

Land Access, Land Rental and Food Security: Evidence from Kenya

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Motivation

- Despite the efforts by the international community and national governments, poverty and malnutrition remain major global problems
 - 1.4 billion people lived below the international poverty line in 2005 (Ravallion and Chen 2008).
 - According to FAO (2010), 925 million people in the world, 578 million in Asia and Pacific, 239 million (or 30% of its total population) in sub-Saharan Africa suffer from food insecurity.
 - Number of un nourished children also increased, especially in the sub-Saharan Africa countries.

Food Security in Kenya

- Over half of Kenya's population is deemed chronically food insecure (KNBS 2008).
- According to Kenya Food Security Steering Group (KFSSG, 2012), the number of food insecure people was 3.8 million in August 2011 and 2.2 in August 2012.
- 20% of children in Kenya were undernourished between 2003-2009.

Linkage between Land Access and Food Security

Land as the most important productive asset for rural households, to what extent farmers have access to land has direct implication on food security. Access more productive land means

- Higher production
 - more food from own production available for consumption. In the case of high transaction costs associated with food market transactions, consuming more of own production is a rational decision.
- Higher income
 - Higher ability to buy food from the markets, ability to access food is also improved.

Rental versus Sales' markets

- While both land rental and land purchase allow farmers to access additional land for crop production, land rental is more important for small landholders
 - Land sales markets are generally much less active than rental markets in Africa (Holden et al. 2009).
 - Land purchases require a much greater up-front payment than renting land.
 - Rental payment sometime can be paid after harvest which makes renting land by poor farmers possible.
 - Rental markets are also more flexible in terms of duration.
 - Rental markets are less riskier than sales markets.

Rental as the most important mode of land transfer

Table 1. Access to Land by Mode of Transfer in 2003 and 2006

	Average	2003	2006
Mode of transfer			
Purchased			
Number of Parcels	9.5	13	6
Average Area (acre)	1.14	0.84	1.43
Rented-in			
Number of Parcels	210	197	222
Average Area (acre)	0.89	0.95	0.84
Inherited or Other			
Number of Parcels	7.5	8	7
Average Area (acre)	2.90	0.95	4.84

Research questions

- The research attempts to establish the linkage between land access and food security. Specifically, we seek to address the following specific research questions:
- Whether and to what extent does land access affect household's production, income and consumption?
- What role does land rental market play in terms of land access and how well does it perform in terms of efficiency and land accessibility?

Empirical Models

- Household level panel regressions were used to estimate the effects of operated land size on crop production, Income, and consumption:

$$Y_{it} = \alpha_i + \beta Land_{it} + \gamma X_{it} + \varepsilon_{it} \quad (1)$$

Y_{it} – output variable of interest,

$Land_{it}$ - operated land size,

X_{it} is a vector of HH level control variables,

α_i is HH fixed effect.

- Plot level regressions were used to estimate yield difference (and input use intensity difference) between own plots and rented plots:

$$Yield_{ij} \text{ or } Input_{it} = c_i + \delta Rent_{ij} + \rho Z_{ij} + \mu_{ij} \quad (2)$$

$Rent_{ij}$ – dummy variable for whether or not plot j is rented or owned.

Z_{ij} – steep, irrigation condition, and distance to homestead

c_i - household fixed effect.

Empirical Models (cont'd)

- Finally, a switching regression model was used to estimate the degree to which land rental market allows households to achieve optimal operated land size (Skoufias 1995).

$$y_i = \begin{cases} -\alpha_{out} + \beta_{out}Z_i + \varepsilon_i & \text{if } \varepsilon_i < \alpha_{out} - \beta_{out}Z_i \\ 0 & \text{if } \alpha_{out} - \beta_{out}Z_i \leq \varepsilon_i \leq \alpha_{in} - \beta_{in}Z_i \\ -\alpha_{in} + \beta_{in}Z_i + \varepsilon_i & \text{if } \varepsilon_i > \alpha_{in} - \beta_{in}Z_i \end{cases} \quad (3)$$

y_i – the amount of net area leased-in

Z_i – a vector of household characteristics including land holdings, ownership of bullock, household labor endowment, assets, etc.

α_{in} and α_{out} – the constant terms

β_{in} and β_{out} – a vector of coefficients to be estimated.

The coefficients on landholdings are the key coefficients of interest. The magnitude of these coefficients allows us to test whether or to what degree land rental allow households to optimally adjust operated land size.

Equation (3) can be estimated using maximum likelihood Estimation.

Descriptive Evidence

Data

- Two round of panel household surveys were implemented jointly by GRIPS and Egerton University - Tegemeo Institute in 2004 and 2007.
- 817 households in 2004, 712 households in 2007 resurveyed so the total panel sample size is 712.
- Standard multi-purpose household survey with detailed output, input data at the plot level.
- Consumption data used as an indicator for food security.

Operated Land Size, Production and Income

Farm size quantile	Total income per capita	Net crop income per capita	Gross crop income per capita
1 st (smallest)	22,443	4,178	5,119
2 nd	26,854	6,200	7,506
3 rd	28,274	8,138	9,981
4 th (largest)	35,969	9,791	12,847
Average	28,132	6,948	8,683

Who uses land rental?

Rental Status	All	Rent-in	Rent-out	Autarkic	Purchase during 2004-06
Land owned per capita(acres)	0.55	0.50	1.15	0.50	0.59
Household size (# of people)	8.35	8.96	8.06	8.11	10.40
Number of working age members (15-64)	5.25	5.72	4.96	5.07	6.80
Number of dependents*	3.10	3.24	3.10	3.04	3.60
Household Head's Age	58.62	56.29	56.69	59.89	49.53
% of Fem. Headed HHs	23	16	31	25	7
% of heads completing primary education	31	42	13	28	53
% of HHs w/ a bullock	14	20	10	12	33
Total Value of Asset (Ksh)	71,114	77,141	91,228	60,673	272,108
Total Value of Livestock (Ksh)	48,405	59,051	43,703	44,940	59,907
Number of Observations	713	163	52	483	15

*including these younger than 15 and older than 64.

Land Access and Food Security

Farm size quantile	Total food consumption per capita	Total cereal consumption per capita	Total non- cereal consumption per capita	Total food consumption from own production	Value of food purchased
1 st (smallest)	7,302	2,852	4,450	4,566	2,736
2 nd	8,732	2,995	5,737	6,063	2,669
3 rd	9,491	3,441	6,051	7,137	2,355
4 th (largest)	10,218	3,537	6,681	7,789	2,429
Average	8,881	3,184	5,697	6,322	2,559

Land rental and Productivity, plot level

Tenure Status	Total	Own Plot	Rented Plot
Value of Gross Revenue per Acre (Ksh)	19,892	20,608	16,559
Value of Net Revenue per Acre (Ksh)	12,103	11,492	8,944
Value of Organic Manure per Acre (Ksh)	723	747	388
Value of Chemical Fertilizer per Acre (Ksh)	1,121	1,251	1,328
Land size in acre (acre)	2.69	3	0.93
Number of Observations	1,128	920	208

Econometrics Analysis

Table 6: Impact of Land Access on per Capita Food Consumption (Household Fixed-Effect Model)

VARIABLES	Total Food Consumption (log)	Total Cereal consumption (log)	Total non-cereal consumption (log)	Food consumption, home production (log)	Food consumption, purchased (log)
Operated land size (log)	0.117** (0.054)	0.210*** (0.048)	0.091 (0.060)	0.272*** (0.071)	0.052 (0.065)
Household size (log)	-0.087*** (0.016)	-0.152*** (0.017)	-0.062*** (0.019)	-0.293*** (0.024)	0.039* (0.021)
Total value of assets (log)	0.153*** (0.038)	0.053 (0.035)	0.181*** (0.043)	0.063 (0.048)	0.170*** (0.047)
Female Headed	-0.199 (0.169)	-0.073 (0.141)	-0.174 (0.186)	-0.762*** (0.217)	0.250 (0.153)
Head's age	-0.011** (0.005)	-0.0178*** (0.005)	-0.008 (0.005)	-0.043*** (0.008)	0.013*** (0.005)
Head completed primary education	0.004 (0.102)	0.008 (0.114)	0.019 (0.115)	-0.189 (0.137)	0.180 (0.126)
Value of livestock (log)	0.005 (0.013)	0.001 (0.0142)	0.008 (0.015)	0.042** (0.020)	-0.002 (0.013)
Constant	9.896*** (0.468)	9.862*** (0.465)	8.931*** (0.518)	12.940*** (0.666)	6.633*** (0.520)
Observations	1,406	1,406	1,406	1,406	1,406
R-squared	0.106	0.226	0.066	0.342	0.046
	705	705	705	705	705

Table 7: Impact of Land Access on Production and Income (Household Fixed-Effect Model)

VARIABLES	Value of harvest	Net Agri. income	Net income
Operated land size (log)	0.425*** (0.076)	0.314*** (0.119)	0.305*** (0.091)
Household size	-0.165*** (0.025)	-0.039 (0.064)	-0.056 (0.044)
Total value of assets	0.069 (0.055)	-0.125 (0.117)	0.194** (0.084)
Female Headed	-0.632*** (0.218)	-1.245*** (0.480)	-0.806*** (0.290)
Head's age	-0.025*** (0.007)	-0.026* (0.016)	-0.030*** (0.010)
Head completed primary education	0.007 (0.137)	-0.431 (0.321)	-0.144 (0.148)
Value of livestock (log)	0.033* (0.0191)	0.066* (0.035)	0.052* (0.032)
Observations	1,405	1,406	1,406
R-squared	0.178	0.028	0.089
Number of HH	705	705	705

Robust standard errors in parentheses

Table 8: Impact of Land Tenure on Productivity (Household Fixed Effect Model, Plot Level Data)

VARIABLES	Gross revenue (log)	Gross revenue (log)	Net revenue (log)	Net revenue (log)
Land area	-0.300*** (0.047)	-0.350*** (0.048)	-0.291*** (0.067)	-0.369*** (0.070)
Rented in plot	-0.352*** (0.088)	-0.200** (0.100)	-0.554*** (0.129)	-0.305** (0.144)
Irrigated		0.354 (0.298)		0.292 (0.434)
Steep		-0.0407 (0.112)		-0.0218 (0.162)
Distance from home to the plot		-0.0564*** (0.017)		-0.0934*** (0.024)
Value of total input use	0.126*** (0.015)	0.125*** (0.015)		
Observations			-8.490*** (0.232)	-8.461*** (0.229)
R-squared	8.620*** (0.113)	8.458*** (0.122)	9.232*** (0.050)	8.944*** (0.096)
Number of hhid	712	711	712	711

Robust Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

**Table 9: Impact of Land Tenure on Fertilizer Use
(Household Fixed-Effect Tobit Model, Plot level)**

VARIABLES	Organic manure	Organic manure	Chemical fertilizer	Chemical fertilizer
Land area	48.78 (144.90)	-100.51 (134.20)	-141.10** (62.87)	-189.90** (73.91)
Rented in plot	-2,284*** (765.60)	-2,144*** (753.70)	344.80 (329.4)	333.90 (286.61)
Irrigated		3,508 (2,573)		2,443 (3,605)
Steep		-103.20 (546.10)		278.10 (319.60)
Distance from home to the plot		-534.5*** (110.3)		-31.26 (27.94)
Observations	1,226	1,223	1,226	1,223

Robust Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

**Table 10: Determinants of Net Land Leased In,
Maximum Likelihood Estimates (2007 data)**

Leasing-in equation	(1)	(2)
Area owned	-0.735*** (0.119)	-0.667*** (0.138)
Female head	-0.496 (1.343)	-0.643 (1.348)
Own Bull	6.248** (3.080)	7.706* (4.012)
Value of total assets	0.0810 (0.617)	0.299 (0.676)
Number of dependents (<14 & >65)	-0.176 (0.252)	-0.0884 (0.251)
Members 14-65	0.367 (0.255)	0.494** (0.250)
Head	6.903** (2.843)	7.097** (2.832)
Head's age	0.109** (0.0481)	0.101** (0.0455)
Constant	68.24*** (8.011)	29.06 (39.89)

Leasing-out equation

Area owned	0.439*** (0.0785)	0.487*** (0.103)
Female head	1.122 (0.806)	1.261 (0.780)
Own Bull	-2.731*** (0.921)	-3.402*** (0.981)
Value of total assets	-0.666** (0.296)	-0.373 (0.317)
Number of dependents (<14 & >65)	-0.178 (0.143)	-0.229 (0.149)
Members 14-65	-0.320** (0.145)	-0.324** (0.148)
Head	-1.429* (0.737)	-1.778** (0.775)
Head's age	0.0280 (0.0240)	0.0228 (0.0259)
Constant	-10.13*** (3.866)	-9.189** (4.254)
Division dummies included	No	Yes
Σ	7.156*** (1.259)	6.886*** (1.187)
Log Likelihood	-1003.56	-978.80
Observations	712	712

Summary of Main Results

- We find that operated land size has significant and positive effects on production, agricultural and total income, and most of all, food consumption.
- Rental market is the most important mechanism that farmers access additional land for agricultural production.
- However, rental markets perform below their potential:
 - Production is significantly lower in rented plots than own plots even after plot characteristics and household fixed effects are controlled for. Consistently, farmers also apply less amount of organic manure on rented plots than own plots.
 - Farmers are not able to attain land size at the optimal level. Tenants only rented in 65-70% of the optimal amount of land, and landlords only rented out 40-45% of the optimal amount of rent-out land.

Conclusions

- Promoting land rental markets to facilitate small landholders to access additional land is an important strategy to address food insecurity problems.
- The substantial benefits associated with land access by smallholders may also shed light on the increasing concerns over large scale “land grabs” by foreign investors.
- More research is needed to identify the causes of the considerable underperformance of Kenya’s rural land rental markets.