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# Land Conflicts in Kenya: Causes, Impacts, and Resolutions

Takashi Yamano<sup>1</sup> and Klaus Deininger<sup>2</sup>

<sup>1</sup> Foundation for Advanced Studies on International Development /  
National Graduate Institute for Policy Studies

<sup>2</sup> The World Bank

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## Abstract

Because of changes in some underlying factors, land is increasingly becoming a source of conflicts in Africa. We estimate the determinants of land conflicts and their impacts on input application in Kenya by using a recent survey of 899 rural households. We find that widows are about 13 percent more likely to experience pending land conflicts when their parcels are registered under the names of their deceased husbands than when titles are registered under their names. We also find that pending conflicts reduce the organic fertilizer application, which can be considered as short-term investments in soil structure.

Key words: Conflicts, Land Tenure, Agriculture, Kenya, Africa

Corresponding author: Takashi Yamano

Address: 7-22-1 Roppongi, Minato-ku, Tokyo 106-8677, Japan

National Graduate Institute for Policy Studies

Tel: +81-3-5413-6036

Fax: +81-3-5413-0016

Email: [yamanota@grips.ac.jp](mailto:yamanota@grips.ac.jp)

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## **1. Introduction**

Land is increasingly becoming a source of conflicts in Sub-Saharan Africa, where land access had traditionally been characterized as relatively egalitarian. It has been shown that local land conflicts can erupt into large-scale civil strife and political movements (Andre and Platteau, 1998; Fred-mensah, 1999; Daudelin, 2002). Some underlying factors, such as population pressure,<sup>1</sup> agricultural commercialization, and urbanization, have contributed to the increasing number of land conflicts, and the current land tenure systems in Africa may not be well-equipped to resolve such conflicts (Cotula, Toulmin, and Hesse, 2004; van Donge, 1999). In many African countries, formal institutions for land administration were often simply superimposed on traditional structures without a clear delineation of responsibilities and competencies, implying that they lack both outreach and social legitimacy (Deininger, 2003).

Despite the increasing incidences of land conflicts, previous studies on this topic have been limited to some specific incidences that are related to large-scale civil strife or politically motivated conflicts. A recent study in Uganda, however, shows that rural households experience small-scale land conflicts with relatives, neighbors, landlords, or local governments, and that such small-scale conflicts may have significant impacts on their agricultural productivity (Deininger and Castagnini, 2005).

The purpose of this study, therefore, is to assess the prevalence of land conflicts, examine who suffers from such conflicts, and measure the impacts of land conflicts on farm input application in Kenya. We estimate the determinants of land conflicts at three levels of conflicts (concerned about future conflicts, pending current conflicts, and resolved past conflicts) with the Multinomial Logit model at the parcel level.<sup>2</sup> Then, we estimate the impacts of land conflicts on farm input application (organic and inorganic fertilizer) at the plot level. Because Kenya has one of the most advanced land titling systems in Africa, the findings from this country will provide valuable lessons to other African countries that are in the process of modernizing their land titling systems.

The paper is structured as follows: Section 2 explains the data used in this study and provides descriptive information about land conflicts in rural Kenya. Section 3 proposes the estimation strategies and defines the variables. The estimation results are discussed in Section 4, followed by the conclusions in Section 5.

## **2. Data and Descriptive Analysis**

### **2.1. Data**

The data used in this paper come from 899 households interviewed in a survey conducted in 2004. This survey was conducted as part of the Research on Poverty and Environment and Agricultural Technology (REPEAT) Project.<sup>3</sup> The survey randomly took samples from three surveys conducted by the International Livestock Research Institute (ILRI) in 1996, 1998, and 2000. The three ILRI surveys used a similar sampling method and covered about 3,300 households who resided in central and western regions of Kenya. From the sub-locations that the ILRI samples located, we selected 100 sub-locations randomly and 10 households from each of the 100 chosen sub-locations. In Figure 1, we present the locations of the 100 sub-locations in the map of Kenya. Two waves of surveys were conducted in 2004 over a period of six months on the selected sample households. The first wave was conducted in February 2004, asking respondents about the previous six months (i.e., from August 2003 to January 2004). In October 2004, the second wave took place to cover the following six months, starting from February 2004.

Table 1 shows the number of sampled households and parcels across provinces and ethnic groups in Kenya. To focus on own parcels, we exclude 381 parcels that were rented-in for rent payments. We still include, however, parcels that were borrowed from relatives or others for free. We find that the sampled households are worried about future land conflicts on 9.3 percent of all parcels and have pending conflicts on 4.3 percent of their parcels. They have resolved conflicts on 8.1 percent of the parcels in the past. There are some differences in land conflicts across provinces. In Nyanza, land conflicts do not appear to be a prevailing problem, while in a nearby province, Western Province, households have more pending conflicts than

in any other provinces. This difference seems to be driven partly by the small land size, which is just 1.1 hectare per household, in Western province.

Unlike Western Province, the average land size in Rift Valley Province is large at 2.6 hectare per household, the largest across the provinces. Yet, households are still worried about future conflicts and have pending conflicts. This could be partly due to the high land productivity and partly to the mix of ethnic groups in Rift Valley Province. In Rift Valley Province, people from different ethnic groups have purchased land from white farmers since independence.

To observe the associations between land conflicts and ethnicity, we also divide the samples by ethnicity in Table 1. Masai households have pending conflicts on more than 14 percent of their parcels, and this is probably because they have large grazing land (the average parcel size is 12 hectare), which border on many households. However, they only worry about less than five percent of their parcels and have resolved conflicts on 19 percent of their parcels in the past. This may indicate that they have mechanisms to resolve conflicts and may not have pressing issues that cause them to worry about future conflicts. Other ethnic groups, on the other hand, have fewer pending conflicts currently than the Masai, but worry more about future conflicts. Especially those who have small land size worry about future conflicts. For instance, the Luhya, who reside mainly in Western Province, have pending conflicts on more than nine percent of their parcels and the average land size is only 1.1 hectare.

## **2.2. Descriptive Analyses**

### *Relationship between Land Titling and Conflicts*

Land scarcity and agricultural commercialization are expected to increase land value and lead to the individualization of land rights, creating opportunities to establish institutions to better define and enforce property rights (Boserup, 1965). In Kenya, however, the formal individualization of land has been in place since independence. The 1954 Swynnerton Plan granted secure individual land titles to African farmers, and the Plan was reinforced further by the Native Lands Registration

Ordinance 1959, replaced after independence by the Registered Land Act 1963 and the Land Adjudication Act 1968 (Migot-Adholla and Place, 1998). While the registration process might have increased tenure security for many land owners, it has also created new forms of disputes, such as challenges over registered land and conflicts over land sales (Shipton, 1988). Moreover, the high cost of registration has discouraged updating the registrations after land transactions, such as inheritance and sales.

In Table 2, we find that many sampled households have outdated land registrations. Out of the 1,167 parcels, more than 81 percent of them are registered, while the rest are unregistered. More than half of the registered parcels are under the name of either the household head or spouse who cultivates the parcels. However, the other half of the registered parcels bears names that are other than the household head or spouse. Instead, they bear the names of (living) parents, deceased parents, deceased husbands, or others. This situation arises when new land owners neglect to update the registration because of high costs or are prevented from doing so because they have not been able to reach an agreement among relatives over inheritance.

Turning to land conflicts, we find that the unregistered parcels have pending conflicts on 9.2 percent, while the registered parcels have pending conflicts on only 3.5 percent. Households are more worried about future conflicts on unregistered parcels than registered parcels. When the land registration has the name of either the household head or spouse, the land owners have pending conflicts on 2.3 percent of their parcels and are worried about future conflicts on 6.8 percent of the parcels. When the title has the name of the (living) parent of the household head, the situation is similar. However, if the title has the name of the deceased parent, then the current landowners, i.e. children, are worried about future conflicts on about 20 percent of their parcels. The high level of concern could be due to the expectation of potential conflicts with siblings or other relatives who might be interested in claiming the ownership of the parcels left by the deceased parents.

The proportion of pending conflicts is very high at 8.7 percent if the land titles belong to the deceased husbands. This suggests that widows are experiencing

pending conflicts with the deceased husbands' relatives. The prevailing practice after the death of a husband in Kenya is for the wife of the deceased husband to hold land in trust for her male children because customary laws rarely allow widows to legally inherit land (Drimie, 2002). In some cases, widows are often threaten to leave their land, which belongs to their husbands' ancestral land, especially when they have no children or refuse to marry one of their husbands' brothers (Wanyeki, 2003).<sup>4</sup> In Uganda, for instance, Deininger and Castagnini (2005) find that households headed by female and widows experienced more land conflicts than male headed households.

### *Causes and Resolution of Land Conflicts*

We further stratify the cases of land conflicts into three groups by the starting year: 32 conflicts started from 1965 to 1989, 45 conflicts from 1990 to 1999, and 67 conflicts from 2000 to 2004 (Table 3). To obtain information about actual conflicts, we select conflicts that are either pending or resolved in the past (columns C and D in Table 2). As the data indicate, we find more cases per year in recent years. Although this is consistent with informal information that land conflicts are more prevalent in recent years, it is not clear if this is due to the increasing cases of land conflicts or if the respondents neglected to mention past conflicts, although they were encouraged to do so by the interviewers. About half of the land conflicts are over boundaries that occur mainly with neighbors or relatives who live close by. The second most common reason for conflicts is over inheritance, which exclusively occurs among relatives. In the past five years, it appears that there are more conflicts related to land sales. As the value of land increases due to population pressure, agricultural commercialization, and urbanization, it is expected that the land sales market will develop over time. However, if property rights are not clearly defined, there could be more cases of land conflicts related to land sales.

In the survey, respondents were asked if they had resorted to informal or formal institutions to resolve land conflicts. Informal institutions include community elders or committees, while formal institutions include land tribunals or other governmental institutions. Over 91 percent of the land conflicts that started in

1990-1999 have been brought to informal institutions, and about 49 percent of them have been brought to formal institutions (Table 3). Note that 44 percent of the cases have been brought to both informal and formal institutions. In a related question, respondents were asked why they did not resort to informal or formal institutions. The dominant answer to this question about not resorting to formal institutions suggests that they had resolved the conflicts informally before turning to the formal institutions. The second most common answer to this question is that it is too expensive to bring a case to a formal institution. Therefore, it seems that most cases are brought to informal institutions first, and if the informal institutions are unable to resolve the conflicts and if the complainants have sufficient resources, then the cases are brought to formal institutions.

Regarding the more recent conflicts that started from 2000 to 2004, we find that over 89 percent of the cases have been brought to informal institutions but only about 25 percent of them have been brought to formal institutions. According to the argument above, it seems reasonable to expect that many cases will be brought to formal institutions in the future when informal institutions are unable to resolve the conflicts.

#### *Impacts of Land Conflicts on Input Application*

There exist a rich literature on land tenure security and farm production and investment (Otsuka and Place, 2001). Many of the studies implicitly assume that the weak tenure security is associated land conflicts but do not actually examine land conflicts directly. However, a recent study by Deininger and Castagnini (2005) suggests a 5 to 11 percent productivity loss due to land conflicts. Similarly in Kenya, especially in the western regions closer to Lake Victoria, the HIV/AIDS epidemic has greatly increased the number of widows. Yamano and Jayne (2004), for instance, show that the death of a working-age male household head reduces the land allocated to high value crops and results in a large reduction in per capita household crop value production. Although various factors affect crop production after the death of a working-age male head, land conflicts might be a contributing factor to the reduction

in crop production.

To investigate this issue, we present the input applications per hectare in Table 4, stratified by the land conflict status. We find that the average manure application is significantly lower on parcels with pending conflicts: the average manure application is 1,515 kilograms per hectare on pending conflicts in column D, while it is 3,720 kilograms per hectare on parcels with no conflicts in column A. The difference between the two is statistically significant at the five percent level. When we stratify the pending conflicts based on the causes of the conflicts in columns E-H, we find that organic fertilizer application is drastically lower when the conflicts are related to inheritance or eviction than when there is no conflict: the organic application is 692 kilograms per hectare when the parcel is under the inheritance related conflicts, and it is only 388 kilograms per hectare when it is under the eviction related conflicts. Thus, it seems that households reduce organic fertilizer application when they fear of losing land through inheritance or eviction related conflicts.

Although the chemical fertilizer application is also lower on parcels with pending conflicts, it is not statistically different from the average chemical fertilizer application on parcels with no conflicts: the average chemical fertilizer application is 83.7 kilograms per hectare on pending conflicts, while it is 94.0 kilograms per hectare on parcels with no conflicts. Even when we stratify the parcels with pending conflicts based on their causes, we do not find any significant differences between parcels with pending conflicts and with no conflicts. Because chemical fertilizer is only effective for one or two production seasons, farmers may not have a reason to reduce chemical fertilizer application unless they fear of losing the parcels during a cropping season due to land conflicts.

### 3. Estimation Strategies and Variables

#### 3.1. Estimation Strategies

##### *Determinants of Land Conflicts*

To examine the characteristics of households that are experiencing different levels of land conflicts, we divide parcels into four groups, as we did in Table 2, and estimate the following Multinomial Logit (MNL) model at the parcel level:

$$Prob(c_i) = f(\mathbf{T}_i, \mathbf{P}_i, \mathbf{X}_i), \quad (1)$$

where  $c_i = 1$  if the household is worried about the future conflicts over parcel  $i$ ,  $c_i = 2$  if parcel  $i$  has a pending conflict,  $c_i = 3$  if parcel  $i$  had a conflict that has been resolved, and  $c_i = 0$  otherwise.  $\mathbf{T}_i$  is a set of land titleholder variables of parcel  $i$ ;  $\mathbf{P}_i$  is a set of parcel characteristics; and  $\mathbf{X}_i$  is a set of household and community characteristics. To capture the access to informal institutions for resolution at the community level, we include the number of elder groups per 1,000 households in the community. We also include 14 district dummies to control for regional characteristics. Since the land conflicts variables do not change much over cropping seasons within a year, we use the data from the first cropping season of 2004. To make interpretations of estimated coefficients meaningful, we calculate the marginal changes in the probability for each outcome category according to Wooldridge (2002; pp. 497). Estimated coefficients on a continuous variable are the marginal changes in the probability for each outcome category measured at the mean values, and estimated coefficients on dummy variables are changes in the probability for each outcome category when the value of the dummy variables changes from zero to one.

##### *Impacts on Input Application*

Next, we estimate the impacts of land conflicts on farm input application at the plot level:

$$\ln(Y_{hi}) = f(c_i, \mathbf{T}_i, \mathbf{P}_i, \mathbf{X}_i), \quad (2)$$

where  $Y_{hi}$  is the amount of input applied to plot  $h$  in parcel  $i$  and the other variables are defined as before. We estimate this equation at the plot level, rather than at the parcel

level, because inputs are applied at the plot level. In Kenya, households often have only one or two parcels. To diversify their crop production, they divide one parcel into small plots and plant crops separately. Thus, we can obtain more accurate information about the determinants of input applications if we estimate the model at the plot level. We focus on two important inputs in Kenya: organic and chemical fertilizer. Theoretically, we need to include all input and output prices that may affect the input application, but we do not have all the price information. Instead, we include 95 community (i.e., sub-location) dummies, assuming that all the prices are uniform within the community. Because there are two cropping seasons in most parts of Kenya, we estimate the model with a pooled data of two cropping seasons in 2005. Finally, since inputs are not applied on all parcels, we estimate the equation 2 with Tobit.

A concern arises about the correlation between some of the explanatory variables and the error term, which includes unobserved parcel and household characteristics. One example of such unobserved characteristics is the quality of the parcel. If land conflicts are more likely to occur because of the high quality of the parcel, then the coefficient of the land conflict variables would be biased positively (or negatively) if the input application is positively (or negatively) correlated with the quality of the parcel. To overcome this problem partly, we include the rent of the parcel for one cropping season in the regression. The rent is estimated by respondents for each parcel under a hypothetical question of “How much rent would you get on this parcel if you were going to rent it for one season?” Although, a subjective nature of the variables raises some concerns about the quality, we think it is still a useful variable since there is no alternative. Yet, the concern about the omitted variables problem still remains. One way to reduce the remaining concern is to use instrumental variables that are correlated with the land conflicts but not with the input application. Unfortunately, we do not find plausible instrumental variables that satisfy such a condition for this study.<sup>5</sup> Another way to reduce the omitted variables problem is to use the parcel level fixed effects model, which will control for time invariant fixed effects that might be correlated with the land conflict variables.

However, since the land conflict variables do not change much over a season, we do not have sufficient variation in the land conflict variables in our data. Because of the lack of plausible instrumental variables and the lack of within parcel variations in the land conflict variables over a season, we simply present the Tobit results of equation 2 without controlling for the potential correlation between the land conflict variables and the error term. Thus, the results from the input application should be interpreted carefully. Despite such potential drawbacks, however, the results presented in the later section have some important policy implications.

### **3.2. Variables**

As already described in Table 2 and other places, we define land conflicts in four stages: concerned about future conflicts, pending conflicts, resolved conflicts, and otherwise. For estimations, we create a dummy variable for each conflict stage. These variables represent  $c_i$  in the previous sub-section. On the land titleholder information,  $T_i$ , we also create dummy variables for different land titleholders as specified in Table 2, namely head/spouse, parents, deceased parents, deceased husbands, others, and no land title. We treat the parcels whose titleholder is the household head or spouse as the base group since this is the largest group among the various land titleholders.

Parcel characteristics,  $P_i$ , include parcel size in ha, walking time to the parcel from the homestead in minutes, years since the acquisition of the parcel, a dummy variable for purchased parcels, and the rent for one cropping season. A large parcel is expected to be a source of a land conflict since it has a longer boundary and tends to invite demands for a fraction of it from relatives. A parcel that is farther away from the homestead could be at a higher risk of being involved in a conflict because of the difficulty in monitoring. A parcel that has been acquired a long time ago is expected to have fewer pending conflicts but have more resolved conflicts in the past. The mode of acquisition may influence the probability of being involved in a conflict. Thus, we use a dummy variable for purchased parcels. The base group is the parcels that are acquired via inheritance. It is not clear which acquisition mode has a high

probability of being involved in a conflict since each mode has potential causes of land conflicts. For instance, inherited parcels may suffer from land conflicts among siblings and relatives, while on purchased parcels someone other than the land seller may claim ownership of the purchased land. Finally, we include the rent of the parcel for one season as discussed earlier.

Household characteristic variables,  $X_i$ , require some explanation. We stratify female-headed households in two groups: (female) widow-headed households and non-widow-female headed households (due to migration of the husband). We only include a dummy variable for non-widow-female headed households in the estimation models because many of the widow headed households have parcels whose titles bear the name of their deceased husbands, and they are represented by the dummy variable for deceased husbands as titleholders. If we include both the dummy for deceased husbands as titleholders and female-headed households that include widows, we may have a multicollinearity problem.

Other household characteristics include the household head's age, its squared term, the maximum education levels of men and women in the household, the household size, the value of assets, the number of cattle per hectare, and the distance to the nearest urban center from the household. Finally, to represent access to informal institutions for conflict resolution, we include the number of elder groups per 1,000 households in a sub-location.

#### **4. Estimation Results**

##### *Determinants of Land Conflicts*

In Table 5, we present the results of the determinants of land conflicts that are from the Multinomial Logit model of equation 1. We find that when the land titleholder is the (living) parent, there are no significant differences in land conflicts compared with parcels whose titles belong to the household head/spouse. However, if the land title belongs to deceased parents, then the landowners are more worried about future conflicts than when the titles belong to the household head/spouse. In contrast, when the land titles belong to deceased husbands, the current landowners, i.e.

widows, have 12 percent more likely to have pending conflicts than when they have their own titles. Turning to non-widow female-headed households, we find that they also have 22 percent more likely to have pending conflicts than male-headed households. These findings are similar to what Deininger and Castagnini (2005) find in Uganda and other anecdotal evidence found elsewhere (Wanyeki, 2003).

The results in Table 5 suggest that when the number of elder groups per 1,000 households increases by one, the probability of pending conflicts decreases by 0.2 percent. Although the size of the impact is small, the result suggests that local informal institutions can play important roles in preventing land conflicts. We discuss the importance of including the local institutions in conflict resolutions in conclusions.

#### *Impacts of Land Conflicts on Input Application*

The results of the determinants of input application are presented in Table 6. We present the results on organic fertilizer application in columns A and B and on chemical fertilizer in columns C and D. The results indicate that the organic fertilizer application is significantly lower when there are pending conflicts or the households are concerned about future conflicts, while resolved conflicts do not have any impacts on organic fertilizer application. A simple simulation indicates that the amount of organic fertilizer application decreases by 31 percent when there are pending conflicts than no conflicts. Organic fertilizer is considered to be a long-lasting investment in soil structure, at least for two to three years. Thus, it is understandable that households reduce organic fertilizer application on parcels under conflicts. On the other hand, chemical fertilizer has an immediate impact on crop production for one season but does not have a strong residual impact after one cropping season. Thus, households can obtain quick returns from the fertilizer application even if they worry about losing the land in the future because of land conflicts.

To test if the impacts of the pending conflicts depend on the cause of the conflict, we replace the pending conflict dummy by four dummy variables for inheritance, boundary, land sales, and eviction related conflicts. The results indicate that inheritance and eviction related pending conflicts have significantly negative

impacts on organic fertilizer application, while boundary and land sales related pending conflicts do not. Inheritance and eviction related conflicts are more likely to cause dispossessions of parcels than boundary and sales related conflicts. Thus the results are consistent with the expectations that the households invest less in parcels when they fear of losing them.

As we discussed earlier, we are concerned about the possible omitted variables problem due to a correlation between land conflict variables and unobserved parcel and household characteristics. However, if the land conflict variables are correlated with the unobserved quality of the parcels, then the estimated coefficients of boundary and land sales related conflict variables should be biased in the same way as the estimated coefficients of the inheritance and eviction related variables. We find, however, variations in the results across causes of land conflicts, and the variations are consistent with our expectations. Thus, we think that the results in Table 6 are not entirely driven by the biases caused by the omitted variables problem and that they reflect the behavior of the sample households.

Turning to parcel characteristics, we find that title holders do not make any differences in organic and chemical fertilizer applications. We also find that parcels that are farther away from the homestead receive less organic fertilizer. This could be because organic fertilizer is heavy and bulky and thus difficult to carry. Thus, it tends to be applied on parcels that are closer to the homestead where animals are kept in stalls. Also the larger the parcel size is, the less likely it is for the parcel to receive organic fertilizer. Again, the weight and bulkiness make it cumbersome to apply organic fertilizer to large parcels. We also find that parcels that have been acquired a long time ago receive more organic fertilizer. This could be because the parcels that have been cultivated for a long time had been depleted of the soil fertility and require organic fertilizer to improve the soil structure.

## **5. Conclusions**

Because of the increasing importance of land conflicts in rural Kenya, we have examined the determinants of land conflicts and estimated the impacts of such

conflicts on input application by using recent survey data of 897 households in central and western regions of Kenya. The results indicate that the sampled households have pending land conflicts on four percent of their parcels and are concerned about future conflicts on more than nine percent of their parcels. Because of the advanced land registration system in Kenya, we find that more than eighty percent of the owned parcels in our data have been registered. However, even if the parcels are registered, many of the registrations are outdated because landowners neglected to update them due to high registration fees or disputes among relatives over ownership. Outdated titles raise concerns among *de facto* landowners about future conflicts. For instance, when titles are registered under the names of the deceased parents, we find that children who cultivate the parcels are concerned about future conflicts on about 20 percent of their parcels. Thus, simply having a title may not mean the land tenure is secure.

We also find that when parcels are registered under the names of the deceased husbands, widows are twelve percent more likely to have pending conflicts than landowners who own titles. Because the HIV/AIDS epidemic has increased the number of widows in Kenya, as well as in some other African countries, this finding raises concerns about the welfare of widows and their children. Although there have been proposals to strengthen the land rights of widows and women in general, the implementation of such policies in practices must be sensitive to local customs. It may not be wise to impose a law that simply guarantees the land ownership of widows because the law may increase conflicts against women, not decrease, from husbands' relatives who fear of losing their ancestral land. This is exactly what Deininger and Castagnini (2005) find in Uganda. Sometimes well-intentioned interventions to improve land tenure may unintentionally increase conflict and social polarization (Atwood, 1990; Pinckney and Kimuyu, 1994).

Regarding the impacts of the land conflicts on the farm input application, we find that pending conflicts and concerns about future conflicts reduce organic fertilizer application significantly. The results indicate that organic fertilizer application decreases more than 30 percent when there are pending land conflicts.

Inheritance and eviction related conflicts have especially strong negative impacts on organic fertilizer application. These results suggest that pending land conflicts should be solved to sustain land quality. On conflict resolution, we find that people resort to informal institutions first to resolve the conflicts and then to formal institutions only when the informal institutions are unable to resolve the conflicts. The estimation results also suggest that there are fewer pending conflicts in communities with more elder groups. Thus, it is important to recognize the ability of the local informal institutions and clarify the institutional responsibilities of different institutions. Otherwise, the lack of clarity of institutional responsibilities could be exploited by powerful individuals and may have negative consequences for equity.

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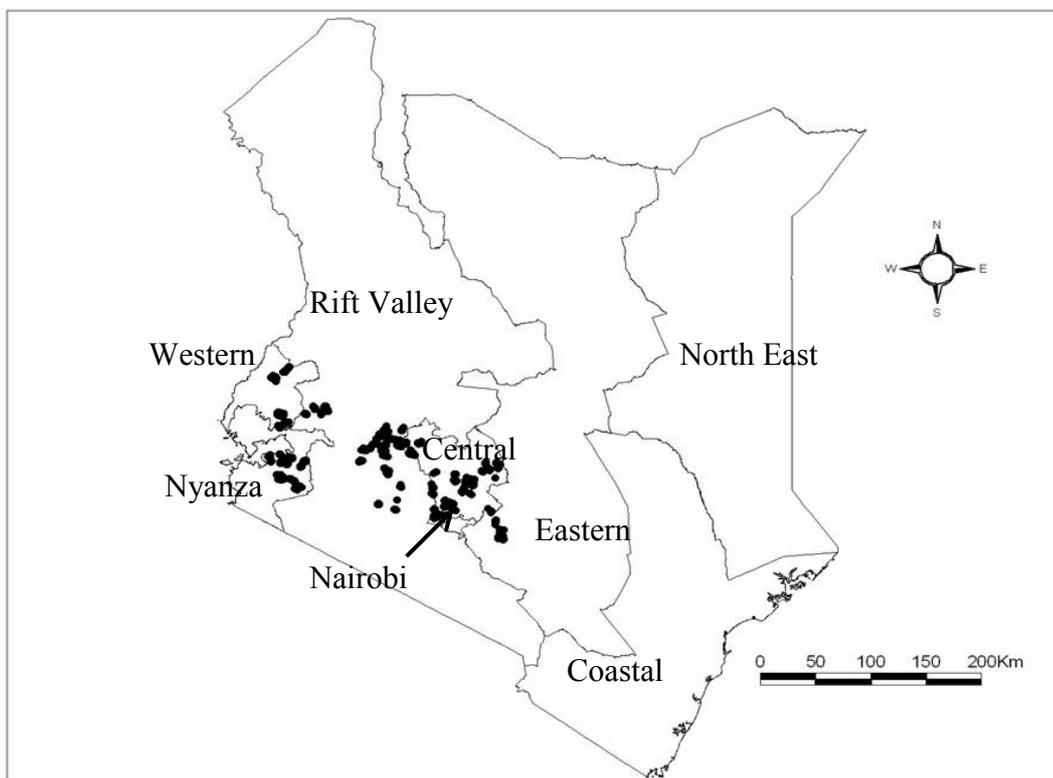
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**Figure 1. Distributions of Sampled Sublocations (Map of Kenya with Provincial Borders)**



Note: Black dots show the sampled sublocations. Names and boundaries of provinces are shown in the map.

**Table 1. Sampled Households and Land Conflicts by Province**

	Number of Households	Number of Own <sup>1</sup> Parcels	Household Land Size in ha	Land Conflicts at the Parcel Level <sup>2</sup>		
				Concerned about future conflicts	Pending Conflicts	Resolved
	(A)	(B)	(C)	(D)	(E)	(F)
	Number	Number	ha	%	%	%
All	897	1,167	1.75	9.3	4.3	8.1
<i>Province</i>						
Eastern	71	125	1.70	3.2	4.8	4.8
Central	318	378	1.47	7.7	3.7	8.7
Rift Valley	222	264	2.71	9.5	4.9	8.7
Western	112	135	1.08	14.8	10.4	13.3
Nyanza	174	265	1.47	6.8	2.3	9.1
<i>Ethnic Group</i>						
Maasai	17	21	12.0	4.8	14.3	19.0
Kamba	69	123	1.68	3.3	4.9	4.9
Kikuyu	469	516	1.53	8.3	3.7	7.6
Kalenjin	71	87	2.55	10.3	3.4	4.6
Kisii	106	148	1.12	8.8	2.7	13.5
Luhya	124	151	1.10	13.9	9.3	13.9
Luo	71	121	1.94	4.1	3.3	3.3

*Note:* <sup>1</sup> 381 parcels that were rented-in are not included in this table and the following analyses. <sup>2</sup> These categories are defined as mutually exclusive.

**Table 2. Land Title Holder and Land Conflicts**

	Number of parcels	Land Conflicts at the Parcel Level <sup>1</sup>		
		Concerned about future conflicts	Pending Conflicts	Resolved
	(A)	(B)	(C)	(D)
	Number (%)	%	%	%
<i>All</i>	1,167 (100)	8.2	4.5	8.1
Not Registered	217 (18.6)	10.1	9.2	8.8
Registered	950 (81.4)	7.8	3.5	8.4
<i>Title Holder of Registered Parcels</i>				
All Registered	950 (100)	7.8	3.5	8.4
Head/Spouse	511 (53.8)	6.8	2.3	7.0
Parent	234 (24.6)	7.7	3.8	10.3
Deceased Parent	46 (4.8)	20.0	3.5	8.2
Deceased Husband	85 (8.9)	2.2	8.7	8.7
Other	74 (7.8)	4.1	6.8	12.2

*Note:* <sup>1</sup> These categories are defined as mutually exclusive.

**Table 3. Causes and Resolutions of Pending or Resolved Conflicts<sup>1</sup>**

	All (A)	Starting Year of Conflicts		
		1965-1989 (B)	1990-1999 (C)	2000-2004 (D)
Number of incidences	144	32	45	67
Incidences per year	3.7	1.3	4.5	13.4
<i>Causes</i>				
Boundaries	50.0	50.0	44.4	53.7
Inheritance	28.5	25.0	37.8	23.9
Land sales	8.3	6.3	4.4	11.9
Use rights	4.2	3.1	4.4	4.5
Eviction	5.6	12.5	4.4	3.0
Others	3.5	3.1	4.4	3.0
All	100 %	100 %	100 %	100 %
<i>Have resorted to</i>				
Informal Institutes (%)	85.4	68.8	91.1	89.6
Formal Institutes (%)	38.9	53.1	48.9	25.4
Both institutes (%)	31.9	31.3	44.4	23.9
<i>Resolved?</i>				
Resolved (%)	64.6	59.4	62.2	68.7
Years before resolution	2.0	3.6	3.2	0.5
Average pending years	8.5	18.9	8.5	2.0

Note: <sup>1</sup> These correspond to the pending and resolved conflicts presented in columns C and D of Table 2.

**Table 4. Land Conflicts and Input Application at the Plot Level<sup>1</sup>**

	No past and current conflicts, and no concern about future conflicts (A)	Land Conflicts Level <sup>2</sup>			Causes of Pending Conflicts (n=260) <sup>3</sup>			
		Concerned about future conflicts (B)	Resolved (C)	Pending Conflicts (D)	Inheritance (E)	Boundary (F)	Land sales (G)	Eviction (H)
		mean (sd)	mean (sd)	mean (sd)	mean (sd)	mean (sd)	mean (sd)	mean (sd)
Manure application (kgs/ha)	3,720 (12,118)	3,552 (17,650)	3,422 (12,040)	1,551** (4,152)	692** (2,038)	2,059* (5,234)	1,805 (2,476)	388* (1,527)
Chemical fertilizer Application (kgs/ha)	94.0 (243.4)	99.6 (226.4)	88.7 (189.1)	83.7 (244.2)	136.9 (431)	79.3 (159.9)	37.5 (67.4)	54.2 (121.8)
Number of plots	4,281	442	520	260	61	136	23	28

Note: \* and \*\* indicate that the mean is smaller than the mean in column A at the 10 and 5 percent, respectively. <sup>1</sup> A plot is defined as a portion of a parcel devoted to one crop or a group of intercrops. Thus, a parcel could be divided into many plots. <sup>2</sup> These categories are defined as mutually exclusive. <sup>3</sup> Because we do not know the causes of land conflicts, we have dropped 12 cases with unknown causes of land conflicts from this table and the following analyses.

**Table 5. Determinants of Land Conflict Status at the Parcel Level (Multinomial logit)** “No experience of past conflicts and no concern about future conflicts” is the base group.

	Land Conflict Status		
	Concerned about future conflicts (A)	Pending (B)	Resolved (C)
<i>Title Holder (ref. Head or Spouse)</i>			
Parents	-0.010 (0.63)	-0.009 (0.44)	0.026 (0.61)
Deceased Parents	0.162 (3.93)**	0.012 (0.88)	0.028 (1.26)
Deceased Husband	-0.048 (0.57)	0.124 (2.60)**	0.017 (0.64)
Others	-0.021 (0.83)	0.078 (1.24)	0.071 (1.88)
No title	0.015 (1.68)	0.058 (1.27)	0.013 (0.97)
<i>Parcel Characteristics</i>			
<i>ln</i> (Parcel size)	-0.008 (0.85)	0.001 (0.09)	-0.001 (0.12)
<i>ln</i> (Walking time to home)	-0.008 (1.43)	0.002 (0.15)	-0.028 (2.75)**
<i>ln</i> (Years since acquisition)	-0.010 (1.24)	0.014 (1.21)	0.008 (0.08)
Purchased Parcel (=1)	-0.006 (0.95)	-0.028 (0.78)	-0.011 (1.01)
<i>ln</i> (Rent for one season)	0.027 (2.49)*	-0.008 (0.26)	0.004 (0.60)
<i>Household Characteristics</i>			
Female Headed HH	0.005 (1.16)	0.218 (3.58)**	0.006 (1.15)
Non-widow (=1)			
Head age	-0.003 (1.17)	-0.002 (0.80)	0.001 (0.42)
Head age squared	1.5*10 <sup>-5</sup> (0.67)	2.6*10 <sup>-6</sup> (0.14)	-5.5*10 <sup>-6</sup> (0.14)
Male Max Education	-0.002 (0.32)	0.001 (0.55)	0.004 (1.42)
Female Max Education	-0.001 (0.42)	-0.003 (1.27)	-0.001 (0.21)
Household size	0.003 (0.98)	0.007 (2.63)**	-0.002 (0.70)
<i>ln</i> (Asset value)	0.018 (1.97)*	-0.011 (1.35)	-0.004 (0.28)

Number of cattle/Land size	-0.006 (1.72)	-0.003 (0.99)	0.002 (0.07)
<i>ln</i> (Distance to Urban)	-0.010 (0.46)	-0.039 (1.58)	-0.036 (1.27)
<i>Community Characteristics</i>			
Number of Elder groups per 1,000 households	0.001 (0.15)	-0.002 (1.98)*	-0.001 (0.61)
14 District dummies	Included	Included	Included
Constant	-0.434 (3.27)**	-0.083 (0.82)	-0.277 (1.73)
Number of observations		1,110	

*Note:* \* and \*\* indicate 5 and 1 percent significance levels, respectively. Coefficients on continuous variables indicate marginal changes in the probability of each outcome category evaluated at the mean values; and coefficients on dummy variables indicate changes in the probability for each outcome category when the value of the dummy variables changes from zero to one.

**Table 6. Impacts of Land Conflicts on Input Application at the Plot Level (Tobit)**  
(with 95 sub-location dummies)

	Organic Fertilizer Application (100 kgs/ha)		Chemical Fertilizer Application (kgs / ha)	
	(A)	(B)	(C)	(D)
<i>Land Conflict status</i>				
Concerned about future conflicts	-27.65 (2.22)*	-27.16 (2.19)*	24.47 (0.99)	24.29 (0.98)
Resolved	-15.41 (1.35)	-14.40 (1.26)	20.58 (0.90)	20.50 (0.90)
Pending	-51.16 (3.10)**		25.00 (0.76)	
<i>Causes of Pending Conflicts</i>				
Inheritance		-117.6 (3.21)**		73.99 (1.14)
Boundary		-34.29 (1.61)		23.72 (0.55)
Land sales		27.49 (0.58)		-58.29 (0.54)
Eviction		-164.1 (2.70)**		-29.02 (0.30)
<i>Title Holder (ref. Head)</i>				
Parents	-7.469 (0.77)	-7.925 (0.82)	8.875 (0.44)	8.913 (0.44)
Deceased Parents	15.81 (1.17)	14.563 (1.08)	-18.19 (0.64)	-17.16 (0.61)
Deceased Husband	-8.216 (0.52)	-10.80 (0.68)	-14.42 (0.41)	-12.58 (0.36)
Others	-6.484 (0.41)	-9.197 (0.58)	-18.40 (0.58)	-18.69 (0.58)
No title	-1.120 (0.10)	-2.080 (0.18)	25.31 (1.07)	24.51 (1.04)
<i>Parcel Characteristics</i>				
<i>ln</i> (Plot size)	-16.03 (6.79)**	-16.22 (6.87)**	38.55 (7.45)**	38.55 (7.45)**
<i>ln</i> (Walking time)	-20.27 (5.69)**	-20.12 (5.65)**	7.572 (1.12)	7.692 (1.14)
<i>ln</i> (Years since acquisition)	8.758 (1.96)*	8.076 (1.81)	-7.150 (0.79)	-6.728 (0.74)
Purchased Parcel (=1)	-3.888 (0.44)	-3.890 (0.44)	31.05 (1.69)	32.59 (1.77)
<i>ln</i> (Rent for one season)	19.05 (2.48)*	18.76 (2.44)*	19.50 (1.22)	20.41 (1.28)

<i>Household Characteristics</i>				
Non-widow Female	13.32	10.92	-24.00	-20.87
Headed Household (=1)	(0.93)	(0.76)	(0.81)	(0.70)
Head age	1.212	1.238	0.471	0.512
	(1.15)	(1.17)	(0.21)	(0.23)
Head age squared	-0.017	-0.017	-0.021	-0.021
	(1.69)	(1.71)	(1.02)	(1.04)
Male Max Education	0.589	0.643	0.957	0.942
	(0.60)	(0.65)	(0.47)	(0.46)
Female Max Education	0.566	0.622	1.960	1.929
	(0.55)	(0.60)	(0.91)	(0.89)
Household size	0.485	0.805	1.798	1.469
	(0.37)	(0.61)	(0.66)	(0.54)
<i>ln</i> (Asset value)	10.95	10.79	8.733	8.889
	(3.39)**	(3.34)**	(1.30)	(1.32)
Number of cattle/Land size	6.566	6.601	2.862	2.814
	(7.53)**	(7.58)**	(1.53)	(1.51)
<i>ln</i> (Distance to Urban)	6.135	5.638	-30.08	-29.54
	(0.31)	(0.28)	(0.74)	(0.73)
Second Season Dummy	-10.58	-10.77	-94.81	-94.64
	(1.63)	(1.65)	(6.90)**	(6.88)**
95 sub-location dummies	included	included	included	included
Constant	-356.2	-353.7	-248.1	-255.7
	(4.56)**	(4.52)**	(1.53)	(1.57)
Number of fields x season	5,492	5,492	5,492	5,492

*Note:* \* and \*\* indicate 5 and 1 percent significance levels, respectively. 95 sub-location dummies are also included.

## Notes

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<sup>1</sup> Jayne et al. (2003) show significant declines in land under crop cultivation relative to rural population in some of African countries since 1960. In Kenya, it has shrunk by half from 0.5 hectare per person to 0.25 hectare per person. Land is also found to be highly correlated with income among small-scale rural households who have limited non-farm income generating opportunities.

<sup>2</sup> We define a parcel as a piece of land that was acquired as a continuous piece of land. A parcel can be divided into small plots that are cultivated separately under different crops.

<sup>3</sup> The REPEAT Project is a collaborative research project of National Graduate Institute for Policy Studies, the World Agro-forest Center, and Tegemeo Institute in Kenya. It was financed by the 21<sup>st</sup> Century Center of Excellency Grant, which was provided by the Ministry of Education and Science of Japan, through National Graduate Institute for Policy Studies. See Yamano et al. (2005) for details about the data collection and preliminary results.

<sup>4</sup> This practice is called “widow inheritance.” Although this practice has traditionally functioned as a safety net mechanism for widows and their children, it has become dysfunctional as a safety net mechanism in the presence of the HIV/AIDS epidemic since it is considered to have contributed to the spread of HIV.

<sup>5</sup> We have tried to use the title holder variables as instrumental variables. However, because the title holder variables are not strongly correlated with the land conflicts variables, we have failed to identify the land conflicts. Ideally, the amount of land owned by parents and the number of siblings who competed for land inheritance would be good candidates for instrumental variables. Unfortunately, we did not collect such data.