Fallow Lengths and the Structure of Property Rights*

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Abstract

We study a fundamental institution in many societies: the structure of property rights over land. Across societies, communal land rights have been more common than private land rights. We test the hypothesis that longer fallow requirements – the time needed to leave land uncultivated to restore fertility – led to a higher prevalence of communal property rights. Longer fallow requirements generate higher protection costs and therefore make communal rights more beneficial. We construct an ecological measure of the optimal fallow length for the most suitable staple crop across grid cells based on soil type, temperature, and climate. We find that places where land needs to be fallowed for longer periods are more likely to have communal property rights both historically and presently. We then examine the implications for efforts to title land. We find that World Bank land titling interventions are less effective in places with longer fallow requirements, suggesting a mismatch between development policy and underlying institutions. Finally, we examine implications for income inequality and conflict. We find that longer fallow requirements are associated with less inequality, less conflict, and greater resilience to negative shocks. Our results highlight the origins of property rights structures and how communal property rights interact with development policies.

Keywords: Property Rights, Communal Land, Titling Reforms, Fallow, Culture, Institutions, Mismatch

JEL Classification: P14, Q15, O43

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1. Introduction

This paper examines a fundamental institution in many societies: the structure of property rights over land. In most contemporary Western societies, private property – where an individual or a nuclear family own land – is the predominant way of organizing land rights. However, many societies instead rely on communal land rights, in which extended families or communities jointly own and allocate land. In fact, historically, communal property rights were common. Over 50% of societies in the Standard Cross-Cultural Sample relied exclusively on communal land rights and over 70% had at least partially communal land rights (Murdock and White 1969). This presents a puzzle: under what conditions are communal relative to private property rights over land more likely to evolve?

Despite the observed prevalence of communal land rights, there are theoretically many potential benefits of private property rights over land (e.g. de Soto 2000; Deininger and Feder 2001; de Soto and Cheneval 2006), particularly in the presence of strong states. This view has led to many land titling policies in developing countries – at times with disappointing results in terms of take-up and effects on agricultural productivity and investment (e.g. Platteau 1996, 2000; Easterly 2007; Fenske 2011; Vendryes 2014). Understanding what drives variation in the emergence of different property rights structures may also generate insight into when land titling policies are likely to be effective.

To understand what drives variation in the structure of property rights over land, we build on Boserup (1965) and Demsetz (1967) and test the hypothesis that longer fallow requirements make communal land rights more likely. Fallow land is land that is usually cultivated but is allowed to lie idle for several years to let it recover its fertility. The amount of time that land should be left fallow is a product of the main crop grown, the types of inputs used (such as fertilizer), and features of the soil and climate. Both Boserup and Demsetz suggest that in societies with longer fallow requirements, it is less likely that there will be private property rights over land because of the cost of protection during long fallow periods.

We combine ethnographic and ecological data to systematically explore the relationship between fallow length and communal land rights. Using models from the FAO, we construct an ecological measure of the optimal fallow length for the maximum caloric suitability crop (as defined by Galor and Ozak (2016)) across $5' \times 5'$ grid cells worldwide assuming low inputs.

The FAO fallow requirement measure is a non-linear function of soil types, growth cycles, temperatures, and climate for a particular crop. The fallow requirement measure reflects the share of time during the fallow-cropping cycle that land should be left fallow. For example, for a fallow requirement of 75%, if the land is cultivated for 5 years it should be left fallow for 15 years.

We take several steps to validate the FAO fallow requirement measure. First, we test whether the fallow requirement measure predicts historical fallowing practices using a variable from the Standard Cross-Cultural Sample (SCCS) (Murdock and White 1969), a data set that captures historical ethnic-group level practices. The variable is a proxy for the amount of land that lay fallow in a given year. We find that the fallow requirement predicts historical fallowing practices; longer fallow requirements are significantly correlated with having more land under fallow historically. Second, we turn to present day plot-level data for 9,500 households across 11 countries in sub-Saharan Africa (Waha et al. 2016). While limited to sub-Saharan Africa, the benefit of these data is that they provide detailed information on the fallowing status of plots in the household. We find that the fallow requirement measure is predictive of present day fallowing practices in this sample.

To guide the empirical results, we develop a conceptual framework to clarify how the fallow requirement affects the structure of property rights. In our model, the length of fallow increases the cost of protecting land. In this setting, we assume the absence of a state able to enforce property rights. Land can be protected individually or jointly by a community. A key assumption is that there are returns to scale in the provision of protection if done as a community. Thus, the main prediction of the model is that when the fallow requirement is sufficiently long, communal property rights will be preferred to private property rights.

We use the fallow requirement data to explore how the required length of fallow is related to the choice of property rights regimes across societies historically. Consistent with Boserup and Demsetz, we find that communal land rights were more common in places with longer fallow requirements using data from the SCCS. A one standard deviation increase in the fallow requirement leads to a 0.27 standard deviation increase in the communality of land rights. We also examine contemporary land tenure arrangements using data from the Afrobarometer (Afrobarometer 2019), which has a question on the importance of traditional leaders for the allocation of land, a common feature of communal land rights. Consistent with the historical results, we find that traditional leaders are more likely to have a role in the allocation of land in places with longer fallow requirements.

Thus far our results suggest that longer fallow requirements led to a greater likelihood of communal land tenure. We now examine how longer fallowing requirements affect land titling reforms, given the relatively lackluster success of titling reforms in some settings. Easterly (2007) posited that land titling reforms are unsuccessful because they ignore underlying property rights norms that are often communal rather than private. To explore this hypothesis, we use World Bank project data from AidData (2017) that provide information on development projects that have been implemented, the type of project (e.g. health, governance, etc.), and ratings of how successful the project was. We find that land titling projects are significantly less successful in places with longer fallow requirements. This negative effect is specific to land titling projects, and not more general to projects in other domains. These results suggest that when there is a mismatch between underlying institutions and development policies, the policies may be less successful.

We also examine mechanisms that may explain the persistence of communal property rights. Our conceptual framework generates two additional predictions. First, communal property may reduce inequality. In the model, this is because individuals vary in how costly it is for them to protect their land; those with a high cost of provision of security may free ride on the security provision of others in the communal regime, which is in effect a form of redistribution. More broadly, communal land may be more flexible and allow for reallocation to those in need (Goldstein and Udry 2008). Second, communal property rights may lead to a reduction in conflict – either through their effects on redistribution or because overall provision of protection is higher in the communal regime. Therefore, we test whether longer fallow requirements are associated with a reduction in inequality and conflict.

To examine the effect of fallow lengths on inequality, we use data from the IPUMS Demographic and Health Surveys (DHS) for 47 countries in Africa, Asia, and Latin America (Boyle et al. 2022). We find that longer fallow requirements are associated with less wealth inequality, particularly in settings with low state capacity. However, we do not find a robust relationship between longer fallow requirements and wealth levels in the DHS, nor do we find that the fallow requirement is associated with a reduction in night light density, an alternative proxy for wealth.

Using ACLED conflict data (Raleigh et al. 2010), we find that conflict is lower in places with longer fallowing requirements. This is the case for all conflict events and for conflict events identified as land-related. The negative relationship is particularly strong in settings with low state capacity. This suggests that communal land rights may be better able to reduce conflict in settings where states are weak and ineffective at enforcing private land rights.

Finally, we ask whether communal property rights may also increase resilience to negative rainfall shocks. Communal land rights may reduce the incidence of conflict in the wake of negative rainfall shocks. This is because they may allow communities to more flexibly redistribute resources in the face of negative shocks (Goldstein and Udry 2008). To examine this hypothesis we leverage time variation in conflicts and rainfall shocks across the world. We construct $.5 \times .5$ degree grid cells for the world. For each grid cell for each year, we measure conflict using data from UCDP and ACLED.

We find that in years with a negative rainfall shock there are more land related conflicts and non-state conflicts. However, this effect is muted in places with longer fallow requirements. The effect is sizeable: when rainfall in a year is 50% of the 5-year rolling average, the number of land conflicts in a place where the fallow requirement is 50% increases by 0.9 land-conflicts. In contrast, when the fallow requirement is 70%, land-conflicts increase by 0.1 conflicts.

Our findings contribute to several strands of literature. First, we contribute to the literature exploring the origins and evolution of property rights over land (e.g. Boserup 1965; Demsetz 1967; Bowles and Choi 2019). We provide novel causal evidence on how ecological factors influence the structure of property rights over land. In this paper, we focus on how fallow lengths affect the emergence and persistence of communal property rights over land. Additionally, existing research has focused on the emergence of private property rights in settings where a counterfactual property rights regime does not exist, i.e. the counterfactual is unregulated "open-access" resources (e.g. Demsetz 1967; Alchian and Demsetz 1973). However, communal property rights are often likely to be the relevant counterfactual (Ostrom 1990; Baland and Platteau 1996).

Our results also speak to the literature on how differences in property rights over land affect economic development (e.g. Galiani and Schargrodsky 2011). One challenge in quantifying the effects of private property rights is that it is difficult to disentangle whether the differences in outcomes arise from differences in the organization of property rights (e.g. communal vs. individual) or differences in the security of rights. Studies have found strong evidence that the security of property rights is essential (e.g. Besley 1995; Acemoglu and Johnson 2005; Goldstein and Udry 2008; Hornbeck 2010; Fenske 2011; Deininger et al. 2011) and even influences cultural norms (e.g. Di Tella et al. 2007). However, as noted by Platteau (2000), communal land rights may actually offer higher security in many settings relative to private land rights – particularly in places with low state capacity or a long history of communal land rights The endogenous formation of land rights has meant that there are few causal studies on how the organization of land rights matters. We provide evidence that fallow requirements led to more communal land rights relative to private land rights, and that this difference has implications for comparative development.

Additionally, the results demonstrate how underlying institutions and cultural norms regarding land rights are important determinants of the success of land titling reforms. These findings contribute to a growing body of work highlighting the need to tailor development policies to the local institutions and cultural norms (Alsan et al. 2019; Ashraf et al. 2020; Lowes and Montero 2021; Bau 2021). In particular, we highlight that the way property rights over land are understood and how people view their relationship to land may be quite different across W.E.I.R.D. and non-W.E.I.R.D. societies (Henrich 2020). Our results highlight the potential for mismatch between development policies and the underlying institutional and cultural context.

Finally, our paper contributes to a growing literature studying how ecological and environmental forces shape culture and institutions (e.g. Alesina et al. 2013; Fenske 2014; Alsan 2015; Galor and Ozak 2016; Becker 2019; Giuliano and Nunn 2020; Buggle and Durante 2021; Fouka and Schläpfer 2020; Mayshar et al. 2022; Le Rossignol and Lowes 2022). Several of these papers have focused on how ecological factors influence culture and institutions through their effects on the pre-industrial agricultural practices of societies (see e.g. Alesina et al. 2013; Galor and Ozak 2016; Mayshar et al. 2017, 2022). We contribute to this literature by focusing on an understudied but prevalent economic institution – communal property rights over land – and show that historical ecological differences in fallow requirements influence land institutions and development policies.

The rest of this paper is organized as follows. Section 2 provides background on fallow practices, land rights, and the conceptual framework describing our main hypothesis that longer fallow requirements increase the prevalence of communal land rights. Section 3 describes the ecological and ethnographic data we use to test our hypotheses. Section 4 presents our empirical strategy and main results. Section 5 examines the implications of our results for land titling policy success. Section 6 explores the mechanisms behind our results. Section 7 concludes.

2. Background and Conceptual Framework

2.1. *Fallow Land*

The agricultural practice of fallowing land involves allowing land that is usually cultivated to lay idle for periods of time, often for many years, in order to let it recover its fertility. Fallowing is the oldest and most widespread agro-forestry practice for restoring land fertility lost in cultivation (Young 1989). The fallow period replenishes nutrients in the land by allowing other natural vegetation to grow.[1] The length of the necessary fallow period depends on soil types, climate conditions, the inputs applied, and the types of crops cultivated (Fischer et al. 2012).[2] Fallow periods that are shorter than optimal (given local conditions, inputs, and crop choice) lead to low soil fertility and low productivity. Additionally, fallow periods that are too short lead to soil erosion as crops do not develop sufficiently strong root systems to protect against flooding and sliding. Rotating between crop cultivation and fallowing, also known as shifting cultivation, remains a common practice in many countries in sub-Saharan Africa and Latin America to restore soil fertility and limit soil degradation (López 1998).

Allowing land to fallow is key to restoring land fertility, but it is a complex decision for agricultural producers. Letting land fallow, while an investment in future productivity, is a source of potential insecurity for two reasons. First, by letting land fallow instead of cultivating it, individuals may face consumption insecurity in the absence of social insurance or if they lack access to sufficient non-fallow land (De Zeeuw 1997; López 1998). Second, in settings with weak state capacity, fallow land may be subject to expropriation by outsiders or other villagers. The investment and insecurity aspects of the fallowing decision may interact: more security may increase the extent of fallowing, yet fallowing itself may lead to less security (e.g. Goldstein and Udry 2008). For these reasons, rather than letting fallow land remain completely unregulated and open to outsiders (i.e. open-access), villages often defined property rights over fallow land.

[1] In more modern agricultural systems, instead of relying solely on naturally occurring vegetation during fallow periods, specific vegetation – such as grasses, a grass-legume mix, or a green-manure crop rotation – are used to further enhance soil fertility during fallow periods (Fischer et al. 2012).

[2] Eventually, all land should be left fallow after a given period of cultivation (Fischer et al. 2012).

2.2. *Property Rights over Land*

Property rights over land are a bundle of rights related to the use, access, and transfer of land. These rights can take various forms, but they almost always involve some regulations regarding how land can be used, if it can be transferred, and who can access it. In other words, land – including fallow land – is not open-access land; instead, groups define a set of land rights to govern and manage agricultural land (Platteau 2000).

In societies with private property rights over land, all land rights for a given plot are held by a sole individual or by a nuclear family (as a single household). In contrast, in societies without fully individual private property rights, communities manage land communally, where several or all land rights are held and granted by a community (Boserup 1965; Gavian and Fafchamps 1996; Platteau 2000; Deininger and Feder 2001). Communities in these cases are defined as a collective group of people who are either extended families, clans, villages, or members of an ethnic group (Binswanger and McIntire 1987; Platteau 2000). This form of kin-based communal land ownership was the predominant form of property rights in pre-industrial Western societies (Boserup 1965; Goody and Goody 1983; Henrich 2020).

Communal land rights can consist of more or less "communality" depending on how many components of rights (e.g. use, access, transfer) are allocated to the community. However, communal land rights tend to have the following characteristics. First, land that is owned communally by villages or lineages has restrictions on its use by outsiders (López 1998). Second, individuals often have exclusive use rights to the land that they are currently cultivating and the crops they produce on the land. However, once the land is left fallow, the land can be reallocated by the community (López 1998; Pande and Udry 2005; Goldstein and Udry 2008).

2.3. *Evolution of Land Rights*

A fundamental debate in anthropology and economics concerns the evolution and emergence of property rights structures. Boserup (1965) highlighted that societies transition across different modes of agriculture in the process of development, often due to increasing population pressures. These modes of agriculture are characterized by differences in their fallowing methods – ranging from long fallow systems to multi-cropping systems. Boserup posited that as population pressures increase and therefore land becomes more scarce, societies transition from extensive to intensive agriculture and tend to develop private property rights for land instead of relying on communal rights.

In a similar vein, an influential view in economics has argued that individual and private property rights emerge as resources become more scarce and the benefits of privatization exceed its non-negligible costs. In particular, Demsetz (1967, pg. 350) summarized the view as follows: "It is my thesis that ... the emergence of new property rights takes place in response to the desires of interacting persons for adjustment to new benefit-cost possibilities... property rights develop to internalize externalities when the gains from internalization become larger than the costs of internalization." Together, these hypotheses from Boserup (1965) and Demsetz (1967) became known as the evolutionary theory of property rights (ETPR) (Platteau 1996).

One critique of the ETPR is that it implicitly assumes that private land rights grant more tenure security, thereby leading to more investment due to an assurance effect. However, this assumption relies on the existence of a strong state or neutral third-party for enforcement. In many settings, this assumption is unlikely to hold and, in fact, communal rights may provide more tenure security (Atwood 1990; Platteau 2000; Brasselle et al. 2002). As noted by Platteau (2000, pg. 140) "as is apparent from the ... survey of the African situation, there is no solid basis for claiming that increased individualization of land rights generates an assurance effect. As it turns out, in customary land areas basic use rights seem to be sufficient to induce landholders to invest and the adding of transfer rights (with the possible exception of the right to bequeath land) does not appear to significantly improve investment incentives."[3]

Both Boserup (1965) and Demsetz (1967) noted a likely relationship between longer fallowing periods and the presence of communal land rights. Boserup (1965) noted that fallow periods play an important role in the evolution of property rights:

> *"The attachment of individual families to particular plots becomes more and more important with the gradual shortening of the period of fallow and the reduction of the part of the territory which is not used in the rotation ... As more and more land is subject to specific cultivation rights little land will be available for redistribution by the chief, and valuable land for redistribution will become available mainly when a family dies out or leaves the territory... Redistribution of land thus becomes a less important and less frequently exerted function of the chief, and in the end it disappears altogether"* (Boserup 1965, pp. 80-81)

In other words, shorter fallow periods are likely associated with more private land rights and less

[3]Additional critiques of ETPR are that it ignores cultural practices communities often develop to manage communal resources (e.g. Ostrom 1990), it abstracts from the direct costs of privatization (Baland and Platteau 1998), and often ignores the distributive consequences of privatization (Platteau 2000).

communal land rights. Similarly, Demsetz (1967) highlighted the relationship between shorter fallow periods and the emergence of private land rights:

> *"Once a crop is grown by the more primitive agricultural societies, it is necessary for them to abandon the land for several years to restore productivity. Property rights in land among such people would require policing cost for several years during which no sizable output is obtained. Since to provide for sustenance these people must move to new land, a property right to be of value to them must be associated with a portable object. Among these people it is common to find property rights to the crops, which, after harvest, are portable, but not to the land. The more advanced agriculturally based primitive societies are able to remain with particular land for longer periods, and here we generally observe property rights to the land as well as to the crops."* (Demsetz 1967, p. 353)

The authors suggest the important role of fallow length for the emergence of communal relative to private property rights over land. We build on this work and test the hypothesis that a longer length of fallow – by affecting the cost of protecting land that is under fallow – makes it more likely that a society will develop communal land rights.

2.4. *Conceptual Framework*

We develop a model to sharpen the intuition for how the ecologically determined length of fallow shapes the structure of property rights, building on the insights of Boserup (1965) and Demsetz (1967). The details of the model are outlined in Appendix B. The intuition of the model is as follows. In the model, a longer length of fallow increases the cost of protecting land. While the fallow requirement can be interpreted as the number of years that the land should be left fallow after a given period of cultivation, the fallow requirement can also be interpreted as the share of land under fallow at any given time. Thus, a longer fallow requirement means more land must be protected. Land protection is preventing outsiders from squatting on or cultivating the land.

Land can be protected individually in a private property rights regime or as a community in a communal property rights regime. It is costly for individuals to protect land, and individuals vary in how costly it is for them to protect the land. However, for all individuals the cost of protection is increasing in the length of fallow. Under both private property and communal property, individuals choose whether to pay the monitoring cost to protect the land. When individuals pay the monitoring cost, they are successful at protecting their land.

A key assumption of the model is that there are returns to scale in the protection of land if done jointly as a community. If enough individuals cooperate to protect the land, then the cost of protection falls. However, individuals can freeride in the communal regime. Thus, to enforce cooperation in the provision of protection, individuals who freeride can be excluded from the community land in the future. In both regimes, if individuals do not pay the monitoring cost, there is some chance that their land can be expropriated.

Payoffs are determined by: the property rights regime, whether an individual chooses to pay the monitoring costs to protect land, the length of fallow, and whether an outsider tries to squat on or expropriate the land. In the private property regime, if an individual chooses to pay the monitoring cost, the payout is a function of benefits from cultivation, the individual cost of providing protection, and the length of fallow. If the individual chooses not to pay the monitoring cost, then their payout is a function of the benefits from cultivation and the probability that the land is expropriated by outsiders, which reduces their payout.

In the communal regime, for an individual who pays the monitoring cost, their payoff is a function of the benefits from cultivation, the individual cost of monitoring, the length of fallow, the share of other individuals who choose to pay the protection cost, and a fixed cost of organizing to provide communal protection. If enough individuals participate in the communal protection of land, then the cost of protection falls. If an individual chooses not to pay the protection cost, their payout is a function of the benefits from cultivation, the probability that the land is expropriated, the share of other individuals who choose to pay the protection cost, and a fixed cost of organizing to provide communal protection.

The key insights are as follows. First, the expected payoff in the private regime is decreasing in the length of fallow. Second, the expected payoff in the communal regime is also decreasing in the length of fallow (see Appendix Figure B1). Third, given the advantages of group protection, above a certain threshold length of fallow, the communal regime is preferred over the private regime as the returns to scale in protection become more valuable (see Appendix Figure B2).

In addition, the model has several other implications. The communal regime reduces inequality. This is because individuals that have high protection costs and that choose to freeride can still benefit in the communal regime from group protection. In effect, this provides redistribution across members in the communal regime. Additionally, communal land rights may reduce conflict. This is through two channels. First, the redistribution channel described above may lead to a reduction in unrest. Second, more protection is provided under the communal regime, reducing conflict. We summarize the set of predictions in Table 1.

Table 1
Summary of Conceptual Framework Predictions

	Prediction:	*Empirics:*
Main prediction:		
↑ Fallow requirement	↑ Communal land rights	↑ Prevalence of communal land rights
Secondary predictions:		
↑ Fallow requirement	↓ Interest in private rights	↓ Success of World Bank land titling projects
	↓ Inequality & unrest	↓ Income inequality & conflict events

Note that our framework abstracts from many important aspects. In particular, the framework assumes that state enforcement of land rights is missing. This stands in contrast to some modern settings where states are effective at arbitrating disputes and enforcing private land rights. Communal land rights are likely to be particularly beneficial when the state is unable to enforce private property rights. Additionally, the framework ignores elite capture, either in state enforcement (Behrer et al. 2021) or in land allocation under communal land rights (Goldstein and Udry 2008).

3. Data Sources

3.1. *Fallow Requirement*

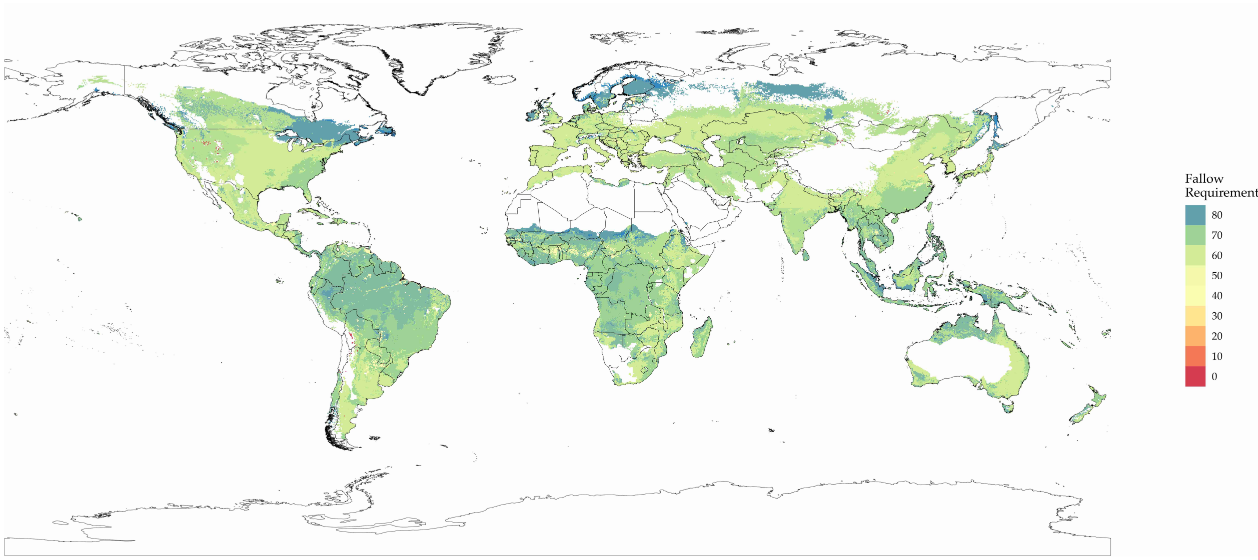
We use FAO GAEZ data and models to construct the extent to which crops in a particular location require fallowing. The FAO estimates fallow requirements for various crop types as a non-linear function of: local soil type, inputs, temperature, crop growth cycles, and climate (Fischer et al. 2012). The FAO models express fallow requirements as the percentage of time during the fallow-cropping cycle the land must be under fallow. For instance, a fallow requirement of 50% means that after three years of cultivation, the land needs to remain fallow for three years; likewise, a fallow requirement of 70% implies that after three years of cultivation, the land needs to remain fallow for seven years.[4] We calculate the fallow requirement for rain-fed agricultural production with low input levels.[5] Using the FAO models, we construct the fallow requirement for the maximum caloric suitability crop (as defined by data from Galor and Ozak 2016) for $5' \times 5'$ grid

[4] The fallow requirements developed by Fischer et al. (2012) were based on previous work estimating fallow periods across different regions (e.g. Young and Wright 1980; FAO/IIASA 1991).

[5] For intermediate level of inputs, the FAO sets fallow requirements at one third of the fallow period requirement under low input levels. For high input levels, the FAO sets fallow requirements uniformly at 10% (Fischer et al. 2012).

cells across the world (approximately 100 km^2).[6] Figure 1 presents a map of fallow requirements across the world.

Figure 1
Fallow Requirements Across the World



Notes: The map presents the fallow requirement for the maximum caloric suitability crop for each 5′ × 5′ grid cell. The fallow requirement for a crop is defined as the optimal percentage of time during the fallow-cropping cycle that land should be under fallow (Fischer et al. 2012). Cells shaded in white represent regions where the land is not suitable for agriculture.

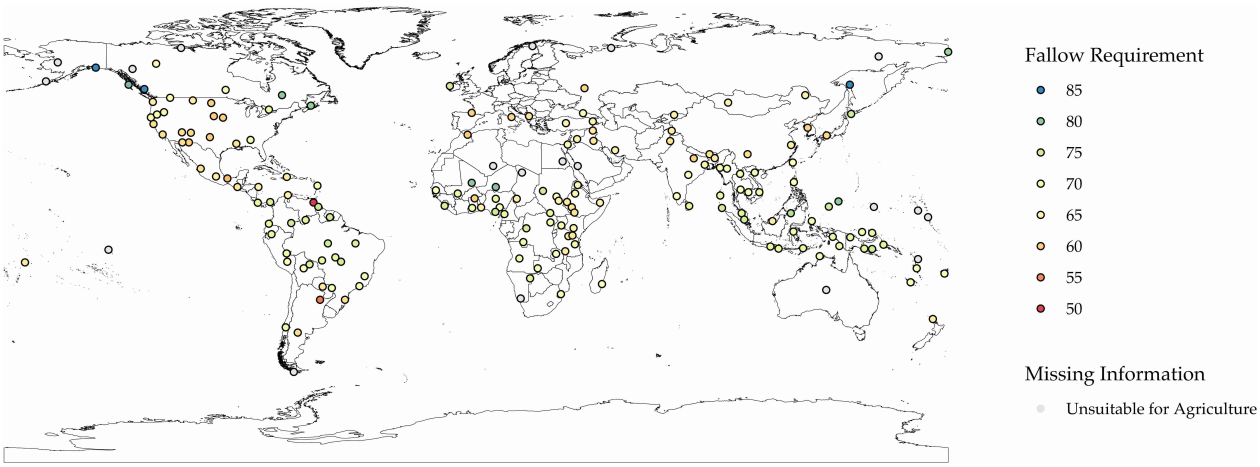
3.2. *Ethnographic Data*

We use ethnographic data from the Standard Cross-Cultural Sample (SCCS) (Murdock and White 1969) for information on societies' agricultural practices historically. This data source contains detailed ethnographic questions – including on land rights – for 186 cultures. The SCCS societies were chosen from the full sample of societies in the Ethnographic Atlas (EA), which provides ethnographic data on 1,265 societies (Murdock 1967); this sample was chosen to be representative of the full EA sample and to be culturally and historically independent from other societies sampled.[7] While the EA covers a larger set of societies than the SCCS, the EA does not contain detailed questions on land rights.

[6] See Galor and Ozak (2016) Figure A.1 for a map showing the maximum caloric suitability crop for 5′ × 5′ grid cells.

[7] To select societies for the SCCS, they first grouped the 1,265 societies from the EA into 186 clusters of closely-related cultures, and then one representative and well-documented society was chosen from each cluster to be part of the SCCS (Murdock and White 1969).

Figure 2
Fallow Requirements Across SCCS Societies



Notes: The map presents the fallow requirement – percentage of time during the fallow-cropping cycle that land must be under fallow – for the maximum caloric suitability crop for each group in the SCCS. Grey dots represent groups where the land is not suitable for agriculture.

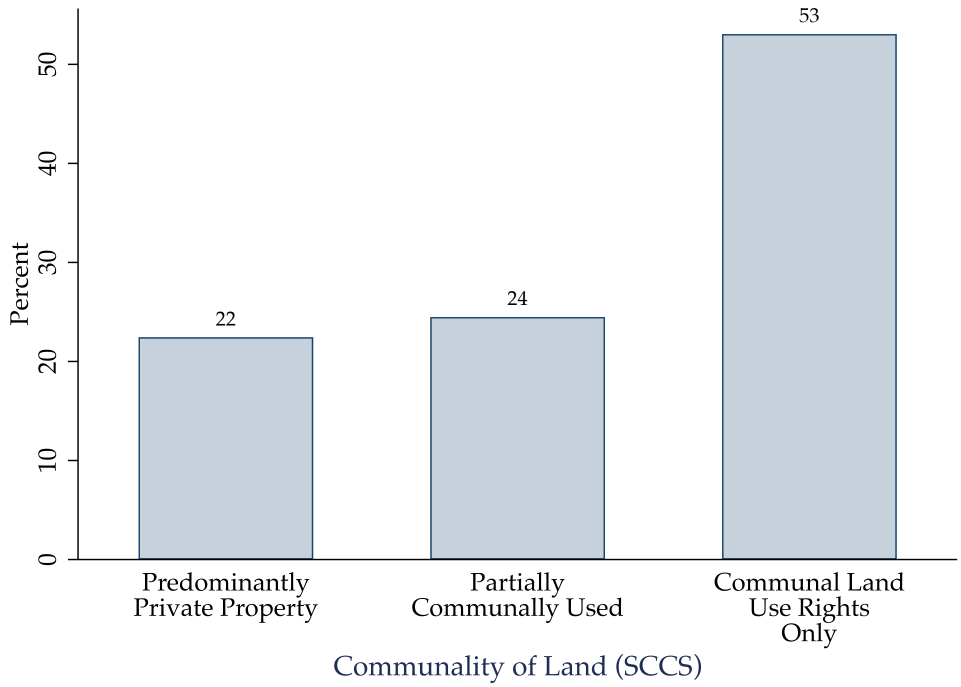
For the ethnographic data in the SCCS, information on each society is coded for the earliest possible period that contains satisfactory ethnographic data.[8] This information has been coded to attempt to reflect conditions prior to industrialization and (where applicable) prior to European contact. Both data sources contain longitude and latitude measures for the centroid of a society's historical location. Figure 2 presents a map with the centroids of SCCS societies and the estimated fallow requirement for a 100 km buffer around these centroids.

To examine whether a society in the SCCS has communal land rights or private land rights, we use variable 1726 denoted as measuring the "Communality of Land" (Murdock and White 1969). This is a 1 to 3 categorical variable, where 1 = land is predominantly private property, 2 = land is partially communally used, and 3 = communal land use rights only. Figure 3 presents the distribution for the "Communality of Land" variable. 53.06% of SCCS societies had communal land rights only, 24.49% had partially communal land rights, and 22.45% had predominately private property rights. Figure 4 presents a map of the communality of land measure across SCCS societies. Communal land rights are particularly prevalent in South America, sub-Saharan Africa, and parts of Asia.

To validate that our measure of fallowing requirements correlates with the historical amount of fallow land in a society, we use variable 1128 from the SCCS, labeled as the "Cropping Index (Rough indicator of Fallowing) for Major Crops" (Murdock and White 1969). This variable

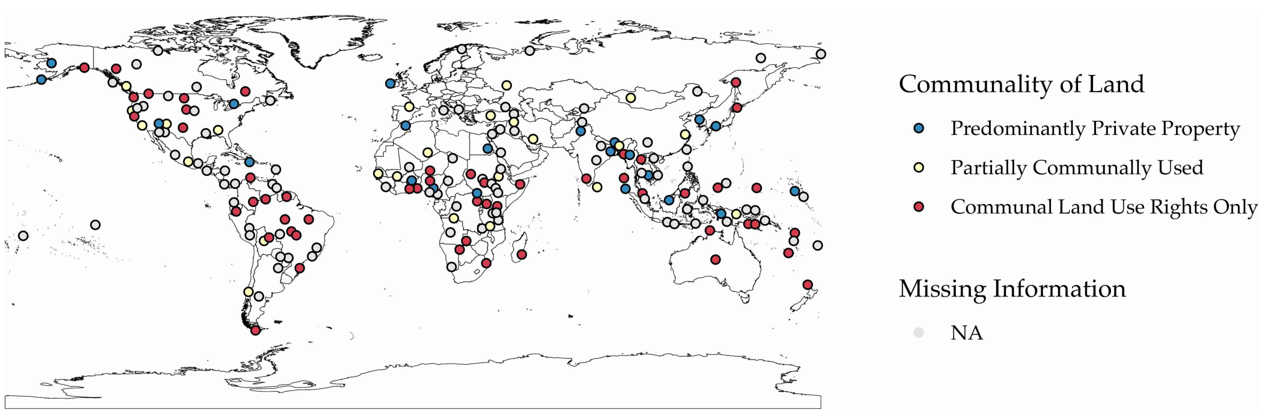
[8] For societies with a written history, the dates of this written history are the observation dates. For groups without written histories, the dates of observation refer to the dates of earliest observation of these cultures by ethnographers.

Figure 3
Communality of Land in the SCCS



Notes: The Figure presents a histogram for the "Communality of Land" variable (v1726) for societies in the SCCS.

Figure 4
Communal Land Rights Across SCCS Societies



Notes: The map presents the extent to which land rights are organized communally in the SCCS.

measures the "percentage of total land used for major crops in any given year," where land that is not used is presumed to be fallow land (Pryor 1986).[9] For societies that practiced agricultural production, the variable is a 1 to 5 categorical variable, where 1 = less than 10% of land used per year, 2 = 10% - 29% of land used per year, 3 = 30% - 49% of land used per year, 4 = 50% - 99% of land used per year, and 5 = 100% or more of land used per year.[10]

3.3. *Ethnologue to Link Ethnographic Data to Modern Data*

While some outcomes of interest (such as land rights historically) are available at the society-level, some more modern outcomes of interest are available at more aggregated levels. Thus, for analyses involving these modern outcomes, we construct measures of the fallow requirements at the ethnologue group or country level using the data and methodology developed by Alesina et al. (2013) and Giuliano and Nunn (2018). The ethnologue-level and country-level measures correspond to the average fallowing requirement faced by the ancestors of individuals currently living in an ethnologue group or country. To create this measure, we use data from Giuliano and Nunn (2018) on (i) the location of ethnic groups using over 7,000 different languages or dialects from Ethnologue 16 linked to societies in the EA, and (ii) information on global population densities (at a one-kilometer resolution) from the Landscan database. By using the link between the EA societies and each of the 7,000+ Ethnologue dialects, we create a measure of the ancestral fallow requirements for all individuals living in an ethnologue group or country today. Figure A1 presents a map of the fallow requirement for the Ethnologue language groups linked to EA societies, and Figure A2 presents a map of the ancestry-adjusted fallow requirements across countries.

3.4. *Additional Data Sources*

We also use the following data sets in our supplementary analyses. We use detailed data on contemporary farming practices and the structure of property rights collected from 11 sub-Saharan African countries (Waha et al. 2016). To examine the role of local leaders in the allocation of land, we use data from Afrobarometer Round 8 (Afrobarometer 2019). To examine the efficacy of World Bank projects, we use geo-referenced project data from AidData (2017). To analyze effects

[9]Note, for this variable, tree crops are considered to have no fallow.

[10]The amount of land used for major crops can be over 100% due to double cropping.

on wealth and inequality we use data from IPUMS DHS (Boyle et al. 2022). Finally, to examine effects on conflict we use two data sources: ACLED (Raleigh et al. 2010) and UCDP (Uppsala Conflict Data Program 2021). For additional information on the datasets used in the analyses, variable definitions, and for maps displaying the various samples, refer to Appendix A.

4. Results

4.1. Empirical Strategy

We examine the relationship between the fallow requirement and our outcomes of interest (e.g. communal land rights) in the ethnographic data by estimating the following equation:

$$y_{sc} = \gamma_1 \text{Fallow Requirement}_{sc} + \mathbf{X}'^{G}_{sc}\Gamma + \mathbf{X}'^{E}_{sc}\Phi + \delta_{r(c)} + \varepsilon_{sc} \quad (1)$$

where y_{sc} is the outcome of interest for society s in country c. We measure the Fallow Requirement$_{sc}$ as the average percentage of time during the fallow-cropping cycle that land should be under fallow for the maximum caloric suitability crop of a society s using a 100 km buffer around the society's centroid. We include $\mathbf{X}'^{G}_{sc}$, a vector of geographic covariates at the society-level, and $\mathbf{X}'^{E}_{sc}$, a vector of historical pre-colonial ethnographic covariates. The society-level geographic and ethnographic controls and are described in detail below. We also include continent fixed effects, $\delta_{r(c)}$ (where $r(c)$ is a function that maps countries c to continents $r(c)$) to account for time-invariant differences across regions, and we estimate robust standard errors. We also report Conley standard errors to address spatial correlation. Our coefficient of interest is γ_1: the effect of the fallow requirement on our various outcomes.

We add the following sets of control variables in our analyses to address a wide-variety of potential omitted variables. For geographic covariates ($\mathbf{X}'^{H}_{sc}$), we include: temperature (Fick and Hijmans 2017), precipitation (Fick and Hijmans 2017), land suitability (Ramankutty et al. 2002), longitude (Murdock and White 1969), elevation (NOAA National Geophysical Data Center 2009), and suitability for the plough (Galor and Ozak 2016). We also include disease suitability controls: tsetse fly suitability (Alsan 2015) and the malaria ecology index (Kiszewski et al. 2004). In an additional specification, we include fixed effects for the maximum CSI-crop (Galor and Ozak 2016) to account for unobserved differences across crops. This is important given recent work on how differences across crops lead to differences in state institutions (Mayshar et al. 2022). Finally, we include the following ethnographic controls ($\mathbf{X}_{sc}^{\prime E}$) from the SCCS: pre-colonial centralization, settlement density, and the presence of large animals (Murdock and White 1969). Appendix A provides details on the data sources and variable definitions.

When using contemporary data to examine the relationship between the fallow requirement and outcomes of interests, we modify equation (1) and estimate the following equation:

$$y_{iesc} = \gamma_2 \text{Fallow Requirement}_{esc} + \mathbf{X}_{esc}^{\prime G}\Gamma + \mathbf{X}_{esc}^{\prime E}\Phi + \delta_{r(c)} + \varepsilon_{iesc} \tag{2}$$

where y_{iesc} is the outcome of interest for observation i belonging to ethnologue group e linked to society s in country c. Fallow Requirement$_{esc}$ is the average percentage of time during the fallow-cropping cycle that land must be under fallow for the maximum caloric suitability crop for the Ethnographic Atlas group s linked to ethnologue group e as in Nunn and Guiliano (2018). As in equation (1), we include $\mathbf{X}_{esc}^{\prime G}$, a vector of geographic covariates at the EA society-level, and $\mathbf{X}_{esc}^{\prime E}$, a vector of historical pre-colonial ethnographic covariates. We also include continent fixed effects, and we estimate standard errors clustered at the ethnologue level. In more demanding specifications, we include country fixed-effects, δ_c, to control for time-invariant differences across countries. Our coefficient of interest is γ_2: the effect of ancestral fallow requirements on our various outcomes.

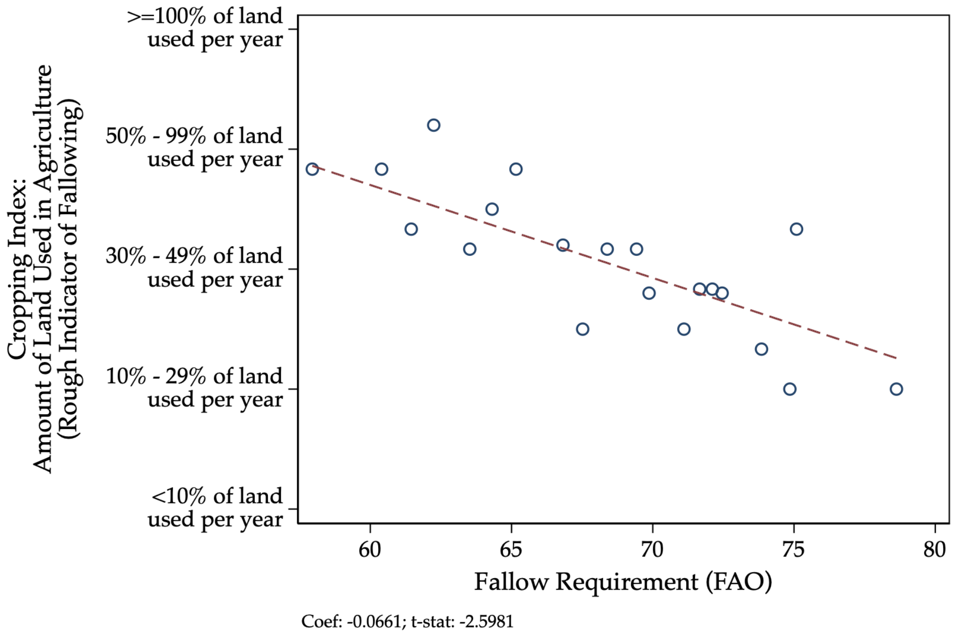
4.2. *Validating the Fallow Requirement Measure*

We first confirm that the FAO fallow requirement measure is correlated with observed fallowing practices across societies. We estimate equation (1) for SCCS societies where the outcome variable is the "Cropping Index" – the percentage of total land used in any given year for major crops. If our fallow requirement measure is a reasonable proxy for agricultural practices historically (and subsequent property rights), then we would expect a strong negative relationship between the fallow requirement measure and the percentage of land used for major crops in a given year.

Figure 5 presents a binscatter between a society's estimated fallow requirement and the cropping index measure. We find a negative and statistically significant relationship between a society's estimated fallow requirement and the cropping index measure, suggesting that the fallow requirement measure captures historical fallowing practices.

We further investigate the robustness of this relationship to the inclusion of geographic covariates. This addresses the concern that the relationship between the fallow requirement and

Figure 5
Fallow Requirements and Observed Fallowing Intensity: SCCS



Notes: The figure presents a binscatter between the fallow requirement and the reported share of a land used for major crops (a proxy for the amount of land that lay fallow in a given year). The unit of observation is a SCCS group. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic using robust standard errors.

the cropping index might be driven by omitted differences in geographic characteristics. Table 2 presents the estimates for equation (1), where we sequentially add a number of geographic covariates that might affect the amount of fallow land. In particular, we include continent fixed-effects (in column (2)); controls for latitude, longitude, average precipitation, average temperature, and agricultural suitability (in column (3)); controls for malaria suitability and tsetse fly suitability (in column (4)); fixed-effects for the maximum caloric crop for each society (in column (5)); and controls for the presence of large animals, settlement density, and pre-colonial centralization (in column (6)).[11] Throughout, we continue to find a negative and statistically significant relationship between fallowing requirements and the amount of agricultural land used in a given year: a 10 percentage point increase in fallow requirements is associated with using 4.5% less land in a given year.[12] We also present Conley standard errors in brackets to account for spatial auto-correlation

[11] All geographic and disease controls aside from latitude and longitude are calculated using a 100 km buffer around an SCCS societies centroid.

[12] Boserup (1965) noted that longer fallowing requirements would also be associated with more extensive (less intensive) agricultural production. Table C1 presents estimates for the relationship between longer FAO fallow requirements and the intensity of agriculture across societies in the SCCS. We find evidence consistent with Boserup (1965): longer FAO fallow requirements are associated with less intensive agricultural production. However, this relationship is not statistically significant once we add geographic controls.

Table 2
Effect of Fallow Requirement on Amount of Land Used for Agriculture in SCCS
(Rough Indicator for Fallowing)

	Dependent Variable: *Amount of Agricultural Land Used [1-5]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-0.122^{***}	-0.105^{***}	-0.125^{***}	-0.127^{***}	-0.133^{***}	-0.135^{***}
	(0.029)	(0.034)	(0.040)	(0.038)	(0.032)	(0.039)
	[0.029]	[0.032]	[0.035]	[0.033]	[0.026]	[0.030]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	3.00	3.00	3.00	3.00	3.00	2.98
Adjusted R2	0.179	0.210	0.249	0.238	0.310	0.324
Beta Coef.	-0.438	-0.376	-0.448	-0.454	-0.477	-0.491
Observations	63	63	63	63	63	61

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses, and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Amount of Agricultural Land Used* is a 1 to 5 categorical variable, where 1=<10% of agricultural land used per year, 2=10-29% of agricultural land used per year, 3=30-49% of agricultural land used per year, 4=50-99% of agricultural land used per year, and 5=≥100% of agricultural land used per year. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* include the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

within 100 kilometers of an SCCS centroid.

We also examine whether the fallow requirement measure predicts contemporary fallowing practices. In developed countries, the practice of fallowing has decreased over the last century due to increased access to modern inputs. Therefore, we focus on data from Africa to investigate the relationship between fallow requirements and contemporary fallowing practices. For this exercise, we rely on data from an agricultural survey of 9,500 farm households conducted in 11 African countries (Waha et al. 2016). This dataset provides information on the farming system for all the plots in each farm household. For a given plot, respondents answer a question about how the land is used. Respondents can select one of the six following forms of cultivation: (i) shifting cultivation (with long fallow period), (ii) continuous cropping (no fallow period), (iii) continuous cropping with multiple rotations (includes short fallow period), (iv) livestock grazing land, (v) other, and (vi) combination of above.

We focus on the first three categories, which together account for 93% of the farming systems in the sample. We generate a 0 to 2 variable where 0 = "continuous cropping (no fallow period)", 1

= "continuous cropping with multiple rotations (includes short fallow period)", and 2 = "shifting cultivation (with long fallow period)". We estimate a variant of equation (2), where the unit of analysis is a plot. Standard errors are two-way clustered by country and ethnologue group. Table 3 presents the results.[13] The positive coefficient associated with the fallow requirement suggests that longer fallow requirements are presently correlated with forms of cultivation that rely more on fallowing.

Table 3
Effect of Fallow Requirement on Contemporary Fallowing Practices

	Dependent Variable: *Contemporary Fallowing Practices [0-2]*				
	(1)	(2)	(3)	(4)	(5)
Fallow Requirement	0.013**	0.012*	0.012*	0.015**	0.014**
	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
	[0.006]	[0.007]	[0.007]	[0.007]	[0.007]
Country FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	0.72	0.72	0.72	0.72	0.72
Adjusted R2	0.044	0.048	0.052	0.057	0.057
Beta Coef.	0.112	0.104	0.101	0.133	0.125
Observations	10,744	10,744	10,744	10,744	10,744
Clusters	121	121	121	121	121

Notes: The unit of observation is a plot in the *An agricultural survey for more than 9,500 African households* survey (Waha et al. 2016). Standard errors that are two-way clustered by country and ethnologue group are presented in parentheses, and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. All regressions include controls for household head age and gender. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each Enumeration Area. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

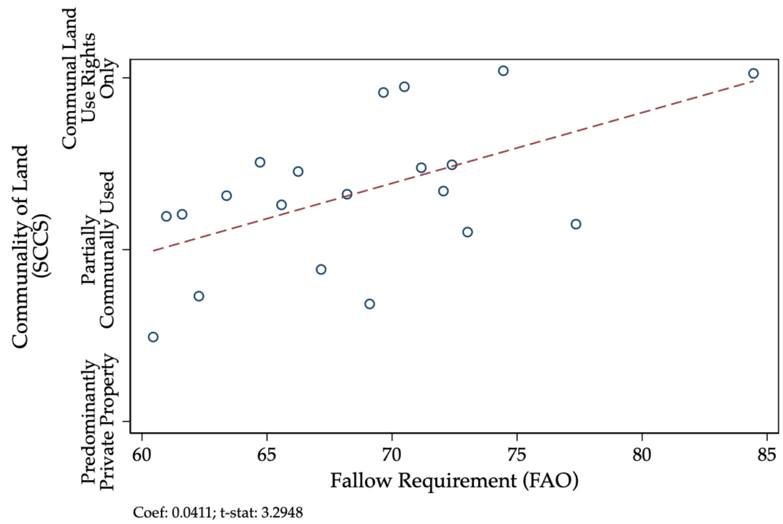
4.3. *Fallow Lengths and Land Rights*

We next test the main hypothesis that longer fallow requirements are associated with a higher probability that a society has communal land rights instead of private land rights. We estimate equation (1) for SCCS societies where the outcome variable is the "Communality of Land" variable. Figure 6 presents a binscatter examining the relationship between a society's FAO fallow

[13] Table C2 shows estimates from an ordered logit specification.

requirement and the extent to which land rights were communal. Consistent with our hypothesis, we find that societies that had longer fallow requirements were more likely to have communal property rights over land.

Figure 6
Effect of Fallowing Requirement on Communal Land Rights: SCCS



Notes: The figure present the binscatter between the fallow requirement and the communality of land property rights. The unit of observation is a SCCS group. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of each figure presents the estimated bivariate coefficient and t-statistic using robust standard errors.

Table 4 presents the estimates for equation (1) while sequentially including geographic and ethnographic covariates. Columns (2)-(5) include the geographic covariates and crop fixed effects; column (6) adds the ethnographic controls.[14] Across all specifications, we find a positive and statistically significant relationship between fallow requirements and the presence of communal land rights: a 10 percentage point increase in the fallow requirement is associated with a 0.35 increase in the communality of land rights measure. The results suggest that fallowing constraints were an important factor determining how communities organized land ownership.

We provide several robustness tests of the relationship between fallow requirements and communal land rights in Appendix Section C.1. First, Table C3 presents estimates from an ordered logit specification to account for the ordinal nature of the communality of land measure; the results are robust to this alternative specification. Second, Table C4 presents results using a measure of fallow requirements that defines the maximum CSI crop as the pre-Colombian

[14]Note that many of the ethnographic variables could also be affected by fallow lengths and are potentially "bad controls". For this reason, we show results with and without their inclusion.

Table 4
Effect of Fallow Requirement on Communal Land Rights

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	0.043***	0.039***	0.035***	0.038***	0.036**	0.035**
	(0.013)	(0.014)	(0.013)	(0.014)	(0.015)	(0.015)
	[0.013]	[0.013]	[0.012]	[0.013]	[0.013]	[0.013]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Adjusted R2	0.098	0.113	0.131	0.115	0.201	0.267
Beta Coef.	0.329	0.296	0.269	0.286	0.276	0.266
Observations	88	88	88	88	88	86

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses, and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

exchange crop; we find that the results are very similar using this crop definition. Third, Table C5 presents estimates using an alternative measure for the fallow requirements faced by societies that takes the average fallow requirement for the top-3 maximum caloric suitability crops; we find that our results are robust to using this alternative measure of fallow requirements. Finally, in Table C6, we present the coefficient on suitability for agriculture, which is included as a geographic control variable in our specifications. While we find a consistent effect of fallow length on property rights over land, we find no consistent relationship between suitability for agriculture and property rights. This addresses the concern that the fallow requirement measure is actually capturing lower agricultural suitability. Taken together, these results suggest a robust relation between longer fallow requirements and communal land rights.

As a test for how fallow requirements impact contemporary land rights, we use data from the Afrobarometer Round 8 (Afrobarometer 2019). This round of the Afrobarometer has questions on the role of traditional leaders for governing the community and for allocating land. We expect that where fallow requirements are longer and thus communal property rights more likely, that local leaders should also have a greater role in the allocation and management of land. Consistent with this, in Table 5, we find that traditional leaders are more likely to have an active role in governing the community and allocating land where there are longer fallow requirements.

Table 5
Fallow Requirement and Influence of Traditional Leaders

	Dependent Variable:			
	Influence of Traditional Leaders in:			
	Governing Community [0-3]		*Allocating Land [0-3]*	
	(1)	(2)	(3)	(4)
Fallow Requirement	0.010***	0.010***	0.012***	0.011***
	(0.004)	(0.004)	(0.004)	(0.004)
	[0.003]	[0.003]	[0.004]	[0.004]
Country FEs	Y	Y	Y	Y
Individual Controls	Y	Y	Y	Y
Geography Controls	Y	Y	Y	Y
Disease Controls	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y
Ethnographic Controls	N	Y	N	Y
Outcome Mean	2.83	2.83	2.65	2.65
Adjusted R2	0.111	0.111	0.120	0.120
Beta Coef.	0.044	0.046	0.050	0.048
Observations	39,156	39,156	39,044	39,044
Clusters	630	630	630	630

Notes: The unit of observation is a respondent in the Afrobarometer Surveys round 8. Standard errors that are two-way clustered by country and ethnologue group are presented in parentheses and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. All regressions control for a respondent's age, age squared and gender. Enumeration areas' latitude and longitude included in every specification. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each Enumeration Area. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We also examine whether fallow requirements affects the codification of property rights in constitutions using data from Elkins et al. (2009). These results are presented in Appendix Table C8. We focus on whether a constitution grants individuals rights to transfer property, own property, testate property, and inherit property. We find evidence that longer fallow requirements are associated with less protections for these individual property rights. See Appendix C.2 for additional details.

5. Land Titling Policy Success

We have found that longer fallow requirements are associated with more communal land rights. We now explore the implications of communal land rights for the success of land titling policies. Many scholars and policy makers have posited that private property rights for land are essential for economic development and, therefore, policies should aim to increase their prevalence in developing economics (e.g. de Soto 2000; de Soto and Cheneval 2006). This influential view impacted World Bank policy and led to multiple reforms aimed at titling land, especially in the 1990s and 2000s across Africa and Latin America (Deininger and Binswanger 1999). For instance, in 2005, the World Bank alone was supervising a portfolio of more than U.S.$1 billion worth of land administration projects (Galiani and Schargrodsky 2011). However, many of these titling reforms have had mixed and often disappointing results (e.g. Platteau 1996, 2000; Jacoby and Minten 2007; Vendryes 2014; Lawry et al. 2017). In recent years, the World Bank has shifted away from principally promoting private land titling and has acknowledged some beneficial aspects of communal land rights (World Bank 2011).

Given these lackluster results despite immense foreign investment in titling policies, Easterly (2007) hypothesized that the lack of success may occur because land titling reforms ignore underlying property rights norms, where land rights are often communal rather than individualistic. Colonial land tenure reforms often faced resistance for precisely this reason. For instance, the British colonial land reforms in Kenya sought to privatize land in settings where customary land rights were strong and well-defined; this led to low levels of take-up and, instead, efforts to recognize communal land rights (Easterly 2007; Home 2013). Similar efforts were undertaken by the Belgians during the colonial era in the Demogratic Republic of the Congo, through a land re-organization scheme called the *paysannat*. The goal was to modernize land tenure systems – transitioning from communal to individually managed land. Ultimately, the effort was not as successful as hoped as it faced substantial resistance from clan leaders (Salacuse 1985; Clement 2013).

To explore whether the success of titling reforms interacts with the underlying land right structures, we use World Bank project data provided by AidData (2017). These data cover World Bank funded projects between 1995 and 2014 and include information on the projects' location, description, and sectors. To examine the success of projects, we explore the outcome rating of projects. A subset of projects are given an outcome rating based on "the extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently". The outcome rating is a six point categorical scale ranging from highly unsatisfactory project to highly satisfactory project. We limit the sample to those projects that are given a rating.[15]

We use information on project sectors and project description to classify whether projects involved land titling or not. We define a project as a land titling project if one of its five sector categories or the project title refer to land titling. Specifically, the project is labeled as a titling project if the description or sector includes one of the following keywords: titling, title, land reform, property right, land administration, land registration, land development project, cadastre, land records, or land management. We exclude urban projects (i.e. those projects that include the following key words: urban or real estate).

We test whether regions that have longer ancestral fallow requirements – and therefore more communal land rights – have less successful land titling projects. In particular, we compare the success of land projects and non-land projects by ancestral fallow requirements. We present the results of a pooled regression of the project outcome on the ancestral fallow requirement measure in Table 6. On average, World Bank projects receive a rating between moderately satisfactory and satisfactory in our sample. For land titling projects, we find a significant negative effect of fallow requirements on the rating received: a one standard deviation increase in the fallow requirement is associated with approximately a 0.25 point decrease in the project rating.[16]

Additionally, in Figure 7, we present binscatters of the relationship between the fallow requirement and World Bank project ratings for land titling and non-titling project separately. The figure shows that land titling projects are significantly less successful in places with longer fallow. We do not find a similar effect when examining other types of projects.[17] These results suggest that the success titling reforms may depend on the underlying property rights regimes. We interpret these results as potential evidence of mismatch between the land-titling policy and the institutional and cultural environment, where changing de jure land rights might not be sufficient to realize the

[15] We also test whether there is a differential likelihood of receiving a project rating based on the fallow requirement. We find no evidence that this is the case in Appendix Table C9.

[16] We present results using country-level fallow requirements in Table C10 to examine whether the results are sensitive to the exact geolocation of projects; we find that the results are similar using country-level fallow requirement measures.

[17] Figure C1 shows equivalent binscatters using the country-level fallow requirement measures.

Table 6
Effect of Fallow Requirement on World Bank Project Success

	Dependent Variable: *World Bank Project Rating [1-5]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-0.362^{***}	-0.344^{***}	-0.287^{***}	-0.246^{***}	-0.241^{***}	-0.230^{**}
× *Land Titling Project*	(0.086)	(0.086)	(0.087)	(0.087)	(0.088)	(0.091)
	[0.056]	[0.055]	[0.052]	[0.051]	[0.051]	[0.051]
Continent FEs	N	Y	Y	Y	Y	Y
Project Sector FEs	N	N	Y	Y	Y	Y
Project Year FEs	N	N	Y	Y	Y	Y
Geography Controls	N	N	N	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Ethnographic Controls	N	N	N	N	Y	Y
Country FEs	N	N	N	N	N	Y
Outcome Mean	4.20	4.20	4.20	4.20	4.20	4.20
Adjusted R2	0.016	0.038	0.128	0.150	0.153	0.271
Beta Coef.	-0.058	-0.055	-0.046	-0.039	-0.039	-0.037
Observations	29,483	29,483	29,427	29,427	29,427	29,426
Clusters	1,653	1,653	1,653	1,653	1,653	1,652

Notes: The unit of observation is a project-ethnologue pair. Standard errors are clustered at the ethnologue level and presented in parentheses. The dependent variable *World Bank Project Rating* is a variable ranging from 1 to 6, where 1 = a project was rated as highly unsatisfactory, 2 = unsatisfactory, 3 = moderately unsatisfactory, 4 = moderately satisfactory, 5 = satisfactory, and 6 = highly satisfactory. *Land Titling Project* is an indicator variable equal to 1 if the project description mentions land titling. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop. *Ethnographic Controls* includes settlement complexity, political centralization, and historical presence of large animals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

benefits of privatization.

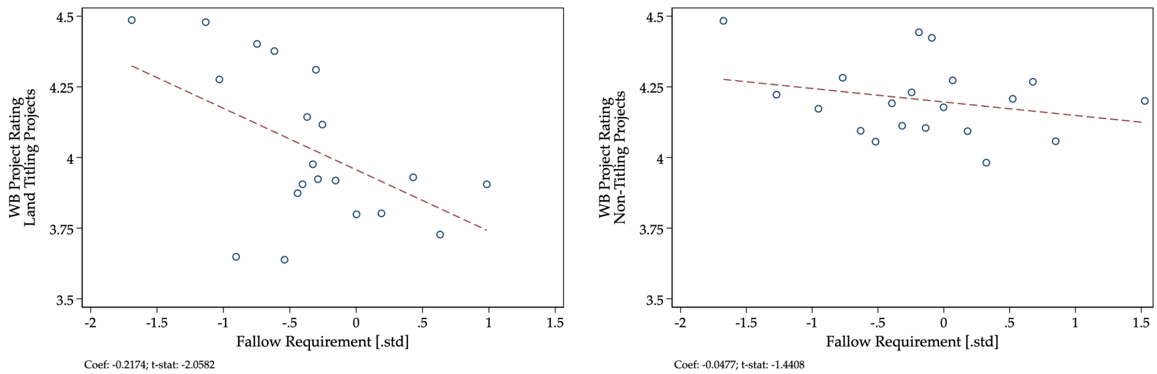
6. Mechanisms: Social Insurance and Conflict

Guided by our conceptual framework, we examine the implications of fallow length for wealth inequality, wealth, and the incidence of conflict. We also examine heterogeneity by quality of institutions. Finally, we also explore how fallow requirements may increase resilience to adverse climate shocks.

6.1. Inequality and Wealth

As highlighted in Section 2.4, communal land rights may be associated with lower income inequality. In the model, the mechanism through which communal land rights reduce inequality is that those who have high costs of monitoring benefit from the communal provision of protection.

Figure 7
Fallow Requirements and World Bank Project Success



a. Land Titling Projects

b. Non-Land Titling Projects

Notes: The figure presents binscatters between the World Bank project success rating for projects related to land titling (a.) or projects not related to land titling (b.), and fallowing requirements. The unit of observation is a project-ethnologue pair. The bottom-left of each figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the ethnologue level. The regressions control for latitude and longitude and include continent, project sector, and project year fixed effects.

Anecdotal evidence suggests that communal land rights may also allow for greater flexibility in redistributing land across households (Goldstein and Udry 2008).

To examine modern-day inequality and wealth, we use data from the Demographic and Health Surveys (DHS). We assembled all DHS samples that included geographic coordinates for enumeration clusters. In total, the sample includes 123 surveys spanning 47 countries; Figure A5 presents a map of the location for the DHS clusters in our sample and a list of survey-waves included in the analysis. The DHS data include wealth score measures for each surveyed household. The wealth score is constructed using principal component analysis of household asset ownership within each country-year survey. We use the wealth score measures to examine cluster-level income levels and inequality levels. We link DHS clusters to ethnologue groups based on their location to determine the fallow requirement for each DHS cluster.

Table 7 presents the regression estimates for the relationship between wealth scores in the DHS data and the fallow requirements of ethnologue groups. We first examine whether longer fallow requirements are associated with less income inequality, as proxied by either the standard deviation (columns (1) and (2)) or the inter-quartile range (columns (3) and (4)) of the wealth score. We find that across both of these measures longer fallow requirements are associated with a reduction in inequality. A one standard deviation increase in the fallow requirement is associated with a .021 standard deviation reduction in the inter-quartile range of the wealth score. These

Table 7
Effect of Fallow Requirement on Income and Inequality:
Demographic and Health Surveys (DHS)

	Dependent Variable: *... of DHS Wealth Score*					
	Inter-Quartile Range		*Standard Deviation*		*Average*	
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-0.545^{***}	-0.509^{***}	-0.401^{***}	-0.398^{***}	-1.018	-0.641
	(0.190)	(0.189)	(0.114)	(0.122)	(0.645)	(0.719)
	[0.323]	[0.320]	[0.242]	[0.240]	[0.760]	[0.749]
Country-Year FEs	Y	Y	Y	Y	Y	Y
Geography Controls	Y	Y	Y	Y	Y	Y
Disease Controls	Y	Y	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y	Y	Y
Ethnographic Controls	N	Y	N	Y	N	Y
Outcome Mean	78.23	78.93	62.87	63.46	-2.80	-0.86
Outcome SD	101.61	104.63	77.04	79.43	165.79	170.17
Adjusted R2	0.539	0.541	0.625	0.627	0.222	0.218
Beta Coef.	-0.024	-0.021	-0.023	-0.022	-0.027	-0.016
Observations	66,167	61,773	66,169	61,775	66,169	61,775
Clusters	114	114	114	114	114	114

Notes: The unit of observation is a DHS cluster. Standard errors are two-way clustered by country-survey wave and ethnologue group and are presented in parentheses. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. *Inter-Quartile Range* is the inter-quartile range of the DHS wealth score. *Standard Deviation* is the standard deviation of the DHS wealth score. *Average* is the average DHS wealth score. All regressions control for the number of observations per DHS cluster and rural-urban status. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each DHS cluster. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

results are robust to a number of geographic and ecological covariates and country-survey-year fixed-effects.[18] Interestingly, we find little evidence that fallow requirements affect average wealth scores (columns (5) and (6)): the point estimates are statistically insignificant. However, the beta coefficient is of a similar magnitude to the inequality estimates. Therefore, as an alternative proxy for average wealth levels, we also examine the impacts of fallow requirements on contemporary night light density (Elvidge et al. 2017). The results, presented in Table C11, do not provide evidence that there is a significant relationship between fallowing requirements and night light density. The results suggest that societies with longer fallow requirements and more communal land rights experience less income inequality.

[18]See Table C12 for results on each outcome when controls are included sequentially.

6.2. *Conflict*

Another potential benefit of communal property rights is that they may reduce the incidence of conflict. In our model, the reduction in conflict is generated by both the higher level of monitoring provided in the communal regime and the increase in redistribution across members in the communal regime. In practice, it may be that communal land rights are more secure – particularly in a low state capacity state setting.

To explore this mechanism, we use two complementary sources of data. First, we use geo-referenced conflict data from ACLED (Raleigh et al. 2010). These data have broad coverage, capturing conflict events from 1997-2021 for Africa, 2016-2021 for Latin America, and 2018-2021 for all other countries. However, the ACLED data do not consistently disentangle whether conflict events are land-related or not. To capture whether a conflict event was due to land conflicts, we follow the methodology in Eberle et al. (2020) to construct measures of "land-related" violence using the "notes" recorded for each event. We identify instances that mention land issues in the description.

Second, to complement the ACLED data, we also use data from the Institutional Profiles Database (IPD) (French Ministry for the Economy and Finance 2016). The IPD records the severity of land-related conflict at the country level. The IPD data was constructed using surveys completed by country or regional Economic Services agents of the French Ministry for the Economy and Finance. The benefit of these data is that they provide high-quality measures from experts. However, the data covers only 95 countries and relies on perceptions rather than on specific reports or instances of conflict.

Table 8 presents the regression estimates for the relationship between the number of conflict events in the ACLED data and the fallow requirement of the ethnologue group. We find that longer fallow requirements are associated with less conflict. These results are robust to a number of geographic and ecological covariates and country fixed-effects. Furthermore, we also include controls for population density in columns 5 and 6 to address concerns that fallow requirements directly impact population density and that lower population density drives the relationship with conflict. We find that our results are unaffected by the inclusion of population density controls. The results are consistent with the model predictions and suggest that societies with longer fallow requirements – and thus more communal land rights – experience less conflict.

Finally, we examine the relationship between fallow requirements and land-specific conflict

Table 8
Effect of Fallow Requirement on Conflict

	Dependent Variable: *Number of Conflict Events*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-10.183^{**}	-10.854^{***}	-10.726^{***}	-10.559^{**}	-10.213^{***}	-8.854^{**}
	(4.217)	(3.907)	(3.921)	(4.151)	(3.945)	(3.596)
	[4.236]	[3.976]	[3.982]	[4.200]	[3.694]	[3.635]
Country FEs	Y	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Population	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	142.46	142.67	142.67	142.67	142.67	152.33
Outcome SD	1460.68	1461.76	1461.76	1461.76	1461.76	1537.24
Adjusted R2	0.157	0.158	0.159	0.161	0.191	0.194
Beta Coef.	-0.032	-0.034	-0.034	-0.033	-0.032	-0.026
Observations	6,718	6,708	6,708	6,708	6,708	5,997

Notes: The unit of observation is an ethnologue group. Robust standard errors clustered are presented in parentheses and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Number of Conflict Events* is defined as the number of conflict events per ethnologue group in the ACLED data (1997-2021). *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Population* includes log population for each group. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

events across ACLED and the IPD. Figure C3 presents the binscatter for the number of land-related conflicts in the ACLED data. It shows that areas with longer historical fallow requirements have fewer land-related conflicts. Figure C4 provides the binscatter for the severity of land-related conflict across countries from the IDP data. It also shows that countries with longer historical fallow requirements tend to have less land-related conflict. The IPD also reports expert-coded measures of land tenure security in rural areas. Thus, we can test whether the fallow requirement undermines land tenure security. Figure C5 presents a binscatter for extent of land tenure security in rural areas using the IDP data. We find that countries with longer historical fallowing requirements do not have less land security. Overall, the results suggest that longer fallow requirements may lead to a reduction in land-related conflict.

6.3. *Heterogeneity by State Capacity*

Throughout our analysis, we have focused on the reduced form effects of fallow requirements. Our interpretation for this analysis is that the fallow requirement affects our outcomes of interest through its effect on the presence of communal land rights as highlighted in our conceptual framework in Section 2.4. However, we note that we do not formally estimate instrumental variables estimates of the effect of communal land rights on outcomes due to data limitations. Reliable micro data on communal land rights with ample spatial coverage is unfortunately lacking. Furthermore, changes in land institutions inevitably co-evolve with changes in social norms regarding land (Platteau 2006; Di Tella et al. 2007), making it challenging to satisfy a strict interpretation of the exclusion restriction assumption in this case. Thus, we focus on the reduced form effects of fallow requirements on our outcomes of interest, with the caveat that we cannot rule out that fallow requirements affect outcomes outside of property rights structures.

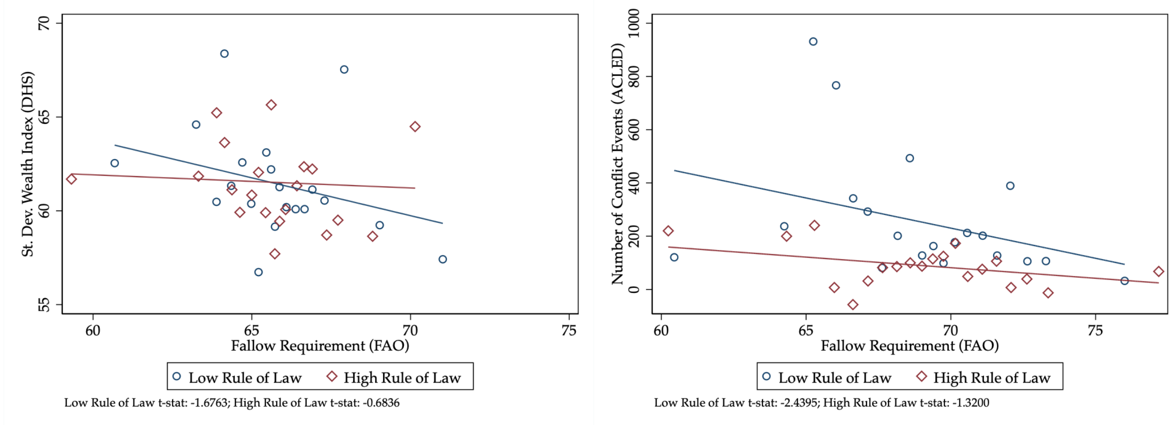
For these reasons, we rely on our conceptual framework and show heterogeneity results consistent with our framework to interpret our results of the effects of fallow requirements. One key implication from this framework is that fallow requirements are likely to matter most in settings without a strong state to enforce property rights. Therefore, we also examine whether the effects of fallow requirements for income inequality and conflict vary by state capacity.

Specifically, we examine this relationship by separately estimating effects for countries with high (above median) and low (below median) "Rule of Law" as measured by the World Bank Governance Indicators data (Kaufmann and Kraay 2023). This is motivated by the observation that we expect the effects of fallow requirements on our outcomes of interest to be particularly binding in settings with low state capacity, where the state is unlikely to be able to enforce property rights.

Figure 8 (a) presents the binscatter for the standard deviation of the wealth score by high and low rule of law countries. We find that the negative relationship between inequality and fallowing requirements is concentrated in low rule of law countries. This provides suggestive evidence that communal land rights might be particularly effective at reducing inequality in settings with weak states.

Figure 8 (b) presents the binscatter for the number of conflict events in the ACLED data by high and low rule of law countries. Again, we find that the negative relationship between conflict and historical fallowing requirements is concentrated in low rule of law countries. This suggests that communal land rights (relative to private land rights) might be particularly effective at reducing conflict in settings with weak states.

Figure 8
Fallowing Requirements & Conflict: Heterogeneity by Rule of Law



a. Inequality

b. Conflict

Notes: The figure presents binscatters between the fallow requirements and (a) the standard deviation of the DHS wealth score measure and (b) the number of conflict events in the ACLED data. The unit of observation is (a) a DHS cluster and (b) an ethnologue group. The figure presents results separately for groups in countries with low (below median) and high (above median) Rule of Law measures from the World Bank Governance Indicators dataset. Regressions control for country-survey-year fixed effects, geography controls, and disease controls. The bottom-left of each figure presents the estimated bivariate coefficient and t-statistic for each subset of countries. Standard errors are clustered at the ethnologue group level.

6.4. Resilience to Climate Shocks

Our results suggest that there are fewer conflicts in places where the fallow requirement is higher and thus communal land rights are likely more prevalent. As discussed in Section 2, communal land rights may be more flexible, allowing communities to redistribute resources to those in need. This increased flexibility may mean that in the face of negative income shocks, communities are more resilient, and conflict is less likely to emerge. We test this hypothesis using data on negative rainfall shocks. We leverage the time variation in rainfall shocks and conflict events.

The estimating equation is:

$$\begin{aligned} y_{ict} =& \beta_1 \text{Negative Rainfall Growth}_{it} + \beta_2 \text{Negative Rainfall Growth}_{it} \times \text{Fallow Requirement}_i \\ &+ \alpha_i + \alpha_{c(i)} \times t + \epsilon_{ict} \end{aligned} \tag{3}$$

where, y_{ict} is the outcome of interest (e.g. number of conflict events) in cell i in country c at time t. Our unit of observation is a .5 $\times$ .5 degree grid cell. As before, Fallow Requirement$_i$ is the percentage of time during the fallow-cropping cycle that land should be fallowed for a cell i. α_i are grid cell fixed effects that control for time-invariant differences across grid cells and $\alpha_{c(i)t} \times t$

are country-specific time trends. We two-way cluster standard errors at the .5 $\times$ .5 degree grid cell and climate-zone by year levels.

Following Miguel et al. (2004), our measure of rainfall shocks is Negative Rainfall Growth$_{it}$ which captures the deviation of observed rainfall at time t from the historical average rainfall recorded between $t-6$ and $t-1$ in grid cell i. This deviation is normalized by the average rainfall within the same historical period. Our rainfall data are from the Global Precipitation Climatology Centre (Schneider et al. 2023). The data include monthly estimates of rainfall measured in centimeters at a .5 $\times$ .5 degree grid cell level. The data cover a period from 1970 to 2022, and we aggregate these data at annual level for our study.

We expect a positive coefficient for β_1, which would indicate that negative rainfall growth correlates with more conflict. Furthermore, if longer fallow requirements attenuate the impacts of negative rainfall shocks on conflict, we hypothesize that β_2 would be negative.

We use geo-referenced conflict data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010) to explore this hypothesis. We present results for four types of conflict: land conflict, non-state conflict, state conflict and any conflict. For an event to be recorded in the UCDP database, it must satisfy two main criteria. First, it must involve at least one fatality. Second, the conflicting parties, either together or individually, must have been responsible for a minimum of 25 deaths within a single calendar year. Moreover, at least one of the parties in the conflict must be an organized entity, such as a government or a politically structured rebel group or militia. In contrast, the ACLED database has less stringent inclusion criteria, with no specific requirement for a certain number of fatalities either annually or per event. Therefore, ACLED may be more effective at documenting smaller, local conflicts, including those related to land disputes.

We present the estimates of equation (3) in Table 9. We find that negative rainfall shocks are associated with increases in land related conflict and non-state conflict. Furthermore, we find that the relationship between negative rainfall shocks and conflict is attenuated in places with a longer fallow requirement. The relationship is only statistically significant for land-related and non-state conflicts, the types of conflicts we would expect to be most affected by communal property rights. These results provide suggestive evidence that communal land rights may help prevent small-scale local conflict and land-related conflict. The magnitude of the effect is also meaningful. For example, when rain is 50% lower in a year relative to the 5-year average, the number of land

Table 9
Negative Rainfall Growth and Conflict

	Dependent Variable: Number of Conflict Events						
	ACLED				UCDP		
	Land	Non-State	State	Any	Non-State	State	Any
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Negative Rainfall Growth (t)	0.061**	1.124**	0.426	1.549	0.091**	0.263	0.353
	(0.025)	(0.477)	(0.710)	(1.059)	(0.038)	(0.229)	(0.241)
Negative Rainfall Growth (t)	−0.001**	−0.015**	−0.005	−0.020	−0.001**	−0.003	−0.004
× Fallow Requirement	(0.000)	(0.006)	(0.009)	(0.014)	(0.001)	(0.003)	(0.003)
Cell FEs	Y	Y	Y	Y	Y	Y	Y
Country Trend	Y	Y	Y	Y	Y	Y	Y
Outcome Mean	0.022	0.534	0.655	1.188	0.018	0.165	0.184
Observations	243,668	243,668	243,668	243,668	1,294,272	1,294,272	1,294,272
Climate-Zone-Year Clusters	417	417	417	417	864	864	864
Cell Clusters	29,397	29,397	29,397	29,397	40,446	40,446	40,446

Notes: The unit of observation is a .5 × .5 degree grid-cell and year. Standard errors are clustered by climate zone year and .5 × .5 degree grid-cell. Across columns the outcome variables are continuous variables measuring the number of violent conflicts at time t in grid cell i. The data are from the Armed Conflict Location & Event Data Project (ACLED) in columns (1) to (4) and from the Uppsala Conflict Data Program (UCDP) in columns (5) to (7). *Land* is the number of land-related conflicts in cell i at time t. *Non-State* is the number of violent conflicts not involving the state in cell i at time t. *State* is the number of violent conflicts involving the state in cell i at time t. *Any* is the number of violent conflicts in cell i at time t. Every specification includes .5 × .5 degree grid-cell fixed effects and a country trend. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

conflicts in a place where the fallow requirement is 50% increases by 0.9 land-conflicts or 44% of the mean. In contrast, in setting where the fallow requirement is 70%, land-conflicts increase only by 0.1 or 5% of the mean.

7. Conclusion

Most societies have historically had communal land rights rather than private land rights. However, there has been a strong focus on private land rights in development policies, specifically with the implementation of various tilting reforms in developing countries. This paper addresses two important questions. First, we examine one potential ecological determinant of the prevalence of communal land rights. We then explore how communal land rights interact with development policy.

We find that these communal land rights evolve endogenously and matter for the success of development policies. In particular, we systematically test the hypothesis that communal land rights were more common in areas with longer fallow requirements. This is because land with longer fallow requirements faces higher protection costs, which favors the adoption of communal land rights over private land rights in settings with low state capacity. Combining various ecological and ethnographic data sets, we provide empirical evidence that longer fallowing requirements are strongly associated with communal land rights relative to private land rights.

We then use this variation to show that the underlying property rights over land affect the success of land policies: titling reforms are less successful in places where communal land rights are more common. We provide suggestive evidence that this may be because communal land rights are relatively more effective at reducing inequality and reducing land conflicts in places where states are weak. Additionally, they are associated with greater resilience in the face of negative rainfall shocks. This has important implications for land policy in the context of developing countries.

Our results provide insight into the economics of property rights. Property rights are a bundle of various rights (e.g. use rights, inheritance rights, transfer rights) and these bundles display considerable variation worldwide. Our findings highlight that the success of common development land policies depends on the underlying land rights and cultural norms regarding the ownership of land. The results suggest that tailoring policies to local land rights may be important for the design of development policies.

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Online Appendix for:

Fallow Lengths and the Structure of Property Rights

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1 March 2024

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A.1. Data Sources and Variable Definitions

Geographic Data:

- Elevation: NOAA National Geophysical Data Center (2009)
- Fallow requirement: Fischer et al. (2012)
- Land suitability: Ramankutty et al. (2002)
- Longitude: Murdock and White (1969)
- Malaria ecology index: Kiszewski et al. (2004)
- Maximum caloric suitable crop: Galor and Ozak (2016)
- Precipitation: Fick and Hijmans (2017)
- Suitability for the plough: Galor and Ozak (2016)
- Temperature: Fick and Hijmans (2017)
- Tsetse fly suitability: Alsan (2015)

Ethnographic Data:

- Ethnologue: Giuliano and Nunn (2018)
- Standard Cross Cultural Sample: Murdock and White (1969)
- Ethnographic Atlas: Murdock (1967)

Additional Data Sources:

- ACLED: Raleigh et al. (2010)
- Afrobarometer: Afrobarometer (2019)
- Agricultural survey for more than 9,500 African households: Waha et al. (2016)
- Comparative Constitutions Project: Elkins et al. (2009)
- Demographic and Health Surveys: Boyle et al. (2022)
- Institutional Profiles Database: French Ministry for the Economy and Finance (2016)
- Rainfall: Schneider et al. (2023)
- World Bank Project Data: AidData (2017)
- UCDP Uppsala Conflict Data Program (2021)
- Legal Origins: La Porta et al. (2008)
- Rule of Law: Kaufmann and Kraay (2023)

- Nightlights: Elvidge et al. (2021)
- Population density: Center for International Earth Science Information Network - CIESIN - Columbia University (2018)

Variable Definitions:

- **Fallow Requirement**: We use FAO models to construct the fallow requirement for the maximum caloric suitability crop as defined by data from Galor and Ozak (2016) for 5′ × 5′ cells across the world. The FAO estimates fallow requirements for various crops as a non-linear function of local soil types, temperature, crop growth cycles, and moisture. The fallowing requirement is measured as the percentage of time during the fallow-cropping cycle the land must be under fallow.
- **Communality of Land**: We measure the communality of land using data from the Standard Cross-Cultural Sample (Murdock and White 1969) (variable v1726 in the SCCS). The variable takes three values: where 1 is "land is predominantly private property", 2 is "land is partially communally used", and 3 is "communal land use rights only".
- **Cropping Index**: We use the Cropping Index measure for each society in Standard Cross-Cultural Sample (Murdock and White 1969) (variable v1128 in the SCCS). This variable is defined as the "Amount of Agricultural Land Used (Rough Indicator for Fallowing)". The measure is a 1 to 5 categorical variable, where a value of 1 corresponds to "<10% of agricultural land used per year", 2 to "10-29% of agricultural land used per year", 3 to "30-49% of agricultural land used per year", 4 to "50-99% of agricultural land used per year", and 5 to "≥100% of agricultural land used per year".
- **Contemporary Communal Rights**: We use data from Waha et al. (2016) to measure the presence of communal rights in contemporary data. The data collects information on the tenure system for all plots held by farm households, with one of the response options being "Communal Land (traditional ownership)". We create an indicator variable equal to 1 if a plot is said to be held under communal tenure regime and 0 otherwise.
- **Contemporary Fallowing Practices**: We use data from Waha et al. (2016) to measure contemporary fallowing practices. The dataset provides information on the farming system for all plots held by farm households. The exact survey question is "Please answer the following land use questions with respect to total amount and type of land operated by members of the household: System of Farming". For each plot, respondents can select one of the following six farming systems: (i) shifting cultivation (with long fallow period), (ii) continuous cropping (no fallow period), (iii) continuous cropping with multiple rotations (includes short fallow period), (iv) livestock grazing land, (v) other, and (vi) combination of the above. We generate a 0 to 2 variable where 0 is "continuous cropping (no fallow period)", 1 is "continuous cropping with multiple rotations (includes short fallow period)", and 2 is "shifting cultivation (with long fallow period)".
- **Gender in Contemporary Fallowing Practices Data**: We use data from Waha et al. (2016) and include as a control the gender of the head of household. However, gender is missing for Zimbabwe. For Zimbabwe, we set gender equal to male for all respondents. Regressions include country fixed effects to account for these differences across surveys.
- **Influence of Traditional Leaders in Governing Community**: We use data from Afrobarometer (2019) to measure the role of traditional leaders in governing the community. The exact survey question is "Now let's talk about traditional leaders and their role in politics and

government in this country. How much influence do traditional leaders currently have in each of the following areas: Governing your local community". Respondents could select one of the following four responses: (i) "A lot", (ii) "Some", (iii) "A small amount", (iv) "None", or "Don't know". We construct a 0 to 3 variable where 0 is "None", 1 is "A small amount", 2 is "Some", and 3 is "A lot".

- **Influence of Traditional Leaders in Allocating Land**: We use data from Afrobarometer (2019) to measure the role of traditional leaders in allocating land. The exact survey question is "Now let's talk about traditional leaders and their role in politics and government in this country. How much influence do traditional leaders currently have in each of the following areas: Allocating land". Respondents could select one of the following four responses: (i) "A lot", (ii) "Some", (iii) "A small amount", (iv) "None", or "Don't know". We construct a 0 to 3 variable where 0 is "None", 1 is "A small amount", 2 is "Some", and 3 is "A lot".

- **World Bank Project Rating**: We measure a World Bank project's rating using data from AidData (2017). Specifically, we use the "IEG Outcome Rating", which is defined as "the extent to which the operation's major relevant objectives were achieved, or are expected to be achieved, efficiently". The World Bank Project Rating variable ranges from 1 to 6, where 1 is "highly unsatisfactory", 2 is "unsatisfactory", 3 is "moderately unsatisfactory", 4 is "moderately satisfactory", 5 is "satisfactory", and 6 is "highly satisfactory".

- **World Bank Project Rating, Land Titling Projects**: We catalog whether a World Bank project is a land project using data from AidData (2017). We define an indicator variable equal to 1 if the project title ("project title" variable), project name ("project name"), main theme ("theme 1"), or main goal ("goal 1") includes one of the following key words: titling, title, land reform, property right, land administration, land registration, land development project, cadastre, land records, land management; otherwise, the variable takes a value equal to 0. Furthermore, to exclude urban land projects, we set the variable equal to 0 is by excluding projects where the project title, project name, main theme, or main goal includes any of the following key words: urban or real estate.

- **Inter-Quartile Range of DHS Wealth Score**: We construct the inter-quartile range of the DHS wealth score using data from the Demographic and Health Surveys (Boyle et al. 2022). The wealth score is "a composite measure of a household's cumulative living standard". It is constructed using Principal Component Analysis (PCA) and measures of a household's ownership of selected assets (e.g. televisions), household quality (e.g. roof materials), and access to water and sanitation.[1] For each DHS cluster, we calculate the inter-quartile range of the wealth score for survey respondents in the DHS cluster. We exclude DHS clusters that have fewer than twenty survey respondents. We multiply the measure by 100 to ease the interpretation of coefficients.

- **Standard Deviation of DHS Wealth Score**: We construct the standard deviation of the DHS wealth score using data from the Demographic and Health Surveys (Boyle et al. 2022). For each DHS cluster with over twenty survey respondents, we calculate the standard deviation of the wealth score for survey respondents in the DHS cluster. We multiply the measure by 100 to ease the interpretation of coefficients.

- **Average of DHS Wealth Score**: We construct the average DHS wealth score using data from the Demographic and Health Surveys (Boyle et al. 2022). For each DHS cluster with over twenty survey respondents, we calculate the average of the wealth score for survey

[1] For more information, see https://dhsprogram.com/topics/wealth-index/Wealth-Index-Construction.cfm.

respondents in that DHS cluster. We multiply the measure by 100 to ease the interpretation of coefficients.

- **Right to Transfer Property in Constitution**: We use data from Elkins et al. (2009). The exact question is "Does the constitution mention the right to transfer property freely? 1 = Yes; 2 = No; 96 = other". We create a dummy variable labelled Transfer Property which equals 1 if the the constitution of a given country in a given year grants the right to transfer property and 0 otherwise.

- **Right to Own Property in Constitution**: We use data from Elkins et al. (2009). The exact survey question is "Does the constitution provide for a right to own property? 1 = Yes; 2 = No; 90 = left explicitly to non-constitutional law; 96 = other." We create a dummy variable labelled Own Property which equals 1 if the constitution of a given country in a given year grants the right to own property and 0 otherwise.

- **Right to Testate Property in Constitution**: We use data from Elkins et al. (2009). The exact survey question is "Does the constitution provide for a right of testate, or the right to transfer property freely after death? 1 = Yes; 2 = No; 96 = other. Testate or testacy refers to the right to give property". We create a dummy variable labelled Testate Property which equals 1 if the constitution of a given country in a given year grants the right to testate property and 0 otherwise.

- **Right to Inherit Property in Constitution**: We use data from Elkins et al. (2009). The exact survey question is "Does the constitution provide for inheritance rights? 1 = Yes; 2 = No; 96 = other. Inheritance refers to the right to receive property". We create a dummy variable labelled Inherit Property which equals 1 if the constitution of a given country in a given year grants the right to inherit property and 0 otherwise.

- **Any-Conflict**: We compute any-conflict counts at the .5-degree by .5-degree grid cell level, using data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010). In UCDP's dataset, the primary unit of analysis is defined as 'a distinct incident of lethal organized violence where an organized actor engages another organized actor or civilians, resulting in at least one direct death'. For a conflict to be recorded, it must involve a cumulative fatality count exceeding 25 deaths between the involved actor pairs. UCDP's dataset offers a global perspective, encompassing the years 1989 to 2020. ACLED's data focuses on 'an event characterized by a violent confrontation between two organized armed groups at a specific time and location'. This dataset does not require a minimum death toll for an event's inclusion. ACLED's coverage includes African regions from 1997 to 2020, Latin America from 2016 to 2020, and the remainder of the world from 2018 to 2020.

- **State-Conflict**: We compute state-conflict counts at the .5-degree by .5-degree grid cell level, using data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010). We classify conflict as state-based if one of the two parties involved is the state, such as the military, government militia or the police.

- **Non-State Conflict**: We compute Non-state-conflict counts at the .5-degree by .5-degree grid cell level, using data from UCDP (Uppsala Conflict Data Program 2021) and ACLED (Raleigh et al. 2010). We classify conflict as non-state-based if the two parties involved are non-state actors such as rebel groups or militias.

- **Land Conflict**: We compute land-conflict counts at the .5-degree by .5-degree grid cell level, using ACLED data (Raleigh et al. 2010). We follow the methodology in Eberle et al. (2020) to construct measures of "land-related" violence using the "notes" recorded for each event to find instances that mention land issues in the description. Specifically, we search for the following keywords: dispute over land, control of land, over land, clash over land, land grab, farm land, land invaders, land invasion, land redistribution, land battle, over cattle and land, invade land, over disputed land, over a piece of land, farm, crop, and harvest.

- **Negative Rainfall Growth**: We compute negative rainfall growth as the deviation of observed rainfall at time t from the historical average rainfall recorded between $t-6$ and $t-1$. This deviation is normalized by the average rainfall within the same historical period. The measure is calculated at a spatial resolution of .5-degree by .5-degree grid cells. A higher negative rainfall growth value indicates a more severe negative deviation from the average, signifying a stronger negative rainfall shock. The rainfall data employed for this computation is from Schneider et al. (2023).

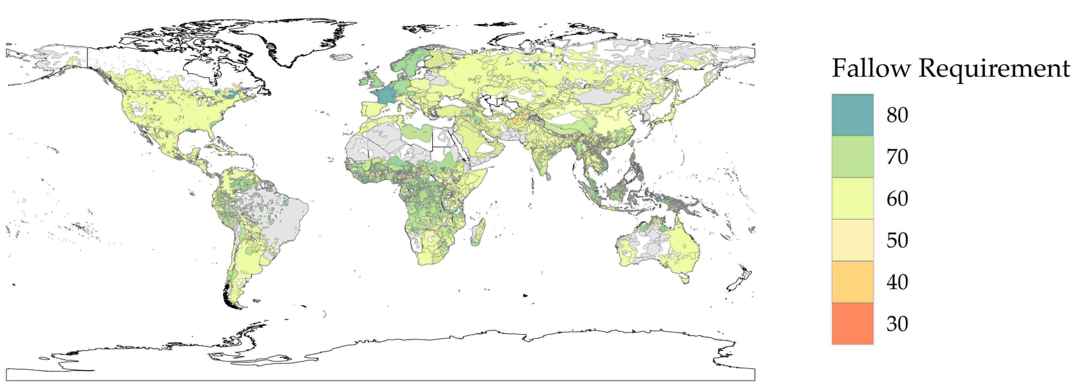
- **Nightlight Intensity**: We measure the intensity of nightlights using data from Elvidge et al. (2021). We define our measure as the log of the mean night light intensity plus one in the VIIRS data for 2019.

- **Intensity of Agriculture**: We measure the intensity of agricultural production using variable v232 from the Standard Cross-Cultural Sample (Murdock and White 1969). The measure is a 1 to 6 categorical variable, where 1 is no agricultural production, 2 is casual agriculture ("incidental to other subsistence modes"), 3 is extensive or shifting agriculture, 4 is horticulture ("vegetal gardens or groves of fruit trees"), 5 is intensive agriculture, and 6 is intensive irrigated agriculture.

- **Extent of Jurisdictional Hierarchy**: We use the measure of jurisdictional hierarchy beyond the local community from variable v237 in the Standard Cross-Cultural Sample data (Murdock and White 1969). This measure is a 1 to 5 categorical variable, where 1 is no levels ("no political authority beyond the community"), 2 is one level ("e.g. petty chiefdom"), 3 is two levels ("e.g. larger chiefdom"), 4 is three levels ("e.g. states"), and 5 is four levels ("e.g. larger states").

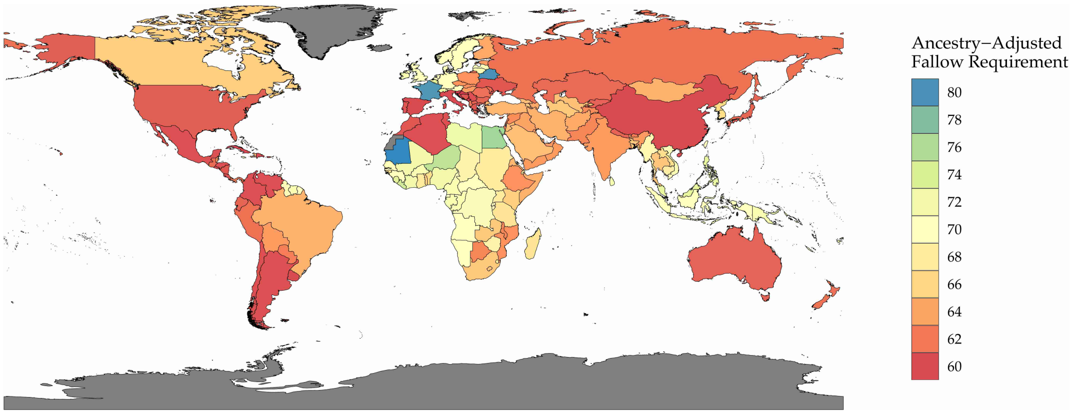
A.2. Samples

Figure A1
Fallow Requirements Across Language Groups



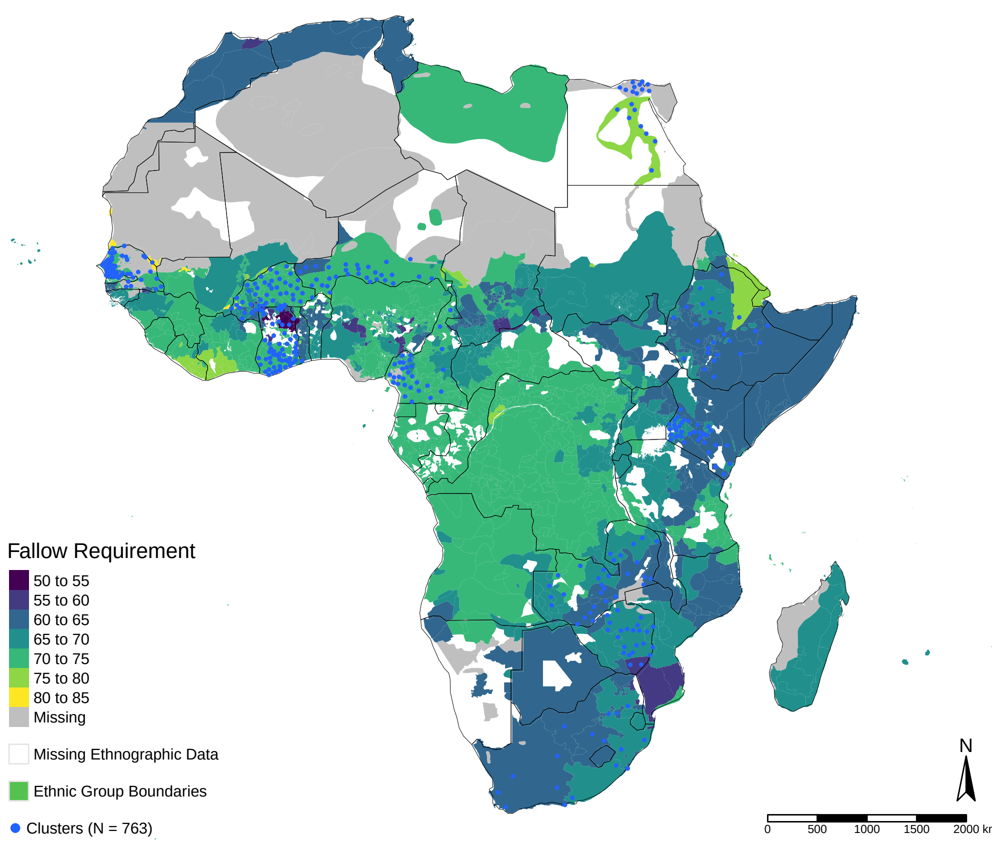
Notes: The map presents the fallow requirement – percentage of time during the fallow-cropping cycle that land must be under fallow – for the maximum caloric suitability crop for each language group in the Ethnologue linked to the EA (Giuliano and Nunn 2018). Grey areas represent groups where the land is not suitable for agriculture.

Figure A2
Ancestry-Adjusted Fallow Requirements



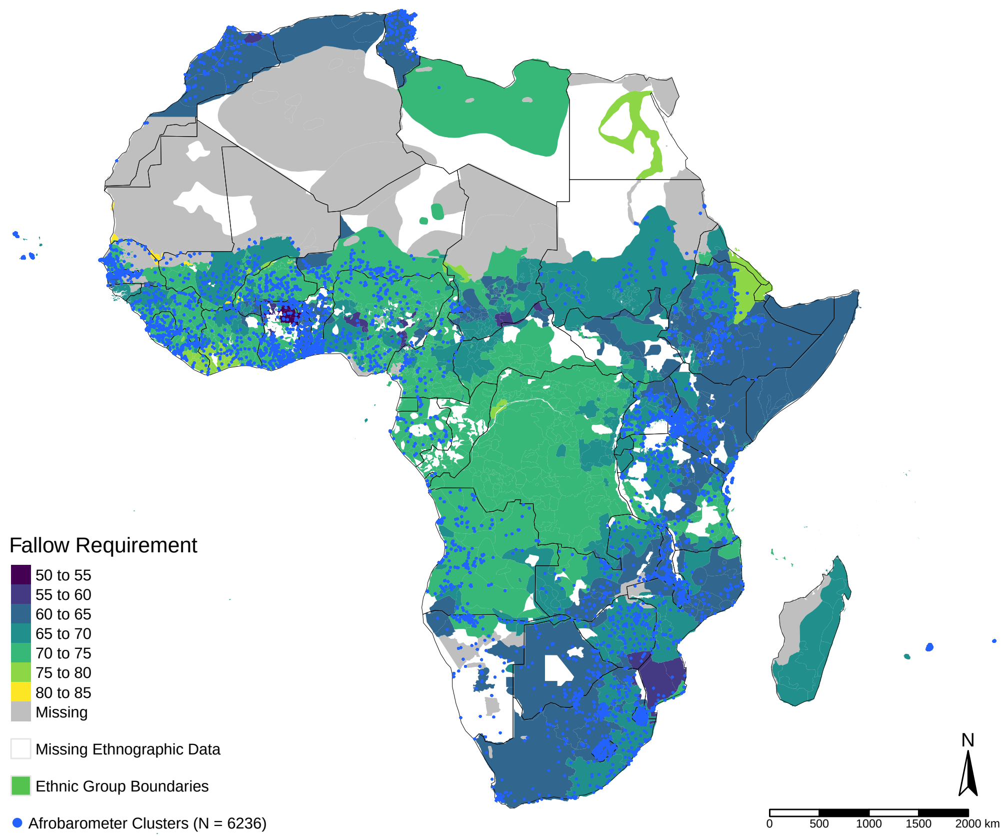
Notes: The map presents the ancestry-adjusted fallowing requirement – percentage of time during the fallow-cropping cycle that land must be under fallow – for the maximum caloric suitability crop for each country using the methodology from Giuliano and Nunn (2018). Grey areas represent groups where the land is not suitable for agriculture.

Figure A3
"An agricultural survey for more than 9,500 African households" Sample



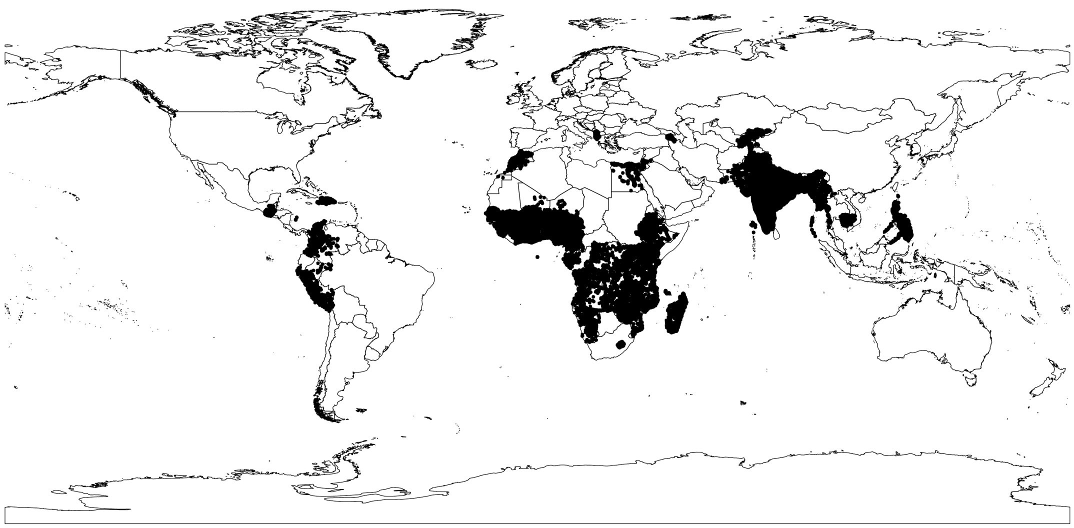
Notes: The map presents the cluster location for the "An agricultural survey for more than 9,500 African households" sample from Waha et al. (2016). In addition, the map also presents the fallow requirement each ethnologue group (Fischer et al. 2012; Giuliano and Nunn 2018). The sample includes the following countries: Burkina Faso, Cameroon, Egypt, Ethiopia, Ghana, Kenya, Niger, Senegal, South Africa, Zambia, and Zimbabwe.

Figure A4
Afrobarometer Round 8 Sample



Notes: The map presents the Afrobaromter Round 8 clusters (Afrobarometer 2019). In addition, the map also presents the fallow requirement each ethnologue group (Fischer et al. 2012; Giuliano and Nunn 2018). The Afrobarometer sample includes the following countries: Angola, Benin, Botswana, Burkina Faso, Cameroon, Ivory Coast, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Kenya, Lesotho, Liberia, Malawi, Mali, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

Figure A5
IPUMS DHS Sample



Notes: The map presents the cluster locations for the Demographic and Health Surveys (DHS) sample. The DHS sample includes the following country-waves: Albania (2008, 2017); Angola (2015); Armenia (2010); Bangladesh (2000, 2004, 2011, 2014); Burkina Faso (1993, 1999, 2003, 2010); Benin (1996, 2001, 2012); Burundi (2010, 2016); Cambodia (2005); Cameroon (1991, 2004, 2011); Colombia (2010); Comoros (2012); Cote d'Ivoire (1994, 1998, 2012); Democratic Republic of the Congo (2007, 2013); Dominican Republic (2007, 2013); Egypt (1995, 2000, 2003, 2005, 2008, 2014); Ethiopia (2000, 2005, 2010, 2016); Gabon (2012); Ghana (1993, 1998, 2003, 2008, 2014); Guatemala (2015); Guinea (1999, 2005, 2012); Haiti (2000, 2006, 2012, 2016); India (2014); Jordan (2002, 2007, 2012); Kenya (2003, 2008, 2014); Kyrgyzstan (2012); Lesotho (2004, 2009, 2014); Madagascar (1997, 2008); Malawi (2000, 2004, 2010, 2015); Mali (1996, 2001, 2006, 2012); Morocco (2003); Mozambique (2011); Myanmar (2015); Namibia (2000, 2006, 2013); Nepal (2001, 2006, 2011, 2016); Nigeria (1990, 2003, 2008, 2013); Niger (1998, 2012); Pakistan (2006); Peru (2009); Philippines (2008, 2017); Rwanda (2005, 2008, 2010, 2014); Senegal (1997, 2005, 2010, 2012, 2015, 2016, 2017); Sierra Leone (2013, 2019); Tajikistan (2012); Tanzania (1999, 2010, 2015); Uganda (2000, 2006, 2011, 2016); Zambia (2007, 2013); Zimbabwe (1999, 2005, 2010, 2015).

Appendix B. Theoretical Framework

In this section, we outline the economic model for how fallow lengths impact property right choices. This model is used to guide the empirical analysis. In the model, longer fallow requirements lead to higher protection costs. These costs could be paid individually (in private land rights) or jointly (in communal land rights). Communal protection has returns to scale but also involves the potential to free ride. We discuss the model setup, payoffs, and predictions below.

B.1. Model Structure

1. The fallow requirement, $f \in [0, 1]$, is given by nature. It is exogenous and perfectly observable to all citizens. The fallow requirement f represents the fraction of land that must be kept fallow each period. The rest of the land $1 - f$ can be cultivated and provides the same cultivation payoff c irrespective of f.[2]

2. Citizens are part of a property rights regime – either private or communal. If communal property rights are the regime, an organizing cost k is paid by every citizen. Private and communal property rights are referred to as individual (I) and group monitoring (G) respectively.

3. Nature assigns a type (monitoring cost) $e_i \in [0, 1]$ to every citizen $i \in [0, 1]$ (a continuum of citizens). Monitoring ability e is a joint-uniform distribution in [0, 1]. Individuals know only their own type and the joint distribution from which types are realized.[3]

4. In either property rights regime, every citizen plays simultaneously and has two options – to monitor $(a_i = 1)$ or not $(a_i = 0)$. If citizens choose to monitor, they pay a monitoring cost dependent on their type e_i. The higher the type e_i, the higher the monitoring cost. The

[2]We make this assumption for two reasons. First, it helps us abstract from modeling how previous fallow choices affect cultivation payoffs. Second, FAO models do not indicate that land with higher (lower) fallow requirements are less (more) productive on average if the land is being cultivated.

[3]The mapping $e()$ of individual $i \in [0, 1]$ to monitoring type $t \in [0, 1]$ is one-to-one, and onto. Let $p_i(t)$ be the probability of individual i being assigned type t. Formally,

$$\forall i, j \in [0, 1], p_i(t) = p_j(t)$$
$$\forall i, j \in [0, 1], e(i) = e(j) \implies i = j$$
$$\forall t \in [0, 1], \exists i \in [0, 1] \text{ s.t. } e(i) = t$$

There will always be a distribution of monitoring abilities in the society. It is only unclear what an individual's ability is relative to others. For simplicity, we refer to $e(i)$ as e_i.

monitoring cost scales with f – the fallow requirement: higher fallow requirements imply a higher total monitoring cost ($e_i f$).

5. After citizens choose a_i, they cultivate their land and get a cultivation payoff c. However, with probability p, any individual's land is attacked.

   - In the private regime, whether or not they can protect their land depends on their individual choice a_i. If $a_i = 1$, since the citizen already paid a monitoring cost fe_i, they successfully protect their land. If $a_i = 0$, the citizen did not pay a monitoring cost and they lose the cultivation payoff c. The payoff from $a_i = 1$ is $c - fe_i$, and from $a_i = 0$ is $c - pc$.
   - In the communal regime, whether or not they can protect their land depends on their individual choice a_i and others' choices ($\int_{i=0}^{1} a_i di$). The communal regime has a returns-to-scale component to group-monitoring. If the fraction of people monitoring is greater than or equal to β, group-monitoring is successful and everybody's land is protected. Also, if group-monitoring is successful, the cost of monitoring gets halved to $\frac{fe_i}{2}$ for all the people that chose to group-monitor. There is an incentive to free-ride in the communal regime because if group-monitoring is a success, everybody's land is protected even if only some pay the individual monitoring cost in group-monitoring, $\frac{fe_i}{2}$. The payoff from $a_i = 1$ is $c - \frac{fe_i}{2} - k$ if group-monitoring is a success, and $c - fe_i - k$ if group-monitoring is a failure. The payoff from $a_i = 0$ is $c - k$ if group-monitoring is a success, and $c - pc - k$ if group-monitoring is a failure.

B.2. Payoffs

- Private regime payoffs

$$\begin{cases} \underbrace{c}_{1} - \underbrace{fe_i}_{2} & a_i = 1 \\ \underbrace{c}_{1} - \underbrace{pc}_{3} & a_i = 0 \end{cases}$$

- Communal regime payoffs

$$\begin{cases} \underbrace{c}_{1} - \underbrace{fe_i}_{2} + \underbrace{\mathbb{1}\left(\int_0^1 a_i di \geq \underbrace{\beta}_{7}\right) \times \frac{fe_i}{2}}_{4} - \underbrace{k}_{6} & a_i = 1 \\ \underbrace{c}_{1} - \underbrace{pc}_{3} + \underbrace{\mathbb{1}\left(\int_0^1 a_i di \geq \underbrace{\beta}_{7}\right) \times pc}_{5} - \underbrace{k}_{6} & a_i = 0 \end{cases}$$

$$f, \beta \in [0,1];\ c, k \geq 0; e \sim U[0,1]$$

Explanation for terms in payoffs:

1. Cultivation payoff
2. Monitoring cost
3. Probability of attack
4. Returns-to-scale halving monitoring cost
5. Returns-to-scale allowing free-riding
6. Organizing cost
7. Fraction of people required for success of group-monitoring

B.3. Analysis

We compare choices and ultimate payoffs across the two types of property regimes, private (I) or communal (G). In both regimes, citizens (with types) choose to monitor or not based on their type-dependent payoff. To compare payoffs across regimes, given that types are realized after regime choice, we compare the ex-ante expected payoffs in equilibrium – the same for every citizen – for both regimes for a given f.[4]

[4]Alternatively, one can have individuals choose regimes prior to types being assigned. In other words, they solve the game backwards and choose the regime with the higher expected payoff (which will be the same for all individuals prior to types being assigned). To simplify, we directly compare ex-ante expected payoffs instead of specifying this additional step.

B.3.1. Private Regime: Expected Payoffs

Given the payoffs above, individuals in the private regime will choose to monitor ($a_i = 1$) only if $e_i > \frac{pc}{f}$. Thus:

- The expected payoff in the private regime if $\frac{pc}{f} < 1$ is
$$= \int_0^{\frac{pc}{f}} (c - fe_i)de_i + \int_{\frac{pc}{f}}^1 (c - pc)de_i$$
$$= c\left(\frac{pc}{f}\right) - \frac{f}{2}\left(\frac{pc}{f}\right)^2 + c\left(1 - \frac{pc}{f}\right) - pc\left(1 - \frac{pc}{f}\right)$$
$$= c - pc + \frac{(pc)^2}{2f}$$

- The expected payoff in the private regime if $\frac{pc}{f} \geq 1$ is
$$= \int_0^1 (c - fe_i)de_i$$
$$= c - \frac{f}{2}$$

The expected payoff in the private regime is decreasing in f in both cases:

$$\begin{aligned} &= c - \frac{f}{2} && f \leq pc \\ &= c - pc + \frac{(pc)^2}{2f} && f > pc \end{aligned}$$

B.3.2. Communal Regime: Expected Payoffs

To simplify the analysis, we group people in three.

- Group I is the set of people such that $c - fe_i \geq c - pc \implies e_i \in [0, \frac{pc}{f}]$. These people are willing to do individual monitoring regardless of whether group-monitoring is a success or failure.

- Group II is the set of people such that $c - fe_i < c - pc \wedge c - fe_i/2 \geq c - pc \implies e_i \in (\frac{pc}{f}, \frac{2pc}{f}]$. These people can help in group-monitoring (if they expect enough people to monitor, i.e. the share of people monitoring is $> \beta$) but would choose to not do individual monitoring (if they expect too few people to monitor).

- Group III is the set of people that cannot do either group-monitoring or group-monitoring because it is too costly for them. $c - \frac{fe_i}{2} < c - pc \implies e_i \in (\frac{2pc}{f}, 1]$.[5]

[5]Of course, it need not be the case that all the groups are present for every possible set of parameter values. For example, $\frac{2pc}{f} > 1 \implies$ Group III does not exist.

With the notation for different groups above, we solve the model:

- Suppose $\beta \leq \frac{2pc}{f}$. In this case, there exist multiple Nash equilibria of the one-shot game where group-monitoring is a "success" (i.e., $> \beta$ share of individuals choose $a_i = 1$). In any equilibrium, Group III always chooses $a_i = 0$. In equilibria where group-monitoring is a success, any set of 'size'/measure β consisting of members from Group I or II chooses group-monitoring. The rest of the people from Group I and II choose to free-ride.

  Why is it a Nash equilibrium? In this equilibrium those who choose group-monitoring know the actions of everybody and do not wish to deviate because group-monitoring fails without them. There is no incentive to deviate because $c - \frac{fe_i}{2} - k \geq c - pc - k$. Also, the people who are free-riding cannot do better than a payoff of $c - k$. In the most efficient Nash equilibrium, β share of individuals choose group-monitoring and everybody else (1-β) free-rides.[6] We assume that the most efficient equilibrium is chosen, because it is the risk-dominant equilibrium. (We discuss this in more detail in section B.4.) The expected payoff in equilibrium is

$$= \int_0^{\beta} \left(c - \frac{fe_i}{2} - k \right) de_i + \int_{\beta}^{1} (c-k) de_i = c - k - \frac{\beta^2 f}{4}$$

- Suppose $\beta > \frac{2pc}{f}$. In this case, there exists no Nash equilibrium of the one-shot game where group-monitoring is a success. Group I chooses monitoring and Groups II and III choose free-riding/$a_i = 0$. The expected payoff in equilibrium is

$$\begin{aligned} &= \int_0^{\frac{pc}{f}} (c - fe_i) de_i + \int_{\frac{pc}{f}}^{1} (c - pc) de_i - k \\ &= c - pc + \frac{(pc)^2}{2f} - k \end{aligned}$$

Thus, the expected payoffs in the communal regime are also decreasing in f

$$\begin{aligned} &= c - k - \frac{\beta^2 f}{4} && f \leq \frac{2pc}{\beta} \\ &= c - pc + \frac{(pc)^2}{2f} - k && f > \frac{2pc}{\beta} \end{aligned}$$

In what follows, we focus on equilibria where free riding is possible. That is, we assume that $f \leq \frac{2pc}{\beta}$.

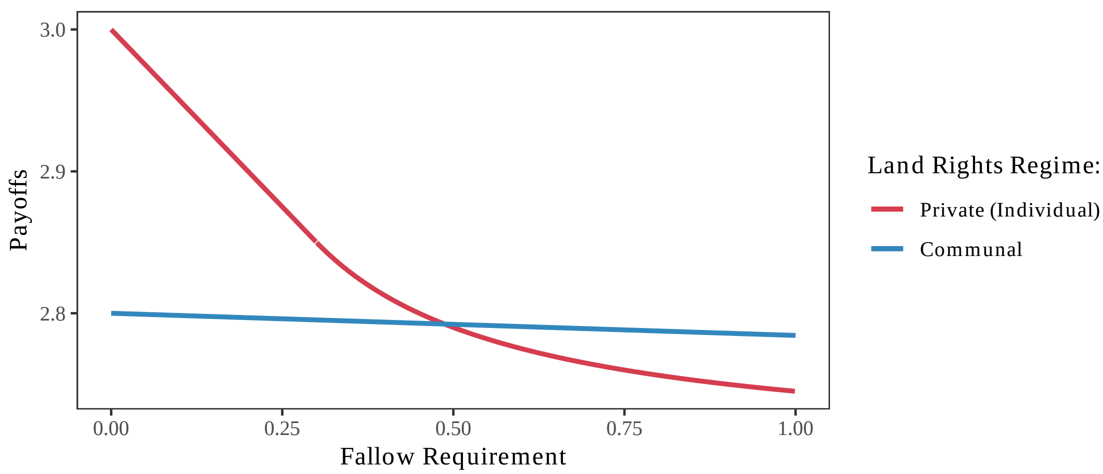
[6] Efficiency is defined using the sum of all individuals' payoffs, or equivalently, the ex-ante expected payoff for any individual for a regime.

B.3.3. Model Predictions

Prediction 1: There is an increasing preference for communal land rights as f increases

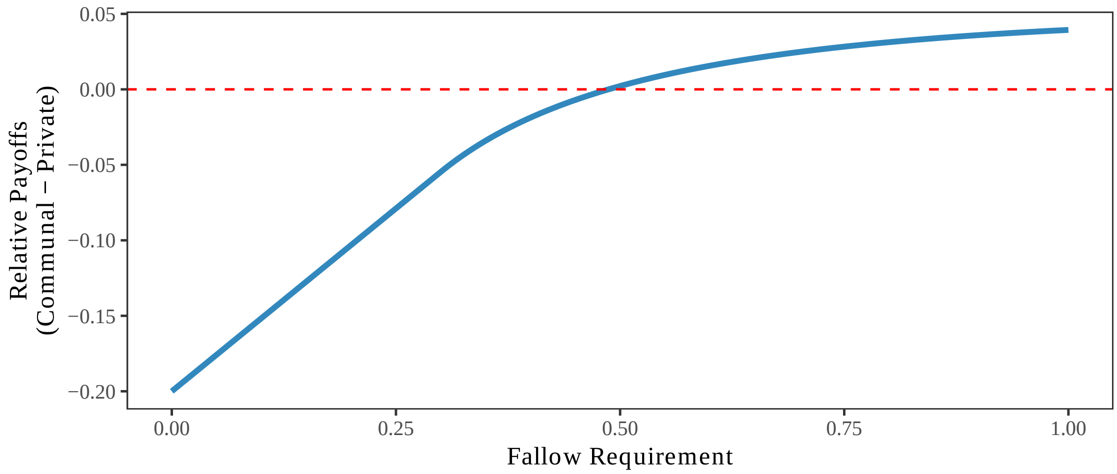
Figure B1 presents the expected payoffs as a function of f for individuals in the private regime and the communal regime, and Figure B2 presents the difference in expected payoffs between communal and private regimes under specific parameter values for (p, β, c, k).[7] We find that, for high enough fallow requirements f, individuals' expected payoffs are higher in the communal regime than in the private regime.

Figure B1
Payoffs as a Function of Fallow Requirement f
by Land Rights Regime



[7]The plots assume $p = 0.10$, $\beta = 0.25$, $c = 3$, and $k = 0.2$.

Figure B2
Payoff of Communal Relative to Private Land Rights
as a Function of Fallow Requirement f



Prediction 2: There is an increasing preference for communal land rights as p increases

- If $pc > 1 \implies p > \frac{1}{c}$,

  Relative payoff (communal - private) as a function of f is

  $$= -k + \left(\frac{2-\beta^2}{4}\right) f \qquad \forall f \in [0,1]$$

  and $\forall p > \frac{1}{c}$ relative payoff is independent of p

- If $pc \leq 1 \implies p \leq \frac{1}{c}$,

  Relative payoff as a function of f is

  $$= -k + \left(\frac{2-\beta^2}{4}\right) f \qquad f \leq pc$$
  $$= -k + pc - \frac{(pc)^2}{2f} - \frac{\beta^2}{4} f \qquad 1 \geq f \geq pc$$

  Relative payoff as a function of p is

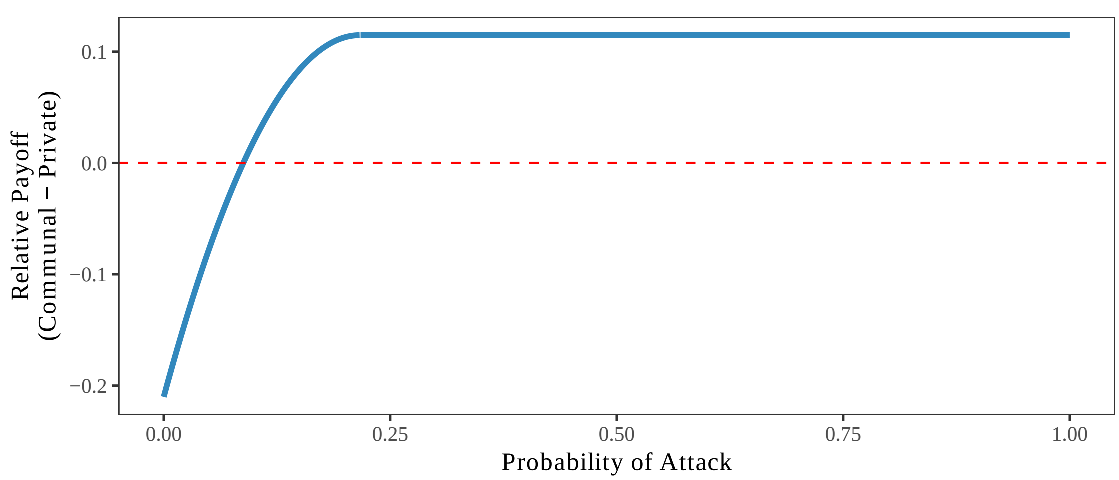
  $$= -k + pc - \frac{(pc)^2}{2f} - \frac{\beta^2}{4} f \qquad p \leq \frac{f}{c}$$
  $$= -k + \left(\frac{2-\beta^2}{4}\right) f \qquad \frac{1}{c} \geq p \geq \frac{f}{c}$$

Thus, relative payoff $R(p)$ as a function of p is,

$$
\begin{aligned}
&= -k + pc - \frac{(pc)^2}{2f} - \frac{\beta^2}{4} f && p \leq \frac{f}{c} \\
&= -k + \left(\frac{2-\beta^2}{4}\right) f && p \geq \frac{f}{c} \\
R'(p) &= c - \frac{pc^2}{f} && p \leq \frac{f}{c} \\
&= c\left(1 - \frac{pc}{f}\right) \\
&\geq 0 \iff \frac{pc}{f} \leq 1 \text{ which is always true } \forall\, p \leq \frac{f}{c}
\end{aligned}
$$

Thus, $R(p)$ is an increasing function of p within the range $[0, \frac{f}{c}]$. This suggests that for a given combination of (f, β, c, k) as p – the probability of attack – increases, the preference for communal regime increases. Figure B3 shows the relative payoffs as a function of p.[8]

Figure B3
Payoff of Communal Relative to Private Land Rights
as a Function of Probability of Attack p



Prediction 3: Inequality is lower in the communal regime

We define inequality of payoffs in a regime $IE_r = \max(u_{ir}) - \min(u_{ir})$ where u_{ir} is the payoff of individual i of type e_i in regime r.

For individual rights, $IE_i = c - (c - pc) = pc$.

For communal rights, $IE_g = (c - k) - (c - \frac{f\beta}{2} - k) = \frac{\beta f}{2}$

[8] The plots assume $f = 0.65$ and, as before, $\beta = 0.25$, $c = 3$, and $k = 0.2$.

Our previous assumption that $\forall f \in [0,1]\ \beta \leq \frac{2pc}{f} \implies pc \geq \frac{\beta f}{2}$. This means that the communal regime reduces inequality by reducing the spread of possible payoffs.

B.4. *Risk-dominant equilibrium choice as the efficient equilibrium*

We briefly discuss why the risk-dominant equilibrium choice corresponds to the efficient equilibrium choice for group monitoring (where individuals with the lowest monitoring costs up to β perform the monitoring).

Consider a two player game between types e_1 and e_2 such that both belong to either Group I or II – their monitoring costs are low enough so that they could contribute to group-monitoring. Assume β is such that only one individual is sufficient for group-monitoring success. The below two-player game has payoffs similar to our model. $(a_1, a_2) = (1,0)$ and $(0,1)$ are the two Nash equilibria. However, can we motivate the choice of one over the other?

Type e_2

Type e_1		$a_2 = 1$	$a_2 = 0$
	$a_1 = 0$	c , $c - \frac{fe_2}{2}$	$c - pc$, $c - pc$
	$a_1 = 1$	$c - \frac{fe_1}{2}$, $c - \frac{fe_2}{2}$	$c - \frac{fe_1}{2}$, c

Following the formal definition of risk dominance, in a two player game between types e_1, e_2 with $e_2 > e_1$, $(1,0) \succ (0,1)$ where $\succ$ stands for "risk-dominates". This is because $(1,0) \succ (0,1)$ if and only if the product of payoff deviations from $(1,0)$ is greater than the product of payoff deviations from $(0,1)$:

$$\left(-pc + \frac{fe_1}{2}\right)\left(-\frac{fe_2}{2}\right) > \left(-pc + \frac{fe_2}{2}\right)\left(-\frac{fe_1}{2}\right)$$
$$\frac{pcfe_2}{2} > \frac{pcfe_1}{2}$$
$$e_2 > e_1$$

If we extrapolate this logic to a continuum of types, every equilibrium where a lower type chooses $a_i = 1$ risk dominates the sister equilibrium where a higher type chooses $a_i = 1$ instead. Thus, it is plausible that in equilibrium, the lowest types in the set $[0, \beta]$ will choose $a_i = 1$ and the rest will free-ride to result in the most efficient Nash equilibrium.

Appendix C. Additional Tables and Figures

C.1. Additional Results: Robustness of Ethnographic Results

Table C1
Effect of Fallow Requirement on Intensity of Agricultural Production

	Dependent Variable: *Intensity of Agriculture [1-6]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-0.052^{**}	-0.058^{***}	-0.035	-0.039	-0.038	-0.029
	(0.023)	(0.020)	(0.024)	(0.025)	(0.025)	(0.025)
	[0.023]	[0.019]	[0.023]	[0.024]	[0.024]	[0.022]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	3.47	3.47	3.47	3.47	3.47	3.46
Adjusted R2	0.029	0.199	0.201	0.193	0.206	0.487
Beta Coef.	-0.186	-0.206	-0.126	-0.140	-0.134	-0.100
Observations	167	167	167	167	167	154

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses. The dependent variable *Intensity of Agriculture* is a 1 to 6 categorical variable, with higher values related to more intensive agricultural production. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C2
Effect of Fallow Requirement on Contemporary Fallowing Practices: Ordered Logit

	Dependent Variable:				
	Contemporary Fallowing Practices [0-2]				
	(1)	(2)	(3)	(4)	(5)
Fallow Requirement	0.033*	0.031	0.032*	0.043**	0.041**
	(0.018)	(0.020)	(0.019)	(0.019)	(0.019)
Country FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	0.72	0.72	0.72	0.72	0.72
Pseudo R2	0.031	0.033	0.036	0.039	0.040
Observations	10,744	10,744	10,744	10,744	10,744
Clusters	121	121	121	121	121

Notes: The unit of observation is a plot in the *An agricultural survey for more than 9,500 African households* survey (Waha et al. 2016). Standard errors that are two-way clustered by country and ethnologue group are presented in parentheses. Estimated using ordered logistic regression. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each Enumeration Area. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C3
Effect of Fallow Requirement on Communal Land Rights: Ordered Logit

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	0.127***	0.112**	0.095**	0.101**	0.116*	0.115**
	(0.046)	(0.050)	(0.044)	(0.047)	(0.064)	(0.057)
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Pseudo R2	0.063	0.097	0.147	0.151	0.248	0.334
Observations	88	88	88	88	88	86

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. Estimated using ordered logistic regression. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C4
Effect of Fallow Requirement on Communal Land Rights:
Pre-Colombian Exchange Measure of Fallow Requirements

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement (Pre-1500 Crops)	0.043***	0.036**	0.036**	0.036**	0.039**	0.037**
	(0.014)	(0.015)	(0.015)	(0.014)	(0.017)	(0.016)
	[0.014]	[0.014]	[0.013]	[0.013]	[0.014]	[0.014]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.31	2.31	2.31	2.31	2.31	2.31
Adjusted R2	0.089	0.106	0.112	0.099	0.170	0.246
Beta Coef.	0.316	0.266	0.261	0.263	0.289	0.272
Observations	85	85	85	85	85	83

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. Estimated using ordered logistic regression. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C5
Effect of Fallow Requirement on Communal Land Rights:
Fallow Requirement Using Average of Top-3 Max CSI Crops

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	0.043***	0.039***	0.036***	0.038***	0.037**	0.035**
(Average Top-3 Max CSI Crops)	(0.013)	(0.014)	(0.013)	(0.014)	(0.014)	(0.015)
	[0.013]	[0.013]	[0.012]	[0.013]	[0.013]	[0.012]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Adjusted R2	0.098	0.113	0.131	0.116	0.201	0.267
Beta Coef.	0.330	0.296	0.269	0.287	0.277	0.266
Observations	88	88	88	88	88	86

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. Estimated using ordered logistic regression. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C6
Effect of Fallow Requirement & Land Suitability on Communal Land Rights

	Dependent Variable: *Communality of Land Rights [1-3]*					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	0.043***	0.039***	0.035***	0.038***	0.036**	0.035**
	(0.013)	(0.014)	(0.013)	(0.014)	(0.015)	(0.015)
	[0.013]	[0.013]	[0.012]	[0.013]	[0.013]	[0.013]
Land Suitability			−0.158	−0.119	0.108	0.280
			(0.346)	(0.354)	(0.361)	(0.343)
			[0.317]	[0.320]	[0.315]	[0.291]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.33	2.33	2.33	2.33	2.33	2.34
Adjusted R2	0.098	0.113	0.131	0.115	0.201	0.267
Beta Coef.	0.329	0.296	0.269	0.286	0.276	0.266
Observations	88	88	88	88	88	86

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS). Robust standard errors in parentheses and Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Communality of Land Rights* is a 1 to 3 categorical variable, where 1=land is predominantly private property, 2=land is partially communally used, and 3=communal land use rights only. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C7
Effect of Fallow Requirements on Jurisdictional Hierarchy

	Dependent Variable: *Extent of Jurisdictional Hierarchy [0-5]*					
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: SCCS Societies					
Fallow Requirement	−0.026	−0.021	0.008	0.014	0.019	0.013
	(0.016)	(0.013)	(0.016)	(0.017)	(0.017)	(0.016)
	[0.016]	[0.013]	[0.015]	[0.016]	[0.016]	[0.015]
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	2.14	2.14	2.14	2.14	2.14	2.14
Adjusted R2	0.009	0.247	0.276	0.288	0.290	0.440
Beta Coef.	-0.124	-0.097	0.038	0.066	0.091	0.062
Observations	165	165	165	165	165	152
	Panel B: EA Societies					
Fallow Requirement	−0.005**	−0.005**	−0.004	−0.001	−0.001	−0.000
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Continent FEs	N	Y	Y	Y	Y	Y
Geography Controls	N	N	Y	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	N	Y
Outcome Mean	0.24	0.24	0.24	0.24	0.24	0.24
Adjusted R2	0.003	0.203	0.221	0.247	0.251	0.290
Beta Coef.	-0.066	-0.061	-0.048	-0.008	-0.010	-0.001
Observations	1,021	1,021	1,021	1,021	1,021	1,003

Notes: The unit of observation is a society in the Standard Cross Cultural Sample (SCCS) in Panel A or the Ethnographic Atlas (EA) in Panel B. Robust standard errors in parentheses. The dependent variable *Extent of Jurisdictional Hierarchy* measures the degree of jurisdictional hierarchy beyond the local level, ranging from 0=no levels, to 5=four levels. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C.2. Additional Results: Constitutions

The results in Section 4.3 show that longer fallowing requirements are associated with a historically higher prevalence of communal land rights and a lower prevalence of private land rights. We now explore whether this relationship continues to hold in more contemporary measures of land rights. We use data from the Comparative Constitutions Project (hereafter CCP) (Elkins et al. 2009). The CCP database is a systematic codification of the characteristics (form and content) of all the world's constitutions, both past and present. The database covers country-year pairs for most independent countries since 1789. In addition, the database records all changes made to the constitution of a country over time (amendments, new constitutions, reinstatement, interim constitutions). In the following analysis, the unit of observation is the constitution in force in a given country on December 31st of a given year since that country has had a written constitution. We examine five different measures of property rights, each a different dimension of property rights. We define indicator variables equal to 1 if a constitution grants individual rights to: (1) transfer property, (2) own property, (3) testate property (right to give property at death), and (4) inherit property. We view each of these measures as proxies for stronger private property rights. Additionally, we combine all four measures in an index of private property rights that is computed as the average of the other four variables.

Table C8 presents the estimates for the relationship between these outcomes and the ancestry-adjusted fallowing requirement measure (described in Section 3.3). Odd columns only condition on continent fixed-effects, while even columns also include the same ancestry-adjusted geographic, disease and ethnographic covariates that are in Table 4. We find that higher ancestral fallowing requirements have a negative and statistically significant relationship with most of these measures of individual property rights. The exception is "inherit property", where the coefficient is negative but not significant. For the index of property rights (columns (9) and (10)), a 10 percentage point increase in the ancestry-adjusted fallow requirement is associated with a 0.8% to 1.2% reduction in the index of property rights measure. These results provide evidence that ancestral fallowing requirements continue to shape the organization of property rights today.

Table C8
Fallow Requirement and Property Rights in National Constitutions

	Dependent Variable: *Right to [...] in Constitution (0/1)*								*Index of Property Rights*	
	Transfer Property		*Own Property*		*Testate Property*		*Inherit Property*			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Fallow Requirement	−0.017**	−0.002	−0.011**	0.003	−0.008***	−0.010**	−0.012	−0.020	−0.012***	−0.008
	(0.007)	(0.012)	(0.005)	(0.006)	(0.003)	(0.005)	(0.008)	(0.013)	(0.003)	(0.006)
Continent FEs	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Baseline Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Geography Controls	N	Y	N	Y	N	Y	N	Y	N	Y
Disease Controls	N	Y	N	Y	N	Y	N	Y	N	Y
Crop FEs	N	Y	N	Y	N	Y	N	Y	N	Y
Ethnographic Controls	N	Y	N	Y	N	Y	N	Y	N	Y
Outcome Mean	0.22	0.22	0.82	0.82	0.10	0.10	0.26	0.26	0.35	0.35
Adjusted R2	0.574	0.616	0.676	0.733	0.611	0.656	0.597	0.645	0.637	0.685
Beta Coef.	-0.211	-0.030	-0.141	0.035	-0.148	-0.174	-0.140	-0.231	-0.251	-0.157
Observations	8,188	8,188	8,024	8,024	8,288	8,288	8,079	8,079	8,633	8,633
Clusters	122	122	122	122	121	121	121	121	123	123

Notes: The unit of observation is a country's constitution-year pair. Standard errors are clustered at the country level and presented in parentheses. Data are from the *Comparative Constitutions Project* (Elkins et al. 2009). Across specifications, outcomes are dummy variables equal to 1 if a constitution grants rights to transfer property (columns (1) and (2)), own property (columns (3) and (4)), testate property (columns (5) and (6)), and inherit property (columns (7) and (8)). The outcome variable in columns (9) and (10) is a property rights index computed as the average of the previous four variables. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop. *Ethnographic controls* include includes settlement complexity, political centralization, and historical presence of large animals. Every specification controls for the log number of years since a constitution was first written, year in which the current constitutional system was promulgated, the length of a constitution in words, year dummies and continent fixed effects. The sample is restricted to countries where all groups practiced agriculture to varying degrees and for which information on fallow length is available. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

C.3. Additional Results: World Bank Projects

Table C9
Effect of Fallow Requirements on World Bank Project Selection

	Dependent Variable:			
	Any Project (0/1)		*Rated Project (0/1)*	
	(1)	(2)	(3)	(4)
Fallow Requirement	−0.012	−0.012	−0.000	−0.000
	(0.014)	(0.015)	(0.008)	(0.008)
Continent FEs	Y	Y	Y	Y
Project Sector FEs	N	N	Y	Y
Project Year FEs	N	N	Y	Y
Geography Controls	Y	Y	Y	Y
Disease Controls	Y	Y	Y	Y
Crop FEs	Y	Y	Y	Y
Ethnographic Controls	N	Y	N	Y
Outcome Mean	0.32	0.32	0.57	0.57
Adjusted R2	0.105	0.109	0.703	0.703
Beta Coef.	-0.025	-0.024	-0.000	-0.000
Observations	6,871	6,871	52,175	52,175
Clusters	216	216	133	133

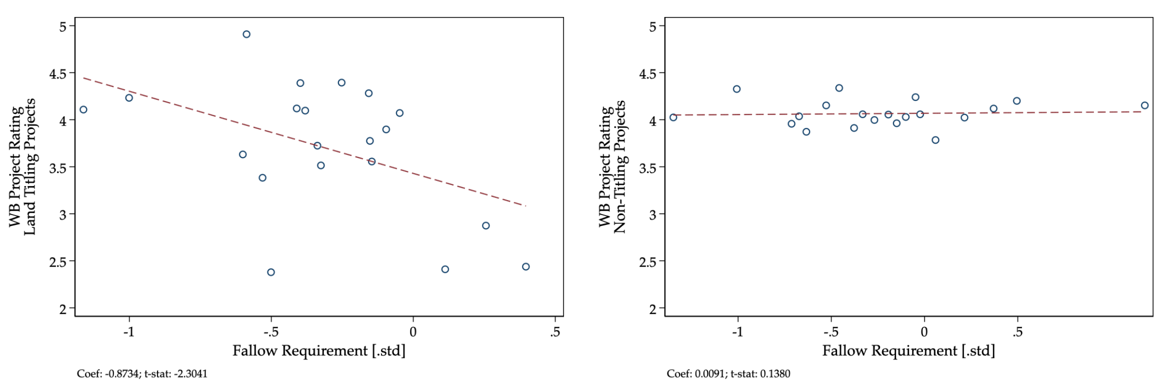
Notes: The unit of observation is an ethnologue group in columns 1 and 2, and a world bank project by ethnologue group in columns 5 and 6. Standard errors clustered by ethnologue group in parentheses. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable in columns 1 and 2, *Any Project*, is an indicator variable equal to 1 if the ethnologue group had at least one world bank project in the Aid Data sample. The dependent variable in columns 3 and 4, *Rated Project*, is an indicator variable equal to 1 if a world bank project has an outcome rating. *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, an index of settlement density, and an index of political development. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C10
Effect of Fallow Requirement on World Bank Project Success
Country-Level Fallow Requirement

	Dependent Variable:					
	World Bank Project Rating [1-5]					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	-0.651^{**}	-0.650^{**}	-0.613^{**}	-0.523^{**}	-0.530^{**}	-0.536^{**}
$\times$ *Land Titling Project*	(0.252)	(0.263)	(0.251)	(0.242)	(0.242)	(0.246)
	[0.086]	[0.084]	[0.084]	[0.082]	[0.082]	[0.085]
Continent FEs	N	Y	Y	Y	Y	Y
Project Sector FEs	N	N	Y	Y	Y	Y
Project Year FEs	N	N	Y	Y	Y	Y
Geography Controls	N	N	N	Y	Y	Y
Disease Controls	N	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Ethnographic Controls	N	N	N	N	Y	Y
Country FEs	N	N	N	N	N	Y
Outcome Mean	4.21	4.21	4.21	4.21	4.21	4.21
Adjusted R2	0.016	0.035	0.136	0.163	0.163	0.299
Beta Coef.	-0.104	-0.104	-0.098	-0.084	-0.085	-0.086
Observations	18,763	18,763	18,707	18,707	18,707	18,707
Clusters	87	87	87	87	87	87

Notes: The unit of observation is a project-country pair. Standard errors are clustered at the country level and presented in parentheses. The dependent variable *World Bank Project Rating* is a variable ranging from 1 to 6, where 1 = a project was rated as highly unsatisfactory, 2 = unsatisfactory, 3 = moderately unsatisfactory, 4 = moderately satisfactory, 5 = satisfactory, and 6 = highly satisfactory. *Fallowing Requirement* is the country-level population-weighted measure of a country's fallowing requirement. *Land Titling Project* is an indicator variable equal to 1 if the project description mentions land titling. *Geography Controls* include longitude, latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop. *Ethnographic Controls* includes settlement complexity, political centralization, and historical presence of large animals. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure C1
Fallow Requirements and World Bank Project Success
Country-Level Fallow Requirement



a. Land Titling Projects

b. Non-Land Titling Projects

Notes: The figure presents binscatters between the World Bank project success rating for projects related to land titling (a.) or projects not related to land titling (b.), and population-weighted fallowing requirement. The unit of observation is a project-country pair. The bottom-left of each figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the country level. The regressions control for latitude and longitude and include continent, project sector, and project year fixed effects.

C.4. Additional Results: Inequality and Conflict

Table C11
Effect of Fallow Requirement on Night Light Density

	Dependent Variable:					
	Log(Night Light Density + 1)					
	(1)	(2)	(3)	(4)	(5)	(6)
Fallow Requirement	0.001 (0.002) [0.002]	0.003 (0.002) [0.002]	0.003 (0.002) [0.002]	0.003 (0.002) [0.002]	0.002 (0.002) [0.002]	0.002 (0.002) [0.002]
Country FEs	Y	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y	Y
Crop FEs	N	N	N	Y	Y	Y
Ethnographic Controls	N	N	N	N	Y	Y
Population Controls	N	N	N	N	N	Y
Outcome Mean	0.22	0.22	0.22	0.22	0.22	0.22
Adjusted R2	0.318	0.331	0.331	0.333	0.354	0.355
Beta Coef.	0.007	0.028	0.029	0.029	0.023	0.023
Observations	3,825	3,825	3,825	3,825	3,734	3,734
Clusters	143	143	143	143	142	142

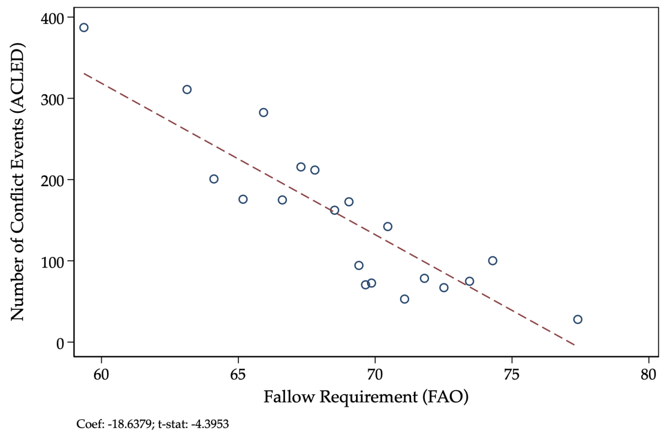
Notes: The unit of observation is an ethnologue group. Standard errors clustered by ethnologue group in parentheses. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. The dependent variable *Log(Night Light Density + 1)* is defined as the log of the mean night light intensity plus one in the VIIRS data per ethnologue group in 2019 using nighttime lights data from Elvidge et al. (2021). *Geography Controls* include centroid longitude, centroid latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization. *Population Controls* includes log population density for each group. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table C12
Effect of Fallow Requirement on Inequality and Wealth Score:
Demographic and Health Surveys (DHS)

	(1)	(2)	(3)	(4)	(5)
	Dependent Variable:				
	Panel A: Dep. Var.: Standard Deviation of Wealth Scores				
Fallow Requirement	-0.314^{**}	-0.411^{***}	-0.411^{***}	-0.401^{***}	-0.398^{***}
	(0.128)	(0.124)	(0.117)	(0.114)	(0.122)
	[0.142]	[0.253]	[0.246]	[0.242]	[0.240]
Country-Year FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	62.87	62.87	62.87	62.87	63.46
Outcome SD	76.88	77.04	77.04	77.04	79.43
Adjusted R2	0.615	0.625	0.625	0.625	0.627
Beta Coef.	-0.018	-0.023	-0.023	-0.023	-0.022
Observations	66,453	66,169	66,169	66,169	61,775
Clusters	114	114	114	114	114
	Panel B: Inter-Quartile Range of Wealth Scores				
Fallow Requirement	-0.465^{**}	-0.544^{***}	-0.553^{***}	-0.545^{***}	-0.509^{***}
	(0.208)	(0.206)	(0.190)	(0.190)	(0.189)
	[0.199]	[0.336]	[0.327]	[0.323]	[0.320]
Country-Year FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	78.26	78.23	78.23	78.23	78.93
Outcome SD	101.42	101.61	101.61	101.61	104.63
Adjusted R2	0.527	0.539	0.539	0.539	0.541
Beta Coef.	-0.020	-0.024	-0.024	-0.024	-0.021
Observations	66,451	66,167	66,167	66,167	61,773
Clusters	114	114	114	114	114
	Panel C: Average Wealth Score				
Fallow Requirement	0.206	-1.243^{*}	-1.339^{*}	-1.018	-0.641
	(0.707)	(0.712)	(0.724)	(0.645)	(0.719)
	[0.843]	[0.800]	[0.775]	[0.760]	[0.749]
Country-Year FEs	Y	Y	Y	Y	Y
Geography Controls	N	Y	Y	Y	Y
Disease Controls	N	N	Y	Y	Y
Crop FEs	N	N	N	Y	Y
Ethnographic Controls	N	N	N	N	Y
Outcome Mean	-2.57	-2.80	-2.80	-2.80	-0.86
Outcome SD	165.51	165.79	165.79	165.79	170.17
Adjusted R2	0.017	0.219	0.220	0.222	0.218
Beta Coef.	0.006	-0.033	-0.036	-0.027	-0.016
Observations	66,453	66,169	66,169	66,169	61,775
Clusters	114	114	114	114	114

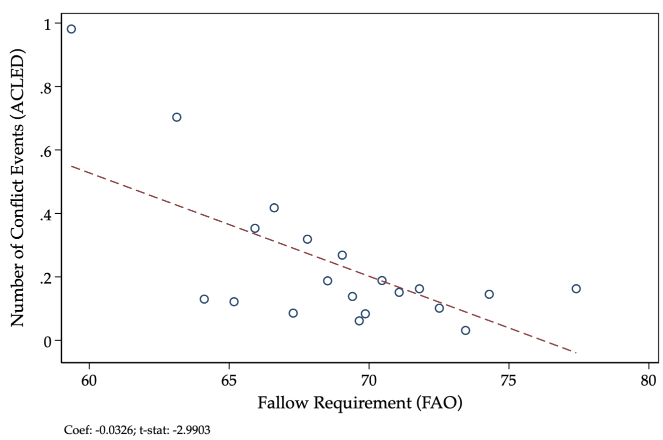
Notes: The unit of observation is a DHS cluster. Standard errors in parentheses are two-way clustered by country-survey wave and ethnologue group. Conley (1999) standard errors calculated using a 100 km cut-off window are presented in brackets. In Panel A, the outcome variable is the standard deviation of the DHS wealth score. In Panel B, the outcome variable is the inter-quartile range of the DHS wealth score. In Panel C, the outcome variable is the average DHS wealth score. All regressions control for cluster size and rural-urban status. *Geography Controls* include cluster longitude, cluster latitude, average rainfall, average temperature, elevation, plough suitability, and agricultural suitability. *Disease Controls* include malaria suitability and tsetse suitability. *Crop FEs* are fixed effects for the maximum caloric suitability crop in each society. *Ethnographic Controls* includes the presence of large domesticated animals, settlement density, and pre-colonial political centralization for the ethnologue group of each DHS cluster. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure C2
Fallowing Requirements & Conflict: All Conflicts



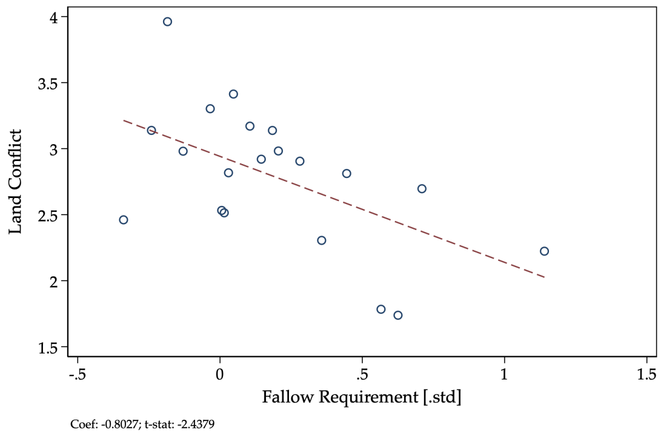
Notes: The figure presents a binscatter between the fallow requirement and the number of conflicts in the ACLED data. The unit of observation is a ethnologue group. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the ethnologue group level.

Figure C3
Fallowing Requirements & Conflict: Land-Related Conflicts



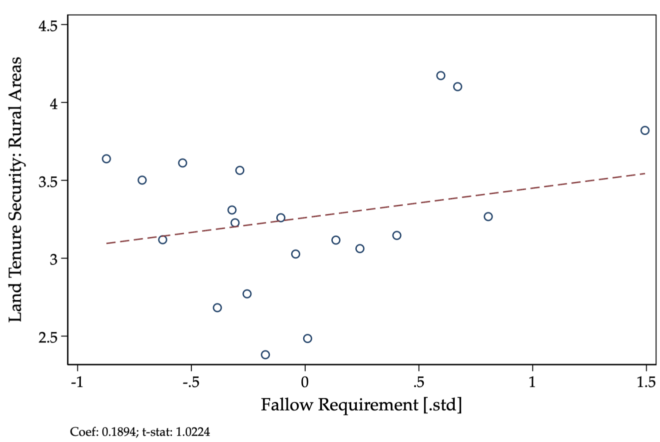
Notes: The figure presents a binscatter between the fallowing requirement and the number of land-related conflict events in the ACLED data. The unit of observation is an ethnologue group. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the ethnologue group level.

Figure C4
Fallowing Requirements & Land-Related Conflict: IPD Data



Notes: The figure presents a binscatter between the fallow requirements and the severity of land-related conflict in rural areas in the IPD data. The unit of observation is a country. Land conflict is a 0 to 4 categorical variable, where 0 = No land-related conflict in rural areas, and 4 = Serious land-related conflict in rural areas. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-left of the figure presents the estimated bivariate coefficient and t-statistic. Standard errors are clustered at the country level.

Figure C5
Fallow Requirements & Land Security: Institutional Profiles Dataset



Notes: The figure presents a binscatter between the fallow requirement and the extent of land tenure security in rural areas in the Institutional Profiles Database. This variable is a 0 to 4 categorical variable ranging from less to more secure land tenure, where 0 = very high land tenure insecurity, 1 = high insecurity, 2 = moderate insecurity, 3 = low insecurity, 4 = Very low insecurity. The unit of observation is a country. Regressions control for latitude, longitude, and continent fixed-effects. The bottom-right of each figure presents the estimated bivariate coefficient and t-statistic. Robust standard errors are in parentheses.