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by Daniel Ayalew Ali and Klaus Deininger

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Abstract: Despite accounts of increasing large farm penetration in Africa and an active debate on the differential potential of smallholder vs. large farms to satisfy Africa's food requirements, evidence on the extent and performance of different farm types remains limited. A census and subsequent representative survey of 3,000 large farms in Zambia, one of the African countries with the highest share of large farms, allows characterizing the impact of institutional arrangements on large farms' establishment and productive performance. While policies rather than exogenous price shocks seem to have driven large fam expansion, average productivity is not different from small farms and title has no impact on productivity, investment, or credit access, most likely because transferability of titled remains limited, undermining the suitability of such land as collateral. Significant effects of title on self-reported land prices point towards land being acquired for speculative purposes, suggesting that a tax on titled land tax, together with improved land service delivery might be a desirable policy option.

1. Introduction

There is little doubt that with economic development, Africa's agricultural sector will undergo significant structural change like what was experienced historically in developed economies. Yet, the nature of this change, and in particular the role of large farms and the role of Government policies to support establishment and operation of such farms, remains subject to debate. While there is agreement about the importance to provide an appropriate institutional framework so that markets can operate, opinions are divided as to whether a more activist policy stance to attract investors may be beneficial or possibly even harmful. While the uptick in demand for land following the 2007/08 food price shock brought this topic into sharp relief and many studies emphasized the effects of foreign agricultural investment on households' livelihoods, evidence of impacts of institutional arrangements on outcomes of investment by domestic actors remain rare. This is unfortunate as failure to put in place proper institutional arrangements may leave countries ill-prepared to deal with potential future waves of demand if commodity prices rise again.

This paper explores impacts of institutional arrangements on large farm performance in Zambia, a country that, given its relative land abundance, could benefit from capital and know-how by outside investors who set up large and medium farms.[1] To attract domestic and foreign investors, policies to prioritize large farm development by establishing 'farm blocks' where land would be combined with infrastructure and market access were adopted and a dualistic land tenure system that gives formal recognition only to 'state land', de facto envisaging transformation of all customary to statutory tenure.[2] The ensuing land transfers to large farms made Zambia one of only two African countries where more than half of the agriculturally suitable area is estimated to be under large farms (Jayne *et al.* 2014a).

To obtain systematic evidence on farms' evolution and productive performance, a full listing and mapping of large and medium farms was added to the mapping exercise undertaken in preparation of the 2020 census

[1] Throughout the paper, we will use 'large farms' to refer to large and medium farms which, based on Zambian definitions, are larger than 5 ha.
[2] Studies pointed out that limited capacity and local presence of relevant state institutions makes implementing this 'replacement' paradigm (Bruce and Migot-Adholla 1994) difficult, implying that relevant laws may have little effect on local realities (Atwood 1990; Pinckney and Kimuyu 1994).

in Zambia's Eastern Province. Maps thus generated were overlaid with administrative records (survey, deed and sketch plans) to assess cadastral records' accuracy. Farm census data were then also used as frame for a detailed large farm survey that, by providing data on performance, allows inferences on the impact of title on investment, productivity, and land prices.

Descriptive evidence highlights that the pace of land acquisition peaked in the 5-year period immediately after the entry into force of the new land law (i.e., 1995-2000) rather than in reaction to the 2007/08 global commodity price boom, suggesting that local policies affect the domestic response to global price signals. Also, most owned land remains uncultivated and with less than 20 ha, average farm size remains modest, and at most 26% of the Province's agricultural area is estimated to be owned by large and medium farms.[3] We find that even for large farms, the share of titled land remains limited, possibly indicating regulatory or capacity constraints to title supply. Those lacking a title think it would be very useful and are be willing to pay an amount that would cover costs of efficient provision.

Yet, services provided by the Ministry of Lands are rationed and difficult to access and often of poor quality. Overlaying our data with official maps shows clear discrepancies between official records and ground reality. This is consistent with weak maintenance undermining the value of titles; in fact, owners estimate that less than half of titled land can be sold freely. Such limits on transferability would undermine the scope of pledging titled land as collateral for credit and limited benefits from formality may further accelerate a move towards informality. Rather than validating a unidirectional and supposedly irreversible movement from customary to state land, this suggests that, even without a legal mandate, chiefs' local presence makes them a more accessible and socially accepted intermediary in land matters than Central Government.

Instrumental-variables regressions, where possession of title is instrumented using parcels' tenure status at acquisition some 26 years ago, suggest that title has no effect on land-attached investment and productivity of land use at parcel- or access to credit at household-level similar to what was found elsewhere (Sitko et al. 2014). In fact, some types of investment (fallowing and construction of soil and water conservation structures) are much lower on state land without title than on customary land. While title is also associated with somewhat higher levels of self-assessed transferability and an increase in the value respondents believe their land could fetch in the market, higher land values unconnected to productive performance may reflect rents arising from the fact that access to title is rationed or from speculative land acquisition.

More efficient service provision to reduce the cost and enhance the quality of title by moving towards a fully digital environment will be essential to be able to respond to such demands. Land taxes have long been identified as a policy response to address this and encourage productive land use (Hoff 1991) and

[3] If applied nationally, even 26% of area owned by large farms would mean that 10 mn. ha was converted from customary tenure since 1995.

limiting them to state land would address most of the administrative and equity issues that made levying such a tax difficult (Deininger *et al.* 2020) with the possibility of using non-payment of taxes for an extended period of time as a reason for cancelling titles. Sharing proceeds with traditional authorities and involving them in decision-making based on clear objective criteria can leverage their access to local information (Basurto *et al.* 2020) and trust (Baldwin 2018), thereby creating an entry point for constructively involving them in the formal system.

We contribute to three strands of literature. First, following the 2007/08 commodity price boom, a body of studies explored nature and impact of large scale land-based investment (LSLBI), initially based on case studies (Deininger and Byerlee 2011) and subsequently using complete national inventories (Glover and Jones 2019), possibly complemented with remote sensing (Deininger and Xia 2018) to draw representative and testable conclusions. They were, however, unable to distinguish formal from informally established ventures or explore level and determinants of economic performance. A complete census plus an in-depth farm survey provides insights on dynamics of farm establishment and land use. It points towards high levels of informality, partly because the centralized Ministry struggles to perform its functions and suggests that neither location on designated state land nor possession of a title are associated with higher levels of productivity. Rather than picking winners to transform the agricultural sector, Government policies and constraints on service delivery may well have ended up subsidizing speculative land acquisition, increasing rent seeking and inequality, and possibly preventing more enterprising individuals form accessing land.

Second, the impact of land title on small farms has been explored by numerous studies (Lawry *et al.* 2016).'Stylized facts' from this literature are that titling helps to increase investment (Fenske 2011), transferability (Deininger and Jin 2006), and -if women's rights are documented- female empowerment (Ali *et al.* 2014; Deininger *et al.* 2008) but not credit access, largely due transaction costs.[4] Exploring the impact of title for large farms is important as such farms multiply across Africa (Jayne *et al.* 2019) and, e.g. by leveraging title to access credit, could in principle generate benefits for neighboring small farmers. Our finding of title for Zambian large farms having no effect on investment or credit is consistent with limits on enforcing titles by state institutions that lacks local presence and can no longer count on cooperation by chiefs.[5] A land tax, proceeds of which could be shared with chiefs, would in principle address both issues.

Finally, studies on the scope for structural transformation of developing countries' agricultural sectors highlight the importance of well-functioning markets for growth of farm size as wages increase and capital

[4] In developing countries, foreclosing on owner-occupied urban properties is often difficult (Galiani and Schargrodsky 2010) while for small farmers the transaction costs associated with loan processing relative to loan size are often very high (Carter and Olinto 2003). The high cost of updating land registries may also make it difficult to maintain rural land registries in developing countries (Ali *et al.* 2017; Ali *et al.* 2019b).
[5] Huntington and Shenoy (2021) also find a significant zero effect of land documentation on investment in Zambia. As discussed in more detail below, this finding is more likely due to the fact that these documents have no legal than use of a randomized approach.

substitutes labor (Ma *et al.* 2021). A growing literature shows that, by reducing the scope for long-term transfers (Restuccia and Santaeulalia-Llopis 2015) and labor movement out of the agricultural sector (Chen 2017) customary tenure systems' scope for redistribution may widen the gap between actual performance and a hypothetical first best, the estimated size of which will vary depending on measurement error (Gollin and Udry 2020),[6] institutional change will allow narrowing this gap only if new arrangements improve land market functioning, make it easier for third parties to obtain authoritative information on land ownership, and in case of default allow quick liquidation of land pledged as collateral in an active market (Arruñada 2012). Measuring output gaps as a function of institutional performance and quality, properly defined, will be a fruitful direction for research.

The rest of the paper is structured as follows. Section two provides a conceptual framework and institutional background on land tenure and LSLBI in Zambia to lay out the questions to be explored. Section three discusses descriptive evidence from the listing, a comparison of cultivated area with digitized cadastral records, and the farm performance survey. Section four presents the results from regressions exploring the impacts of title on self-assessed land rights, land values, investment, and productivity. Section five concludes by discussing implications for policy and future research.

2. Background and conceptual framework

A large literature shows that LSLBI can provide benefits for local populations while also highlighting that policies and the institutional arrangements to implement them affect volume and impact of such investment and that geo-referenced inventories are needed to assess quantity and impact of such investment. Low levels of agricultural productivity and large amounts of potentially suitable land have long led Zambia to adopt policies, including a dualistic land tenure regime, to encourage large farm growth. While this is estimated to have led to an agricultural sector dominated by (domestic) large farms, neither the extent and nature of large farms nor the effect of such policies on their productivity is known.

2.1 Lessons from large land-based investment

While early contributions highlighted the scope for "pioneer investors" to support discovery of agro-ecological suitability and establishment of technology and market linkages (Collier and Venables 2012). The extent to which large land acquisition by large farms can support Africa's agricultural transformation has long been subject to debate (Collier and Dercon 2014; Cotula 2014; Deininger and Byerlee 2011).[7] Large farms' superior access to credit and product markets together with the ability to substitute capital for

[6] Even if the size of relevant estimates are affected by measurement error (Gollin and Udry 2020), the magnitudes involved are larger than in other regions such as China (Ma 2018) and (Giles and Mu 2018).

[7] Most of the land available for expansion in Africa is concentrated in a few countries (Deininger and Byerlee 2012), with poor access to infrastructure, low levels of profitability (Jayne *et al.* 2014b), and often weak governance (Arezki *et al.* 2015) that are outweighed by the advantages of resource access (Lay and Nolte 2018) and institutional proximity (Raimondi and Scoppola 2018).

labor (where small farmers have a supervision advantage) implies that, for a wide range of parameters, models predict economic development to be associated with higher shares of large farms, a phenomenon the welfare effects of which would depend on demand elasticities (Ma *et al.* 2021). However, with few exceptions (Muyanga and Jayne 2019), evidence on large farms' productivity or its determinants is lacking.

Several studies explore long-term effects of foreign cash crop plantations using discontinuity designs. They often find negative and persistent effects on human capital as in South America (Dell 2010) or Puerto Rico (Bobonis and Morrow 2014) due to labor coercion. In the DRC individuals located inside the perimeter of a historical rubber concession exhibit significantly worse outcomes in terms of education, wealth, and health whereas their village chiefs are elected less competitively and provide less public goods (Lowes and Montero 2020). Positive impacts of a large banana plantation in Costa Rica on a range of welfare indicators highlight the importance of labor mobility; in the case studied labor highly mobile and had ample alternative sources of employment so it could be retained by the monopsonist only by offering amenities (Mendez-Chacon and van Patten 2021).

The wave of LSLBI triggered by the 2007/08 commodity boom spawned many descriptive case studies. These studies generally support the notion that LSLBI can increase output and create positive external effects for small producers if (i) large and small farms do not compete for land or other resources but complement each other (e.g., by large farms providing ancillary infrastructure) and there are no negative externalities;[8] (ii) large farms increase productivity (Dubbert (2019) or labor demand (Nolte and Ostermeier 2017), e.g. through investment in irrigation (Schuenemann *et al.* 2017), high-value production (Negash and Swinnen 2013), or agro-processing; and (iii) institutional arrangements, such as contract farming (Hall *et al.* 2017) rather than increase skills and benefits beyond what is observed for wage labor -though better endowed individuals may still reap disproportional benefits (Boamah and Overa 2016). Case studies also suggest that public agencies may use LSLBI to pursue objectives other than that of increasing productivity[9] and that the type of rights large farms can access and the way to obtain them will affect potential benefits.

As case studies may be subject to selection bias, e.g. by focusing on foreign investors to the detriment of locals (Jayne *et al.* 2019) even if the later comprise the vast majority of ventures and area (Hausermann *et al.* 2018), complete geo-referenced concession inventories, overlaid with existing household or farm surveys, provide a more representative way of exploring and testing welfare and productivity effects of

[8] Potential negative externalities in terms of environment (Baumgartner *et al.* 2015) and health (Xia and Deininger 2019) will have to be accounted for. Similarly, even if economic effects are positive, women may lose out (Tsikata and Yaro 2014) although programs to enhance their agency to address this have shown success in Malawi (Adams *et al.* 2019).

[9] Beyond aiming to improve productivity of land use, LSLBI has been used to support territorial control (Lavers 2016), provide political patronage (Bélair 2021), transfer resources to central or local Government (Lanz *et al.* 2018) or support specific political actors (Widengard 2019). Moreover, if the prospect of LSLBI reduces security of existing rights without but fails to put in place robust alternatives, net effects may well be negative, even if desired investments never materialize (Burnod *et al.* 2013).

LSLBI on neighboring households. Studies using this methodology have been conducted in Cambodia (Anti 2021), Laos (Nanhthavong *et al.* 2020), Mozambique (Deininger and Xia 2016; Glover and Jones 2019), and Ethiopia (Ali *et al.* 2019a). Though an interesting approach, this provides no direct evidence on the productivity of large investments and cannot be used to ascertain determinants of large farm performance. Below, we focus on Zambia, one of Africa's most eager adopters of LSLBI, to explore how mechanisms for large farms to access and use land, and in particular their possession of title, affect productivity, credit access, and investment.

2.2 Land tenure and large farms in Zambia

With smallholders only cultivating a fraction of the country's area of 74 mn. ha (of which 58% is of high or medium agricultural suitability) at rather low productivity, a desire to support development of a large farm sector has long been a central element of Zambia's agricultural strategy. In fact, long before the 2007/08 commodity price boom, polices focusing on establishment of settlement schemes and 'farm blocks' as clusters for large farm development had been put in place.[10] The idea was that through such schemes, in infrastructure and markets would be easily available (Middelberg et al. 2020) together with land to stimulate commercial agriculture and boost food security. The impact of this strategy is debated, partly because it mixed political and economic objectives (Roth 1995): some studies find blocks generated employment- and income- benefits (Matenga and Hichaambwa 2017) by providing market linkages (Burke *et al.* 2020) and involving outgrowers (Manda *et al.* 2020). Others suggest that settlement schemes were not associated with higher levels of productivity (Sitko et al. 2014), raising concerns that such schemes may, by tying up land, do more to forestall future development than to encourage it (Sitko and Jayne 2014).[11]

Assessing success and future of Zambia's large farms is complicated by the lack of clarity on the amount of land owned or cultivated by them. Experts agree that 94% of the country's 74 mn. ha was under customary tenure in 1995 when conversion of customary to state land became legally possible (Roth 1995). Although based on a somewhat weak basis,[12] recent studies put the share of land owned by large farms above 50% (Jayne *et al.* 2014a), with estimates of up to 60% (Honig and Mulenga 2015). This would imply a transfer of more than 30 mn. ha of state land to large farms since 1995 or a more than six-fold increase.[13]

[10] The 2006 Zambia Development Agency (ZDA) Act as amended establishes ZDA to consolidate different agencies that had historically been involved in administering such schemes (see Roth (1995), p. 173-99 for a concise summary of the historical evolution).
[11] Before 2000, retired or retrenched civil servants accounted for a significant share of land acquisition while after 2000, speculative land acquisition by those who accumulated resources in non-agricultural ventures seem to predominate (Sitko and Jayne 2014). "Land titling may be implicated in process of elite capture of land at the possible expense of future small-scale farm growth and farm consolidation" (Sitko and Jayne 2014, p. 199).
[12] The estimate by Jayne *et al.* (2014a) is based on binned data from the DHS. Sitko *et al.* (2015) note that "Data on state lands (which include farm blocks) are from a spatial boundary dataset in wide circulation within the Ministries of Agriculture, Finance, Planning, and other governmental and non-governmental entities, although the provenance of this dataset cannot be determined with certainty. To evaluate the validity of these datasets, we confirmed that mapped boundaries conformed to knowledge held by managerial and operational personnel within the relevant ministries" (p.13).
[13] Given the greenhouse gas emissions associated with converting natural *miombo* woodlands (Wilson and Scholes 2020), the climate impact of such an expansion could be far-reaching.

The fact that according to FAO statistics agricultural output at most doubled over the same period suggests that, if these figures are to be believed, large part of land transferred in this way is not used productively.

Zambia's long-standing policy stance in favor of large farms is also evident from it having adopted one of Africa's most dualistic land policies. It is one of few countries maintaining a clear dichotomy between customary and statutory land rights based on an implicit assumption of a linear progression from customary to statutory tenure (Alden Wily 2018).[14] The only way to have land rights formally documented is to convert customary to 'state land'. Effecting such a conversion is complex (Adams 2003) and costly (Larson 2014). The fact that it involves high levels of administrative discretion (German *et al.* 2013) and weak procedural safeguards (Nolte 2014) may have been one of the reasons that studies found large land transfers to have adversely affected locals' welfare and access to natural resources (Merten and Haller 2008).

Implementing this policy must contend with two main challenges. One is that, their potential advantages in terms of accessing information and providing public goods (Baldwin 2018) notwithstanding, traditional authorities have no formal role in administering state land or influence its use (Honig 2017). As it would gradually deprive them of power and income without reducing locals' expectations for them to provide access to land and arbitrate land disputes,[15] transfer from customary to statutory tenure is resisted by chiefs (Ng'ombe et al. 2014). As documented more broadly for contexts of legal pluralism in Africa (Eck 2014), competition between customary and statutory authorities creates risk of decisions by one level of authority possibly being overturned by another for all land users (Jorgenson and Loudjeva 2005).

Rather than transfer land to the state, many chiefs enter into direct agreements with investors or issue informal documents ('chief certificates') to some or all of their subjects. Although in some cases supported by donors, there is no legal basis or mechanism for recording/updating of such 'chief certificates' and whether or they can be enforced or will be respected is at the sole discretion of the chief (or her successor). Descriptive accounts suggest chiefs used such certificate to capitalize on land user's demand for secure title to favor well-connected individuals, making land access more unequal overall and possibly even making people worse off by forcing them to pay for worthless pieces of paper (Green and Norberg 2018). Such a selection process would be consistent with the results form a randomized control trial that found no impact of these documents on investment or other relevant outcomes except (short term) subjective tenure security (Huntington and Shenoy 2021).

A second challenge centers around the high cost of service delivery resulting from the Ministry of Lands' high level of centralization and limited adoption of modern information technology. Land registry offices

[14] Land relations in Zambia are governed by the 1995 Land Act. Following long deliberations, a National Land Policy was adopted in May 2021.
[15] A key concern raised informally by many chiefs is that, unlike traditional leaders who are aware of local demand, the central state is unable to repossess or re-assign land if an external investment fails and that therefore irrevocably changing its designation to state land makes little sense.

exist in only two of the country's cities (Lusaka and Ndola), implying that some land users are located more than 700 km from the next registry office. Ill-defined workflows and the associated need for informal payment to ensure processing, together with formal fees for title processing close to US$ 500 in addition to survey costs that can add thousands of dollars led many landowners to abandon the titling process mid-way after having taken the initial steps and received an 'offer letter' from the Ministry. Rudimentary filing systems and almost exclusive reliance on paper records that are easily be tampered with further increase the cost of service provision,[16] making it more difficult to ascertain absence of competing claims to titled land, thereby increasing the cost of underwriting for any bank that would like to use title as security for a loan. Together with cost of foreclosure estimated at 48% of property value (World_Bank 2008), this will limit banks' ability to foreclose properties pledged as collateral in case of default.

3. Data and descriptive statistics

To gain a better understanding of the size of Zambia's medium and large farm sector and its temporal and spatial evolution, we combine a listing and mapping of large farms with digitized administrative records and a detailed large farm performance survey for the country's Eastern Province. We find that at most 26% of owned and 12% of cultivated land is accounted for by large farms; that formalized holdings are clustered in blocks with better soil quality and infrastructure access though neither yields nor profits are higher inside as compared to outside blocks. While titled land does not seem to enjoy a productivity advantage, there is considerable unsatisfied demand for title.

3.1 Emergent farmer census

To obtain a complete enumeration of all large farms in Eastern Province, a farm module was added to the mapping exercise for the 2020 population census conducted between January and March 2020. Computer assisted personal interviewing was used to list all structures, their purpose, and for those that were inhabited, administer a short questionnaire to residents. At the end of this questionnaire, a question was added asking respondents to indicate if they owned, operated, or guarded an agricultural holding greater than 5 ha.

For those answering in the affirmative, basic questions on the nature of the property were asked and boundaries of farms in the same district mapped using high resolution satellite imagery pre-loaded on enumerators' tablets as a base map.[17]. The listing identified 8,301 farms in 1,729 enumeration areas (EAs) of which 6,782 were mapped (and 6,703 had a mapped area above 5 ha). To generate a sample frame for a

[16] In principle, the Zambia Integrated Land Information and Management System created in 2003 on an Oracle platform should allow fully digital document processing. However, the system is not operational, and the Ministry has neither access to source code nor capacity to even execute basic queries. The largely textual information in the system is of poor quality. While all spatial records for Eastern Province were digitized with World Bank support, the Ministry of Lands continues to run paper-based and digital systems in parallel so that absence of a competing claim in the electronic system cannot provide conclusive evidence of property ownership, failing the basic requirement of a titling system.

[17] Mapping was limited to farms located in the same district as loading imagery beyond the district would have exceeded tablets' storage capacity.

more detailed farm performance survey, we dropped all wards with less than 30 farms as these would have been too costly to visit. This provides us with a frame of 5,620 farms in 1,066 EAs from 62 wards. To attain our target sample size of 3,000, we include all farms greater than 20 ha and a random sample of farms below 20 ha.[18] This provides the basis for studying the extent to which farms' productivity, level of land-related investment, and self-assessed land values are affected by access to formal documentation.

Table 1 presents summary statistics overall (col. 1) and by size class (col. 2-4). Almost 95% of interviews were conducted with the farm owner and 87% of farms are fully owner operated. With an average size of about 26 ha (with the largest farm in the sample having 6,670 ha), the size of Zambian large farms is still modest by international standards.[19] More than 75% of large farms (with 29% of the area) own less than 20 ha while 18% (with 22 % of the area) own 20-50 ha and 7% (with 49% of the area) own more than 50 ha.

The data also show that chiefs remain the dominant source of land for large farms with 45% of farms having acquired land through chiefs; followed by Government agencies, mostly Ministries of Lands, Agriculture, or Resettlement (20%); inheritance (19%); and purchase (13%). Some 40% have formal documentation either in the form of title (25%) or offer letter (16%); 43% have a document or consent from traditional authorities; and 17% no document.[20]

To appreciate land acquisition dynamics, we construct bins for all 5-year periods after the 1995 land law came into force. Using these suggests that, after responding to supposedly pent-up demand after 1995, the pace of land acquisition has slowed consistently: while 17% of current large farms acquired their land in 1996-2000, this share declined to 11% in 2001-2010 and 9% and 7% in 2011-15 and 2016-20, respectively. The lack of a visible response to the 2008-08 commodity price boom indicates that domestic institutions have an important role in translating exogenous shocks into effective demand by investors with the means and know how to improve agricultural performance.[21] Dynamism and market functioning are also limited: only 3% of all farms acquired any additional land after their establishment.

While listing survey data provide information on the amount of land owned by farms greater than 5 ha, translating this into a share of the total requires an estimate of the area cultivated by small farmers. To get such an estimate, we use micro data from the 2014/15 post-harvest survey by the Zambia Statistical Agency which puts the total area cultivated by farmers below 5 ha in Eastern Province at 502,852 ha (with the 95%

[18] We include all 1,451 farms above 20 ha from the listing and randomly select 1,549 out of the 4,169 farms in the 5-20 ha category. Enumerators managed to interview 2,903 (96.8%) of the original sampled farms and they ended up replacing 42 (from a randomly selected replacement list) of the 97 missing cases. The final sample size is thus 2,945 farms, resulting in roughly less than 2% attrition rate.

[19] Although discrepancies between own estimation and mapped area for large farms seem significant, potential discrepancies between base map dates and the fact that the software used did not allow immediate cross-checking of polygons caution us against over-interpretating these.

[20] It seems that formalized land rights are biased against women. About 30% more male household members (either alone or jointly with female members) are reported to be listed as owners on title documents (table 1).

[21] The limited response of investment volume to external shocks as compared to policy incentives supports the notion that, without such changes, demand-side initiatives such as 'principles for responsible agricultural investment' are unlikely to changes outcomes.

confidence interval between 481,529 and 524,174 ha). Based on table 1, the total area owned by large farms in the province amounts to 175,753.[22] Assuming farmers below 5 ha cultivate all of the land they own (compared to slightly more than a third or about half of the area measured by imagery or farmers' own estimate, respectively, for farms greater than 5 ha), this would imply that large farms account for at most 26% of the total area owned by farmers in Eastern Province, though only about 12% of cultivated area.[23] The estimate of owned area is below the more than 50% of land suggested to be held by farms in the 5-100 ha group nationally by recent estimates (Jayne *et al.* 2014a), suggesting if more than 50% of land is cultivated by large farms nationally, large farm participation in other provinces would be well above 50%.

3.2 Linking census data to administrative records

As official cadastral data include spatial information only for properties located in Lusaka and neighboring provinces, comparing area actually occupied to what is recorded in official deeds or survey plans requires digitization of survey plans and sketch maps.[24] Doing so suggests a total area under digitized parcels of 275,625 ha of which 231,758 ha is clustered in farm blocks or resettlement schemes.[25] Of these, 107,700 ha overlap with area found as cultivated in our survey, implying that a significant share of the land to which formal rights have been awarded is not utilized in the way it was intended to.[26]

Table 2 panel A reports the results from overlaying digitized with listed parcels overall (col. 1) and by type of documentation (col. 2-5). The extent of overlap between registered and cultivated parcels is, with about one third, limited. It is higher (57%) for land with formal documentation, i.e., either title or offer letter. Yet, the fact that about 35% of the parcels or 11,061 ha of listed and mapped area located in a registered block has either no or only an informal document suggests state land may revert back to informality, possibly undermining the benefits that farm blocks were expected to provide. Conversely, it may imply expansion of cultivated area beyond farm blocks that may be environmentally less sustainable.

Panel B of table 2 shows that 37% of land with formal documents was obtained from chiefs. The fact that only 3% of land with formal documents was received from local Government illustrates the centralized nature of Zambia's formal land institutions while the fact that more of the titled land was acquired through chiefs (31%) than through all Government institutions together (30%) highlights that traditional authorities

[22] Note that the total area of listed parcels given in table 2 includes only mapped parcels at the time of the survey. Some parcels were not mapped due to distance from the place of interview and inability of respondent to identify the location on the high-resolution imagery used as a base map.
[23] Total area owned by large farms is 6,703*26.24 = 175,753 ha which is 25.7% of the estimated total area owned of 677,130 ha. The estimate of area owned by large farms would be lower if small farmers cultivated only part of their holding. Of course, the share of land cultivated by large farms would be much smaller, amounting to 11.96% (65,086/544,410) where 65,086 = 6703*9.71 as the average area cultivated by larger farms.
[24] Cadastral data come from the Zambia Integrated Land Information and Management System (ZILMIS). Digitization of cadastral data was supported by the Zambia Integrated Landscape Management Project (ZIFLP).
[25] Blocks consist of contiguous piece of recorded parcels ranging from 6 to 942 parcels with total area ranging from 892 ha to 76,450 ha.
[26] Interviews with local leaders and data on crop cover from interpreting remotely sensed imagery (using georeferenced data from the farm performance survey as training data) will be needed to explore this in more detail. Such interviews would also have to explore the mechanisms of informal subdivisions in more detail.

continue to play a major role in land administration and management. By comparison, formal institutions issued close to 80% of all offer letters and the failure to convert these into titles either points towards formal barriers towards title acquisition or suggests offer letters provide enough security or possibly transferability.

Before discussing descriptive statistics at parcel level, we focus on changes in output and key inputs with block distance. Listing information in table 3 panel A suggests that digitized parcels are considerably larger than what is actually utilized by individual farms, possibly due to informal subdivisions of large blocks. Although not all the land in the block seems to be utilized, the time profile of acquisition suggests expansion gradually moves away from the block.[27]

Survey information in table 3 panel B suggests that levels of crop output/ha and profitability are not significantly higher inside farm blocks than outside. Moreover, crop output/ha, cost of purchased inputs and gross profit are higher by 30%, 10% and more than 60% on farms more than 20 km from the blocks than on farms inside them, possibly suggesting that more productive farmer (who acquired land more recently) find it increasingly difficult to acquire land next to farm blocks. While detailed analysis of profitability and the shadow price of labor is beyond the scope of this paper, family labor use increases monotonically with block distance up to the point where large farms more than 20 km from the blocks use some 60% more family labor/ha, possibly due to easier access to mechanized services on farm blocks.

While 37% of listed properties inside blocks have title, 83% of those without a title inside blocks (and 81% overall) are interested in acquiring a title and 96% (95% overall) are willing to pay ZMK 300 per ha (ZMK 226/ha overall). Although acquiring title should be much easier within blocks as no conversion to state land is required, demand and willingness to pay for such documents are, if anything, higher inside blocks than the immediate vicinity. This points towards binding supply side constraints to accessing title beyond land conversion, in line with studies suggesting that farm blocks often fail to offer higher levels of tenure security or marketability of land, thus not always meeting the expectations placed on them (Middelberg *et al.* 2020).

3.3 Evidence from the farm performance survey

Table 4 provides descriptive evidence for the total of about 3,000 owned (panel A) and 2,700 operated parcels (panel B) used in the regression analysis. Figures are reported for the entire sample (col. 1) and parcels with title (col. 2), chief certificate (col. 3), without a document (col. 4) and for medium scale (≤ 20 ha) and large (> 20 ha) farms (cols. 5 and 6) separately.

[27] With 12% of the total (23% within blocks), purchase plays a limited role for getting land access. Chiefs are the main avenue for accessing land outside blocks where 56% of area is accessed through them, although 22% of total and more than one third of land not obtained via inheritance or purchase inside blocks is from chiefs.

While perceived risk of conflict is, with 2% negligible, levels of perceived transferability are also very low; with 30%, the share of parcels that can be sold is comparable to the average (26%) from a nation-wide household survey (Ali and Deininger 2021). This implies that, albeit partly located on farm blocks, land cultivated by large farms is no more transferable than that by smallholders. Only about half of titled land is perceived to be transferable by sale, suggesting that rights supposedly associated with having title may be difficult or impossible to exercise. Such limited transferability can reduce investment incentives and slow structural transformation by constraining productive farmers' ability to take over land from less productive ones and to access credit which banks may not be willing to provide if they cannot foreclose.[28] Indeed, self-assessed ability to access credit is, with 20% for titled land, only slightly above the level for the entire sample (17%).

Despite the limited effect of title on self-assessed rights, the share of those who would like to acquire title is slightly higher but statistically insignificant for small than for large farms. Possession of title also does not seem to be related to either the self-assessed risk of land dispute or the level of soil conservation investment. For the subset of cultivated parcels, we note that levels of crop output or profit per ha do not seem to be affected by title status. However, self-assessed land values for titled land are, with ZMK 14,300 per ha well above the sample mean of 10,600 per ha. This could indicate speculative land holding or imply that barriers to acquisition of title generate rents that are capitalized in land prices.

4. Econometric analysis

While descriptive analysis is suggestive, regression analysis suggests that title increases perceived ability to sell (45%) as well as land values but has no impact on investment or overall productivity, with little difference between titled parcels that were previously communal or state land. Demand and willingness to pay for title are high overall but highest on untitled state land, suggesting that starting policy reform from these areas may be appropriate.

4.1 Econometric approach

To assess the impact of title on perceived tenure security and transferability; self-assessed land values; land-related investment in soil and water conservation structures, tree planting, or fallowing; and productivity, we index parcels by *i* and use a linear regression of the form

$$Y_i = \alpha + \boldsymbol{T}_i\boldsymbol{\beta} + \boldsymbol{P}_i\boldsymbol{\gamma} + \boldsymbol{X}_i\boldsymbol{\delta} + \varepsilon_i, \quad (1)$$

where $\boldsymbol{T}_i$ is a vector of dummy variables indicating tenure status; $\boldsymbol{P}_i$ is a vector of parcel characteristics; $\boldsymbol{X}_i$ is a vector household characteristics; ε_i, is a random error term; and α, β, γ and δ are parameters to be

[28] This is consistent with the fact that most farms in our sample still operate only the parcel they received originally.

estimated. Key right hand side variables are presence of a formal document (either title or offer letter), chief certificate, and a separate dummy for location on state land without title so that customary land with no document is the omitted category*;* log of parcel size, years since acquisition, dummies for soil quality and slope in $\boldsymbol{P}$*;* and the head's age, gender, education, farmer group membership and leadership in local organizations in $\boldsymbol{X}$. The coefficient vector of interest is $\boldsymbol{\beta}$ denoting the estimated impact of tenure status on relevant outcomes. As we have information on whether titled land was previously state or customary land, we include these variables in a separate set of regressions.

As those with better access to connections and resources are likely to be better placed to gain access to title, OLS estimates of effects on perceived tenure security and transferability as well as actual investment and productivity will be biased. We thus follow Besley (1995) and instrument current tenure status with tenure status at acquisition on average some 26 years ago. Results from the first stage regression are reported in appendix table 1.[29] With an R^2 of close to 0.50, they suggest that land that was either titled and in the process of being titled at the time of acquisition are significantly more likely to have had an updated title at the time of the survey. Farms are more likely to acquire title for state land without title at the time of acquisition while having chief certificate is not significantly associated with the likelihood of having a title. Relevant test statistics are included in the bottom of the tables.

4.2 Transferability, land values and land-related investment

Table 5 reports IV estimates of the estimated impact of title on perceptions regarding the risk of conflict measured by the self-assessed risk of having any disagreement on the land parcel arising within the next 5 years (col. 1); the right to sell (col. 2); access to credit (col. 3) and self-assessed land values (col. 4). Results in panel A are for overall effects of land title whereas panel B distinguishes between title on land that was previously under customary tenure or state land with coefficients on land and household characteristics omitted throughout.

Compared to the omitted category of customary land without document, formal rights are estimated to not reduce the likelihood of future dispute[30] but to increase perceived ability to sell by 45 percentage points. The estimated coefficient on state land without title is insignificant, suggesting that untitled state land is perceived to be no more transferable than customary land without document while an informal certificate from the chief is estimated to be associated with an increase in the right to sell by about 8 percentage points.

[29] We added distance to blocks of digitized blocks, but it does not have any additional explanatory power and it is statistically insignificant throughout all the specifications reported in appendix table 1. As distance can only be computed for parcels that were mapped during the survey, we will lose some observations when distance is included. Hence, we decide to drop it from the list of instruments.

[30] Having a chief certificate is estimated to increase the likelihood of conflict by 2 percentage points, probably as chief certificate is more likely to be acquired for parcels with a higher risk of conflict.

To assess if title effects differ between land previously under state or customary tenure, we use survey information to differentiate between these two types. Results from doing in panel B suggest that acquisition of title results in a greater increment in the perceived ability to sell with a point estimate of 69 percentage points on land that was already state tenure compared to 41 percentage points on land that was previously under customary tenure. The p-value for the χ^2 test statistic shows that the null of equality of coefficients between the two tenure regimes is marginally rejected at the 90% confidence level.

In contrast to transfer rights, title or possession of a chief certificate is estimated to have no impact on access to credit (col. 3). While this is in line with the literature that finds no credit effect even for urban titling (Galiani and Schargrodsky 2010) and expected given the lack of a functioning register in Zambia (Jorgenson and Loudjeva 2005), it is in stark contrast to the unrealistic expectations of credit access through rural titling reported for Tanzania (Stein *et al.* 2016), lending credibility to the questions on perceived rights.

Tenure status is estimated to have significant and large effects on self-assessed land values. Formal title is estimated to increase land value per ha by a factor of 1.4, with no significant difference between land that was previously under state or customary tenure while an informal document from traditional authorities is estimated to increase land values by about 50% and lack of title on state land to reduce it by 83% compared to customary land without certificate. Length of possession is estimated to be associated with higher (a 5% increase for every 10 years) and land size with lower (a reduction of 36% for a doubling of size) land values.

Consistent with the results reported in panel A and B, simple comparison of state and customary land (panel C of table 5) irrespective of documentation shows that transferability and subjective land value of state land are slightly superior to that of communal land. Estimated coefficients suggest that state land without documentation dampens the effect of tilting with respect to transferability and self-reported value of land.

Although few other variables are significant, results from regressions in table 6 point towards no significant impact of title on land related investment throughout. Construction of soil and water conservation structures seems to be significantly lower on state land without title (col. 1) while the negative and marginally significant (at 10 %) coefficient on chief certificate is consistent with a slightly higher likelihood of conflict on such land found earlier. None of the p-values for the χ^2-tests in panel B is remotely near standard levels of significance, implying previous tenure status of newly titled land does not affect land-related investment in a statistically significant manner. Panel C suggests no investment differential between customary and state land except a higher likelihood of tree planting (some 3 percentage points) on customary land.

4.3 Agricultural productivity and demand for formalization

To test if the increment of perceived land values on land with formal documents may be due to higher levels of productivity on such lands, table 8 reports results for IV regressions to assess impact of title on value of

output (cols. 1 and 2), purchased inputs (cols. 3 and 4) and gross profit (cols. 5 and 6). As before, in addition to having one variable for title (in panel A), results of distinguishing between title on previously customary or state land as well as simple state or customary tenure status are reported in panel B and C, respectively.

Results do not support a systematic relationship between title and productivity as measured by gross profit per ha. The positive relationship between formal documentation and value of output per ha is offset by a negative impact of roughly similar magnitude in purchased inputs. A chief certificate is, however, negatively associated with gross profit per unit of land (semi-elasticities of 32-38%).[31] The data also suggest a highly significant negative link between parcel size and the value of output and (with a larger magnitude) value of inputs, resulting in a positive and significant link between parcel size and profit/ha in line with Chen *et al.* (2021). While farm households whose head is literate or enjoys a leadership position in local organizations have significantly higher levels of output, profits and input use, members of farmer groups (similar to those with title) obtain higher levels of output largely by using more inputs, implying no significant impact on profits.

Panel B reveals that differences between land previously under state or customary tenure in terms of output and input levels are significant at 5% and 10%, though any impact on profits is not statistically significant. Thus, notwithstanding the fact that exploring determinants of profits in more detail will be of interest in its own right, title does not seem to affect overall productivity.

Regressions regarding interest in acquiring and willingness to pay for title in table 8 suggest that demand for title and willingness to pay for it are significantly higher on untitled state than on customary land: point estimates of the increase in willingness to obtain title of 14 percentage points and an amount that is almost 50% higher than for customary land (mean willingness to pay of ZMK 263 vs. 149 per ha, respectively). While coefficients on other variables suggest higher demand for title by literate heads, those with chief certificate, and on gently sloped land, willingness to pay is insignificant for (literacy), negative for chief certificate, and positive for undulating landform.

5. Conclusion and implications

Although the literature on this topic largely focused on foreign agricultural investment, in most countries, domestic players are quantitatively more important. Zambia allows us to study their productive performance in a policy environment aiming to actively promote such investment. Results from doing so for Eastern Province suggest that, without well-functioning markets for land (and possibly labor), efforts to promote

[31] Only the coefficient of chief certificate is found to be statistically significantly different from zero in the profit function reported in Panel A and B. The semi-elasticates of having chief certificate calculated using equation (10) of Bellemare and Wichman (2020) are -38% and -33%, respectively for cols. 5 and 6 of panel A and -37% and -32% respectively for cols. 5 and 6 of panel B.

large farms will at best be ineffectual and lead to a return to informality -as productive farms' will be unable to access credit and unlikely to invest.

For Zambia -and, if our results generalize, other countries suitable for such investment- wants to benefit from large farm establishment or future commodity price booms, more profound regulatory changes are needed in at least two areas. First, quality and efficiency of land service provision need to be improved -enhancing transparency and reducing scope for fraud- by completely moving workflows for issuance and maintenance of titles to a digital environment, establishing service standards, and passing gains in efficiency to end users as fee reductions, thereby allowing significant expansions in coverage in response to demand. Second, to support improved service delivery and increase incentives for effective land use, a recurrent land tax should be introduced, and proceeds shared with local and traditional authorities in return for assuming greater responsibility for record maintenance and conflict resolution following clear norms and regulations. Given their agricultural potential and access to other infrastructure, farm blocks are key candidates for introducing such changes, possibly first on a pilot basis, and evaluating their economic, social, and environmental benefits in a way that would be of relevance well beyond Zambia.

Table 1: Descriptive statistics from farm census and digitization

	Total	5-20 ha	20-50 ha	>50 ha
Type of respondent				
Farm owner	0.94	0.94	0.94	0.95
All operated by owner	0.87	0.88	0.85	0.80
Part operated by owner	0.12	0.11	0.14	0.20
If part or none: operated by a renter	0.08	0.09	0.05	0.07
Time of land acquisition[a]				
Before 1995	0.44	0.41	0.55	0.55
1996-2000	0.17	0.18	0.14	0.17
2001-2005	0.11	0.11	0.11	0.10
2006-2010	0.11	0.12	0.09	0.06
2011-2015	0.09	0.10	0.07	0.07
2016-2020	0.07	0.08	0.05	0.04
No. of years possessed	25.15	23.88	28.58	29.66
Modality of land acquisition				
From Chief	0.45	0.42	0.55	0.52
From Central Government	0.20	0.21	0.18	0.20
From Local Government	0.01	0.01	0.02	0.03
Inherited	0.19	0.21	0.14	0.16
Purchased	0.13	0.15	0.10	0.08
Type of documentation[a]				
Title	0.25	0.24	0.26	0.33
Male member only	0.37	0.37	0.31	0.47
Female member only	0.08	0.09	0.05	0.04
Jointly male & female	0.49	0.47	0.55	0.46
Non-household member	0.07	0.07	0.09	0.03
Offer letter	0.16	0.18	0.11	0.06
Document from chief	0.43	0.42	0.48	0.44
Other/no document	0.17	0.17	0.14	0.17
Size and land allocation (% of area)[b]				
Farmer own estimation (ha)	19.74	11.72	28.42	82.35
Mapped area (ha)	26.22	10.19	30.98	184.02
Cultivated area (ha)	9.71	7.08	13.19	28.44
… of which maize	0.36	0.37	0.33	0.33
… of which Groundnut	0.24	0.24	0.25	0.24
… of which Cotton	0.19	0.18	0.22	0.21
… of which Tobacco	0.11	0.10	0.16	0.12
… of which Soybeans	0.08	0.08	0.07	0.08
… of which Others incl. vegetables	0.12	0.12	0.12	0.13
Number of farms	6,703	5,010	1,221	472

Source: Own computation from 2020 Zambia Eastern Province Farm Survey

[a] Information was collected only from owner respondents. Data from the detailed survey shows that only 3% of the farms were engaged in expanding their farm size and the share of the expansion area was only about 1% of the land acquired at the time of establishing the farm.

[b] Area is proportionally allocated to all the crops cultivated on the land.

Table 2: Overlap between cultivated and digitized parcels and mode of acquisition by type of document

	Total	Title	Offer letter	Chief document	No document
Panel A: Overlap					
Total area of listed parcels in ha	107,699	31,751	13,443	46,830	15,675
Share located in registered block	0.34	0.60	0.50	0.19	0.25
if yes, total area of listed parcels in ha	41,015	21,696	8,259	8,218	2,843
if yes, total overlap area in ha	36,024	18,450	7,732	7,219	2,622
if yes, share of area overlapping	0.88	0.85	0.94	0.88	0.92
Panel B: Mode of acquisition					
Chiefs	0.45	0.31	0.06	0.76	0.31
Ministry of Lands	0.07	0.15	0.18	0.00	0.01
Dept. of Resettlement	0.08	0.05	0.38	0.00	0.01
Ministry of Agriculture	0.05	0.07	0.18	0.01	0.02
Local Gov't	0.01	0.03	0.03	0.00	0.01
Inherited	0.19	0.16	0.09	0.18	0.38
Purchased	0.13	0.23	0.09	0.04	0.23
Don't know	0.01	0.01	0.01	0.00	0.04
Number of farms	6,703	1,557	986	2,698	1,060

Source: Own computation from 2020 Zambia Eastern Province Farm Survey. Information from owner respondents only.
Note: There are 14 registered blocks with a total area of 231,758 ha sub-divided into 2,688 digitized parcels and 35 digitized isolated fragments with a total area of 43,866 ha.

Table 3: Time and mode of land acquisition as well as output by distance to farm/resettlement blocks

	Total	Distance to block				
		0	< 5 km	5-10 km	10-20 km	> 20 km
Panel A: Listing information						
Location						
Dist. to next block (km)	11.26	0.00	1.93	7.30	14.57	55.45
Size of next block	32,092	53,946	30,849	18,695	19,159	7,905
Avg. size of listed parcel (ha)	17.35	19.10	15.49	16.42	18.05	15.34
Time of land acquisition						
Before 1995	0.47	0.53	0.50	0.47	0.35	0.40
1996-2000	0.19	0.18	0.21	0.15	0.23	0.17
2001-2005	0.12	0.11	0.11	0.12	0.14	0.12
2006-2010	0.10	0.08	0.07	0.11	0.15	0.12
2011-2015	0.08	0.06	0.06	0.09	0.08	0.14
2016-2020	0.04	0.03	0.05	0.06	0.05	0.05
Mode of acquisition						
From chief	0.44	0.22	0.56	0.61	0.55	0.52
From Government	0.23	0.39	0.13	0.12	0.24	0.08
Inherited	0.19	0.15	0.18	0.21	0.15	0.35
Purchased	0.12	0.23	0.11	0.05	0.05	0.03
Title	0.22	0.38	0.16	0.16	0.14	0.07
Offer letter	0.18	0.26	0.12	0.11	0.22	0.09
No. of parcels	6,584	2,337	1,227	976	1,191	853
Panel B: Survey information						
Titled land	0.21	0.37	0.12	0.09	0.17	0.07
If no, would like a title?	0.81	0.83	0.83	0.86	0.81	0.63
If yes, would like to pay for it?	0.95	0.96	0.96	0.94	0.95	0.91
Willing to pay for title (ZMK/ha)	225.90	299.64	199.84	207.19	166.16	233.62
No. of parcels (owned)	2,645	921	535	423	509	257
Crop output (ZMW/ha)	3,264	3,326	2,933	3,112	3,115	4,284
Purch. inputs (ZMW/ha)	1,917	2,084	1,795	1,851	1,647	2,206
Family labor (d/ha)	85	68	80	96	101	109
Cultivated area (ha)	6.20	6.31	6.77	6.10	5.90	5.34
No. of parcels (cultivated)	2,314	821	453	379	444	217

Source: Own computation from 2020 Zambia Eastern Province Farm Survey

Table 4: Parcel-level descriptive statistics

	Total	Title	Chief Cert.	t-test	No doc.	t-test	5-20 ha	>20 ha	t-test
Panel A: Owned parcels									
Head's characteristics									
Male head	0.84	0.80	0.83		0.85	***	0.85	0.83	*
Age	54.12	56.57	54.01	***	53.35	***	52.71	55.62	***
Head is literate	0.75	0.82	0.79		0.72	***	0.73	0.78	***
Head is member of farmers group	0.41	0.50	0.31	***	0.42	***	0.39	0.44	**
Head leader in local organization	0.29	0.32	0.26	**	0.29		0.28	0.30	
Land endowment & characteristics									
Parcel area in ha	15.26	27.70	14.84	***	11.35	***	8.40	22.66	***
Cultivated land in ha	4.49	4.66	4.64		4.40		3.69	5.36	***
Titled land	0.20	1.00	-		-		0.20	0.20	
State land	0.17	0.85	-		-		0.17	0.17	
Previously customary land	0.03	0.15	-		-		0.03	0.03	
Parcel with chief certificate	0.18	0.00	1.00		-		0.17	0.20	***
State land w/o document	0.11	-	-		0.17		0.13	0.08	***
Customary land w/o document	0.51	-	-		0.83		0.51	0.51	
Perceived rights									
Has the right to sell land	0.33	0.51	0.26	***	0.29	***	0.36	0.29	***
Self-assessed land value (ZMK/ha)	10,632	14,317	11,320	*	9,214	***	10,394	10,888	
Likelihood of disagreement	0.02	0.02	0.02		0.03		0.02	0.03	
Would like to have a title?	0.81	-	0.84		0.80		0.82	0.79	
Would like to pay for a title?	0.94	-	0.94		0.95		0.95	0.94	
Amount willing to pay (ZMK/ha)	227	-	149		252		249	202	**
Land use									
Share of fallowed land	0.15	0.16	0.16		0.15		0.14	0.16	*
Left land fallow in past 5 years (y/n)	0.06	0.07	0.05		0.06		0.05	0.07	***
Has SWC measures (y/n)	0.17	0.19	0.14	**	0.17		0.16	0.18	
Has trees (y/n)	0.40	0.39	0.40		0.40		0.40	0.39	
Number of trees per ha	2.83	2.44	2.70		3.00		3.17	2.46	
Got access to credit (holding level)	0.17	0.20	0.20		0.15	***	0.15	0.19	**
Tenure status at acquisition									
Titled at acquisition	0.09	0.39	0.01	***	0.02	***	0.07	0.12	***
Title under process at acquisition	0.04	0.10	0.01	***	0.03	***	0.04	0.04	
Chief certificate at acquisition	0.21	0.04	0.82	***	0.08	***	0.18	0.24	***
State land w/o tile at acquisition	0.15	0.37	0.01	***	0.13	***	0.20	0.11	***
Customary w/o doc. at acquisition	0.49	0.08	0.15	***	0.73	***	0.50	0.49	
Number of parcels	3,072	614	566		1,892		1,592	1,480	
Panel B: Operated parcels									
Crop output (ZMW/ha)	3,378	3,570	3,237		3,406		3,296	3,471	
Purchased inputs (ZMW/ha)	2,114	2,113	1,972		2,224		2,102	2,128	
Gross profit (ZMW/ha)	1,264	1,457	1,264		1,183	*	1,194	1,343	
Cultivated area (ha)	6.12	6.33	6.25		6.00		5.64	6.64	***
Years since acquisition	23.06	23.18	23.64		23.45		21.42	24.89	***
Titled land	0.18	1.00	-		-		0.19	0.18	
State land	0.16	0.85	-		-		0.16	0.15	
Previously customary land	0.03	0.15	-		-		0.03	0.03	
Parcel with chief certificate	0.17	-	1.00		-		0.15	0.19	***
State land with no document	0.09	-	-		0.17		0.11	0.07	***
Customary land with no document	0.46	-	-		0.83		0.45	0.47	
Number of parcels	2,737	503	456		1,512		1,444	1,293	

Source: Own computation from 2020 Zambia Eastern Province Farm Survey.

Note: Exchange rate is about ZMK 15 per USD at the time of the survey. Stars indicate significance of a t-test between title and chief certificate, title, and no document, and less than 20 ha and more than 20 ha farm groups: * p<0.10, ** p<0.05, *** p<0.010.

Table 5: IV regressions for impact of title on self-assessed land rights and land values

	Risk of disagreement	Right to sell?	Got credit [a]	Log land value per ha
Panel A: All formal documents				
Parcel with formal document	-0.00808	0.446***	-0.0372	1.416***
	(0.0183)	(0.0609)	(0.0455)	(0.170)
Parcel with chief certificate	0.0243**	0.0791**	0.0302	0.484***
	(0.0109)	(0.0364)	(0.0300)	(0.102)
State land with no title	0.0189	-0.0622	0.0203	-0.836***
	(0.0269)	(0.0897)	(0.0691)	(0.244)
Log parcel area in ha	0.00216	0.00796	0.0173**	-0.363***
	(0.00273)	(0.00911)	(0.00793)	(0.0304)
No. years since acquisition	0.000120	0.000181		0.00514**
	0.00430	-0.0123		-0.114
Panel B: Formal documents by provenance				
State land with title (β_1)	0.000697	0.409***	-0.0392	1.431***
	(0.0185)	(0.0616)	(0.0458)	(0.175)
Prev. cust. land with title (β_2)	-0.0662	0.689***	-0.0225	1.320***
	(0.0462)	(0.154)	(0.118)	(0.406)
Parcel with chief certificate	0.0253**	0.0751**	0.0299	0.485***
	(0.0110)	(0.0367)	(0.0301)	(0.102)
State land with no title	0.0102	-0.0259	0.0221	-0.850***
	(0.0272)	(0.0906)	(0.0694)	(0.249)
Log parcel area in ha	0.00234	0.00722	0.0173**	-0.363***
	(0.00275)	(0.00916)	(0.00795)	(0.0305)
No. of years since acquisition	0.000101	0.000262		0.00511**
	(0.000230)	(0.000766)		(0.00216)
χ^2-test: $\beta_1 = \beta_2$	2.117	3.325	0.0202	0.0733
p-value	0.146	0.0682	0.887	0.787
Panel C: State vs customary land (OLS regressions)				
State land	0.000107	0.215***	-0.00941	0.375***
	(0.00610)	(0.0196)	(0.0164)	(0.0521)
Log parcel area in ha	0.00197	0.0235***	0.0168**	-0.270***
	(0.00248)	(0.00798)	(0.00751)	(0.0250)
No. of years since acquisition	0.000157	-0.000298		0.00283
	(0.000225)	(0.000724)		(0.00194)
No. of observations	2,665	2,665	2,489	2,447

Note: Field characteristics and owner characteristics are controlled for throughout.
Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.010
[a] Regressions are at holding level.

Table 6: IV regressions for impact of title on land-related investment

	Constr. SWC structures	Trees planted	Number of trees per ha	Practiced fallow
Panel A: All formal documents				
Parcel with formal doc	0.0685	-0.0141	-1.288	0.0329
	(0.0422)	(0.0507)	(2.579)	(0.0247)
Parcel with chief certificate	-0.0443*	-0.0146	-0.870	-0.0107
	(0.0254)	(0.0308)	(1.567)	(0.0149)
State land with no title	-0.186***	-0.111	-0.979	-0.0661*
	(0.0623)	(0.0749)	(3.811)	(0.0364)
Log parcel area in ha	0.0118*	0.0133*	-0.297	-0.00186
	(0.00636)	(0.00771)	(0.392)	(0.00372)
No. of years since acquisition	0.000926*	-0.000963	-0.0318	0.00129***
	(0.000531)	(0.000643)	(0.0327)	(0.000311)
Panel B: Formal documents by provenance				
State land with title (β_1)	0.0852**	-0.0285	-1.960	0.0355
	(0.0426)	(0.0510)	(2.599)	(0.0249)
Prev. cust. land with title (β_2)	-0.0421	0.0823	3.199	0.0160
	(0.107)	(0.129)	(6.588)	(0.0626)
Parcel with chief certificate	-0.0424*	-0.0162	-0.945	-0.0104
	(0.0255)	(0.0309)	(1.574)	(0.0149)
State land with no title	-0.202***	-0.0962	-0.312	-0.0686*
	(0.0627)	(0.0753)	(3.835)	(0.0367)
Log parcel area in ha	0.0122*	0.0130*	-0.312	-0.00180
	(0.00639)	(0.00773)	(0.394)	(0.00373)
No. of years since acquisition	0.000889*	-0.000930	-0.0303	0.00128***
	(0.000534)	(0.000645)	(0.0328)	(0.000312)
χ^2-test: $\beta_1 = \beta_2$	1.424	0.742	0.619	0.0981
p-value	0.233	0.389	0.431	0.754
Panel C: State vs customary land (OLS regressions)				
State land	0.00152	-0.0343**	-0.809	-0.00155
	(0.0140)	(0.0172)	(0.874)	(0.00826)
Log parcel area in ha	0.0163***	0.0148**	-0.333	0.000324
	(0.00574)	(0.00706)	(0.359)	(0.00338)
No. of years since acquisition	0.000724	-0.00103	-0.0315	0.00120***
	(0.000519)	(0.000636)	(0.0323)	(0.000305)
Number of observations	2,660	2,654	2,654	2,660

Note: Field and owner characteristics are controlled for throughout.
Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.010

Table 7: IV regressions for impact of title on agricultural productivity

	Output value (ZMK/ha)		Purchased inputs (ZMK/ha)		Profit (ZMK/ha)	
Panel A: All formal documents						
Parcel with formal document	0.180*	0.185*	0.187	0.187	0.000127	0.000264
	(0.102)	(0.102)	(0.119)	(0.119)	(0.00371)	(0.00372)
Parcel with chief certificate	-0.0237	0.00448	0.00400	0.0324	-0.00517**	-0.00449*
	(0.0653)	(0.0655)	(0.0762)	(0.0762)	(0.00238)	(0.00238)
State land with no title	-0.113	-0.143	-0.154	-0.185	0.000800	0.000497
	(0.158)	(0.160)	(0.184)	(0.186)	(0.00575)	(0.00582)
Rented-in land	-0.0614	-0.0461	-0.180***	-0.178***	0.000520	0.000938
	(0.0571)	(0.0572)	(0.0666)	(0.0665)	(0.00208)	(0.00208)
ln parcel area in ha	-0.393***	-0.396***	-0.416***	-0.416***	-0.00623***	-0.00640***
	(0.0188)	(0.0188)	(0.0219)	(0.0219)	(0.000685)	(0.000684)
Log head's age	-0.0685	-0.0925	0.0246	-0.0199	-0.00287	-0.00255
	(0.0604)	(0.0608)	(0.0705)	(0.0707)	(0.00220)	(0.00221)
Male headed household	0.261***	0.243***	0.0431	0.0240	0.00770***	0.00781***
	(0.0436)	(0.0437)	(0.0509)	(0.0509)	(0.00159)	(0.00159)
Head is literate?	0.262***	0.239***	0.235***	0.206***	0.00552***	0.00550***
	(0.0371)	(0.0373)	(0.0433)	(0.0435)	(0.00135)	(0.00136)
Member of farmers group		0.119***		0.218***		-0.00152
		(0.0327)		(0.0381)		(0.00119)
Leader in local organization		0.152***		0.131***		0.00227*
		(0.0359)		(0.0417)		(0.00131)
R-squared	0.161	0.174	0.124	0.138	0.0416	0.0479
Panel B: Formal documents by provenance						
State land with title (β_1)	0.228**	0.227**	0.217*	0.209*	0.00130	0.00150
	(0.104)	(0.104)	(0.121)	(0.120)	(0.00380)	(0.00377)
Prev. cust. land with title (β_2)	-0.194	-0.180	-0.0481	-0.00242	-0.00903	-0.0106
	(0.305)	(0.330)	(0.355)	(0.383)	(0.0111)	(0.0120)
Parcel with chief certificate	-0.0152	0.0119	0.00933	0.0363	-0.00496**	-0.00427*
	(0.0658)	(0.0660)	(0.0768)	(0.0767)	(0.00240)	(0.00241)
State land with no title	-0.158	-0.184	-0.182	-0.206	-0.000301	-0.000692
	(0.160)	(0.161)	(0.187)	(0.187)	(0.00584)	(0.00588)
Rented-in land	-0.0690	-0.0541	-0.185***	-0.183***	0.000334	0.000701
	(0.0575)	(0.0577)	(0.0671)	(0.0670)	(0.00210)	(0.00210)
ln parcel area in ha	-0.390***	-0.393***	-0.414***	-0.414***	-0.00614***	-0.00630***
	(0.0190)	(0.0190)	(0.0221)	(0.0221)	(0.000692)	(0.000693)
Log head's age	-0.0692	-0.0925	0.0241	-0.0198	-0.00288	-0.00255
	(0.0604)	(0.0608)	(0.0705)	(0.0707)	(0.00220)	(0.00222)
Male headed household	0.265***	0.247***	0.0459	0.0260	0.00781***	0.00792***
	(0.0437)	(0.0438)	(0.0509)	(0.0509)	(0.00159)	(0.00160)
Head is literate?	0.260***	0.237***	0.233***	0.205***	0.00547***	0.00544***
	(0.0371)	(0.0374)	(0.0433)	(0.0434)	(0.00135)	(0.00136)
Member of farmers group		0.120***		0.218***		-0.00150
		(0.0328)		(0.0381)		(0.00119)
Leader in local organization		0.150***		0.131***		0.00223*
		(0.0359)		(0.0417)		(0.00131)
R-squared	0.160	0.173	0.124	0.139	0.0394	0.0443
F-test: $\beta_1 = \beta_2$	1.831	1.476	0.529	0.294	0.823	0.975
p-value	0.176	0.224	0.467	0.588	0.364	0.324
Panel C: State vs customary land (OLS regressions)						
State land	0.0721**	0.0542	0.0811**	0.0615	0.00154	0.00133
	(0.0353)	(0.0354)	(0.0411)	(0.0411)	(0.00129)	(0.00129)
ln parcel area in ha	-0.392***	-0.395***	-0.415***	-0.414***	-0.00627***	-0.00644***
	(0.0188)	(0.0188)	(0.0219)	(0.0218)	(0.000684)	(0.000684)
R-squared	0.164	0.178	0.129	0.146	0.0463	0.0509
Number of observations	2,731	2,677	2,731	2,677	2,731	2,677

Note: To prevent dropping negative observations, the inverse hyperbolic sine (IHS) transformation is applied to the profit function. As estimated coefficients depend of the unit of measurement of the IHS-transformed variables (Aihounton and Henningsen 2020), we use the R^2 criterion to select the optimal scale factor. Field characteristics are controlled for throughout. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.010.

Table 8: Determinants of demand and willingness to pay for title

	Would like to obtain title	Willing to pay for title	Log amount willing to pay per ha
Parcel with chief certificate	0.111***	0.0121	-0.341***
	(0.0216)	(0.0133)	(0.0751)
State land with no title	0.135***	0.0479***	0.469***
	(0.0272)	(0.0165)	(0.0918)
Log parcel area in ha	0.0221***	-0.00649	-0.759***
	(0.00760)	(0.00511)	(0.0332)
No. of years since acquisition	0.00174***	-0.000128	-0.00113
	(0.000667)	(0.000422)	(0.00239)
Good soil quality	-0.0356	0.0235	0.122
	(0.0382)	(0.0240)	(0.137)
Fair soil quality	-0.0924**	0.0144	0.199
	(0.0383)	(0.0241)	(0.138)
Flat land	0.0469	0.0365	0.303**
	(0.0361)	(0.0236)	(0.137)
Gently slopped land	0.0705*	0.0505**	0.470***
	(0.0372)	(0.0243)	(0.141)
Male headed household	0.0185	0.0241	0.0796
	(0.0237)	(0.0151)	(0.0864)
Log head's age	0.0725**	-0.00257	0.229*
	(0.0318)	(0.0207)	(0.117)
Head is literate?	0.0908***	0.0310**	0.0961
	(0.0190)	(0.0125)	(0.0711)
Member of farmers group	0.0202	0.0205*	0.0984
	(0.0173)	(0.0110)	(0.0622)
Leader in local organization	0.0145	0.0114	-0.115*
	(0.0193)	(0.0121)	(0.0688)
Constant	0.274**	0.849***	4.405***
	(0.132)	(0.0863)	(0.487)
Number of observations	2490	1907	1765
R-squared	0.0510	0.0173	0.263

Notes: Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.010

Appendix table 1: First stage regression for determinants of having a formal document

Titled land at the time of acquisition (β_1)	0.784***	0.783***	0.783***	0.782***
	(0.0194)	(0.0196)	(0.0213)	(0.0216)
Title being processed at acquisition (β_2)	0.459***	0.458***	0.473***	0.473***
	(0.0275)	(0.0278)	(0.0287)	(0.0291)
State land without title at acquisition (β_3)	0.444***	0.444***	0.460***	0.461***
	(0.0155)	(0.0157)	(0.0164)	(0.0166)
Had chief certificate at the time of acquisition	-0.00652	-0.00487	-0.00875	-0.00688
	(0.0140)	(0.0142)	(0.0149)	(0.0152)
Log parcel area in ha	0.0193***	0.0192***	0.0208***	0.0207***
	(0.00459)	(0.00466)	(0.00514)	(0.00523)
No. of years since acquisition	-0.00114***	-0.00125***	-0.00125***	-0.00138***
	(0.000432)	(0.000437)	(0.000465)	(0.000470)
Male headed household	0.00334	0.00145	0.000562	-0.00147
	(0.0148)	(0.0151)	(0.0158)	(0.0161)
Log head's age	0.0113	0.00916	0.0147	0.0131
	(0.0210)	(0.0214)	(0.0222)	(0.0227)
Head is literate?	0.0366***	0.0321**	0.0323**	0.0274**
	(0.0126)	(0.0129)	(0.0133)	(0.0137)
Member of farmers group		0.0208*		0.0209*
		(0.0113)		(0.0119)
Leadership position in local organization		0.0110		0.0124
		(0.0123)		(0.0131)
Good soil quality			-0.0321	-0.0325
			(0.0267)	(0.0271)
Fair soil quality			-0.0248	-0.0245
			(0.0268)	(0.0272)
Flat land			-0.00389	-0.000965
			(0.0253)	(0.0257)
Gently slopped land			0.0145	0.0200
			(0.0260)	(0.0264)
Constant	-0.0496	-0.0445	-0.0353	-0.0358
	(0.0826)	(0.0842)	(0.0924)	(0.0940)
Number of observations	2997	2934	2699	2639
R-squared	0.468	0.469	0.466	0.467
$\beta_1 = \beta_2$	0.3240 ***	0.3250 ***	0.3100 ***	0.3100 ***
	(0.0315)	(0.0319)	(0.0334)	(0.0338)
$\beta_1 = \beta_3$	0.3400 ***	0.3390 ***	0.3230 ***	0.3220 ***
	(0.0222)	(0.0225)	(0.0242)	(0.0246)
$\beta_2 = \beta_3$	0.0159	0.0142	0.0131	0.0116
	(0.0296)	(0.0300)	(0.0310)	(0.0314)

Note: Dependent variable is an indicator of having a title. Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.010

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