Land Market Responses to Weather Shocks: Evidence from rural Uganda and Kenya

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1. Introduction

Land plays at least two fundamental roles in Africa. Firstly, it provides the basis for agricultural production and thus a source of livelihood for poor households. Secondly, land is increasingly a tradable asset which can be used to smooth consumption and shield investments in schooling and health. Africa has long been seen as a land abundant region. However, land scarcity is increasing in many parts of Africa such as in East Africa due to population pressure. In this context of scarcity, land markets notably land rental markets are increasingly active in countries such as Uganda and Kenya. Land markets are known to enhance efficiency in agricultural production and induce equity in land distribution.

1.1 Research Questions

- To what extent does exposure to extreme weather events (droughts) affects rural household's decision to participate in land sales and rental markets? In other words, do land markets provide an avenue for rural household to cope with weather shocks?

- To what extent does extreme weather events affect land distribution in rural Kenya and Uganda? Do weather shocks increase (decrease) inequality in land distribution? In other words, to what extent does weather shocks induce distress participation in land markets?
- Do weather shocks attenuate the impact of land markets on welfare?

1.2 Testable Hypothesis

- Increasingly active land markets in rural Kenya and Uganda provide an avenue for households to adjust their land size in response to extreme weather events.
- Weather shocks exacerbates inequality in land distribution through distress participation in land markets i.e. it pushes poor land constrained households to rent-out or sell their cultivated land in other to engage in low return off farm activities.
- Though land markets are known to be efficiency and welfare enhancing, weather shocks significantly attenuates the gains in efficiency and welfare induced by land markets.

1.3 Policy Relevance

The main concern of policy makers regarding land markets is whether land markets are equity and productivity enhancing. In this vein, it is important to increase our understanding on how aggregate shocks such as weather shocks affects the equity and efficiency impacts of land markets and the resultant impact on welfare. In recent years, Kenya and Uganda have suffered major droughts which have worsened food security and expose many rural households to famine. If weather shocks induces distress sales and increases inequality in land distribution, what policy interventions are needed to support households which are exposed to weather shocks? Should there be restrictions in land market transactions in communities prone to shocks?

2 Data

This study uses longitudinal household and community data collected from rural Uganda and Kenya as part of the longitudinal rural household panel survey project called Research on Poverty, Environment and Agricultural Technology (RePEAT).[1] The RePEAT project is carried out by the Foundation for Advanced Studies in International Development, The National Graduate Institute for Policy Studies (GRIPS). In Uganda, Kenya and Ethiopia, the project is carried out in collaboration with Makerere University, Tegemeo Institute and ILRI respectively.

The baseline survey adopted a two-stage random sampling design. Firstly, approximately 100 villages (communities) were randomly sampled at baseline. From each village, approximately 10 households were randomly sampled for data collection. The data represents the universe of smallholder rural households in Kenya, Uganda and Ethiopia.[2]

The households were surveyed in Uganda in 2003, 2005, 2009, 2012 and 2015. The overall attrition rate is 30%. In Kenya, the household were surveyed in 2004, 2007, 2012 and 2018. The attrition rate is 16%.[3] The survey elicits information at the parcel, household and community levels. Data on Demography, education, health, farm and off farm production activities, land transactions, financial inclusion amongst others is covered in the surveys.

[1] A member (Rayner Tabetando) of the research team submitting this proposal for mentorship has completed a postdoc working on the RePEAT panel data. His publications using the RePEAT data can be accessed here

[2] Due to security concerns data was collected in northern Uganda only in the 5th wave i.e. 2015

[3] The 2018 round of the survey will be made public In September 2021.

2.1 Data Accessibility

RePEAT panel data is made publicly available following the principle "Publicly funded survey data should be public". The data is publicly accessible through the National Graduate Institute for Policy Studies 21st Century Center of Excellence (COE).[4]

2.2 Prior Experience using the data

Rayner Tabetando* and Yoko Kijima (2020) "Efficiency and Equity of Rural Land Markets and the Impact on Income: Evidence in Kenya and Uganda from 2003 to 2015" *Land Use Policy 91(February): 104416.*

Rayner Tabetando* and Tomoya Matsumoto (2020) "Mobile Money, Risk Sharing and Educational Investment: Panel Evidence from Rural Uganda" *Review of Development Economics 24 (1) 84 - 105*

2.3 Most Recent Publication using the RePEAT panel data[5]

M.P. Mugizi and Tomoya Matsumoto(2021) "A curse or a blessing? Population pressure and soil quality in Sub-Saharan Africa: Evidence from rural Uganda" *Ecological Economics, Elsevier, vol. 179(C)*

2.4 Using RePEAT data for Research and Policy Advocacy:

Policy advocacy for research that uses the RePEAT panel data is done through conferences organized by a network of institutions that are partners in the RePEAT project. For example, the

[4] Access the data through http://www3.grips.ac.jp/~21coe/e/data/content/main.html or write to Prof. Yoko Kijima (kijima@grips.ac.jp).

[5] * indicates publications for which a member of the research team submitting this proposal for mentorship is a co-author

Economic Policy Research Centre (EPRC) in the University of Makerere has played a frontline role in disseminating research results within policy circles in Uganda. Tegemeo Institute and ILRI play a similar role in Kenya and Ethiopia respectively.

3. Empirical Framework and Construction of Key Variables

Given that weather shocks are arguably exogenous, we relate weather shocks to land markets and welfare using linear regressions notably household fixed effects. This enables us to control for household-level time invariant factors such as unobserved ability which may enhance resilience to shocks as well as affect land market participation decisions. Interacting district and time (year) dummies enables us to control for district time trend which may enhance (attenuate) resilience to shocks well as affect land market participation decisions. Given the censored nature of most of our outcome variables, we also report nonlinear estimations i.e. Tobit analyses combined with the Mundlak Chamberlain device.

3.1 Weather shocks and Participation in Land Markets

The impact of weather shocks on participation in land market is estimated using the following model:

$$R_{ijt=} \alpha + \gamma_1 S_{jt-1} + \gamma_2 lnL_{ijt} + \gamma_3\gamma_2 lnX_{ijt} + \gamma_4 V_{jt} + \gamma_5 T_t + \mu_{ij} + \varepsilon_{ijt} \ldots\ldots (1)$$

where R_{ijt} is a continuous measure of the size of land rented-in, rented-out, or borrowed-in by household *i* in community *j* at time *t*. The main variable of interest in this estimation is S_{jt-1} i.e., the probability that community (village) *j* experienced a negative weather shock (drought) in year *t-1*. L_{ijt} is measure of own land. X_{ijt} is a vector of household characteristics such as the heads' gender, age, and years of schooling as well as the value of household agricultural assets and total asset holding and the size of land owned ; V_{jt} is a vector of village-level controls such as distance to markets and district town and T_t is a vector of year dummies. Equation (1) is estimated using the household fixed effects, μ_{ij}. The parameter of interest γ_1 measures the effects of exposure to drought on the size of land purchased, sold, rented-in, rented-out and borrowed-in.

3.2 Do weather shocks induce distress participation in land markets?

We use a variant of Eq. (1) to estimate the impact of weather shocks on distress participation in land markets

$$R_{ijt=}\ \alpha + \gamma_1 S_{jt-1} + \gamma_2 lnL_{ijt} + \gamma_3 lnL_{ijt-1} * lnS_{ijt-1} + \gamma_4 lnX_{ijt} + \gamma_5 V_{jt} + \gamma_6 T_t + \mu_{ij} + \varepsilon_{ijt} \ldots\ldots (2)$$

All variables are as defined earlier. The only difference is the addition of an interaction variable of lagged exposure to shock and lagged own land. The parameter of interest γ_3 captures the extent to which the equity impact of land markets are attenuated by weather shocks. In other words, distress participation in land markets is captured by the difference between γ_3 and γ_2.

3.4 Do weather shocks exacerbate inequality in land distribution?

Weather shocks can worsen inequality in land holding through distress sales/rent-out. If land constrained households rent-out or sell out their land in response to weather shocks, this would exacerbate inequality in land distribution. We estimate Gini coefficients for different types of land holding (rented-in, borrowed-in and purchased land). The Gini coefficients are estimated at the community (village) level. We relate inequality in land holding (Gini coefficients) to weather shocks at the community level using a variant of Eq. (1).

$$G_{jt=}\ \alpha + \gamma_1 S_{jt-1} + \gamma_2 lnL_{jt} + \gamma_3 lnX_{jt} + \gamma_4 V_{jt} + \gamma_5 T_t + \mu_{ij} + \varepsilon_{ijt} \ldots\ldots (3)$$

Where G_{jt} is vector of Gini coefficients measuring inequality in the distribution of different type of land holding (rented-in, purchased and borrowed-in land). All other variables are community-level averages. Our parameter of interest γ_1 captures the impact of weather shocks on land inequality.

3.5 Construction of weather shocks

In addition to survey data, the study uses gridded daily precipitation data to construct the probability of a negative rainfall shock (drought). The precipitation data was obtained from the Prediction of World Energy Resources project (POWER) hosted by NASA.[6] The data was constructed from the year 1983 to near present. Monthly precipitation data was used to generate Standard Precipitation Index (SPI) for all the communities (villages) covered in the household surveys. SPIs were generated for the four-month period preceding the main rainfall season. The index is given by the percentage ratio between the number of years in which the estimated Standard Precipitation Index (SPI) was below the threshold of 1.5 over the total number of years preceding the reference period.

[6] https://power.larc.nasa.gov/data-access-viewer/

4.0 Preliminary Results

The mentees are experienced working on land issues in East Africa using the RePEAT data. Determinants of participation in land markets and the resultant impact on welfare in Kenya and Uganda has been examined and published here

Table 1: Summary Statistics (Whole sample)

	Uganda					Kenya		
	2003	**2005**	**2009**	**2012**	**2015**	**2004**	**2007**	**2012**
Household Size	7.19	7.57	7.37	7.24	6.55	6.89	7.70	7.96
Size of Land Accessed (Hectares)	2.71	3.03	2.81	2.74	3.16	1.86	1.82	1.74
Size of land Owned (Hectares)	2.20	2.42	2.16	1.45	2.38	1.76	1.70	1.63
Share of HHs with any land certificate	0.05	0.08	0.07	0.08	0.08	0.83	na	0.86
Share of HHs with at least one purchased plot	0.56	0.57	0.57	0.68	0.61	0.34	0.32	0.34
Share of area inherited out of owned land	0.53	0.08	0.04[7]	0.42	0.51	0.66	0.68	0.66
Share of area purchased out of owned land	0.46	0.57	0.36	0.56	0.47	0.31	0.30	0.31
Last 12 months								
Share of HHs who Rented In land	na	0.20	0.21	0.17	0.17	0.18	0.22	0.16
Share of HHs who Rented Out Land	na	0.06	0.07	0.08	0.10	0.00	0.07	0.09
Share of HHs who Borrowed In Land	na	0.16	0.03	0.10	0.06	0.01	0.01	0.01
Share of HHs who Borrowed Out Land	na	0.07	0.07	0.06	0.06	na	na	Na
Share of HHs who Rented-In & Out land	na	0.01	0.00	0.00	0.01	0.00	0.00	0.00
Share of HHs who Purchased Land	0.05	0.03	0.03	0.06	0.01	0.01	0.02	0.01
Between survey rounds								
Share of HHs who purchased land		0.09	0.04	0.07	0.04		0.01	0.01
Share of HHs who sold land		0.03	0.03	0.03	0.05		0.00	0.01
Number of Households	940	831	909	896	1378	899	714	751

1) Authors computation from RePEAT surveys in Uganda and Kenya
2) The 2018 data from Kenya would be made available in September 2021

[7] The mode of land acquisition was not elicited in the 2005 and 2009 surveys. These statistics are dodgy since they are extrapolated from the 2005 and 2012. We should probably not report them

Table 2: Households Characteristics by land Market Participation

Panel A: Uganda	2005					2015				
	Rented In	**Rented Out**	**Borrowed In**	**Borrowed Out**	**Autarky**	**Rented In**	**Rented Out**	**Borrowed In**	**Borrowed Out**	**Autarky**
Size of Land Owned(Hectares)	1.25	2.97	0.71	3.19	2.73	1.36	3.16	0.53	3.42	2.53
Area under cultivation (Ha)	1.35	1.51	1.12	1.51	1.32	2.08	2.97	1.22	3.45	2.03
Per Capita Income(USD)	226.51	288.93	220.48	164.55	205.93	254.58	208.46	206.02	233.11	169.05
Value of All Assets(USD)	177.24	226.07	187.99	255.44	212.11	145.66	152.34	209.25	421.18	173.36.84
Proportion of Poor Households	0.49	0.46	0.55	0.35	0.51	0.36	0.32	0.33	0.33	0.31
1 if Male Headed household	0.92	0.83	0.77	0.80	0.85	0.84	0.84	0.71	0.76	0.78
Head's years of schooling	6.25	6.02	5.9	6.36	6.44	5.45	6.25	4.5	5.67	5.28
Age in years of Household Head	41.77	51.86	39.79	59.80.74	48.26	57.15	51.74	41.87	54.25.	54.58
Household Size	7.71	7.21	6.37	9.50	7.61	6.66	7.26	6.71	8.57	6.43
1 if Migrant household	0.15	0.13	0.16	0.28	0.17	0.39	0.4	0.36	0.46	0.45
Adult Equivalent	4.79	4.79	3.78	6.10	4.86	5.03	4.47	4.23	6.21	4.16
Number of Households	105	22	26	5	484	93	56	9	9	498

Panel B: Kenya	2007			2012		
	Rented In Only	**Rented Out Only**	**Autarky**	**Rented In Only**	**Rented Out Only**	**Autarky**
Size of Land Owned(Hectares)	1.08	4.57	1.6	1.79	3.43	1.54
Area under cultivation (Ha)	1.51	1.31	1.15	1.48	1.29	1.12
Per Capita Income(USD)	265.48	218.83	245.91	493.35	428.98	419.24
Value Of All Assets(USD)	582.37	623.58	511.63	1506.64	976.52	1255.59
Proportion of poor Households	0.56	0.71	0.65	0.34	0.54	0.45
1 if Male Headed household	0.8	0.67	0.71	0.8	0.71	0.70
Head's years of Schooling	7.94	5.38	7.33	10.32	6.33	8.11
Age in years of Household Head	54.88	59.4	58.01	57.74	61.61	60.60
1 if Migrant household	0.34	0.24	0.36	0.4	0.24	0.35
Household Size	8.18	7.37	7.59	8.14	7.91	7.93
Adult Equivalent	5.92	5.37	5.54	6.54	5.96	6.20
Number of Households	153	52	508	112	67	572

1)Authors computation from RePEAT; 2) Monetary values have been adjusted for inflation

5.0 **Division of Labor and Proposed Timeline**

Division of Labor and Proposed Timeline			
Timeline	**Task**	**Person in Charge**	**Deliverable**
2021			
October-December	Inception meetings with Mentors. Workshops and Seminars	All team members	Effective Participation
2022			
January-February	Data compilation and cleaning	Tabetando	Summary statistics and Stata codes
March-April	3 weeks visit to Cornell, IFPRI or MSU	All mentees	Effective Participation
May-June	In depth review and compilation of relevant literature	Djomo	Presentation to all team members
June-July	Initial Results of data analyses	All mentees	Presentation to all team members
August	Revised Results of data analyses	All mentees	Presentation to all team members
September-Nov	Writing of academic paper	All mentees	First draft submitted to mentors for review
December	Presentation/Revision of academic paper	All mentees	Second draft and presentation