ASSESSING THE COSTS OF TENURE RISKS TO AGRIBUSINESSES – APPENDICES

March 2019

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THE QTR INITIATIVE

Quantifying Tenure Risk (QTR) is a joint research initiative from the Overseas Development Institute (ODI) and TMP Systems funded by the UK Government. Our aim is to provide data and analysis to reduce land conflict and improve land governance through better informed investment decisions. QTR's initial focus is on Africa and agriculture, but plans are underway to expand to other sectors and regions.

ODI AND TMP SYSTEMS

ODI is the UK's leading global development think tank. ODI has produced an extensive body of research on land rights and an in-house team dedicated to agricultural policy.

TMP Systems is an asset management and investment consultancy specialising in global development. ODI and TMP have discussed tenure risk with nearly 80 companies and TMP manages a database of over 500 cases of tenure disputes.

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FIGURES AND TABLES

ACRONYMS

ACLED	Armed Conflict Location & Event Data Project
CAPEX	capital expenditure
CPI	Corruption Perceptions Index
DR	discount rate
ESG	environmental, social and governance
FDI	foreign direct investment
HDI	Human Development Index
MPI	Multidimensional Poverty Index
NGO	non-governmental organisation
NPV	net present value
OPEX	operating expenditure
QTR	Quantifying Tenure Risk
TRT	Tenure Risk Tool
UN	United Nations
WGI	Worldwide Governance Indicators

INTRODUCTION

These appendices refer to the summary report, *Assessing the costs of tenure risks to agribusinesses*. The report is a product of the Quantifying Tenure Risk (QTR) initiative, a joint research programme conducted by the ODI and TMP Systems and funded by the UK Government.

Appendix 1: Details on primary and secondary data collection and how it informs the Tenure Risk Tool (TRT), a due diligence tool produced to help companies quantify tenure risk as part of the QTR initiative.

Appendix 2: More information on the case examples referred to in the report, which provide detail on past agricultural investments which have suffered financial damage as a result of tenure risks.

Appendix 3: A methodological background of how TMP Systems' 'uncertainty risk scores' are calculated. These scores capture the prevalent risk based on the geophysical location of an investment and inform the TRT.

Appendix 4: Robustness checks demonstrating how variables affect the results of the TRT, according to:

- location – based on the uncertainty risk scores in Appendix 3
- commodity – across oil palm, sugar cane, coffee and cocoa
- plantation size – in hectares
- greenfield versus brownfield investments – taking into account differences in capital expenditure (CAPEX) between the two types of investment
- discount rates – using different assumptions.

Please note that, as much of the data we collected directly from 80 companies operating across the sub-Saharan African agricultural supply chain was commercially sensitive, we anonymised company names. There are two exceptions: a) where we received explicit permission from companies to use their names; and b) where the information was publicly available.

APPENDIX 1: DATA REVIEW

Data collection concentrated on three types of data, as listed in Table 1.1. Of these, the first two were used in developing the Tenure Risk Tool (TRT). Data points on 'additional costs' were not built into the model because, across the cases assessed, these did not exceed roughly 2% of total original expenditure on a project. However, we recognise the need for additional research on 'additional costs' to demonstrate to companies that the costs of 'doing it right' are far smaller than those of 'doing it wrong', as highlighted by TRT.

We collected data on the above using secondary data research of publicly available data on tenure disputes. This was especially important for delay data (category 1) but also for data on CAPEX and revenues. Where possible, we supplemented or verified data collected from public sources with primary data research with investors involved. Data on operating expenditure (OPEX) and additional costs was primarily obtained from primary data. We conducted 35 semi-structured interviews with companies involved throughout the African agricultural supply chain, either in person or over the phone. Nine of these companies sent us detailed financial data on cashflows or the additional costs of mitigation. Further detail on how the data was used in the model, and on its limitations, is provided below.

DATA AVAILABILITY

Both primary and secondary data collection allowed us to obtain reliable and granular information on the nature and distribution of delays as well as the associated forgone revenue. Taken together, this gives us insight into tenure risk in different commodities, regions and investment approaches. At one end of the spectrum, disputes can result in little more than minor increases in OPEX, while at the other they can lead to project cancellations that create considerable headwinds at the corporate level.

TABLE 1.1: DATA TYPES AND DESCRIPTIONS

CATEGORY	TYPE	DESCRIPTION
1.	Delay data	Based on 90 cases of tenure disputes between private companies and local people and verified by companies to capture: a) delay values (days) by location and project b) likelihood that these delays will occur, based on a risk score from Landscope.[1]
2.	Forgone revenue from delays	TRT is a discounted cashflow model and therefore requires detailed financial data to generate the margin lost because of a delay linked with tenure disputes. That data includes: a) Production costs: these need to be further split between CAPEX and OPEX so that the model can account for the impact of depreciation and interest rates on capital, as well as the difference that delays have on brownfield versus greenfield investments. b) Revenues: data on crop production (including yield and planting over the project lifecycle) and crop prices.
3.	Additional costs	Identified in Phase I as: a) legal costs for remediating disputes b) lost or impaired assets c) compensation and mediation costs d) cost of new staffing requirements to generate the capacity to deal with tenure problems.

SECONDARY DATA

At the core of the modelling process is a calculation of the distribution of possible delays that might affect a project as a result of disputes over land and resource rights, to provide a sense of the range and timing of delays (see Figure 4 in the main report). The review of secondary data (often verified with companies themselves) on delays revealed that these could range between 12 and nearly 2,000 days (over five years).[2]

We have summarised information from four particularly detailed case studies in Table 1.2. Appendix 2 provides further information on these.

PRIMARY DATA

The primary data presents several limitations that prevent us from illustrating results with the same freedom that we can use with publicly available data. Where required, financial information provided by companies was aggregated and anonymised to protect commercially sensitive data. The model relies on cashflows, which in turn are generated by subtracting CAPEX and OPEX from revenues associated with crop production over the course of a project. Since this reveals the gross margin of an operation and therefore also its profitability, operators – particularly larger listed companies with shareholder interests – were often reluctant to disclose detailed information. Data on CAPEX was more easily available, either from companies themselves or within the public domain.

Financial data from nine companies enabled us to develop broad-brush figures and required a pan-African approach, generalising scenarios despite sometimes large variations in prices, production costs, scale of production and agronomic conditions across the continent. In the sugar sector, we found considerable variation in the margins that businesses face depending on domestic price dynamics. Equally, labour costs are an important driver of palm-oil production margins, as are yields. A final consideration is that the cost data does not take into account the impact of economies of scale on reducing or increasing costs.

However, these issues do not undermine the utility of the model, which is designed for businesses to input their own projected cashflows of a particular investment rather than relying on the examples that we generated for model testing and awareness raising.

DATA ON ADDITIONAL COSTS

Beyond costs caused by operational delays incurred by companies, we sought data on additional costs related to delays, including legal costs for remediating disputes, lost or impaired assets, compensation and mediation costs, cost of new staffing requirements to generate the capacity to deal with tenure problems, and costs associated with reputational risks.

Data was not readily available on these costs and many companies interviewed tend to aggregate land-specific costs within costs related to wider environmental, social and governance (ESG) costs, making it difficult to obtain specific costs to factor into the model. However, where we did find such evidence, it appeared that the additional cost was low or negligible as a percentage of the overall investment (typically much less than 2% of CAPEX and OPEX), such that not including these costs in the model does not reduce its effectiveness.

TABLE 1.2: OVERVIEW OF DATA FROM CASE STUDIES DESCRIBED IN APPENDIX 2

	CASE 1	CASE 2	CASE 3	CASE 4
Scenario	Cancellation before operation	Delays during establishment	Delays during establishment + operations	Operations disrupted
Commodity	Sugar cane	Rice	Sugar cane, rice, energy	Sugar cane
Location	East Africa	East Africa	East Africa	Southern Africa
Type of investment	Greenfield	Greenfield	Greenfield	Brownfield
Size of investment (ha)	20,000	3,000	50,000	Unknown
Length of dispute	11 years	12–14 months	14–18 months	Unknown
Loss (US$)	CAPEX: 52 million OPEX: N/A	CAPEX: 1.05 million OPEX: 1.5 million	CAPEX: 10 million OPEX: unknown	Unknown

APPENDIX 2: DETAILED CASE EXAMPLES

Using the information gathered during this research process, we have examined the impacts of disputes over a range of typical scenarios. Specifically, we have identified at least four scenarios in which tenure disputes create financial losses, primarily via delays during inception, operation or both:

1) **Cancellation before operations**: disputes can create delays and additional costs that compel investors to walk away before a project becomes operational. This step may be taken even where many years and millions of dollars have to be written off. While this is not a common outcome, there are numerous examples of this scenario.

2) **Increased establishment time and cost**: in a large number of greenfield investment processes, disputes with local people during the early stages inject significant delays. Companies generally have to make additional, unplanned expenditures on things like social engagement capacity to address these problems.

3) **Establishment delays continue during operations**: tenure disputes during the establishment phase can be resolved, but in many cases they become chronic, increasing operational expenditure and reducing revenues. In some instances these problems can compel operators to abandon or offload distressed assets.

4) **Operations disrupted by dispute**: tenure disputes may be avoided or suppressed during establishment only to re-emerge during operations. Even when quite low-level – e.g. persistent peaceful protest – these disputes can introduce delays and/or increase operational expenditure.

CANCELLATION BEFORE OPERATIONS: SUGAR INVESTMENT IN EAST AFRICA

In this scenario, a company or investor typically loses all of the capital and resource invested in the project. They may be protected by insurance and can seek international arbitration but, even in most of these instances, the proportion of the total investment lost is likely to be significant. This scenario does not therefore create a challenge for financial modelling. Rather, we highlight the headline costs in a few key examples to demonstrate how these disputes create financial problems.

In the case of this sugar investment in East Africa, a total of $52 million ($48 million expenditure, $4 million taxation) was invested over a period of 11 years without reaching an operational stage. The opportunity cost here was significant, as the company and its investors had initially aimed to invest ~$569 million in 20,000 ha of land with an expectation of annual revenues of ~$120 million within seven years.

In 2005, the company worked closely with the national government to identify an area for investment. It then proceeded to invest in establishing a nursery and model farm with the aim of scaling to a full-sized plantation. These plans came unstuck after late consultations with local people failed to secure local consent for the project. In 2009, the first company backing the project went bankrupt and was reconstituted, with a 10% stake handed to the national government. This should underline the fact that this investment, initially at least, had the full support of the state.

Investors remained hopeful because of government support and apparent progress in consultations with local people. But the delays in securing local support soon began to create a vicious cycle, as the hiatus in distributing compensation created frustration. Linked to this were investor complaints of people moving from other areas of the country to the project site in the hope of claiming compensation. In 2011, some project-affected people launched a lawsuit with the support of local and international non-governmental organisations (NGOs) claiming that compensation was being withheld. This significantly increased the reputational risk of the project, further encouraging some investors to withdraw support in 2015.

By 2012, $28 million had been sunk into the project to establish the model farm and nursery. However, a number of additional licences and permits were needed before scale-up to operations could begin. The company again worked closely with local and national government in pursuit of these licences and permits, investing a further $20 million between 2012 and 2016. This was a lengthy process, in part because new requirements were regularly added to the list as local discontent over land governance persisted and as international scrutiny grew.

The project was finally cancelled when the national government withdrew the project's right to occupancy, citing concerns of encroachment of environmentally sensitive and protected areas. It may seem extreme to back an investment for 11 years when success seemed so challenging but there are in fact many examples like this. We know that many investors walked away from land deals struck in the wake of the financial crisis quickly and with minimal investments made. But many companies and investors get hooked by assurances from the government or local partners. Large agricultural investments in Africa can therefore have significant financial exposure to this tenure risk scenario.

INCREASED ESTABLISHMENT TIME AND COST: RICE INVESTMENT IN EAST AFRICA

In many instances, companies and investors are able to mitigate and remediate tenure risks during the establishment phase. This process of local engagement and project adjustment can create long delays and call for unanticipated additional expenditures. However, these projects can reach an operational stage and begin to produce revenue.

An example of this scenario investigated during the consultation process involved a greenfield investment in a rice-production project. This project started in 2012 and became operational in 2015. This represents a 12–14-month delay in the $37.5 million establishment process for a 3,000 ha farm.

Delays were caused by complexities in engaging with local people to earn a social licence to operate. The company pursued these negotiations patiently and facilitated a broader mapping process to ensure fair compensation delivery. This compensation and land reallocation process cost the company ~$845,000, with an additional investment of ~$205,000 in a community development fund taking the direct spend during establishment to $1.05 million or 3% of total establishment costs.

These investments helped the company to avoid the first scenario and start to produce a smooth flow of revenues. The project saw a delay of between two and three months at the start of production as land issues were addressed, which cost the company around $1.5 million in OPEX. The total production area and therefore revenue of the project was also reduced by ~10% after 300 ha of land was returned to the community for reasons of food security. Otherwise, the project has proceeded as the investors hoped and now with robust local cooperation.

ESTABLISHMENT DELAYS CONTINUE DURING OPERATIONS: BIOENERGY IN WEST AFRICA

In the scenario above, the company acted quickly and decisively to resolve a dispute and address its drivers. For example, rapid willingness to return land to local people and to pay out adequate compensation diffused tensions and created an enabling environment for successful agricultural production. In many cases, however, companies struggle to manage disputes effectively, or local people are not open to negotiation, so confrontation becomes entrenched.

In this scenario, delays during establishment persist during operations, significantly reducing revenues and increasing expenditures. During the research process we identified at least one instance – a bioenergy production and processing plant in West Africa – in which these financial problems encouraged the investor to sell the asset despite significant impairment.

In this case study, the company again worked closely with the government to secure a large plot of land (initially intended to be 50,000 ha). The expected annual output of this project was supposed to be one million tonnes of sugar cane, 85,000 litres of ethanol and 15 MW of electricity. This opportunity justified initial investments of $250 million to establish 10,000 ha of sugar, 4,000 ha of rice (which also supported local food security) and 1,000 hectares of ecological services.

The company encountered problems with these plans because it failed to earn social licence among local people. Disputes became entrenched before the company began to invest heavily in a social affairs department and, as a result, the establishment of the

project was delayed by 14 to 18 months between 2009 and 2014 (in other words, delay accounted for about a third of the establishment time).

In addition to this establishment delay, the company had to invest in improving local relationships. These costs included ~$3 million in compensation, $1.5 million on stakeholder engagement and $2.5 million on a food-security programme. These efforts were partly successful but disputes continued and generated additional expenses for the project, including $1.5 million in theft of equipment and $1.5–2 million in idle equipment costs. The total increase of expenditure amounted to at least $10 million, or 4% of CAPEX.

Ultimately, efforts to gain a social licence were not successful and the operation suffered another month of delay at the start of operations (costing ~$2 million in operating expenses). In July 2015 the operation had to be closed down for six months. These difficulties, along with the evident, seemingly non-negotiable, limitations in expanding the project to the extent originally intended, caused the company to reconsider the investment and indeed a wider expansion into this market.

In 2016, the asset was sold to Sunbird Energy. We were unable to get details of this transaction but understand that the project was judged to be severely impaired and so significant losses were made at point of sale. We understand that delays, disputes and problems have continued under the new management regime and that plans for a large expansion have been shelved.

Other factors are at play in this example, like declining biofuel prices and the problems caused in West Africa by the outbreak of Ebola. But tenure issues intersected with and reinforced other challenges to change the calculus of investment.

OPERATIONS DISRUPTED BY DISPUTE: EXPANSION OF SUGAR OPERATIONS IN SOUTHERN AFRICA

Many companies and investors assume that agricultural projects that have been operating for long periods of time already are less exposed to tenure-related dispute than greenfield projects, which are the focus of much of the media reporting on tenure. Our research suggests that these disputes are common but they do typically have more limited operational and financial impact, with a much lower risk of overall project cancellation. However, these disputes in existing operations can easily become chronic and create significant reputational problems.

Many sugar operations in Southern Africa are exposed to legacy land risks. These historical grievances may not be the result of the company's action but the company may nevertheless be seen as responsible by local people. For example, two projects we investigated in the region had difficulty in maintaining social licence because of how the land was originally allocated by the national government in the 1970s.

These legacy disputes increase expenditures and reduce revenues in two ways: first, they lead to cane burning, violent conflict and theft; second, they reduce scope for expanding production, either directly or through outgrower programmes. If unchecked, these problems can become serious enough to invite political intervention by the national government. In the examples we examined, the first category of operational problem (burning, etc.) can reduce output by 5–10% in any given year, although a more typical figure is ~2%. This may not seem particularly significant but these losses are year on year, often for decades: manageable but unnecessary.

The second category (limiting expansion) can be serious, depending on the capacity of the sugar mill. In one example we looked at, the mill was well-supplied and there was little pressure for extra production. The opportunity cost here is being unable to upgrade the mill and increase revenue. Clearly this would limit the interest of investors or lenders. However, another operation in the same country, but backed by another company, desperately needed to increase mill throughput. Under these conditions, sugar mills will run at a large year-on-year loss, the extent of which depends on sugar prices (but can reach 20% of annual revenue).

While this research initiative does not seek to quantify the reputational impacts of tenure disputes, it is worth noting that legacy land issues often attract international scrutiny. In one of the examples above, the company was told by its largest buyer that it had to improve practice, particularly at this operation, in order to retain market access. The company felt it had to respond by increasing investment in social affairs and tenure-mapping processes.

APPENDIX 3: UNCERTAINTY RISK SCORES

We used TMP Systems' publicly available Landscope database[3] to collect and collate geospatial data showing ESG conditions[4] at each project site and its proximate surroundings. The collation of that data then results in an 'uncertainty risk score' which shows the level of various important ESG indicators associated with the location (see below for further explanation).[5]

The risk score is then used to expand or contract the distribution of potential financial losses associated with delay or disruption of a project, as well as to adjust the scoring within those distributions. Lower risk scores contract the distribution of possible losses (due to greater certainty inherent in more stable areas) as well as shifting the potential range of losses rightward. Higher risk scores have the opposite effect.

As such, the risk score is vital in determining the model's output. We therefore wish to explain how we determined which indicators are important, and how we have decided to translate those decisions into software. What follows is a description of both, as well as some discussion of the statistical evidence supporting our decisions.

To be clear, we have relied on our professional judgement in arriving at a number of these decisions. The consultation process that is a part of this project will tell us whether these were correct, and allow us the opportunity to adjust them based on feedback from informed market participants.

OVERVIEW

To understand the likelihood of tenure conflicts occurring in different geographic contexts, we ran analyses at two levels. The first was an analysis of rates of tenure conflict at the national level compared with national indicators of governance and poverty. The second was a sub-national analysis of environmental and social conditions in specific projects that had known tenure disputes associated with them, compared with concessions where we do not have evidence of disputes.

In direct response to requests from investors and companies, we chose our projects from the palm-oil sector,[6] querying a publicly available dataset of mills[7] and comparing it to locations from a database of case studies developed by TMP.[8] We then checked the mill locations and pulled out a subset with no reports of tenure disputes. This process allowed us to compare conditions in locations where tenure disputes have occurred with places where there is no known tenure dispute, and, thereby, develop a statistical profile of each that we could compare.[9]

How that comparison was done depended on whether we were looking at a national or sub-national indicator. For the national indicators, we simply pulled the score associated with the country in which the mill was located. For the sub-national analysis, we extracted data for a 'buffer zone' around each location (a circle with a radius of 50 km, as the people involved in palm-oil disputes tend to live and work within this zone).[10] We then calculated mean average figures for poverty, water risk and soil indicators, and total figures for population, conflict, land-use change and land under protected area status.[11]

Table 3.1 summarises the factors in each area where we found a statistically significant relationship,[12] and the strength of that relationship. In the sections that follow, we provide a brief summary of the theory that connects each factor with tenure conflicts, and the results of our analysis of these relationships.

TABLE 3.1: FACTORS AFFECTING TENURE RELATIONSHIPS

GROUP	INDICATOR	LEVEL	RELATIONSHIP[13]	DESCRIPTION
Social	History of armed conflict	Sub-national	Moderate	The more violent conflict, the higher the risk.
Social	Multidimensional Poverty Index (relative levels)	Sub-national	Moderate	The higher the poverty in the area relative to the nation, the higher the risk.
Social	Local ethnic groups' access to power	Sub-national	Strong	The lesser the access to state power that local groups have, the higher the risk.
Social	Population growth	Sub-national	Strong	The higher the recent population growth, the higher the risk.
Social	Human Development Index (HDI)	National	Strong	The lower the national-level HDI, the higher the risk, unless the country is extremely poor.
Environmental	Flood risk	Sub-national	Strong	The *less* flooding in the area, the higher the risk.
Environmental	Seasonal variability in water supply	Sub-national	Moderate	The more variable the water supplies between seasons, the higher the risk.
Environmental	Proportion of land covered by protected areas	Sub-national	Moderate	The higher the amount of protected areas surrounding the project, the higher the risk.
Governance	Control of corruption	National	Moderate	The less control of corruption, the higher the risk.
Governance	Government effectiveness	National	Strong	The less effective a government is, the higher the risk.
Governance	Regulatory quality	National	Strong	The lower the capacity of government to implement regulations that allow private enterprise development, the higher the risk.
Governance	Rule of law	National	Moderate	The weaker the rule of law, the higher the risk.
Governance	Voice and accountability	National	Moderate to small	The less ability citizens have to select their government, freedom of expression, freedom of association and free media, the higher the risk.

Our goal has been to understand risk at the global and local level. This involves assessing the conditions that are typical of tenure conflicts, and which should thus be regarded as risky regardless of any causal relationship. Analysing the causal role of additional factors, how risk factors change over time, and how the factors themselves interact (including assessing the endogeneity of related indicators) will further improve our understanding of tenure risks.

Our description of results starts with sub-national indicators before moving onto a description of national-level data.[14] As Table 3.1 shows, sub-national factors are extremely important in assessing tenure risk. The influence of local factors on land investments is recognised anecdotally but we have found that investors typically use national assessments for issues like tenure risk.

New datasets are emerging that look directly at tenure security, and so offer additional insight to investors. For example, the Prindex project measures global perceptions of land and property rights based on robust surveying down to the household level.[15] This data shows significant difference in perceived tenure insecurity between regions, underlining the fact that the governance of land rights can vary considerably at the sub-national level. This project, like other datasets, will continue to increase transparency around tenure risk at the sub-national level.

The new datasets will reinforce what we already know about the variance between levels of conflict, water availability and government effectiveness around conflicts in a country like Tanzania, or even a smaller and more homogenous country like Malawi. Since data exists to enable this sub-national differentiation, it makes complete sense to enhance the granularity of tenure-risk analysis.

SUB-NATIONAL DIFFERENTIATION: ENVIRONMENTAL AND SOCIAL FACTORS

We looked at three environmental factors – water, land use and soil health – and four social factors – poverty, population levels, ethnicity and armed conflict. These factors were selected based on evidence indicating possible relationships with tenure conflict[16] or with violent conflict more generally, and the availability of globally comparable datasets.[17]

In some instances we have looked at multiple indicators for a factor. For example, in the case of land use we looked at protected areas, soil quality and land-cover change. These combinations give the best quantitative picture of the factor in question based on data available. We continue to scan available data for the best available indicators.

To compose our datasets, we first removed from the mill dataset all areas that were covered by cases from the Case Study database in order to produce our control dataset of locations. We then used the IAN database[18] to extract the relevant data for our tenure dispute and control locations, calculating mean average values for poverty, water risks and soil health, and total values for conflict event counts, population levels, and land covered by protected areas.

ENVIRONMENTAL FACTORS

Our previous review of case studies suggested that environmental damage is the second-most common driver of tenure disputes (seen in 44% of cases), after forced displacement. Shortage of natural resources is the third most common driver (occurring in almost a third of cases). This suggests that places where the environment is sensitive (e.g. primary forest) or where natural resources are scarce (e.g. low water availability) are more prone to tenure disputes.

This may be because local people are particularly protective of environmental integrity in sensitive areas, in part because they rely on these ecosystem services. This strong connection to a particular place, which will typically be reflected in customary rights, increases the chance of dispute with an investor. Similarly, areas where resources are scarce are more likely to see competition and dispute over the right to access to these resources. But again, this was anecdotal evidence and hard to use in investment decision-making.

The statistical analysis undertaken for this report therefore investigated three major aspects of the environmental context that affect the availability and quality of natural resources: water, land use and soil health. Granular geospatial data with global coverage exists for a number of indicators for each of these factors, allowing us to conduct analyses at the sub-national level. So, for each of these indicators, we can develop reasonable, testable hypotheses about their relationship with tenure conflicts.

WATER

In the case of water, the Aqueduct dataset has near-global coverage, and provides sub-national data at the resolution of major river basins.[19] The eight indicators of water risks that we considered in the analysis each measure risks that water availability, water quality and flooding will have negative impacts on users.[20] For each of these we used the Aqueduct dataset's normalised values, which range from 0 (very low risk) to 5, which give an intuitive sense of risks faced by users.

We expected greater absolute levels of risk in each indicator to correspond with increased levels of tenure risk. Issues relating to water are often given as a reason for grievance in tenure disputes. Land-based projects – particularly in agriculture, extractive industries and hydropower (which together form 66% of the Case Study database) – can have significant effects on the availability and quality of local water supplies. It is therefore logical to assume that places with a more precarious water situation will be more prone to these effects, and feel them more acutely.

For all but two of the indicators, we found no statistically significant relationship between the occurrence of tenure conflicts and water-risk levels. The exceptions were Flood Occurrence (which provides a measure of the number of floods recorded in a given catchment between 1985 and 2011) and Seasonal Variability (which measures the risk that water supply varies dramatically between seasons).

However, the relationship we found was negative, with tenure conflicts occurring in places that had experienced significantly *fewer* floods compared to places where we do not have evidence of tenure conflicts. Figure 3.1 shows the average and range of scores for the tenure-conflict group and the control group for Flood Occurrence. There is a significant amount of covariance between Seasonal Variability and Flood Occurrence, as flooding often results from relatively sudden downpours typical of highly seasonal rainfall patterns.

FIGURE 3.1: RELATIONSHIP BETWEEN TENURE CONFLICT AND FLOOD OCCURRENCE

This may be a result of the particular kinds of locations suited to agricultural development: since there is less investor interest in flood-prone areas and since water risk is increasingly recognised, there may be less competition for this agricultural land and so less contest over ownership and developments. Similarly, this land is less likely to be attractive to local people, who are therefore less likely to dispute new developments.

It is possible that this is picking up aspects of palm-oil production, rather than agriculture in general: oil palm is a very water-intensive crop and is typically grown in areas where rainfall is relatively consistent[21] and so flooding is less likely than, for example, in some alluvial sugar plantations. Further testing for different sectors is in process to help us understand if this finding applies more broadly.

LAND USE

SOIL

We considered three proxies for land use: soil quality, land-use change and protected areas. For each factor, the theory was that lower availability of good-quality land would increase the likelihood of tenure disputes, as there would be fewer alternatives for local people facing displacement by projects.

Because agriculture is the major source of livelihoods for people in rural areas of emerging and frontier markets, the quality and location of alternative land awarded to displaced communities is a frequent source of tension in tenure disputes – so we might expect poor soil quality to be associated with increased levels of tenure dispute. Alternatively, we might hypothesise that projects located on land with particularly good soil quality might be more prone to conflict. Nevertheless, the results of our analysis of soil suggested no statistically significant link between soil health and tenure conflicts.

LAND-COVER CHANGE

We compared change in land cover between two versions of the Globcover dataset,[22] which categorises land cover according to 22 classes defined by the United Nations (UN). The two versions are 2.2 (covering the period 2005–2006) and 2.3 (2009).

We found that the mean and median total change in land-cover types were greater in places where tenure conflict had occurred than in the control group. We further found that the difference was statistically significant, although we consider these results preliminary because of the limited time period of the Globcover datasets. We do not currently use them in the overall tenure-risk scoring model for this reason, although further testing may corroborate these results with data that can be used in a live model.

PROTECTED AREAS

Using data from the World Database of protected areas,[23] we calculated the area covered by designated protected areas within each buffer zone. We did not differentiate between different types of protected area because of limited data completeness for this variable.

In theory, any form of restriction on the types of economic activity allowed is likely to have some effect on land availability, and thus increase the likelihood of disputes over projects that further decrease the availability of land. We therefore expected that tenure-conflict locations would have larger coverage of protected areas than places without documented tenure conflicts.

Our analysis, based on a binomial logistic regression model, showed that the area covered by protected areas[24] was a significant predictor of tenure risk. As Figure 3.2 shows, projects where tenure disputes occurred were typically in places with a much greater coverage of protected areas than project locations where disputes have not been documented.

The differences between dispute locations and our control group are striking. Control locations rarely had more than 500 square kilometres (6%) of nearby land

FIGURE 3.2: RELATIONSHIP BETWEEN TENURE CONFLICT AND PROTECTED AREAS

covered by protected area status, and never more than 25% coverage. In the dispute locations, however, a quarter of locations had over 30% protected area coverage of nearby land.

This may be because significant presence of protected areas means that there is limited land available for local communities. Alternatively, it may be a result of the local landscape being environmentally or culturally sensitive, and additional legal protections existing for the land that affected communities can use to dispute encroachment.

Regardless of the cause, the risk that projects will run into conflict with local communities is significantly higher in these locations. This suggests that investors should apply particularly high standards of diligence and community engagement where projects occur in areas where protected areas cover a significant amount of local land, or consider alternatives.

SOCIAL FACTORS

There is some compelling evidence that the social context in which a project occurs is a key contributor to risks of disruption as a result of tenure disputes. Previous studies have noted that the most common underlying issues in mining conflicts are related to social and economic factors, for example,[25] while an analysis of dam projects in Asia identified a lack of 'social safeguards' to be a necessary condition for significant opposition to those projects.[26]

We explore the relationships between relative poverty levels and tenure conflicts based on the availability of high-quality sub-national datasets. There is a wealth of evidence on the relationships between armed conflict and various social and environmental factors.[27] We therefore also explore the relationship between armed-conflict events and tenure conflicts, as we expect some of the drivers of armed conflict to be closely related to those that contribute to tenure disputes.

There are a number of demographic factors for which reasonable connections with tenure disputes can be theorised – tenure disputes disproportionately feature minority or indigenous groups, for example.[28] We have focused on the most fundamental factor for which high-quality, highly granular geospatial datasets exist – the population density in the vicinity of a project.

DEMOGRAPHY

POPULATION GROWTH

The presence and composition of people are fundamental to tenure disputes – there are, for all practical purposes, no locations on land where there are no people affected by private investment.[29] We examined population distribution data from the Gridded Population of the World Dataset (v4),[30] looking at change in population between 2005 and 2015.

We expected that places where tenure conflicts had occurred would have seen higher population growth over the period, which would lead to increased demand for local resources and so greater pressure on them.

As Figure 3.3 shows, the two groups of locations have significant differences in terms of average population growth. The maximum values – excluding outliers – are similar between the two groups. However, places where tenure disputes occurred

FIGURE 3.3: RELATIONSHIP BETWEEN TENURE CONFLICT AND POPULATION GROWTH

uniformly witnessed positive population growth, while a number of places without documented disputes experienced population declines. As a result, the mean growth was significantly higher in the tenure-dispute locations (at 0.46%), with the large number of non-dispute locations seeing low growth or declines, skewing the average downwards (and giving a mean growth rate of 0.25%).

The results of a binomial logistic regression test demonstrated historic population growth to be a significant predictor in a model for tenure risk. Historic population growth can therefore be helpful in identifying and addressing tenure risks. Projections of future growth may also be of interest in assessing risks for investments reliant on long-term projects.

ACCESS TO POWER OF ETHNIC GROUPS

Marginalised minority groups like indigenous peoples are involved in over half of tenure disputes in our Case Study database. We used the geocoded version of the Ethnic Power Relations database to look for relationships between the status of local groups' access to power and the incidence of tenure disputes.

The Ethnic Power Relations dataset identifies all 'politically relevant' ethnic groups and their access to state power from 1946 to 2017.[31] It provides seven classifications of this access, which we placed into two groups: access to power (where their status is 'Junior Partner', 'Dominant', 'Senior Partner' or 'Monopoly') and no access to power ('Powerless', 'Discriminated' or 'Irrelevant').

We found that places that had seen tenure disputes were, on average, home to more than twice as many groups that had no – or very limited – access to power. Conversely, these areas were very rarely populated by groups who had some access to power, but control locations typically had at least two of these groups in the area. Our analysis suggested that this was a strong relationship (Cliff's Delta = 0.855).[32]

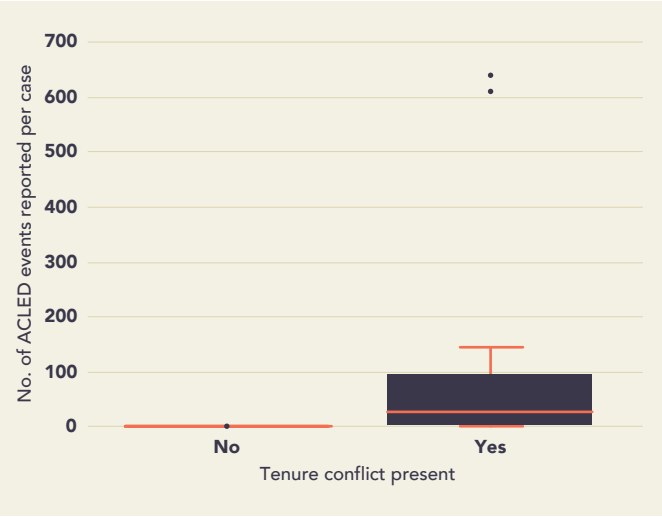
CONFLICT

A number of the ESG factors with theoretical links to tenure risks are also linked with armed civil conflicts. It is therefore intuitive to suppose that locations that are witness to other types of conflict are also likely to be more prone to tenure disputes.

We used the total number of conflict events from the Armed Conflict Location & Event Data Project (ACLED) database.[33] For the different locations covered by our datasets – excluding Costa Rica, Colombia, Papua New Guinea and Malaysia from the analysis as these are not covered by the dataset.

We found a significant association between places with a history of conflict and known tenure disputes. On average, places where tenure conflicts had occurred were witness to over 100 events of violent conflict, while places with no evidence of tenure conflict saw less than one on average. Figure 3.4 illustrates the differences between the two datasets.

FIGURE 3.4: RELATIONSHIP BETWEEN TENURE CONFLICT AND OTHER REPORTED CONFLICT



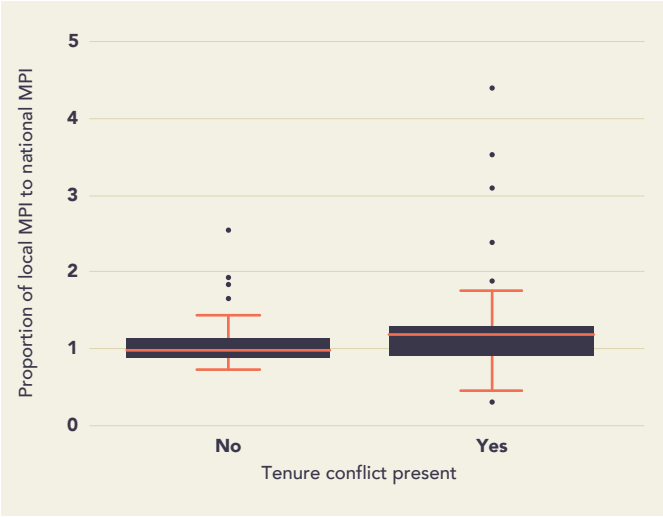
RELATIVE POVERTY

We looked at a composite metric of poverty – the Multidimensional Poverty Index (MPI) – which combines an indicator of the proportion of people in poverty with the intensity of deprivation suffered by those people.[34] The MPI dataset provides sub-national data for 104 countries, alongside comparable national values. For each location in the dispute and control groups, we computed the proportion of the local MPI value to the national average value.

We expected that tenure disputes would be more likely to occur in places where poverty was more widespread and intense than the national average. This could be the result of perceived feelings of being left out of national economic progress, or of greater dependence on land and environmental resources – either factor could make communities more sceptical of private enterprise which competes for local resources.

As Figure 3.5 shows, the median relative poverty levels in tenure-dispute locations are higher than in places where disputes have not been documented. In mean terms, local poverty levels were 1.05 times that of the national value in the control group, but 1.36 times national levels in places where tenure disputes have occurred.

FIGURE 3.5: RELATIONSHIP BETWEEN TENURE CONFLICT AND POVERTY (MPI)



NATIONAL-LEVEL FACTORS: POVERTY AND GOVERNANCE

The two factors for which we used national-level data were poverty (as measured by the HDI) and governance (as measured by the Worldwide Governance Indicators (WGI) and the Corruption Perceptions Index (CPI)). For each of these factors, sub-national datasets with global coverage are not available.

For our measure of the occurrence of tenure conflicts, we looked at the number of cases per country in the period covered by both national poverty and governance data, using a subset of 463 cases from the Case Study database that had required data during this period (1996–2016). We then normalised the incidence data by calculating the number of cases per dollar of foreign direct investment (FDI) per year, averaging the FDI values for each conflict in a given country for the two years preceding each conflict and the year of the conflict.[35]

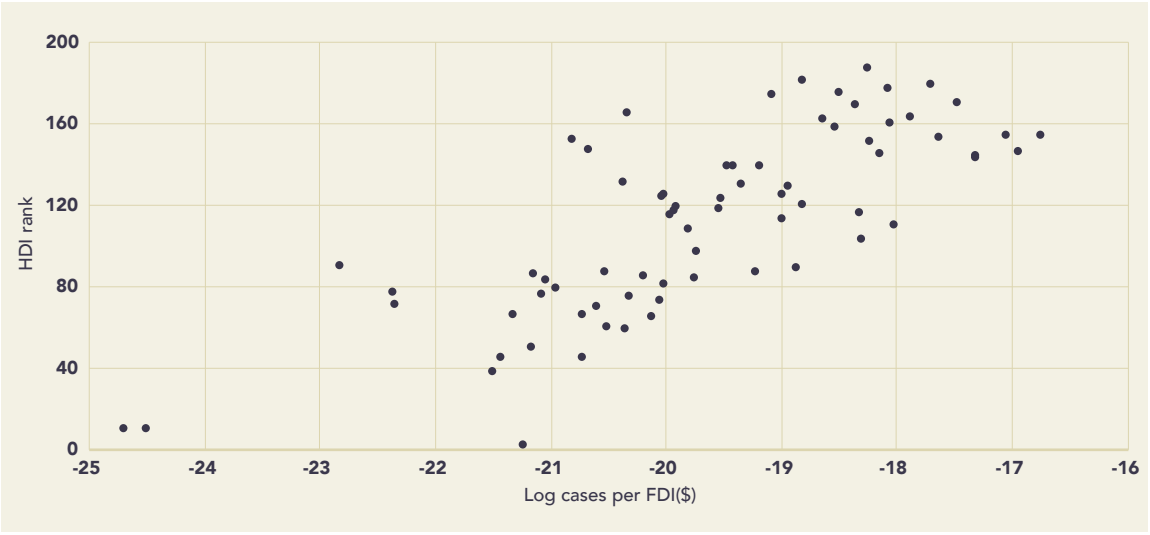
POVERTY

We used the Human Development Index (HDI) to analyse the relationship between national levels of poverty and the occurrence of tenure conflicts.[36] We compared the 'cases per dollar of FDI' data with the average HDI value for periods in which conflict occurred and the two years preceding the conflict. Following previous studies suggesting links between poverty levels and tenure conflicts, we expected to see lower levels of human development associated with higher levels of tenure conflict.[37]

As Figure 3.6 shows, there is a strong linear relationship between the HDI rank of a given country and the number of tenure disputes that occur per average dollar of FDI. The higher a country's level of human development (i.e., the lower its levels of poverty), the fewer cases of tenure dispute it sees in proportion to the amount of FDI it receives.

Figure 3.6 also suggests that, while this relationship holds true at a global level, the strength of the trend varies when considering different income brackets. In particular, for low-income countries the opposite trend appears to be the case (where higher HDI rank appears to correlate with higher levels of dispute per dollar of FDI), i.e. we do not see disputes so regularly in the very poorest places.

FIGURE 3.6: RELATIONSHIP BETWEEN TENURE DISPUTES, FOREIGN INVESTMENT AND HUMAN DEVELOPMENT



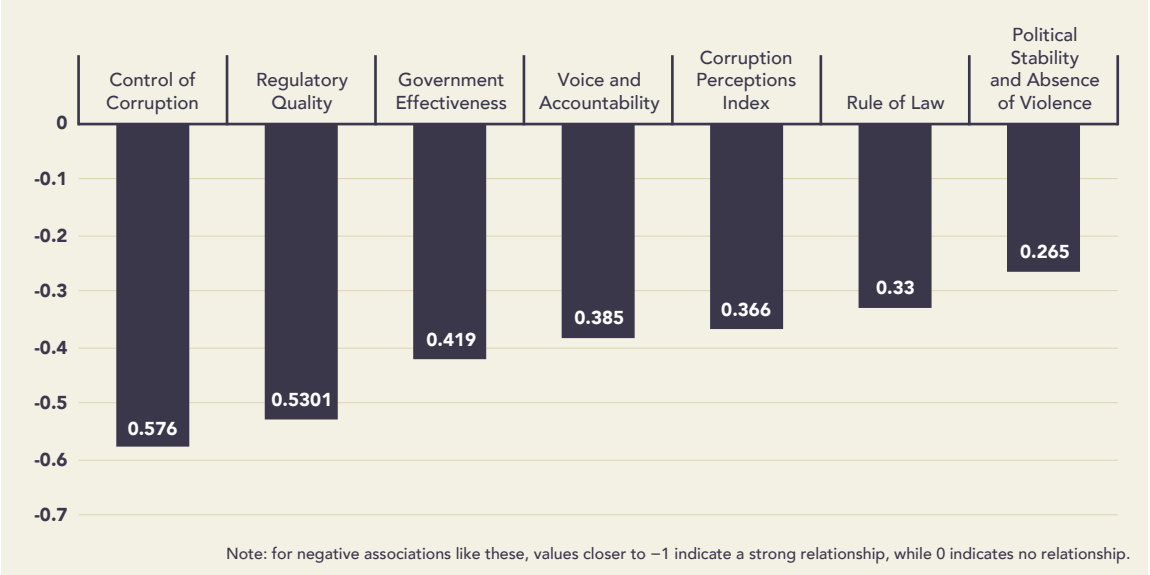
GOVERNANCE

We know from previous research that governance is a key factor for tenure disputes, where poor regulation and enforcement, corruption and repression all contribute to a context prone to tenure disputes.[38] We focused on seven indicators drawn from two datasets: the six indicators of the WGI dataset produced by the World Bank, and the CPI released by Transparency International (see Figure 3.7 and the descriptions in following sections).

We used an average of the six WGI values for a given country for the two years preceding each conflict and the year of the conflict (1996–2016). This provides a sense of the prevailing governance context when conflicts occur and accounts for the comparatively long time-frames for investing in major projects, as well as giving a sense of when governance conditions were *not* contributing to tenure disputes.

For each indicator of governance, we expected inferior governance scores to be associated with higher rates of tenure dispute per dollar of FDI. Our results confirmed this hypothesis: each of these indicators had a statistically significant relationship with the incidence of tenure risk. Figure 3.7 shows the strength of the association for each of the governance variables that we examined.

FIGURE 3.7: STRENGTH OF CORRELATION FOR EACH GOVERNANCE INDICATOR



Note: for negative associations like these, values closer to –1 indicate a strong relationship, while 0 indicates no relationship.

CORRUPTION

The WGI 'Control of Corruption' indicator measures perceptions of 'the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.'[39] In our qualitative assessments of tenure disputes, we have frequently seen cases in which corruption has played a major role in tenure disputes – for example, when permits are improperly granted. De Schutter[40] provides further evidence that these are not isolated incidents.

For Control of Corruption, we found a statistically significant relationship with tenure conflicts (correlation coefficient −0.466). We found that Transparency International's Corruption Perceptions Index[41] also showed a statistically significant relationship, although with a somewhat weaker correlation (correlation coefficient −0.366).

REGULATORY QUALITY

Regulatory Quality – an indicator of 'perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development' – has strong intuitive connections with tenure disputes.[42] Where regulations and policies do not adequately cover issues around private investment in land, there exists a significant space for deal-makers to ignore local peoples' usage of and rights to natural resources.

We found a statistically significant negative linear relationship between Regulatory Quality and tenure risk (correlation coefficient −0.519). As regulatory quality decreases, the number of tenure cases per dollar of FDI increases.

VOICE AND ACCOUNTABILITY

The Voice and Accountability indicator assesses perceptions of the democratic inclusion of citizens, freedom of expression, freedom of association and a free media, at the national level.[43] Low accountability theoretically allows government officials to bypass local claims to land and resources. Limits on freedoms of association and the media can also prevent affected groups from effectively asserting their claims to local resources in negotiations, ultimately fostering unresolved grievances and direct action. On the other hand, we might expect repressive regimes and poor media freedom to stifle dissent and thus lessen the incidence (and reporting) of major disputes.

Our statistical analysis showed a moderate-to-small linear association with the incidence of tenure conflict (correlation coefficient −0.257). As citizens' freedom of expression and dissent, and governmental accountability increase, the rates of tenure conflict per dollar of FDI decrease.

POLITICAL STABILITY AND ABSENCE OF VIOLENCE

The Political Stability metric measures 'perceptions of the likelihood of political instability and/or politically-motivated violence, including terrorism'.[44] We might expect a strong correlation between this indicator and tenure disputes, given the associations between conflict events and tenure disputes. Additionally, political instability could allow elites space to further their own interests at the expense of disempowered communities and unwitting investors.

We found a weak linear association between the two variables (correlation coefficient −0.146). While lower political stability, overall, is associated with higher levels of tenure conflict, there are a number of places – especially with middling scores for this indicator – that do not follow this trend.

GOVERNMENT EFFECTIVENESS

Government Effectiveness is defined as 'perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.'[45]

Effective implementation of regulations around tenure issues is critical to avoiding disputes. In many instances, we have seen that companies working in weak regulatory enforcement get caught out later when national governments, often under significant pressure from civil society, choose to enforce regulations at local level.[46]

The capacity of the civil service at national, but also local, level is particularly important in enabling projects to move forward as planned – delays and changes can damage trust between operators and communities. For example, companies may promise compensation that is then not paid out on time or in full, but have little recourse as executing compensation is the government's responsibility. This capacity is also critical in codifying and resolving the myriad land claims and disputes that are typical of emerging markets, and which frequently contribute to tenure conflicts. Increasingly, these complexities are

understood by national governments, but many local administrations are still not able to provide useful and accurate guidance and support.

We found a moderate-to-strong negative correlation between Government Effectiveness and the incidence of tenure conflicts per dollar of FDI (correlation coefficient −0.563).

RULE OF LAW

This indicator describes perceptions of how much confidence and respect people have in the rules set out by society, focusing on 'quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.'[47] In theory, this indicator should be important to tenure disputes, as we know of associations between other measures of violence and tenure conflicts, and strong property rights could be seen as important to protecting the rights of people threatened with dispossession of their land.

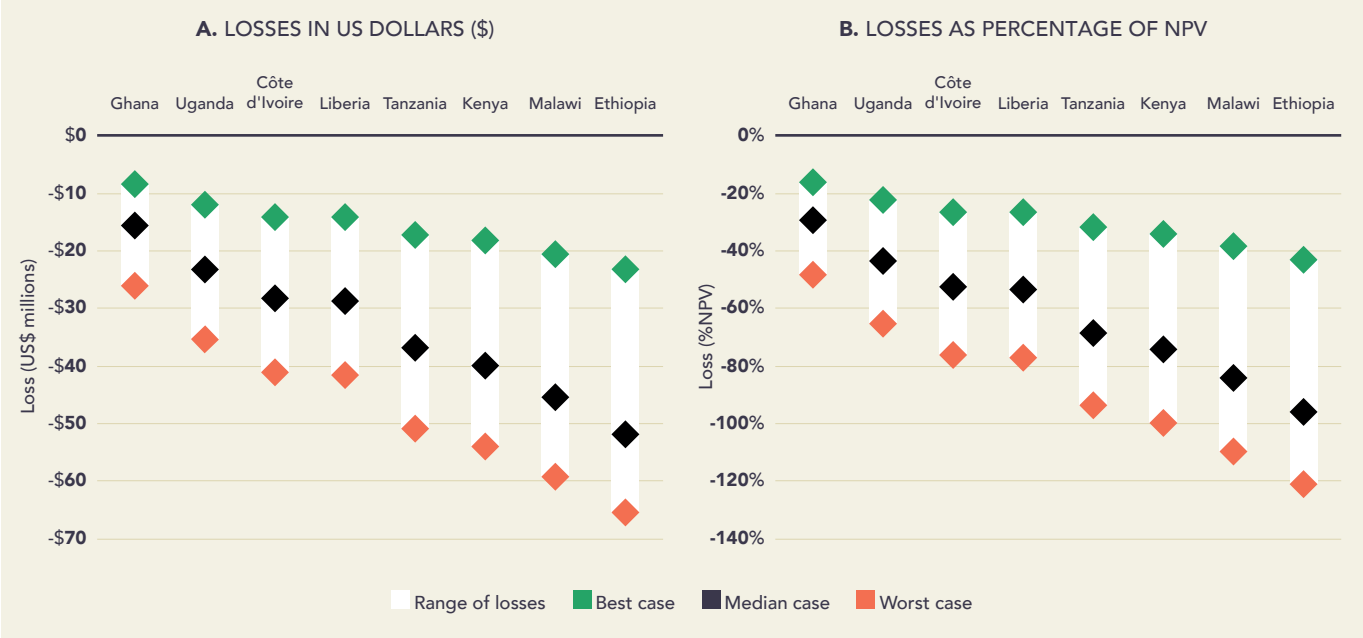
We found a negative association between Rule of Law and tenure conflicts per dollar of FDI over the period studied. However, the association identified was fairly weak (correlation coefficient −0.33).

APPENDIX 4: VARIABLES

LOCATION

The model is highly dependent on the 'uncertainty risk score' associated with the project. We can see the impact of geography on potential losses in Figure 4.1, which displays the risk (in terms of US$ and % of original discounted net present value (NPV)) in best, worst and median case scenarios for a 7,500-hectare greenfield sugar cane project in eight different countries. In the Volta Region of Ghana, where the risk score is relatively low (41), the range of losses is between $8 million and $26 million, or 16–48% of the base case NPV. Ethiopia displays a considerably higher risk score of 68 and the range of losses according to the model reflects this, extending to $23–65 million or 43–121% of the original NPV of the investment.

FIGURE 4.1: RANGE OF LOSSES FOR A GREENFIELD SUGAR-CANE PROJECT IN EIGHT AFRICAN COUNTRIES (DR = 15%)



COMMODITIES

Results differ between commodities as a result of their varying production and harvesting cycles, and scale of upfront capital needed. While oil palm and coffee are considered perennial tree crops, rice is an annual crop that can be harvested up to three times a year depending on its variety and whether it is irrigated. Sugar cane sits in between as it is typically produced in two-year cycles compared to oil palm and coffee, which take several years to reach maturity.

These characteristics can have an impact on the results of the model. Oil palms typically take three to four years to start yielding and need to be replaced after around 20–25 years. To avoid disruptions in production that would result from having to replant older trees at the same time, planting takes place at a much slower rate than it does for other crops. As a result, capital costs – for instance in the establishment of nurseries or the construction and expansion of mills – are spread out over a longer period. This is reflected in the distribution of lost NPV between green- and brownfield projects, which can be similar (particularly towards the beginning of a project) depending on how much planting has been undertaken, but diverge over time to reflect the increasing capital costs associated with establishing oil palm plantations.

Sugar cane is typically harvested after 18 months and replanted every six to eight years in African countries, meaning that plantations can reach their desired capacity at a much faster rate. This requires enormous upfront capital costs for constructing a full-capacity mill and, often, a need to install irrigation. The divergence between the NPV losses of a brown- and greenfield project are therefore always apparent, putting greenfield sugar cane projects at particular risk.

As an annual crop, rice can be harvested in the same year it was planted. In addition, processing needs (drying, hulling and milling) are low compared to oil palm and sugar cane and do not necessarily need to take place in the vicinity of the plantation.

The short cropping cycle associated with rice means that delays have an instant and very strong impact on NPV. The large difference between green- and brownfield projects is a reflection of the low margins associated with rice production. Even though capital costs are low, they can have a large impact in terms of the NPV loss, as delays make it difficult to recuperate lost production.

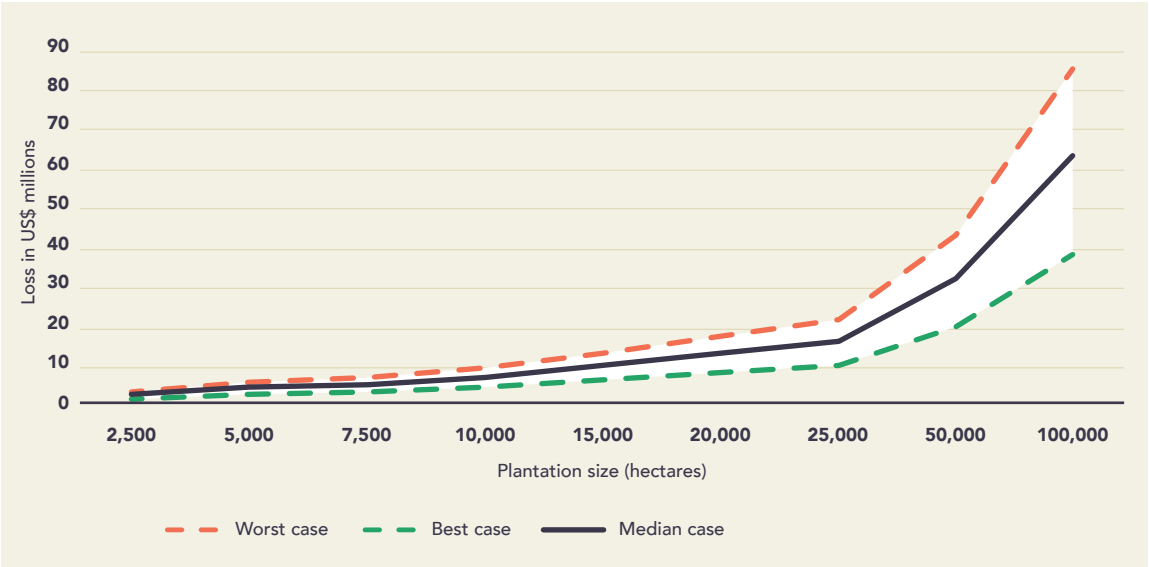
We did not include coffee in this comparison because it is inherently a smallholder crop with plantation sizes rarely exceeding 2,000 hectares. Although coffee trees take longer to mature than oil palm, the beans do not require significant processing beyond drying and hulling, so capital costs are therefore limited.

PLANTATION SIZE

Figure 4.2 illustrates the range of financial losses that palm-oil investments risk incurring across a range of different plantation sizes in the case of Liberia. Even smaller operations with a size of 2,500 hectares can face delays to their operations, costing them between $1 million and $2.5 million in forgone revenue. Larger projects covering 100,000 hectares face losing up to $84.3 million when land-tenure disputes become active.

As a percentage of base case NPV, losses are particularly large for smaller projects, but tend to stabilise the larger the project becomes. This is due to the lower base-case NPVs associated with smaller investments. For instance, the base case discounted NPV (without tenure disputes occurring) for a 2,500-hectare plantation in Liberia is just under $500,000. This compares to a potential loss of nearly $1.3 million under a median-case scenario of delays caused by active tenure conflicts (a loss of 361% in terms of the base case NPV). Medium- and large-scale operations with over 7,500 hectares see losses, in percentage terms, reduce to around 50% of the base case NPV as they can recuperate delays to operations with much larger revenues in a way that smaller producers cannot.

FIGURE 4.2: RANGE OF LOSSES UNDER A LIBERIAN GREENFIELD OIL-PLANTATION BY SIZE (DR = 15%)

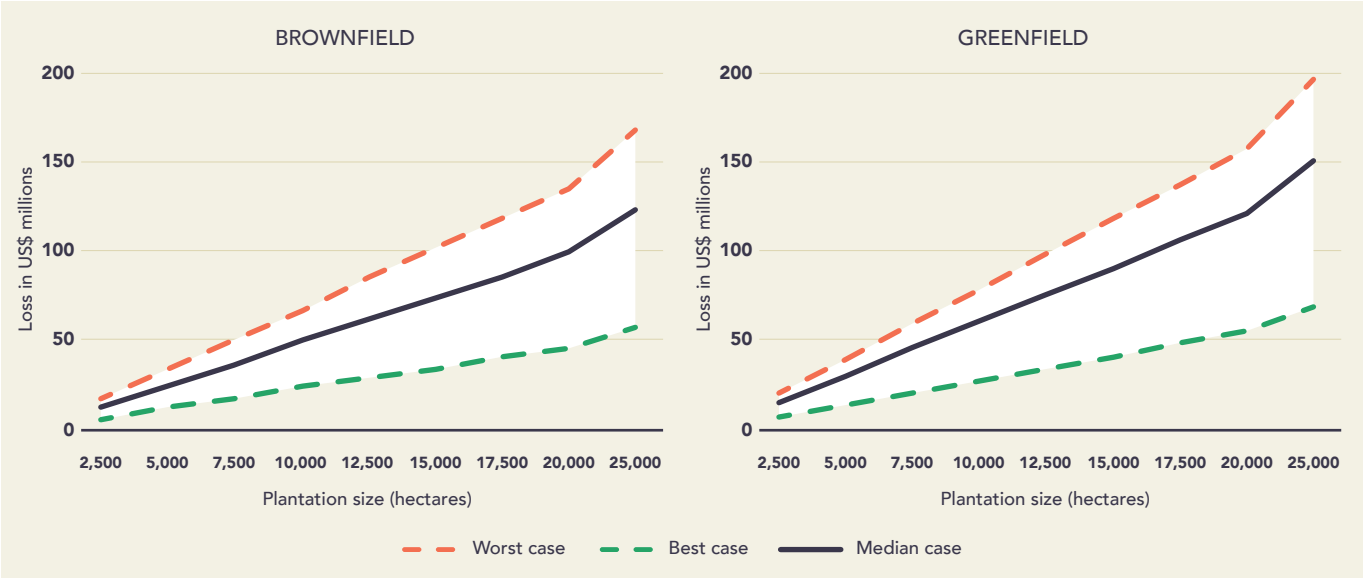


BROWNFIELD VERSUS GREENFIELD INVESTMENTS

Our research showed that many disputes started before operations had even begun. In the sugar sector this has resulted in producers and investors focusing on rehabilitating or expanding existing sites rather than pursuing greenfield projects governed by complex land rights. The increasing pressure of expansion on brownfield sites carries its own risks, since it can reignite or exacerbate existing disputes over legacy land issues. There are often deeply held historical grievances over the original transfer of land that come back to haunt plantation managers generations later if not properly addressed.

The results of the model distinguish between greenfield and brownfield losses. We used a sugar-cane plantation investment in Malawi to investigate these varying losses in Figure 4.3. Losses are, on balance, higher for a greenfield investment, increasing by up to $197 million for a 25,000-hectare project against $117 for a similar brownfield project. However, the range of losses between the two projects is as wide, or wider, for brownfield investments. For instance, the difference between these two scenarios for a 25,000-hectare brownfield project is $25 million, against $23 million for an equivalent greenfield investment. Particularly in the sugar sector, we can see legacy issues broadening the range of potential losses for brownfield investments.

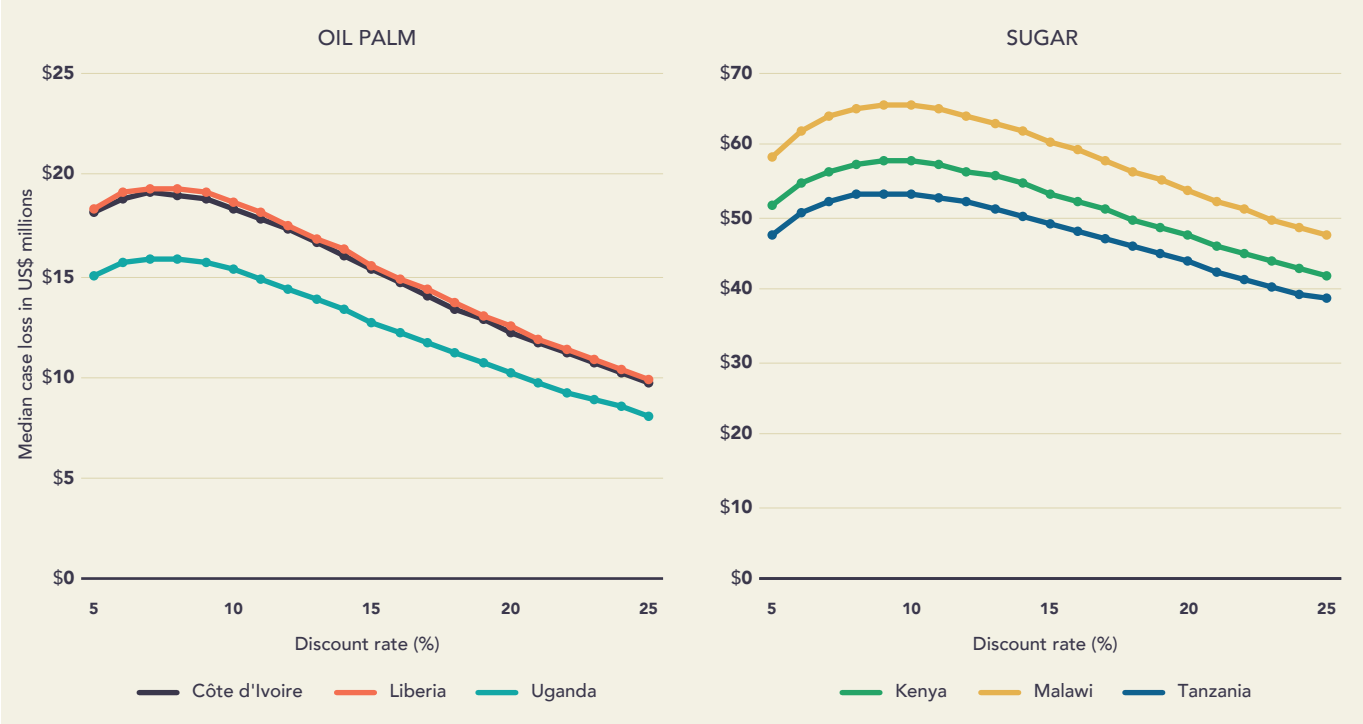
FIGURE 4.3: TENURE RISK OF BROWNFIELD (LEFT) AND GREENFIELD (RIGHT) SUGAR INVESTMENT IN MALAWI, BY PLANTATION SIZE



DISCOUNT RATES

As with any discounted cashflow, the results of the model are also sensitive to the discount rates applied (Figure 4.4). The impact of tenure disputes on financial losses typically increases from a very low discount rate (5%) but declines sharply thereafter and eventually levels off. This is because discount rates affect not only the different risk scenarios but the base case scenario as well. Where capital costs are high, such as with oil-palm and sugar investments, high discount rates reduce the NPV of the base case scenario (where tenure disputes are absent). This also reduces the potential loss that tenure disputes cause against that base case scenario.

FIGURE 4.4: FINANCIAL IMPACT OF TENURE RISKS ON OIL-PALM (LEFT) AND SUGAR (RIGHT) SECTORS BY COUNTRY AND DISCOUNT RATE



ENDNOTES

1. https://landscope.info/

2. We created this distribution using a strict definition of what constitutes a 'delay'. Our research counted only complete suspensions of work that could be directly attributed to land and resource disputes. We did not review instances in which progress had been much slower than originally expected. This choice was made because it is too hard to attribute these slowdowns to tenure issues rather than, for example, inefficient management or regulatory hurdles. As a result, the severe delays presented above are conservative estimates.

3. https://landscope.info/

4. TMP Systems has compiled this data as a part of its work on a separate project, called IIT, completed with funding from the United Kingdom's Department for International Development.

5. These indicators are taken from reliable and respected public sources such as NASA, ESA, World Bank, UN, Oxford University, Columbia University and World Resources Institute (WRI). These datasets have been selected and vetted for relevance and robustness by the team at TMP Systems. They cover the likes of: population, poverty and social welfare, conflict, land-use classifications, water availability, regulatory quality, and corruption. These factors were identified as relevant through analysis of over 500 cases of tenure dispute globally and subsequently through the quantitative analysis described in this document.

6. We have compared these results with other sectors to determine that these results have general value, e.g. in sectors like sugar and soy.

7. http://gis-gfw.wri.org/arcgis/rest/services/commodities/MapServer/27

8. The 'control' palm oil mill dataset was generated by the World Resources Institute, with full details available at: http://data.globalforestwatch.org/datasets/ed8d5951b2a4482a9e62c4fe0bc23b5f_27?geometry=-83.538%2C-23.654%2C69.04%2C34.805. The full Case Study database is available to download at: http://www.tmpsystems.net/ian-diligence/

9. https://landscope.info/

10. https://www.wri.org/blog/2015/12/palm-oil-mill-data-step-towards-transparency

11. We used ArcGIS to calculate 'buffer areas' around each location in each dataset. These buffer areas were a circle with a radius of 50km from the location. For each indicator, we extracted all the data values for the area within that circle, and either provided an average or total count of those values. We then used a variety of statistical techniques to assess the strength of the relationship between each indicator and the presence of tenure conflicts, depending on the nature of the data. We used simple binomial regression models to determine whether indicators were significant predictors, and Mann–Whitney *U* tests where normal distributions were not seen. We then used Cliff's Delta to provide a comparable sense of the strength of association.

    For national-level indicators, we first normalised the 'cases per FDI US$' data by log-transforming the dataset, and performed a Shapiro–Wilk normality test to confirm normality. We then calculated Spearman's correlation coefficient to determine linear relationships, and used Cohen's standard to determine the strength of the association.

12. Our threshold for 'statistical significance' is a 95% confidence level.

13. For linear correlations, the strength of the relationship was determined using Pearson's coefficient and Cohen's standard for correlation coefficients. When testing the difference between the two groups of samples (tenure and no tenure) the strength of the relationship was decided by calculating an effect size using either Cohen's d (for normally distributed data) or Cliff's Delta (for non-normally distributed data).

14. In the sub-national analyses, we were primarily analysing whether the presence of tenure conflict is significantly associated with known risk factors (such as population growth), making use of binomial regression and appropriate statistical hypothesis. However, in these national-level analyses, we are more focused on macro-level conditions, and are able to draw linear regressions across a number of countries plotted against the indicator of interest.

15. https://www.prindex.net/

16. Kirchherr, J., Charles, K.J. and Walton, M.J. (2016) 'Multi-causal pathways of public opposition to dam projects in Asia: a fuzzy set qualitative comparative analysis (fsQCA)' *Global Environmental Change* 41: 33–45.

17. For environmental factors, a useful overview is provided in Bernauer, T., Böhmelt, T. and Koubi, V. (2012) 'Environmental changes and violent conflict' *Environ Res Lett* 7: 015601.

18. http://rightsandresources.org/wp-content/uploads/RRI_IAN_Managing-Tenure-Risk.pdf

19. Gassert, F., Landis, M., Luck, M., Reig, P. and Shiao, T. (2014) *Aqueduct global maps 2.1*. Working Paper. Washington DC: World Resources Institute (http://datasets.wri.org/dataset/9ac625fb-43c8-4635-b2d3-f53feaf0a979).

20. The eight indicators are: Baseline water stress, Interannual variability, Seasonal variability, Flood occurrence, Drought occurrence, Groundwater stress, Return flow ratio, and Threatened amphibians. Descriptions of each are available at: https://www.wri.org/publication/aqueduct-global-maps-21

21. We are aware that the areas where oil palm is grown in Africa typically see less consistent rainfall than in Southeast Asia. Production in these areas is more seasonal. In some instances, particularly in East Africa, palm projects have to be supported by irrigation to provide water consistently.

22. GlobCover is an ESA initiative which began in 2005 in partnership with JRC, EEA, FAO, UNEP, GOFC-GOLD and IGBP. The aim of the project is to develop a service capable of delivering global composites and land-cover maps using input observations from the ENVISAT satellite mission: http://due.esrin.esa.int/page_globcover.php

23. A protected area is a clearly defined geographical space, recognised, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (https://www.iucn.org/theme/protected-areas/about).

24. The boxplot describes this as the 'GIS area'. This refers to the areal extent of the protected area according to the geospatial data and analytical tools that we used.

25. Franks, D.M., Davis, R., Bebbington, A.J., Ali, S.H., Kemp, D. and Scurrah, M. (2014) 'Conflict translates environmental and social risk into business costs' *Proceedings of the National Academy of Sciences* 111(21): 7576–7581 (http://www.pnas.org/content/111/21/7576).

26. Kirchherr, J., Charles, K.J. and Walton, M.J. (2016) 'Multi-causal pathways of public opposition to dam projects in Asia: a fuzzy set qualitative comparative analysis (fsQCA)' *Global Environmental Change* 41: 33–45

27. For example: https://www.worldwater.org/water-conflict/ (water); https://www.prio.org/Projects/Project/?x=1735 (inequality); https://www.sida.se/contentassets/c571800e01e448ac9dce2d097ba125a1/working-paper--climate-change-and-conflict.pdf (climate); https://soc.kuleuven.be/crpd/files/working-papers/wp02.pdf (population/demography); http://www.fao.org/news/story/en/item/1073611/icode/ (food security).

28. http://rightsandresources.org/wp-content/uploads/RRI_IAN_Managing-Tenure-Risk.pdf

29. https://rightsandresources.org/wp-content/uploads/Communities-as-Counterparties-FINAL_Oct-21.pdf

30. http://sedac.ciesin.columbia.edu/data/collection/gpw-v4

31. https://icr.ethz.ch/data/epr/geoepr/

32. We used a Mann–Whitney *U* test.

33. The ACLED database records data on conflict and violence in the developing world (https://www.acleddata.com/).

34. The MPI provides data that identifies 1.3 billion people who are multidimensionally poor across 105 countries (https://ophi.org.uk/multidimensional-poverty-index/databank/)

35. In the sub-national analyses, we were primarily analysing whether the presence of tenure conflict is significantly associated with known risk factors (such as population growth), making use of binomial regressions. However, in these national-level analyses, we are more focused on macro-level conditions, and are able to draw linear regressions across a number of countries plotted against the indicator of interest.

36. For sub-national analyses we use the MPI dataset, which is globally comparable and provides poverty data at the level of district or other local administrative division. However, the MPI dataset currently only covers 103 countries, so for a truly global assessment of risk we used the HDI, which has coverage of 189 countries and similar definitions of poverty to the MPIs.

37. Kirchherr, J., Charles, K.J. and Walton, M.J. (2016) 'Multi-causal pathways of public opposition to dam projects in Asia: a fuzzy set qualitative comparative analysis (fsQCA)' *Global Environmental Change* 41: 33–45

38. Ibid.

39. https://tcdata360.worldbank.org/indicators/hc153e067?country=BRA&indicator=364&viz=line_chart&years=1996,2017

40. De Schutter, O. (2016) *Tainted lands: corruption in large-scale land deals*. San Francisco CA and Washington DC: International Corporate Accountability Roundtable and Global Witness (https://www.icar.ngo/publications/2017/5/9/tainted-lands-corruption-in-large-scale-land-deals).

41. https://www.transparency.org/news/feature/corruption_perceptions_index_2017?gclid=EAIaIQobChMI67Sq3bbh3gIV7ZTtCh0XYQKoEAAYASAAEgLhzPD_BwE

42. https://tcdata360.worldbank.org/indicators/h3e8d3565?country=BRA&indicator=394&viz=line_chart&years=1996,2017

43. https://tcdata360.worldbank.org/indicators/hd8f5d509?country=BRA&indicator=40267&viz=bar_chart&years=2015

44. https://tcdata360.worldbank.org/indicators/af0edbbc?country=BRA&indicator=40273&viz=line_chart&years=2013,2018

45. Ibid.

46. For example, EcoEnergy's project in Bagamoyo, Tanzania, was eventually cancelled after some of the land was designated as a protected area. But the land had been suggested and allocated by the government, which was initially highly supportive of the project. It seems that this support was removed following a series of tenure disputes and civil society campaigns.

47. Ibid.

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