.000	0.001	0.000	0.000	−0.001	−0.001
	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
Urban	0.013	0.014	0.015	0.016	0.015	0.016
	(0.020)	(0.020)	(0.019)	(0.020)	(0.019)	(0.019)
Terrain ruggedness	0.000*	0.000*	0.000*	0.000*	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	−0.076	−0.064	−0.071	−0.056	−0.062	−0.062
	(0.045)	(0.041)	(0.042)	(0.038)	(0.040)	(0.036)
Density: all roads	0.015*	0.013*	0.016**	0.016*	0.020***	0.018**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Density: highways	0.007	0.006	0.005	0.004	0.005	0.004
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Caloric suitability	−0.070	−0.068	−0.091*	−0.086*	−0.040*	−0.044*
	(0.035)	(0.038)	(0.037)	(0.040)	(0.019)	(0.020)
Area * population density	0.000	0.000	0.000	0.000	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	168 091	168 091	168 091	168 091	168 091	168 091
R_2	0.251	0.253	0.251	0.254	0.254	0.256

Note: All three land value variables are logged (plus 0.01). Specifications are otherwise identical to the main text tables.

Table A12. Results are consistent when subsetting to only the most recent survey waves

	(1)	(2)	(3)	(4)	(5)	(6)
Max value	0.016	0.020				
	(0.050)	(0.046)				
Difference (fertilizer)			0.489	0.709		
			(0.452)	(0.403)		
Difference (trees)					0.058***	0.072
					(0.013)	(0.046)
Hierarchy		−0.028		−0.030		−0.005
		(0.074)		(0.084)		(0.050)
Hierarchy * Devolved		−0.059		−0.024		0.002
		(0.080)		(0.083)		(0.049)
Max value * Hierarchy		0.002				
		(0.014)				
Difference (fertilizer) * Hierarchy				0.057		
				(0.534)		
Difference (trees) * Hierarchy						−0.014
						(0.045)
Max value * Devolved		−0.028**				
		(0.009)				
Difference (fertilizer) * Devolved				−1.077***		
				(0.270)		
Difference (trees) * Devolved						−0.073
						(0.046)
Max value * Hierarchy * Devolved		0.035				
		(0.019)				
Difference (fertilizer) * Hierarchy * Devolved				0.902		
				(0.636)		
Difference (trees) * Hierarchy * Devolved						0.086
						(0.048)
Education: preschool	−0.037	−0.036	−0.036	−0.034	−0.027	−0.026
	(0.033)	(0.033)	(0.033)	(0.034)	(0.034)	(0.038)
Education: primary	−0.034	−0.034	−0.034	−0.034	−0.027	−0.027
	(0.043)	(0.043)	(0.044)	(0.044)	(0.045)	(0.047)
Education: secondary	−0.037	−0.036	−0.037	−0.036	−0.031	−0.030
	(0.050)	(0.049)	(0.050)	(0.050)	(0.051)	(0.053)
Education: higher	−0.016	−0.015	−0.016	−0.015	−0.010	−0.009
	(0.064)	(0.063)	(0.064)	(0.064)	(0.064)	(0.066)
Female HH head	−0.047**	−0.047**	−0.047**	−0.047**	−0.047***	−0.047***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
HH head age	0.007*	0.007*	0.007*	0.007*	0.007*	0.007*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
HH head age squared	0.000*	0.000*	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Area	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Population density	0.008	0.008	0.008	0.008	0.006	0.006
	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)
Urban	−0.006	−0.006	−0.006	−0.006	−0.006	−0.007
	(0.032)	(0.032)	(0.032)	(0.031)	(0.032)	(0.031)
Terrain ruggedness	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Distance to capital	−0.080	−0.093	−0.087	−0.089	−0.052	−0.069
	(0.059)	(0.055)	(0.060)	(0.054)	(0.058)	(0.053)
Density: all roads	0.003	0.001	0.003	0.000	0.008	0.004
	(0.015)	(0.016)	(0.015)	(0.016)	(0.013)	(0.015)
Density: highways	0.002	0.002	0.002	0.001	−0.001	0.000
	(0.007)	(0.007)	(0.006)	(0.006)	(0.005)	(0.005)
Caloric suitability	−0.102**	−0.097**	−0.103**	−0.096*	−0.038	−0.040
	(0.031)	(0.030)	(0.035)	(0.036)	(0.026)	(0.027)
Area * population density	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Country-Wave Fixed Effects	X	X	X	X	X	X
Num.Obs.	60 857	60 857	60 857	60 857	60 857	60 857
R_2	0.326	0.328	0.326	0.328	0.329	0.331

Note: This table subsets to only the most recent wave of the DHS or LSMS data collection. Specifications are otherwise identical to the main text tables.

Table A13. Country-level titling rates across most recent survey waves

Country	Year	Titling rate	N. Obs.	N. Obs. with titling
Benin	2021	0.16	8032	2661
Burkina Faso	2021	0.04	7176	6045
Burundi	2016	0.03	7951	3872
Cameroon	2018	0.14	5839	1984
Côte d'Ivoire	2021	0.12	12965	12226
Ethiopia	2018	0.79	6513	2756
Gambia	2019	0.31	3913	373
Guinea	2018	0.22	3311	157
Guinea-Bissau	2021	0.02	5351	5135
Liberia	2019	0.17	3463	65
Malawi	2019	0.07	3178	1163
Mali	2021	0.03	6143	5888
Niger	2021	0.05	6622	3039
Nigeria	2018	0.21	13896	3575
Rwanda	2019	0.69	6346	1293
Senegal	2021	0.10	7120	2329
Sierra Leone	2019	0.16	6212	154
Tanzania	2020	0.05	4709	1210
Togo	2021	0.10	6462	2330
Uganda	2019	0.09	3097	2222
Zambia	2018	0.07	3947	411
Zimbabwe	2015	0.28	9415	2283

Note: This table shows the weighted average titling rate in the most recent survey wave across the 22 countries in the sample. All survey weights are scaled to the number of observations (i.e. Liberia's 65 observations are not over-weighted in the survey).

B Measurement strategy for crop prices

This appendix section provides additional details on the geospatial strategy for measuring land values and the returns to agricultural investment. In the list of crops, I exclude tomatoes because the IMF commodity price is calculated as the consumer price per kilo in metropolitan France, rather than the price per kilo on the international commodity market. For the GAEZ data, I exclude crops for which the global commodity prices are unavailable. Some crops use other measures (for example, "alfalfa, miscanthus, napier grass, reed canary grass, pasture legumes and grasses the yields are in 10kg dry weight per hectare"); I apply appropriate conversation factors where necessary (Fischer et al. 2021: 129).

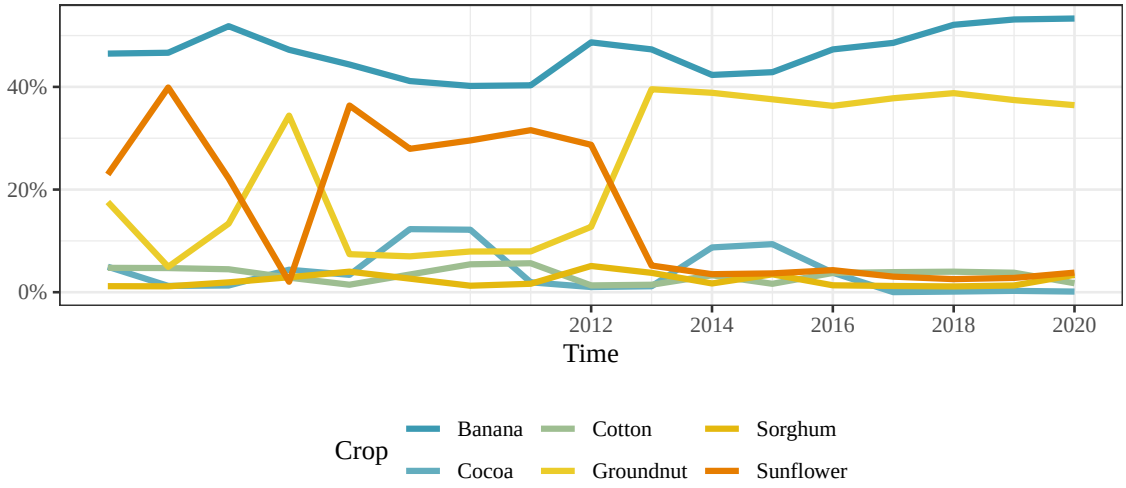
B.1 Measurement details

Figure B1 shows the percentage of grid cells for which a given crop has the highest attainable value. The figure excludes crops which are the most potentially valuable in less than one percent of grid cells. This excludes a number of important cash crops; coffee, for example, often has high attainable values but only within small areas.

These data are an important first check for whether this land value metric appears accurate. All seven listed crops are common across different parts of Africa. Bananas are consistently the most profitable potential crop. Cotton is a notable cash crop in the Sahel. Sorghum is notable for growing where other crops would falter. It is important to note that crops can be consistently profitable without appearing in these time series. These figures suggest that this measure has some face validity for measuring change in agricultural attainable value.

Table B1 shows the descriptive statistics for the land value measure in each year (in constant 2011 USD). These values are roughly similar per year, but we can see some key trends. Values decrease over time. While the maximum value increases most years, the 25th percentile, median, and 75th percentile decrease over time. These data illustrate how additional political variables are necessary to contextualize the relationship between the value of land and the uptake of land titles. Land tenure formalization is increasing over time; attainable land values are not. These data are too detailed for visual detail across

Figure B1. Percentage of grid cells where each crop is most valuable



Note: This figure excludes crops which are the most valuable in less than one percent of grid cells. Data are from the FAO's Global Agro Ecological Zone model and the IMF's Primary Commodity Price System.

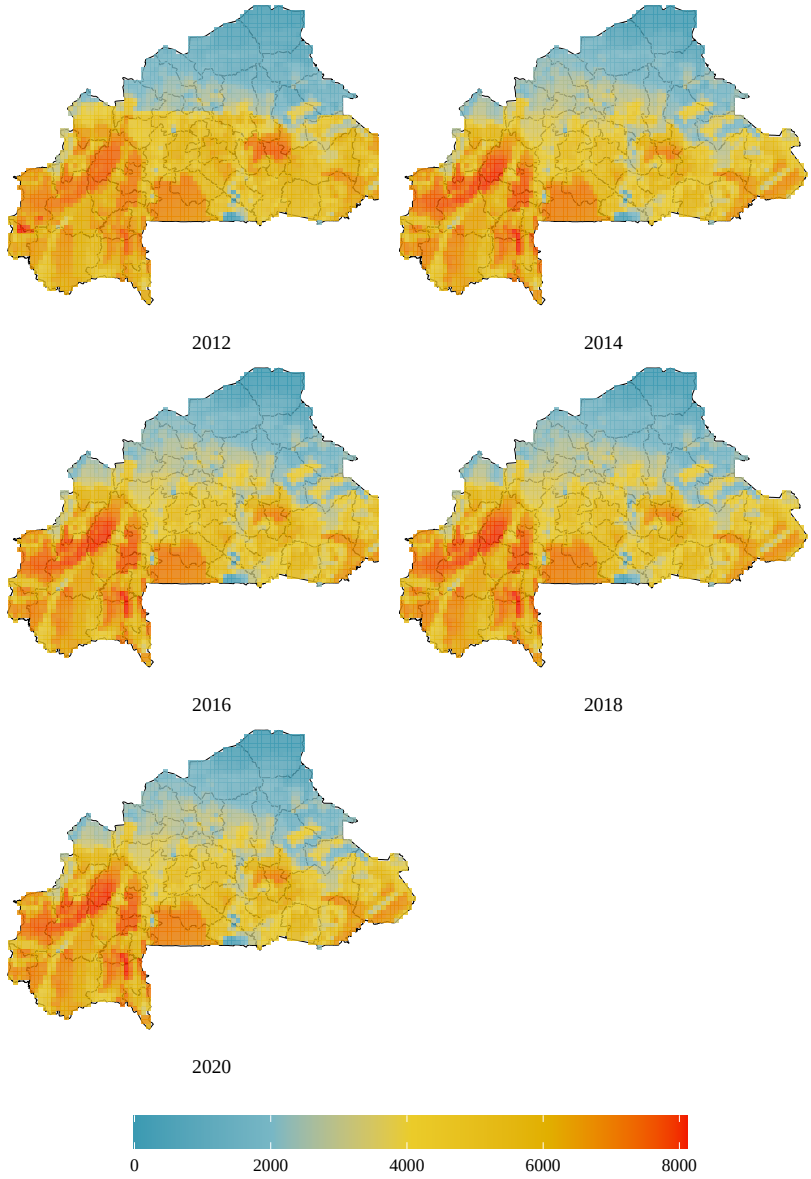
Table B1. Attainable yield summary statistics by year

Year	Mean	StdDev	Min	25th percentile	Median	75th percentile	Max
2011	2562.7	2070.1	0	446.8	2663.5	4270.3	8526.8
2012	2277.9	1842.6	0	344.5	2397.4	3823.1	7778.0
2013	2476.2	1985.1	0	336.8	2645.6	4167.6	8236.8
2014	2271.8	1849.9	0	275.1	2384.7	3821.1	7511.8
2015	2105.9	1729.6	0	254.3	2199.8	3516.6	7447.4
2016	1963.1	1621.7	0	237.9	2047.8	3261.0	7577.5
2017	2054.5	1702.8	0	257.1	2119.7	3413.1	7950.7
2018	2078.5	1727.4	0	267.1	2130.2	3467.9	8292.6
2019	1886.7	1588.3	0	231.1	1929.6	3110.2	8107.5
2020	1975.7	1660.5	0	235.7	2037.0	3255.9	8531.1

Note:
Values are in 1000s of constant 2011 U.S. dollars. Data are from the FAO's Global Agro Ecological Zone model and the IMF's Primary Commodity Price System. These data only cover the countries included in the combined DHS/LSMS dataset.

the continent, but Figure B2 shows this change over time in an example country: Burkina Faso. Overall the trends are the same. Different regions of Burkina Faso see different fluctuations; for example, the Hauts-Bassin regions sees an increase in values around 2012 and 2014. Attainable yields are much lower in the arid far north of the country.

Figure B2. Attainable agricultural value per hectare in Burkina Faso, 2012-2020



Note: Values are in 1000s of constant 2011 U.S. dollars. Data are from the FAO's Global Agro Ecological Zone model and the IMF's Primary Commodity Price System.

B.2 Crop planting elasticity

The primary contributions of this paper are twofold: it documents extensive variation in the uptake of formal land titles, and it shows how neither land values nor the returns to potential agricultural investment predict land titling in a vacuum. For these measures to be valid, they need to affect other economic behaviors that one would suppose to be associated with land values. In this section, I specifically examine whether farmers in areas where crop c has a higher attainable value actually plant more of crop c. In other words, I calculate the elasticity of crop plantings with regards to the attainable value of the crop. For this strategy to measure land values to be reasonable, I would exect a positive association: farmers plant more of crop c where crop c is more profitable.

I calculate these numbers using a subset of the LSMS. This set of surveys, called the *Enquêtes Harmonisé sur les Conditions de Vie es Ménages*, was sponsored by ECOWAS, the Economic Community of West African States. These surveys took place in Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Sénégal, and Togo in both 2019 and 2021. It is useful because the harmonized surveys use identical variable coding, which allows cross-national analysis beyond the level of simple variables such as whether a household possesses a title.[36] These data cover a variety of state capacities, land regimes, and climactic zones.

For each household in this sample, I first calculate the household's overall landholdings. I then calculate the fraction of those landholdings dedicated to a crop. The resulting data uses the household-crop as its unit of observation. For example, one observation would be the fraction of household i's land on which cocoa is grown, another observation would be the fraction of household i's land on which sorghum is grown, and so on. To avoid inflating my sample size without meaningful variation, I only include crops which are grown in the given country. For instance, I do not include sorghum in Côte d'Ivoire, where it is rarely grown, but do include it in Mali and Niger, where it is a major crop.

Table B2 shows the relationship between the attainable value per hectare of a given

[36] More specifically, because LSMS surveys (apart from the EHCVM) are collected by national statistics agencies, variable definitions change. There is no equivalent to the DHS recode files, in which large amounts of variables can be easily combined across countries. Using the EHCVM data removes this challanges and renders data analysis more feasible.

Table B2. Households grow more of a crop when its attainable value per hectare is higher

	(1)	(2)	(3)	(4)
Total value of crop	0.044***	0.047***		
	(0.006)	(0.006)		
log(Total value of crop)			0.130***	0.159***
			(0.017)	(0.020)
Household head age		0.000*		0.000
		(0.000)		(0.000)
Male household head		−0.003***		0.093***
		(0.001)		(0.010)
Country/Crop Fixed Effects	X	X	X	X
Ethnicity Fixed Effects		X		X
Num.Obs.	392 786	368 394	392 786	368 394
R2	0.348	0.346	0.365	0.369

Note: The dependent variable in these models is the fraction of a household's agricultural land where a crop is the principal planting. The independent variable measures the total attainable value for this crop. Observations are at the household-crop level; the data include all crops which are grown in the respondent's country at least once. All regressions include country-crop fixed effects; standard errors are clustered at the second-level administrative division.

crop (calculated across the 2nd level administrative division) and the fraction of households' landholdings planted with that crop. Columns 1 and 2 are untransformed; because this relationship can be thought of as an elasticity, I also include columns 3 and 4, which log-transform both the explanatory and outcome variables. The results are strong and statistically significant. For the elasticity regressions in particular, a one percent increase in the attainable value of a crop leads to a 0.130-0.159 percent increase in the fraction of land farmers dedicate to that crop.

Table B3 shows similar results, but with a different explanatory value. Using my land value measure, I back out the percentage of grid cells in a given administrative area where crop i is the most potentially valuable. This strategy provides an alternative measure: if crop i increases in value, it may still not be the most profitable crop, and so changes to the price of crop i may not be picked up in this paper's primary regressions. In contrast, the percentage of an area where crop i is most profitable is invariant to shifts in prices of other crops, unless that price moves above the threshold to where it has a higher attainable value than crop i.

In Table B3, the results are similar to those of Table B2. For a one percent increase in

Table B3. Households grow more of a crop in areas where it is the most valuable potential crop

	(1)	(2)	(3)	(4)
Total value of crop	0.030*	0.033*		
	(0.013)	(0.014)		
log(Total value of crop)			0.080***	0.076***
			(0.021)	(0.020)
Household head age		0.000		0.000*
		(0.000)		(0.000)
Male household head		−0.002**		0.103***
		(0.001)		(0.010)
Country/Crop Fixed Effects	X	X	X	X
Ethnicity Fixed Effects		X		X
Num.Obs.	392 786	368 394	392 786	368 394
R2	0.339	0.336	0.358	0.361

Note: The dependent variable in these models is the fraction of a household's agricultural land where a crop is the principal planting. The independent variable measures the fraction of grid cells within the second level administrative division where a given crop is most profitable. Observations are at the household-crop level; the data include all crops which are grown in the respondent's country at least once. All regressions include country-crop fixed effects; standard errors are clustered at the second-level administrative division.

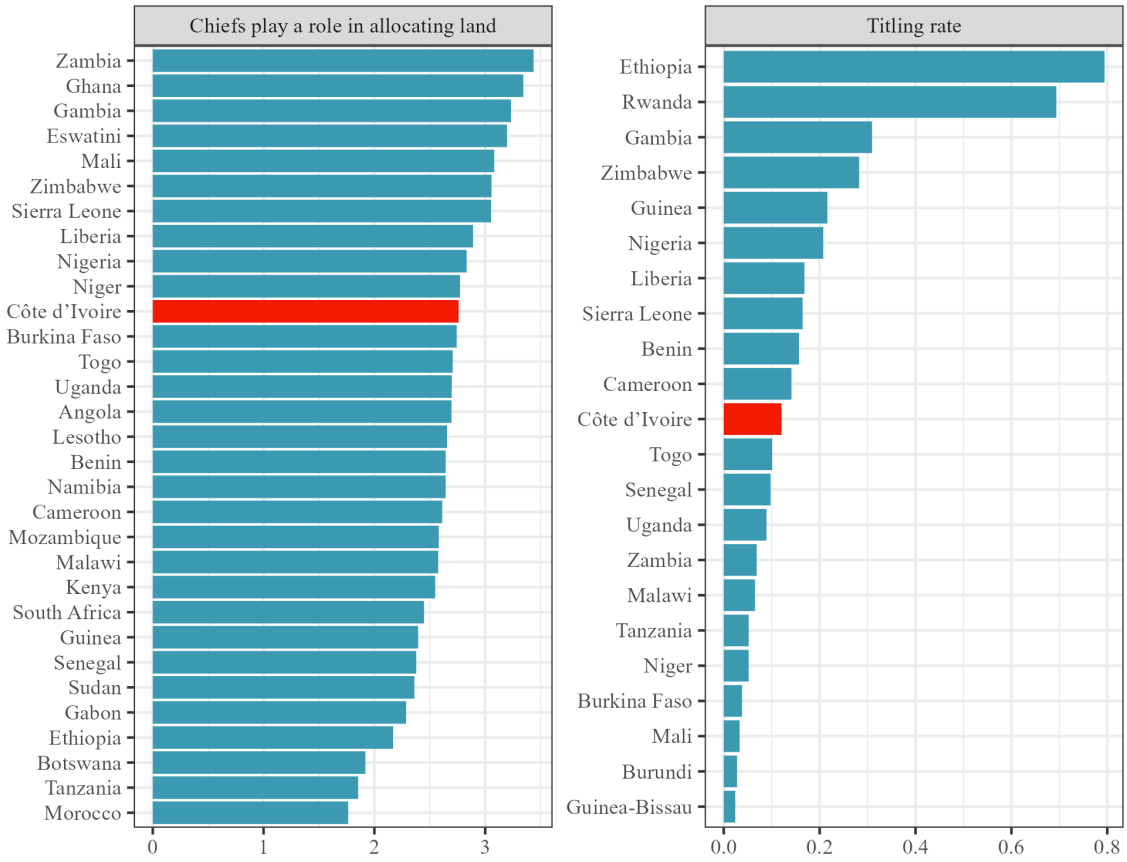
the fraction of an administrative region where crop c has the highest attainable value, the fraction of households' land on which they grow crop c increases by 0.076-0.080 percent. The crop-level elasticity of planting with regards to the land value for that crop is positive and statistically significant.

Taken together, these results suggest that my measure of land values is indeed capturing the underlying agricultural conditions which could drive land titling. Farmers make planting decisions in ways consistent with the measure of land values. Where the attainable value of that crop is higher, farmers are more likely to plant it.

C Côte d'Ivoire survey details

C.1 Case selection

Figure C1. Côte d'Ivoire is roughly average in terms of land titling and chief's influence on land allocation



The lefthand panel shows answers on a four point likert scale (1=None, 2=A small amount, 3=Some, 4=A lot) to the question "How much influence do traditional leaders currently have in each of the following areas: allocating land?" Data are from round 8 of Afrobarometer and use within-country survey weights. The righthand panel shows country averages of titling rate from the most recent round of DHS or LSMS data collection.

This figure shows Côte d'Ivoire's relative position on two key dimensions of the broader theory. The lefthand panel shows results from round 8 of Afrobarometer for the question

"How much influence do traditional leaders currently have in each of the following areas: allocating land?" Côte d'Ivoire is ranked 11th out of 31 countries in which the question was asked. The righthand panel shows country-level averages from the DHS and LSMS data that I use for the main analyses. Côte d'Ivoire is ranked 11th out of 22. These data support the choice of Côte d'Ivoire as a case study—it is roughly typical on both of these important dimensions.

C.2 Sampling strategy

My sampling strategy for this survey maximized variation on my key explanatory outcome: chiefs' political authority.[37] To do this, I leverage a process called village delimitation, which unfurled differently depending on the period of time in which a village was delimited.

Allochthone families often established their fields and households at some distance from the original village. Over time, these settlements grew into hamlets and 'campements.' These hamlets often rival the original village in population and economic prominence. The high number of ethnicities and these quilt-like settlement patterns mean that the important cleavage for land disputes in Côte d'Ivoire is autochthone versus allochthone, not ethnicity per se. It also means that before delimitation, any given area in Côte d'Ivoire will have a diverse set of autochthonous villages, allochthonous villages, camps, hamlets, and other populated clusters. Delimitation forces the issue of the hierarchy between these settlements.

Each village, hamlet, etc., has its own customary headman or chief. When villages are delimited, some villages and chiefs will see their status merely confirmed; others will see their relative position increased or decreased. For example, the headman of a campements could suddenly find himself an independent chief of an administrative village. A formerly independent chief could find himself chief of an 'attached' village. This process creates the potential for village delimitation to create a sudden shock to a chief's perceived authority or legitimacy.

[37] The text for this section is largely taken from the registered pre-analysis plan, available at the Open Science Foundation Registry.

Faced with these disparate constituencies, land policy in Côte d'Ivoire alternated between use-based conceptions of land rights, which benefit the allochthones currently using the land, and customary land rights, which favor the autochthones (Boone 2018; Colin, Le Meur, and Leonard 2009). Use-based rights are exemplified by the long-serving Ivoirian president Houphouët-Boigny's famous statement: "the land belongs to whoever develops it."[38] After a lengthy power-struggle in the 1990s following Houphouët-Boigny's death, Côte d'Ivoire passed the 1998 land law (Law 98-750), signaling a new, land regime which favored customary rights. The law "contained an array of potentially or inherently conflicting provisions for assigning land ownership rights on the basis of autochthony" (Boone 2018: 191). Laurent Gbagbo, the opposition leader, was the major proponent of this policy as it benefited his largely autochthonous political supporters. After Alassane Ouattara took power in 2011, the administration used land administration instead as a tool of state-building (Boone 2018; Chauveau 2009).[39]

These shifts create three periods of village delimitation in Côte d'Ivoire. The first period, until 1998, emphasized use-based land rights and favored allochthones. From 1998 to 2010, the 1998 land law promoted customary rights and favored autochthones. Finally, after Ouattara took power in 2011 village delimitation has been neuteral with regards to autochthony. These shifts are independent of local circumstances—the actual timing of village delimitation has largely been determined by donor considerations. I conducted the survey in three sets of villages: villages which did not see a change in status (control villages), villages where the village was downgraded (chiefs received a negative shock to their legitimacy) and villages where the status was upgraded (chiefs received a positive shock to their legitimacy. Table C1 summarizes these different villages.

Delimitation primarily took place through a series of externally funded programs. These programs are:

- The Plan Foncier Rurale (PFR) (1989-1997), sponsored by the World Bank. This program took place across five pilot zones in Abengourou, Béoumi, Daloa, Ko-

[38] Allochthones often have more capital than allochthones—many cocoa and coffee plantations are maintained by Burkinabè and Baoulé migrants.

[39] Land-based grievances metastasized into violence during the 2010-2011 civil war and prevented broader implementation of land titling at the start of Alassane Ouattara's administration.

Table C1. The history of delimitation in Côte d'Ivoire creates three treatment groups

		After delimitation	
		Attached	Independent
Before delimitation	Attached	No change (control)	Upwards shock (treatment)
	Independent	Downwards shock (treatment)	No change (control)

rhogo, and Soubré.

- The Rural Land Management and Community Infrastructure Project (1997–2010), also known as the Projet National de Gestion des Terroirs et d'Équipement Rural (PNGTER). This program was primarily funded primarily by the World Bank, with contributions from the Ivoirian government and the Agence Française de Développement (AFD). It was meant to expand the PFR across Côte d'Ivoire, but only formalied 171 villages (Bassett 2020: 152).

- The Village Lands Delimitation Pilot Operation, between 2000 and 2001, was funded by the AFD, which failed to delimit additional villages.

- The National Land Tenure Security Program from 2007 to 2012 (Programme National de Sécurisation du Foncier Rural [PNSFR]) also made extremely limited advances in village delimitation.

- The Support Project for the Revival of the Agricultural Sector (Projet d'Appui à la Relance des Filières Agricoles de Côte d'Ivoire [PARFACI]) from 2012 to 2020 built on PNSFR, and delimited 639 villages (AFOR, n.d.).

- The World Bank is currently supporting the Project for the Improvement and Implementation of the Rural Land Policy of Côte d'Ivoire (Projet d'Amélioration et de Mise en Oeuvre de la Politique Foncière Rurale [PAMOFOR]), which started in 2018. The project targets 665 villages across 19 departements; as of 2023, it delivered 41,032 land certificats, making PAMOFOR a dramatic step-up in the pace of land titling and village delimitation. 12 of the 80 villages in which I conducted my

survey were selected for PAMOFOR, and I include a binary control for PAMOFOR participation at the village level.

The survey took place in the rural Indénié-Djuablin and Haut-Sassandra regions. I selected these regions for two reasons. First, they both experienced limited delimitation efforts as part of the World Bank's PR and PNGTER projects. Second, these areas are both squarely located in the country's middle forested region, where cocoa and coffee are commonly grown. These areas were the loci of Burkinabè and Baoulé migration during the Houphouët-Boigny regime. As a result, these areas have the patchwork of autochthonous and allochthonous settlements on which this experiment is predicated. Within these two regions, I sampled within the Daloa and Vavoua departments in Indénié-Djuablin region, and the Abengourou and Agnebilekrou departments in Haut-Sassandra region. As with the region-level selection, this choice is driven by the program areas of the PFR and PNGTER interventions.

My sampling frame was the list of villages from the 2014 census of locations (*répertoire des localités*). I randomly sampled villages across three strata, each strata corresponding to a period in which villages were delimited. One strata comprised villages delimited before 1998 (as part of the original PFR program); another strata comprised villages delimited between 1998 and 2010; and the third strata comprised the remainder of villages.

I used a variety of secondary literature to identify which villages were delimited in each period. First, the impact evaluation of the PFR program has extensive appendices; I sorted all villages which were mentioned at least once in this report into the first strata (Côte d'Ivoire 1996). The second strata comprised villages delimited as part of the PNGTER program, thanks to records generously shared by Catherine Boone. All remaining villages in the census of locations comprise the third strata. This strategy assumes that villages which were not formalized as part of the PNGTER or PFR program were not delimited through another program, but a review of existing evidence suggests that this is the case (Bassett 2020). Regardless, the purpose of stratifying is not to ensure that sampled villages were delimited on a precise time frame, but to ensure that there is variation over the period of time in which villages were delimited.

Within villages, I sampled both the administrative village and either one or two outlying hamlets/settlements. In each settlement/village, I will first administer a brief survey

to the village's chief or headman.[40] Village chiefs are the relevant customary authority in Côte d'Ivoire. Many villages have both a village chief—selected by the village elders as the strongest representative of the village—and a customary authority, such as a land chief (*chef de terre*) or earthpriest. Such authorities may play a role within the villages, but village chiefs serve as interlocutors to the state and who manage the village land committees.

Finally, in each village/settlement, I administered a survey to heads of households. Households were chosen via a random walk. I will aim to administer the survey to 10-15 households per administrative village: five in the administrative village, and five in at most two hamlets/campements/attached villages. We randomly decided the village in which we would sample one versus two outlying hamlets; the choice to sample on average 1.5 hamlets was made for budgetary reasons. I surveyed 80 administrative villages, giving a total sample of 192 chiefs/headmen (one per administrative village, plus one or two per hamlet, depending on the number of existing outlying settlements) and 801 household heads.

C.3 Additional analyses

I also display a variety of alternative analyses of these survey data. First, table C2 shows a balance table of several variables broken out by whether the respondent is an autochthone or an allochthone. This table illustrates several key factors. First, autochthones trust chiefs more. While the distinction is not significant for two chiefs' authority indices, autochthones are much more likely to report that they trust their chiefs and their land committees (CVGFRs). This table also shows that autochthones perceive titles to be dramatically more useful across all measures. Finally, autochthones are less likely to believe that the chief could prevent you from titling and that there is enough land in the village, but are more confident that they could hold on to their land.

Table C3 replicates table 4, but using the individual components of the chief's authority questions rather than the indices. The two tables are consistent. In table 4, the

[40] If the chief was unavailable, I spoke with a member of the village land management committee, the CVGFR.

Table C2. Allochthones and autochthones have different opinions about land titling

	Autochthones		Allochthones		Difference
	Mean	Std.Err.	Mean	Std.Err.	T-score
Chief's authority					
Overall chief's authority	-0.25	2.19	-0.09	2.03	-1.07
Chief is secular	0.27	1.21	0.12	1.11	1.88
Trust in chiefs	0.43	0.77	0.12	0.78	5.56
Trust in land committee	0.46	0.63	0.15	0.85	5.71
Cost of titling					
N. actors you pay to formalize	2.60	1.60	2.92	1.79	-2.67
N. customary actors you pay to formalize	3.82	2.15	3.81	2.04	0.05
N. steps to title	9.77	6.27	9.45	6.05	0.72
Titles are helpful to:					
Succede in a land dispute	4.80	0.56	4.50	0.83	5.95
Keep their land if govt. tries to take it	4.56	0.91	4.37	0.76	3.23
Be compensated fairly for taken land	4.82	0.52	4.56	0.77	5.72
Other titling opinions					
Chief could prevent you from titling	2.41	1.51	2.85	1.44	-4.21
Likely to lose land while titling	0.50	0.83	0.51	0.77	-0.18
There is enough land in the village	0.78	0.86	0.99	0.84	-3.62
Likely to still have access to land in a year	4.21	1.18	3.98	1.17	2.78

Note: Data from a 2024 household survey in the Haut-Sassandra and Indénié-Djuablin regions of Côte d'Ivoire. 355 respondents are autochthones; 443 respondents are allochthones. All calculations use inverse sampling-probability survey weights.

chief's political authority index is associated with higher land titling, but only for autochthones. Table C3 shows that the individual questions which comprise this index have similar results when deployed individually.

Chiefs may selectively enforce *certificats fonciers*, leading to lower uptake among allochthones. Table C4 shows that chiefs/headman of allochthone settlements[41] perceive titles to be less useful. The reference category is chiefs/headmen of settlements which are evenly split between autochthones and allochthones. Columns 1 and 2 show that chiefs/headmen of locations which are mostly allochthonous are less likely to agree that "[h]ouseholds who formalize their landholdings are less likely to lose access to their land than other households." Columns 3 and 4 show that chiefs/headmen of locations which are mostly allochthonous are less likely to agree that "households who formalize their landholdings are better off than before they formalize their land."[42]

[41] I use the word settlement to mean villages, hamlets, and camps; I use the word village only to refer to administrative villages.

[42] I present results using OLS for consistency, but results are qualitatively identical for tables C4 and 6

Table C3. Chief's authority and titling by participation in individual activities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Clean village	0.032						
	(0.048)						
Land for school		−0.049					
		(0.039)					
Land for mosque			0.033				
			(0.035)				
Repair road				0.084*			
				(0.036)			
Plant trees					0.124**		
					(0.036)		
Participate in dance						−0.044	
						(0.044)	
Money for ceremony							−0.043
							(0.039)
Allochthone	0.609*	0.202	0.150	0.709**	0.669***	−0.138	−0.115
	(0.254)	(0.192)	(0.172)	(0.224)	(0.175)	(0.231)	(0.203)
Clean village* Allochthone	−0.111+						
	(0.058)						
Land for school* Allochthone		−0.020					
		(0.048)					
Land for mosque* Allochthone			−0.004				
			(0.044)				
Repair road* Allochthone				−0.135*			
				(0.051)			
Plant trees* Allochthone					−0.129**		
					(0.044)		
Participate in dance* Allochthone						0.072	
						(0.059)	
Money for ceremony* Allochthone							0.068
							(0.050)
Hamlet/camp	−0.048	−0.031	−0.048	−0.042	−0.077	−0.082	−0.068
	(0.076)	(0.080)	(0.079)	(0.073)	(0.074)	(0.081)	(0.076)
Terrain ruggedness	0.001	0.001	−0.002	0.001	0.000	0.001	0.002
	(0.009)	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
PAMOFOR village	−0.058	−0.073	−0.082	−0.078	−0.057	−0.099	−0.104
	(0.108)	(0.110)	(0.110)	(0.107)	(0.108)	(0.111)	(0.113)
Cocoa suitability	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001+	−0.001+
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Coffee suitability	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Distance to the capital	0.003	0.002	0.003	0.003	0.003	0.003	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Education: madrassa	−0.364**	−0.383**	−0.430***	−0.359**	−0.401**	−0.413***	−0.417***
	(0.115)	(0.133)	(0.113)	(0.111)	(0.121)	(0.110)	(0.121)
Education: primary	−0.191*	−0.172*	−0.194*	−0.185*	−0.211**	−0.197*	−0.189*
	(0.079)	(0.078)	(0.077)	(0.080)	(0.080)	(0.079)	(0.077)
Education: middle school	−0.150	−0.143	−0.129	−0.107	−0.134	−0.154	−0.140
	(0.098)	(0.100)	(0.100)	(0.098)	(0.097)	(0.101)	(0.102)
Education: secondary/higher	−0.037	−0.024	−0.027	−0.001	−0.043	−0.032	−0.025
	(0.115)	(0.121)	(0.115)	(0.113)	(0.104)	(0.119)	(0.118)
Female	0.011	−0.011	0.034	0.086	0.086	−0.012	−0.017
	(0.112)	(0.110)	(0.109)	(0.102)	(0.120)	(0.118)	(0.118)
Wealth index 1	0.054	0.050	0.061	0.064	0.057	0.057	0.057
	(0.057)	(0.062)	(0.061)	(0.056)	(0.053)	(0.065)	(0.063)
Wealth index 2	−0.043	−0.035	−0.049	−0.063	−0.058	−0.039	−0.044
	(0.057)	(0.058)	(0.057)	(0.056)	(0.051)	(0.058)	(0.058)
HH head representative	0.299**	0.318**	0.305**	0.305***	0.338***	0.318**	0.322**
	(0.090)	(0.095)	(0.092)	(0.088)	(0.086)	(0.096)	(0.097)
HH head spouse	0.259+	0.261+	0.220	0.161	0.131	0.259+	0.267+
	(0.140)	(0.147)	(0.150)	(0.133)	(0.138)	(0.146)	(0.147)
Department FEs	X	X	X	X	X	X	X
Ethnicity FEs	X	X	X	X	X	X	X
Age group FEs	X	X	X	X	X	X	X
Num.Obs.	774	769	770	768	762	771	771
R_2	0.259	0.263	0.248	0.263	0.296	0.251	0.251

Note: The dependent variable is whether a respondent has a formal land title. The independent variables are responses to: [f]or each of these activities [that chiefs in Côte d'Ivoire sometimes mandate], I would like you to tell me how much of the village you think would do what the chief asked them to do. All regressions use OLS with inverse sampling probability weights. Standard errors are clustered at the administrative village level.

Table C4. Chiefs in allochthonous villages think titles are less useful

	More likely to keep		Are better off	
	(1)	(2)	(3)	(4)
Allochthone village	−0.357*	−0.362*	−0.385**	−0.368**
	(0.154)	(0.162)	(0.131)	(0.132)
Autochthone village	0.056	0.057	0.011	0.055
	(0.149)	(0.147)	(0.139)	(0.146)
Terrain ruggedness		0.004		0.022
		(0.012)		(0.016)
PAMOFOR village		−0.034		−0.179
		(0.173)		(0.189)
Cocoa suitability		−0.001		−0.001
		(0.002)		(0.002)
Coffee suitability		0.001		0.003
		(0.002)		(0.003)
Distance to the capital		0.003		0.001
		(0.007)		(0.009)
Department FEs	X	X	X	X
Num.Obs.	192	192	192	192
R2	0.052	0.055	0.075	0.096

Note: Dependent variables of these models are responses to "[t]o what extent do you agree or disagree with the following statements? (1) Households who formalize their landholdings are less likely to lose access to their land than other households; (2) Households who formalize their landholdings are better off than when before they formalize their land?" Respondents are village chiefs and headmen. Each question is asked by a five point likert. Regressions use OLS with inverse sampling probability survey weights. Standard errors are clustered at the village level. Geographic controls include an indicator for PAMOFOR, distance to department capital, cocoa suitability, coffee suitability, and terrain ruggedness.

Finally, one alternative explanation for both the Ivoirian and the broader results is that confidence in customary chiefs is what determines the uptake of formal land titles. Customary authorities often do a passable job in maintaining property rights, reducing the marginal increase in land tenure security from titling. As a result, citizens who trust their customary authorities would have lower titling, as well as lower perceived utility from titling. I explore this alternative explanation more strongly elsewhere through a field conjoint experiment which asks respondents to judge which profile in a hypothetical land conflict would keep their land [citation redacted]. Households who trust customary

using an ordered logit to account for the likert response scale.

chiefs more place no less weight on formal land titling when adjudicating these disputes than do households who trust their customary chiefs less. Here, I show a limited test of this hypothesis using data from the Ivoirian case study.

Table C5 shows the outcomes from tables 4 and 6, but changes the explanatory variable to trust in customary chiefs. Specifically, I ask 'How much trust do you have in each of the following institutions, or have you not heard enough them to say?'[43] I use the response for 'traditional chiefs' but subtract the average of responses to the other questions. Table C5 shows null results across the board: trust in chiefs does not predict titling or the perceived usefulness of titles.

[43]This phrasing is from Afrobarometer.

Table C5. Trust in chiefs and land titling outcomes

	Has a title		Helpful (peers)		Helpful (keep)		Helpful (compensate)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trust in chiefs	0.018	0.048	0.098	0.084	0.057	0.056	0.099	0.113
	(0.061)	(0.057)	(0.086)	(0.078)	(0.072)	(0.063)	(0.081)	(0.084)
Allochthone	0.176*	0.157	−0.311**	−0.343*	−0.308*	−0.336*	−0.243*	−0.236
	(0.076)	(0.111)	(0.116)	(0.163)	(0.119)	(0.156)	(0.099)	(0.216)
Trust*Allochthone	−0.046	−0.009	−0.001	0.035	−0.005	0.014	0.019	0.052
	(0.089)	(0.079)	(0.115)	(0.101)	(0.111)	(0.094)	(0.092)	(0.098)
Hamlet/camp	−0.058	−0.085	0.091	0.034	0.081	0.004	0.088	0.163
	(0.086)	(0.076)	(0.078)	(0.126)	(0.093)	(0.129)	(0.090)	(0.125)
Terrain ruggedness		0.001		0.016		0.007		0.047***
		(0.010)		(0.010)		(0.009)		(0.012)
PAMOFOR village		−0.112		−0.148		−0.208*		0.011
		(0.110)		(0.105)		(0.097)		(0.121)
Cocoa suitability		−0.001+		−0.001		−0.001		−0.001
		(0.001)		(0.002)		(0.002)		(0.001)
Coffee suitability		0.000		0.001		0.000		0.003*
		(0.001)		(0.001)		(0.002)		(0.002)
Distance to the capital		0.003		0.002		0.008*		−0.004
		(0.003)		(0.003)		(0.003)		(0.004)
Education: madrassa		−0.278*		−0.156		−0.037		−0.086
		(0.118)		(0.185)		(0.235)		(0.176)
Education: primary		−0.182*		−0.089		−0.025		0.017
		(0.085)		(0.104)		(0.074)		(0.153)
Education: middle school		−0.135		0.022		0.068		0.010
		(0.102)		(0.134)		(0.124)		(0.198)
Education: secondary/higher		−0.016		0.103		−0.076		−0.085
		(0.121)		(0.111)		(0.108)		(0.238)
Female		−0.070		0.091		0.061		−0.210+
		(0.102)		(0.211)		(0.177)		(0.121)
Wealth index 1		0.056		−0.158*		−0.126+		0.070
		(0.065)		(0.078)		(0.072)		(0.115)
Wealth index 2		−0.043		−0.007		−0.052		−0.148
		(0.057)		(0.075)		(0.074)		(0.090)
HH head representative		0.326***		0.015		0.122		−0.108
		(0.090)		(0.144)		(0.107)		(0.169)
HH head spouse		0.312*		0.110		0.024		0.491*
		(0.156)		(0.210)		(0.171)		(0.193)
Department FEs	X	X	X	X	X	X	X	X
Ethnicity FEs		X		X		X		X
Age group FEs		X		X		X		X
Num.Obs.	777	775	788	786	788	786	788	786
R2	0.080	0.250	0.131	0.227	0.131	0.208	0.158	0.276

Note: The dependent variables are: (1) whether the household has a title, (2) responses to 'Do you think somebody with a certificat foncier would be more likely to succeed in a land dispute?' (3) ' Do you think somebody with a certificat foncier would be more likely to keep their land if the government attempted to take it?' and (4) 'Do you think that somebody with a certificat foncier is more likely to be compensated fairly for the land, were it taken?' The independent variable is 'How much trust do you have in [customary chiefs], or have you not heard enough them to say?' from which I subtract the average responses to questions about trust in other institutions. All regressions use OLS with inverse sampling probability weights. Standard errors are clustered at the administrative village level.

C.4 Coefficients for control variables

Table C6. Coefficients of control variables for table 4

	(1)	(2)	(3)	(4)
Terrain ruggedness		0.000		0.003
		(0.009)		(0.010)
PAMOFOR village		−0.094		−0.070
		(0.106)		(0.105)
Cocoa suitability		−0.001+		−0.001+
		(0.001)		(0.001)
Coffee suitability		0.000		0.000
		(0.001)		(0.001)
Distance to the capital		0.003		0.003
		(0.003)		(0.003)
Education: madrassa	−0.439***	−0.432***	−0.377**	−0.369**
	(0.117)	(0.116)	(0.113)	(0.113)
Education: primary	−0.199**	−0.192*	−0.197*	−0.193*
	(0.075)	(0.079)	(0.075)	(0.078)
Education: middle school	−0.144	−0.134	−0.147	−0.138
	(0.100)	(0.102)	(0.097)	(0.100)
Education: secondary/higher	−0.040	−0.024	−0.032	−0.018
	(0.110)	(0.115)	(0.108)	(0.114)
Female	−0.019	−0.016	0.025	0.019
	(0.108)	(0.112)	(0.109)	(0.115)
Wealth index 1	0.058	0.057	0.050	0.050
	(0.053)	(0.056)	(0.053)	(0.055)
Wealth index 2	−0.046	−0.044	−0.055	−0.052
	(0.054)	(0.056)	(0.051)	(0.052)
HH head's representative	0.319***	0.323***	0.281**	0.287**
	(0.091)	(0.089)	(0.088)	(0.087)
HH head's spouse	0.267+	0.267+	0.197	0.206
	(0.155)	(0.159)	(0.141)	(0.144)
Department FEs	X	X	X	X
Ethnicity FEs	X	X	X	X
Age group FEs	X	X	X	X
Num.Obs.	785	785	785	785
R2	0.243	0.250	0.275	0.282

Note: This figure shows the coefficients for control variables for table 4. It excludes columns 1 and 4 of table 4 because these columns do not use control variables. The dependent variable is whether a respondent has a formal land title for at least one agricultural parcel. The baseline level for the education variable is none. All regressions use OLS with inverse sampling probability weights. Standard errors are clustered at the administrative village level.

Table C7. Coefficients for control variables from table 6

	Keep land	Be compensated	Win dispute
	(1)	(2)	(3)
Terrain ruggedness	0.010	0.047***	0.020*
	(0.009)	(0.013)	(0.010)
PAMOFOR village	−0.104	0.130	−0.006
	(0.091)	(0.116)	(0.100)
Cocoa suitability	−0.001	−0.001	−0.001
	(0.002)	(0.001)	(0.002)
Coffee suitability	0.000	0.003*	0.001
	(0.002)	(0.001)	(0.001)
Distance to the capital	0.005	−0.007	0.000
	(0.003)	(0.004)	(0.004)
Education: madrassa	0.008	0.057	−0.297
	(0.177)	(0.148)	(0.248)
Education: primary	−0.044	0.006	−0.106
	(0.077)	(0.132)	(0.104)
Education: middle school	−0.002	−0.008	−0.063
	(0.107)	(0.180)	(0.112)
Education: secondary/higher	−0.161	−0.131	−0.005
	(0.097)	(0.213)	(0.106)
Female	0.119	0.108	0.142
	(0.199)	(0.174)	(0.212)
Wealth index 1	−0.096	0.048	−0.139*
	(0.060)	(0.095)	(0.057)
Wealth index 2	−0.058	−0.155	−0.020
	(0.078)	(0.088)	(0.080)
HH head's representative	0.195*	−0.127	0.052
	(0.097)	(0.166)	(0.130)
HH head's spouse	−0.035	0.158	0.053
	(0.161)	(0.204)	(0.187)
Department FEs	X	X	X
Ethnicity FEs	X	X	X
Age group FEs	X	X	X
Num.Obs.	796	796	796
R2	0.306	0.295	0.326

Note: This figure shows the coefficients for control variables for table 6, excluding columns estimated without control variablesThe baseline level for the education variable is none. All regressions use OLS with inverse sampling probability weights. Standard errors are clustered at the administrative village level.

C.5 Ethics and Informed Consent

The IRB at Stanford University reviewed and approved the human subjects portion of this research (i.e. the field survey in Côte d'Ivoire) under protocol IRB-72215. Participants in this research were not compensated for their time. Participation in this research took no more than an hour of time for any respondents, and I do not believe that responding to my survey carried any more than minimal risk to respondents. The data I collected were not sensitive. Were the de-anonymized data to be leaked or otherwise exposed, I do not believe that the exposure could cause more than minimal harm to respondents.

One potential risk to respondents would be that exposed data could identify which households lack formal title to their agricultural landholdings. However, only approximately 38 percent of households in my sample possess a *certificat foncier*, so lacking a formal land title is actually the most common case.

Survey enumerators read an informed consent script to every participant. Consent procedures were identical for the household head and customary elite surveys. In line with the American Political Science Association's ethics principles, this script included my name and affiliation, the general purpose of the research, an explanation of what the research entailed, details about risks and benfits of the research, and an explanation that we could share the aggregated data after having deleted identifying information. The script also included contract details for myself and the firm to whom I contracted the survey work, Le Centre de Recherche et de Formation sur le Développement Intégré (CREFDI). The script also noted that neither I nor the survey firm had any connection with the government of Côte d'Ivoire, AFOR, or any donor.

Literacy rates remain inconsistent in Côte d'Ivoire. As a result, we gave respondents the option of signing a digital consent form or consenting verbally. Among the customary elites, 139 chose to sign their names while 55 consented verbally. Among the household heads, 618 elected to sign their name while 183 consented verbally.

C.6 Deviations from the pre-analysis plan

I registered a pre-analysis plan for the Ivoirian field work on which I base the case study. However, the eventual research differs enough from the PAP that these results should be considered exploratory, rather than confirmatory. Initial analyses of the survey data produced null findings for the bulk of my hypotheses. After these results, I began a series of exploratory, data-driven analyses to understand the actual patterns in my data. The findings in this paper are the result of the latter analyses, rather than the PAP. More specifically, these hypothesis tests differ from the PAP in four key ways.

First, the pre-analysis plan specifies that I would use the village delimitation itself (described in detail in appendix C.2) as an independent variable to capture the power of chiefs. More specifically, I would use whether a location was promoted, demoted, or had no change as the independent variable. I hypothesized that "Households in settlements where the chief received a positive shock will perceive their chief to be more legitimate. Conversely, households in settlements where the chief received a negative shock will perceive their chief to be less legitimate." Ultimately, I found less incidents of promotion and demotion than I had expected, meaning that I was underpowered to test the above hypothesis. I also found no evidence in support of this hypothesis through other mechanisms. As such, I directly use the chief's authority as my independent variable. I also no longer use the term 'natural experiment' to emphasize that I did not find the expected variation.

Second, I did not make mention of dividing the chief's authority into two dimensions (political versus traditional) in the pre-analysis plan. I made this edits as a result of my initial investigation into the null findings. More specifically, I used principal component analysis (PCA) to explore different dimensions of chiefly authority. This analysis revealed two main principal components which together explained most of the variation: one aligned with the traditional elements of authority, and one aligned with the political elements. I then replicated these analyses using the straightforward additive indices in the paper and found identical results. I use the latter rather than the original PCA indices for ease of exposition.

Third, I initially did not plan to explore heterogeneous treatment effects by allochthone

status. However, I started exploring this dimension of variation after gaining a better understanding of land politics in Côte d'Ivoire by way of the qualitative field work which accompanied this survey work. As figure 4 illustrates, adding autochthony into the analyses instantly clarified these results.

Finally, it is worth noting that I present only a small fraction of survey results within this article. This survey also included two conjoint experiments and a number of other questions which I explore further in my dissertation, also titled "Land, Power, and Property Rights: The Political Economy of Land Titling in West Africa"

D Precolonial hierarchy and contemporary customary institutions

My theory of land titling is predicated on the relationship between local hierarchy of precolonial institutions and the strength of contemporary political authorities. In this appendix, I probe that relationship using two sources of data: village-level information on chiefs' involvement in the village from the *Enquête Harmonisé sur les Conditions de Vie des Ménages*, and multiple waves of Afrobarometer.

Importantly, a wide body of literature supports linkages between precolonial hierarchical institutions and contemporary outcomes. Neupert-Wentz and Müller-Crepon (2024) show that groups with higher levels of precolonial institutions have higher levels of political centralization and functional differentiation today. Bahrami-Rad, Becker, and Henrich (2021) also show that the Murdock data correlate with contemporary social practices across a number of outcomes. Wilfahrt (2022) also shows that precolonial institutions condition the distribution of public goods in Sénégal.

Afrobarometer includes a variety of measures of confidence and reliance on customary institutions. Two reasons preclude me from using Afrobarometer for the main analysis. First, the Afrobarometer data are not available at a sufficiently granular level: the available data include only the respondent's first administrative division. In contrast, my outcome data on uptake of formal property rights are available at the second level administrative division, and my primary measure of land values is available at a 10km-by-10km grid across Africa. More importantly, even within the first level administrative regions, the sample size is relatively small. For example, the Saint-Louis region of Sénégal encompasses both the old colonial capital of French West Africa and much of the fertile rice-growing Sénégal River Valley. According to Sénégal's 2023 census, its population is 1.2 million. Afrobarometer sampled 80 respondents from this area for its eight wave; the 2019 round of DHS data collected 336 responses.

Both Afrobarometer and the DHS are accurate *on average*—estimates using these data are unbiased because the samples are random. Combining both sources of survey data will produce a lot of noise because of the moderate sample sizes. The probability of one respondent answering both surveys is minuscule. However, I can still compare

Afrobarometer directly with the measure of hierarchy, because this geospatial data is universal in coverage.

Table D1 shows the relationship between two measures from wave 7 of Afrobarometer. The outcome variable measures the respondents' perceptions of how well their chief has done their job over the past twelve months. The independent variables are (1) a binary indicator for whether a precolonial hierarchical institutions existed within a 25 kilometer radius of the enumeration area centerpoint and (2) the respondents' reported trust in their village chief. For the latter, I subtract the respondents' average level of trust across all other surveyed institutions to obtain the chief-specific elements of trust. Hierarchy itself does not affect whether the respondent approves of the chief's performance. Unsurprisingly households who trust their chiefs more approve more of the chief's performance: a one standard deviation increase in trust in chiefs is associated with a 0.05 standard deviation increase in perception the chief is doing a good job—a statistically significant but modest increase.

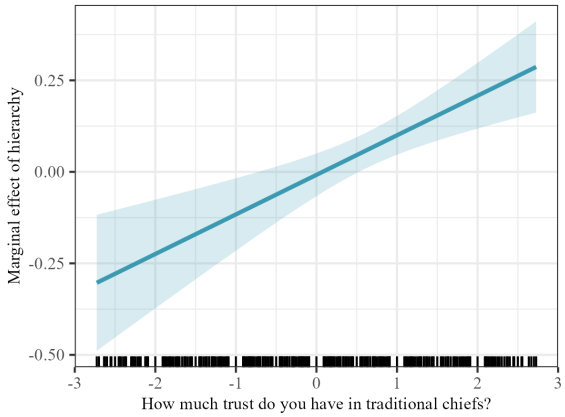
However, columns 5 and 6 show that this increase is concentreated entirely among areas which contain a hierarchical precolonial institution. Figure D1 shows the marginal effect of hierarchy by trust in chiefs. In other words, people in areas with hierarchical precolonial institutions approve their chief's performance more when they trust their chief. In contrast, trust in chief does not affect approval of the chief's performance absent hierarchical precolonial institutions. These results show that hierarchy is a key element of how citizens perceive the performance of chiefs.

Table D1. Households approve the performance of chiefs in hierarchical areas, but only if households trust the chiefs

	(1)	(2)	(3)	(4)	(5)	(6)
Hierarchy	−0.026	−0.005	0.024	0.044	−0.008	0.012
	(0.027)	(0.027)	(0.026)	(0.026)	(0.030)	(0.030)
Trust in chiefs			0.094***	0.095***	0.020	0.022
			(0.011)	(0.010)	(0.024)	(0.023)
Hierarchy * trust in chiefs					0.108***	0.108***
					(0.027)	(0.027)
Education: primary		0.212		0.122		0.125
		(0.121)		(0.131)		(0.130)
Education: secondary		0.143		0.056		0.058
		(0.118)		(0.129)		(0.128)
Education: post-secondary		0.235		0.128		0.131
		(0.123)		(0.132)		(0.131)
Religion: Muslim		0.172***		0.175***		0.176***
		(0.029)		(0.029)		(0.029)
Religion: other		−0.005		−0.032		−0.032
		(0.030)		(0.031)		(0.031)
Urban		0.152***		0.112***		0.112***
		(0.021)		(0.021)		(0.021)
Country fixed effects	X	X	X	X	X	X
Age group fixed effects		X		X		X
Num.Obs.	34 947	34 896	31 559	31 515	31 559	31 515
R2	0.070	0.076	0.047	0.052	0.048	0.053

Note: The dependent variable in this model is household responses to Do you approve or disapprove of the way the following people have performed their jobs over the past twelve months, or haven't you heard enough about them to say: Your Traditional Leader? The independent variables are: (1) a binary indicator for whether an enumeration area is within a hierarchical institution's boundaries, and (2) demeaned responses to How much do you trust each of the following, or haven't you heard enough about them to say: traditional leader. Data are from Murdock's ethnographic atlas and round seven of Afrobarometer. All regressions use OLS with survey weights and country fixed effects. Standard errors are clustered at the enumeration area.

Figure D1. The marginal effect of hierarchy on chief's performance depends on household confidence in customary leaders



The lefthand panel shows answers on a four point likert scale (1=None, 2=A small amount, 3=Some, 4=A lot) to the question "How much influence do traditional leaders currently have in each of the following areas: allocating land?" Data are from round 8 of Afrobarometer and use within-country survey weights. The righthand panel shows country averages of titling rate from the most recent round of DHS or LSMS data collection.

E Additional information on land regime coding

This section provides narrative details to justify the coding of different countries having devolved or centralized land tenure regimes. The crux of this coding is the location of decisions about which households can formalize a title. In many contexts, titles are approved at various stages in the process, but these approvals are often just a confirmation that the appropriate forms were observed. Similarly, I do not code local offices of a national land bureau as indicative of devolved tenure. **No countries changed from devolved to centralized or vice versa during the study period**.

Land tenure formalization procedures in Côte d'Ivoire exemplify these distinctions. The first legal step to obtaining a *certificat foncier* (CF) in the country is to gain the approval of the village land committee (CVGFR). The CVGFR approves the dossier and sends it over to the sous-prefect, who signs it to "control the process." Then the dossier goes to the local office of the national land bureau (AFOR) to record it and to verify that the correct procedure was followed. The CF is then entered into the country's national gazette. Three seperate institutions are involved in the titling process (the CVGFR, the sous-prefects, and AFOR), but the decision about whether to approve the title is made only by the CVGFRs. The other agencies are only involved in verifying that the process was correct, so I code Côte d'Ivoire as devolved.

Table E1. Narratives for coding devolved and centralized land regimes

Country	Devolved	Narrative	Sources
Angola	No	Land tenure is on-demand as per the 2004 land law. There is no national land agency, and most land administration is non-functioning throughout Angola. The 2004 land law said that farmers had to register land by 2010 or risk losing it, but then the government failed to follow up and most land remains un-registered.	Safarik, Navarra, and Rodrigues 2022

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Table E1. Narratives for coding devolved and centralized land regimes *(continued)*

Country	Devolved	Narrative	Sources
Benin	Yes	Land in Benin is governed by the 2009 Code Foncier et Domanial. A national land agency exists, which has implemented a quasi-national cadaster. Benin was also one of the pilot countries for the World Bank's Plan Foncier Rurale (PFR) program. There is a national rural land agency, but rural land management is devolved to the level of the commune, through the Bureaux Communals du Domaine et du Foncier, who approve titles.	Deininger and Goyal 2024; Delville 2019
Burkina Faso	Yes	Land tenure was heavily altered by the 2009 land law, and a subsequent MCC compact. This created land institutions at the municipality and commune levels which adjudicate titles. This means that land was heavily devolved from the Sankara-era legislation, which vested all land with the state. Land tenure remains 'on demand' from these various offices, and a few thousand certificats were distributed, which confirms that certificats are indeed available.	Hughes 2014
Burundi	Yes	Land tenure in Burundi was theoretically devolved by a 2011 land law; land titles are now administered and adjudicated by local Services Fonciers Communaux. Land titles are available but uptake is low. The binding constraint on issuing land titles in Burundi appears to be state capacity, rather than a policy framework.	Tchatchoua-Djomo, Leeuwen, and Haar 2020
Cameroon	No	Applications for land titles in Cameroon are submitted directly to the Divisional Service of Lands. I find no evidence of recent land reform, despite ongoing dialogue within Cameroonian civil society. Very few land certificates here.	Njoh 2013
Cote d'Ivoire	Yes	While the Agence Foncier Rurale formally issues titles, they are adjudicated by Comités Villageois de Gestion Foncier Rurale. Sous-prefects and AFOR officials approve titles, but only to ensure that due process was followed.	Author's own field work

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Table E1. Narratives for coding devolved and centralized land regimes *(continued)*

Country	Devolved	Narrative	Sources
Ethiopia	Yes	In 2003-5, the country underwent a top-down land titling process which demarcated more than six million plots. Land-use committees were elected at the village level, who demarcated parcels and issued certificates. Disputed parcels were appealed to local courts, but the process remained devolved.	Deininger and Goyal 2024: 64–5
Gambia	No	The Ministry of Lands and Regional Government administers freehold and leashold land, although most land in the country remains help in customary tenure. I found no evidence of intermediate institutions which govern land titling, with the exception of customary authorities (alkalos) who govern customary land administration at the village level.	Larson et al. 2021
Guinea	Yes	There are no intermediate land organizations in Guinea to which land institutions are devolved. A new land law took effect in 2024, the effects of which are still unclear, but this took place after these data were collected.	USAID 2016
Guinea-Bissau	Yes	Land has been devolved to local 'land commissions' at the level of the sector. Property rights are technically available—especially in the area around Banjul—but remain rare. Most property is controlled by traditional authorities.	Bank 2006
Kenya	Yes	National Land Commission exists, but practical power is largely devolved to the County Land Management Boards.	Boone et al. 2019; Dyzenhaus 2021
Lesotho	No	All land tenure formalization in Lesotho goes through the national level Land Adminsitration Authority.	Deininger and Goyal 2024: 62–3
Liberia	No	The Liberian Land Authority in Monrovia is a 'one-stop shop' for land titling in the country	The Liberia Land Authority's website.

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Table E1. Narratives for coding devolved and centralized land regimes *(continued)*

Country	Devolved	Narrative	Sources
Malawi	No	Land in Malawi is largely divided between large-scale plantations and small holder farms. The small holder farms hold land almost exclusively through customary tenure, but there is no intermediate formal organization which manages land, it's administered through the Malawi ministry of lands.	Deininger and Xia 2017
Mali	Yes	The 2000 Land tenure code governs land tenure formalization in Mali. Land planning is devolved to the commune level.	Hughes 2014
Niger	Yes	Land tenure in Niger is governed by the 1993 rural code, and most land is still in customary hands. Land tenure certificates are issued at the department level.	Hughes 2014
Nigeria	Yes	Administration of property and property taxes are the responsibilities of Nigerian states	Deininger and Goyal 2024: 119
Rwanda	No	Rwanda is one of the few examples of comprehensive titling in sub-Saharan Africa. All titling goes through the National Land Authority in Kigali.	Deininger and Goyal 2024: 62–3
Senegal	Yes	Land titles (deliberations foncieres) in Senegal are arbitrated and awarded by the 'commissions domaniales' of local municipal councils.	Honig 2022, author's own experiences
Sierra Leone	No	The land tenure system in Sierra Leone was largely inherited from the British colonial period, whereby the state ruled indirectly through customary chiefs. As a result, there are no intermediate institutions administering land tenure formalization between the state and the chief. However, similar to Liberia, different land tenure systems prevail across the country: formal tenure is more common in the Western Peninsula (around Freetown), and customary tenure is dominant in the four rural provinces.	Dieterle 2023

(Continued on Next Page...)

Table E1. Narratives for coding devolved and centralized land regimes *(continued)*

Country	Devolved	Narrative	Sources
Tanzania	No	The Tanzanian Ministry of Lands Awards titling. While village land committees exist, they deal exclusivly with land usage, not with land titling. Land tenure administration in Tanzania also contends with the legacies of the country's previous experiences with 'African socialism.'	Deininger and Goyal 2024: 69–70
Togo	No	A 2018 land reform put into place a national land agency (Agence nationale du domaine et du foncier), but the implementation is unclear. Nevertheless, the bill does not mention any intermediate agencies or devolved powers, so I classify this as a centralized system. In fact, Togo is the only centralized system among francophone African countries.	Gagné 2023
Uganda	No	Different areas of Uganda have historically different forms of tenure, most notably a 'mailo' system wherein many landlords are absentees. While a legal framework has been developed for local government to handle certificates of occupancy, these local institutions do not appear to have been stood up. Moreover, the Department of Land Registration at the Ministry of Land, Housing, and Urban Developments is responsible for titling.	Nakanwagi and Morokong 2021
Zambia	Yes	Land tenure policy in Zambia largely descends from British colonial legislation. Land tenure adminstration has largely been devolved explictly to customary chiefs , who are recognized by the state. According to Honig (2022: 154), "any new title on customary land must have the written permission of an official chief."	Honig 2022
Zimbabwe	No	Land tenure in Zimbabwe is largely subject to political pressure; as a result, there is no intermediary between households, the Deeds Registry which records transactions, and the Ministry of Lands, Rural Resettlement which oversees land tenure formalization. Previous land redistribution continues to shape land tenure policy in Zimbabwe.	Nyoni 2016

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