

Trees on farms in Africa. Myth, fact, or simply forgotten?

Daniel C. Miller¹, Juan Carlos Muñoz-Mora¹ and Luc Christiaensen³

¹ University of Illinois-Urbana-Champaign, ¹ Pompeu Fabra University, and ³ World Bank



Washington DC, Novembre 2016

Trees on Farm

**Natural Resources
Approach**

**Economic
Approach**



Roughly a third of the agricultural land in Sub-Saharan Africa is estimated to have had at least 10% tree cover during 2008-2010 (Zomer and others, 2014).

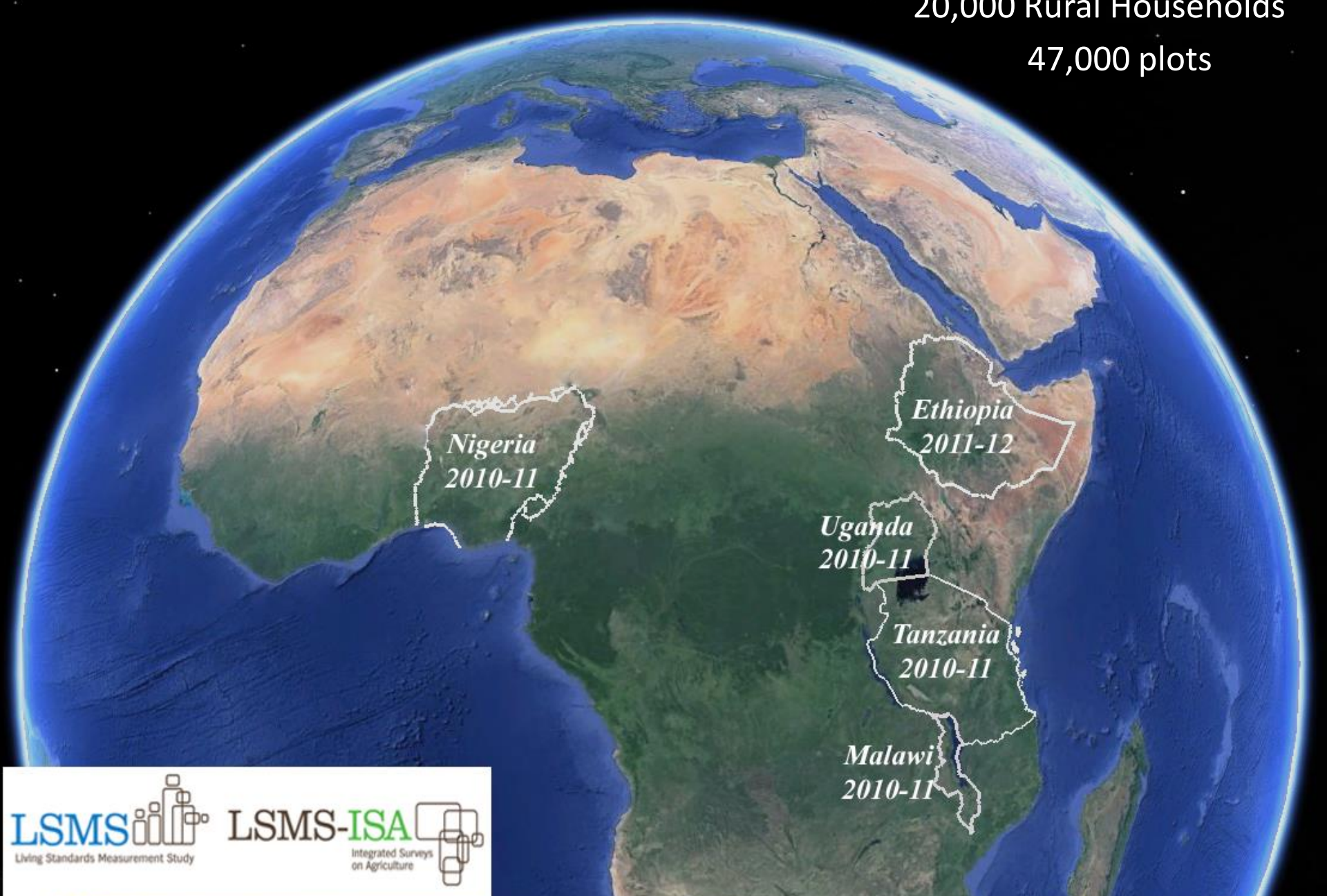
→ Sub-national case studies suggest that on-farm trees can make a substantial contribution to households' welfare (e.g. Mbow et al. 2014; Kalaba et al. 2010; Degrande et al. 2006) .

→ Existing research on trees on farms has typically focused on case studies within particular countries (Godoy 1992, Dewees 1995, Vedeld, Angelsen et al. 2007, Pouliot and Treue 2013) or region-wide aggregated methods that are unable to account directly for household perspectives and practices (Zomer, Trabucco et al. 2014).

There is not a good NATIONAL scale evidence on their prevalence and contribution to household livelihoods

Data

Nationally Representative
20,000 Rural Households
47,000 plots



Nigeria
2010-11

Ethiopia
2011-12

Uganda
2010-11

Tanzania
2010-11

Malawi
2010-11





- The Living Standards Measurement Study-Integrated Surveys on Agriculture (LSMS-ISA) project is a new initiative funded by the Bill & Melinda Gates Foundation (BMGF) and led by the World Bank's LSMS Team.
- It is a household level panel-based survey covering eight Sub-Saharan African countries: Burkina Faso, Ethiopia, Ghana, Malawi, Mali, Niger, Tanzania and Uganda.



Example: Community Module

SECTION 6E: COMMUNAL RESOURCE MANAGEMENT										
RESOURCE	CODE	1	2	3	4	5	6	7		
		Does the community own any communal [RESOURCE]?	Is the community able to determine independently the rules of access and use of its communal [RESOURCE]?	Is the communal [RESOURCE] recognized by the district council?	Is the communal [RESOURCE] challenged or disputed by neighbouring villages or estates?	Is the communal [RESOURCE] sometimes used by outsiders or neighbouring villagers without consulting the LC1?	Does the community have any specific exclusion mechanism targeted at keeping outsiders from using communal [RESOURCE]?	How does the community manage to exclude outsiders from using communal [RESOURCE] without consulting LC1? READ RESPONSES. LIST UP TO 3 IN ORDER OF IMPORTANCE.		
		YES...1 NO...2>> NEXT ROW	YES...1 NO...2	YES...1 NO...2	YES...1 NO...2	YES...1 NO...2	YES...1 NO...2>>8	Use guards.....1 USE THE THREAT OF... Fine.....2 Religious sanctions..3 Physical punishment..4 Other (Specify).....9		
								1ST	2ND	3RD
Crop Land	101									
Forest	102									
Pasture	103									
Water Body: Specify _____	104									
Other (Specify) _____	105									

SECTION CD: LAND USE

1.		How much of the land in the village is used for...	
		ACRES	%
a.	Cultivation by villages		
b.	Agro-business/plantation farming by outsiders		
c.	Forest		
d.	Pasture (common access)		
e.	Wetland		
f.	Residential		
g.	Business		
h.	Other		

Example: Household Module

F14	F15
Do you ever collect firewood?	Where do you go to collect firewood?
YES..1 NO...2>>F18	OWN WOODLOT .1 COMMUNITY WOODLOT .2 FOREST RESERVE .3 UNFARMED AREAS OF COMMUN- ITY . . .4 OTHER (SPECIFY) .5

17.	18.
Major fuel used for cooking?	Major fuel used for lighting?
	IF NO ELECTRICITY OR SOLAR ► 20.
FIREWOOD.....1 PARAFFIN.....2 ELECTRICITY...3 GAS4 CHARCOAL.....5 ANIMAL RESIDUAL.....6 GAS (BIOGAS)...7 OTHER8	ELECTRICITY....1 SOLAR.....2 GAS.....3 GAS (BIOGAS)....4 LAMP OIL5 CANDLE6 FIREWOOD.....7 PRIVATE GENERATOR.....8 OTHER (SPECIFY)9
1	2

Example: Agricultural Module

14.

During the 2012/2013
rainy season, is this
[PLOT]...

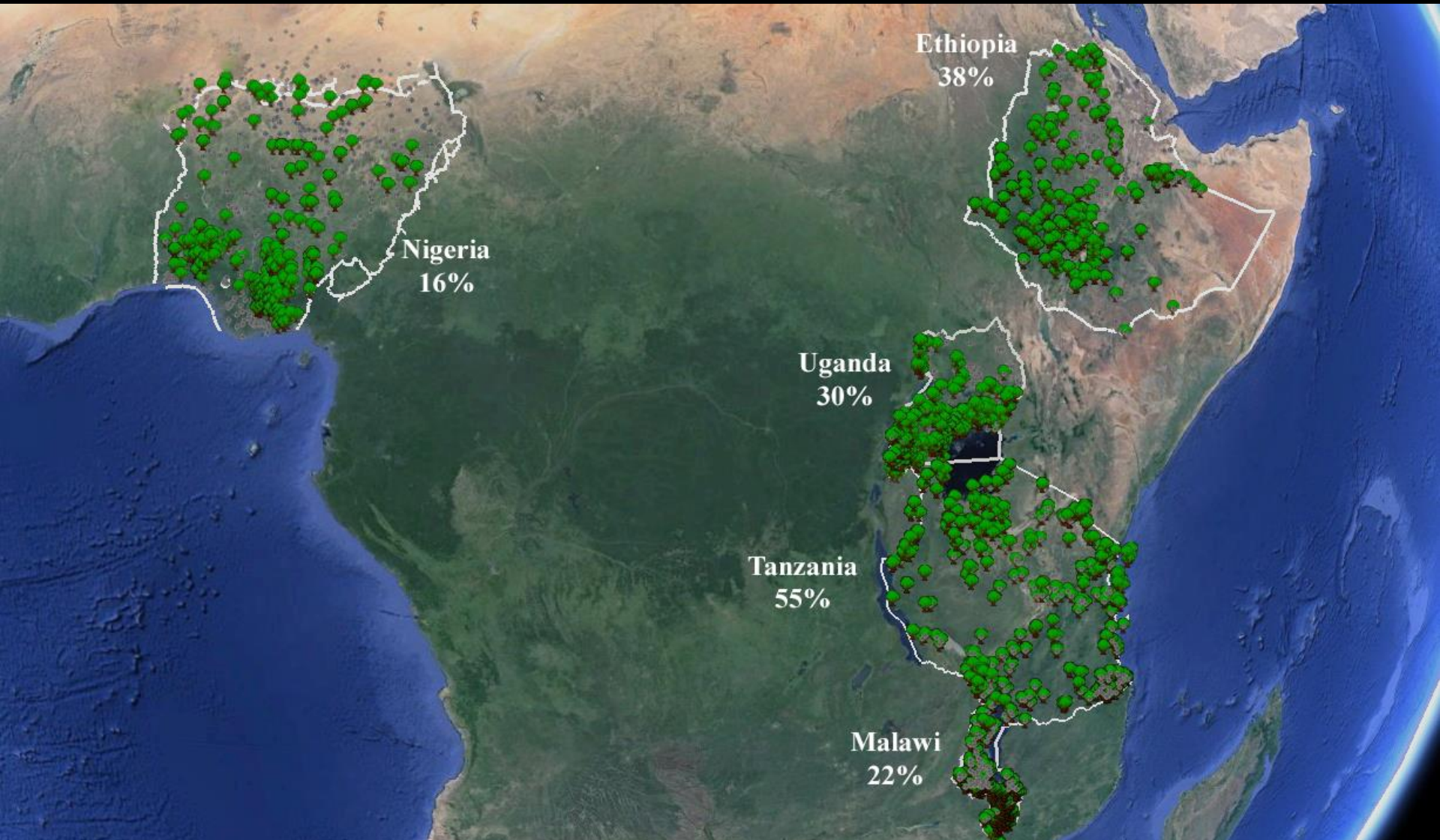
READ ANSWERS

Cultivated..1 >> 20
Rented out..2
Gave out
for free....3 >> 21
Fallow.....4 >> 21
Forest /
Woodlot.....5 >> 35
Pasture.....6 >> 35
Other
(Specify)...7 >> 35

What do we mean by trees?

- Uncultivated plots with presence of forest trees
- Crops classification
 - **Fruit Trees**
 - e.g. Mango, Oranges, etc
 - **Tree Cash Crops**
 - e.g. Coffee, Tea, etc
 - **Trees for Timber or Fuel-wood**
 - e.g. Timber tree, Bamboo, etc

Estimated proportion of landholders with presence of any trees on farm



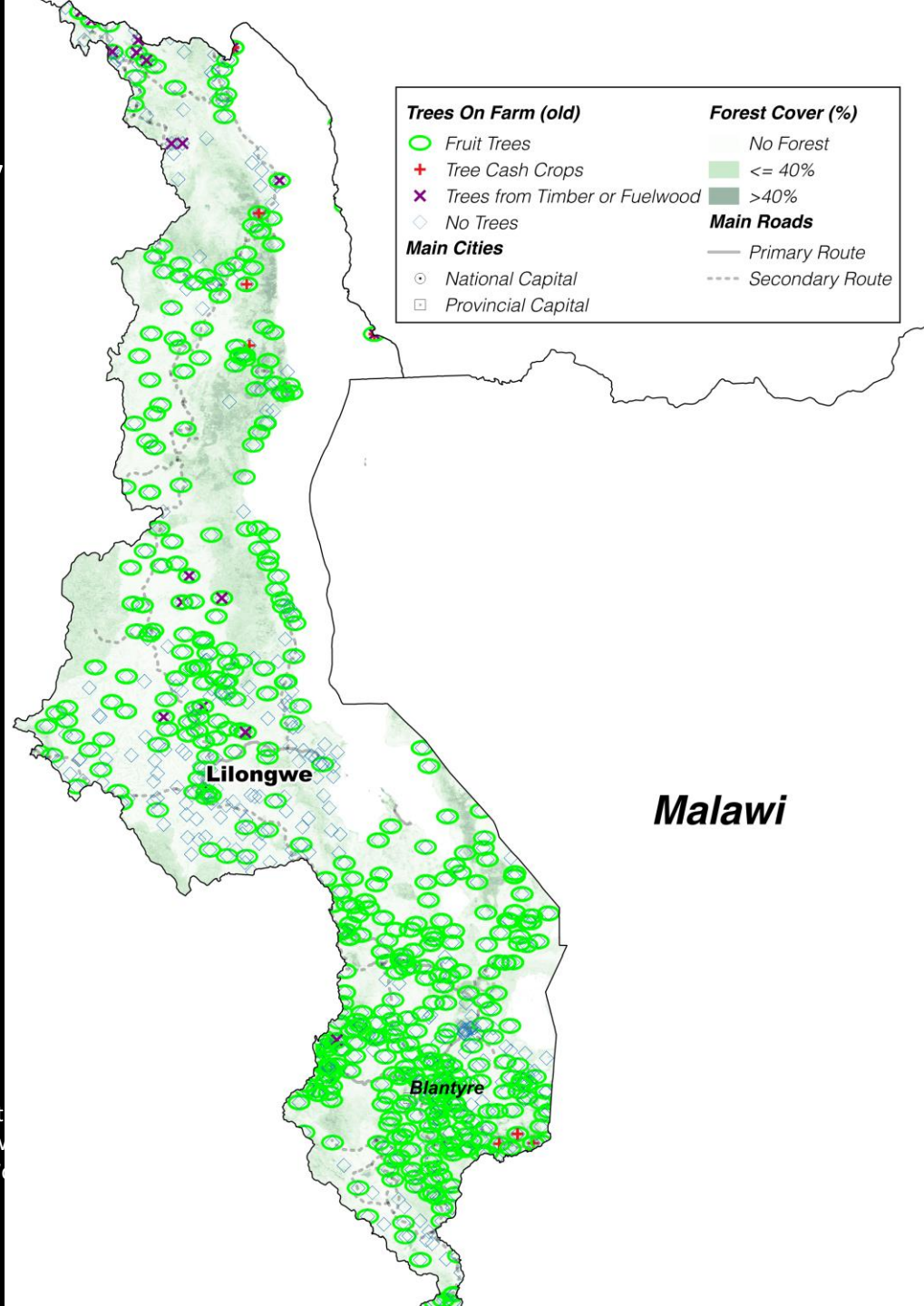
Note: This map shows the spatial distribution of trees on farms in Sub-Saharan Africa. It aggregates trees in three different categories: tree cash crops, fruit trees, and trees for timber or firewood. All statistics were corrected by sampling design. Data source: Authors' calculations from LSMS-ISA data sets, World Bank (2015).

Share of landholders with trees on their farms by category of tree

Country	Percent of landholders with presence of any trees on farms	Percent of landholders with presence of fruit trees	Percent of landholders with presence of tree cash crops	Percent of landholders with presence of trees for timber or fuelwood
Ethiopia	38% (23.76% intercropped)	17% (23.73% intercropped)	33% (27.80% intercropped)	3%
Malawi	22% (16.05% intercropped)	22% (16.24% intercropped)	0.1% (0% intercropped)	0.1%
Nigeria	16% (85.91% intercropped)	6% (91.89% intercropped)	15% (86.67% Intercropped)	Not Available
Tanzania	55% (87.50% Intercropped)	45% (91.89% Intercropped)	22% (87.63% Intercropped)	18% (82.28% Intercropped)
Uganda	30% (95.59% Intercropped)	5% (99.66% Intercropped)	27% (96.59% Intercropped)	2% (77.89% Intercropped)
<i>Overall Average</i>	30% (47.37% Intercropped)	20% (43.78% Intercropped)	12% (63.74% Intercropped)	3%

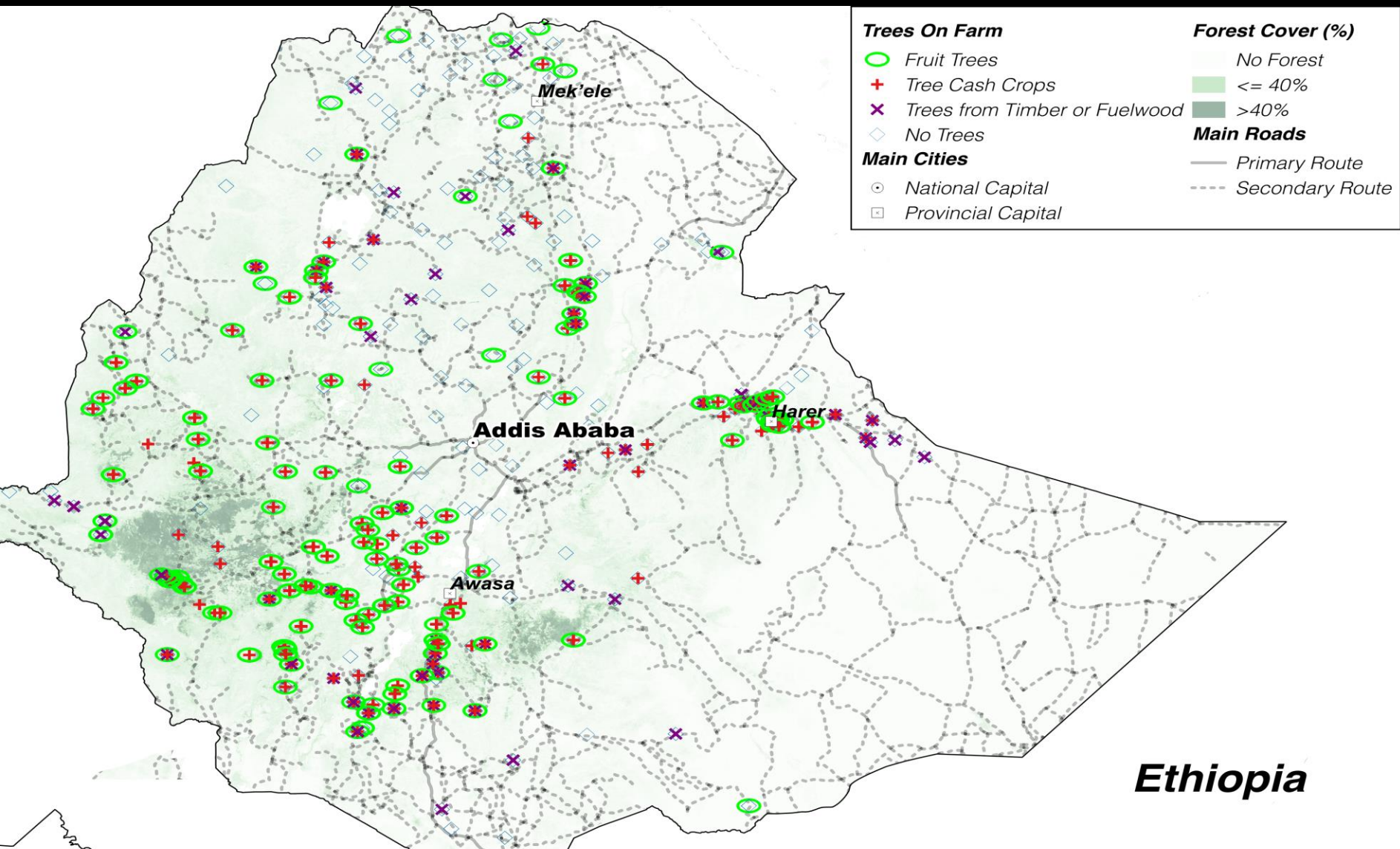
Note: All descriptive statistics corrected by sampling weight.

Spatial distribution of households with presence of on-farm trees by tree type



Note: This map shows the spatial distribution of trees on farms across the five southern countries. The geographical unit of analysis is the household. All statistics were corrected by sampling weight. *Data Source:* Authors' elaboration based on World Bank (2015).

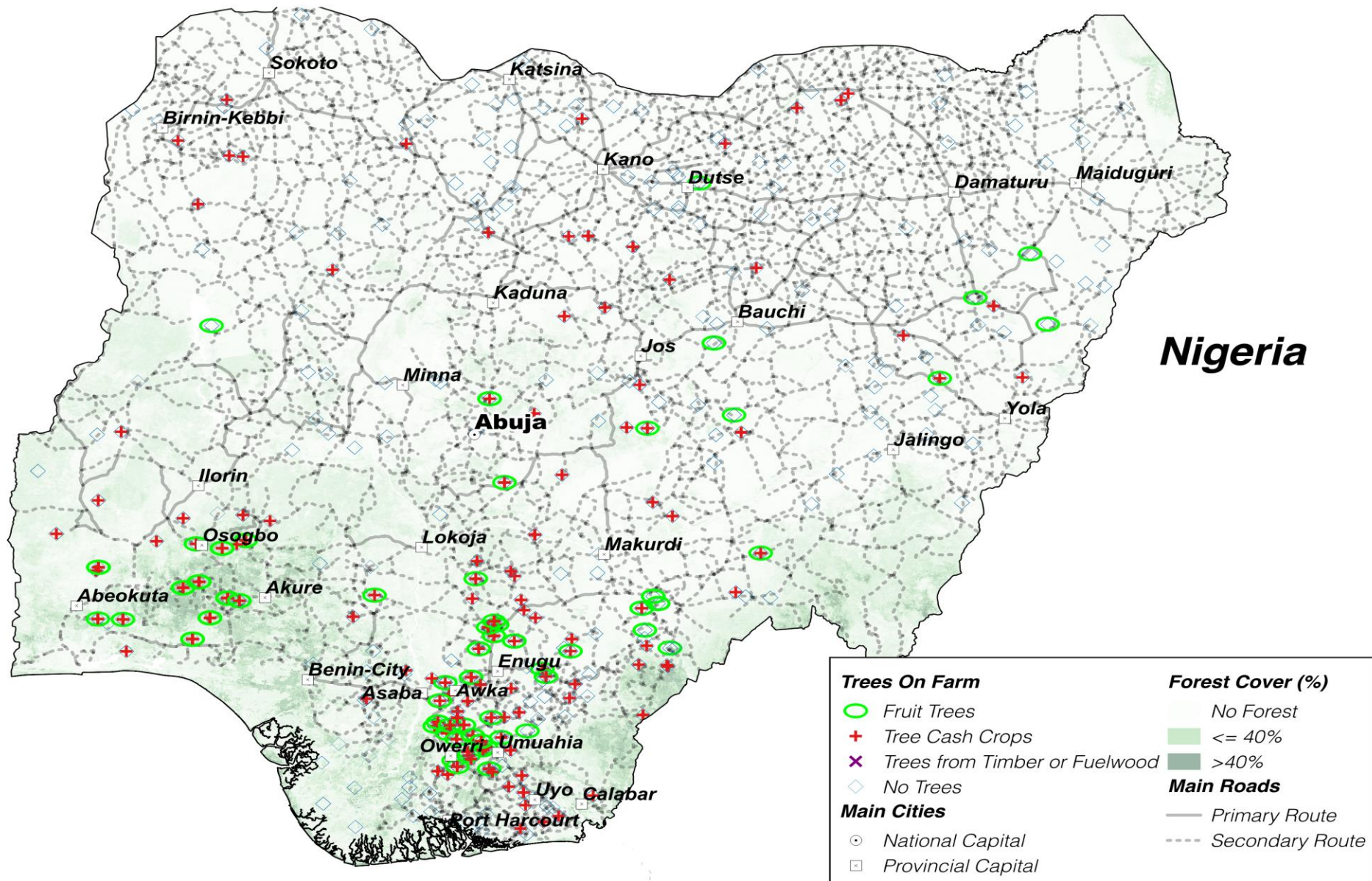
Spatial distribution of households with presence of on-farm trees by tree type



Ethiopia

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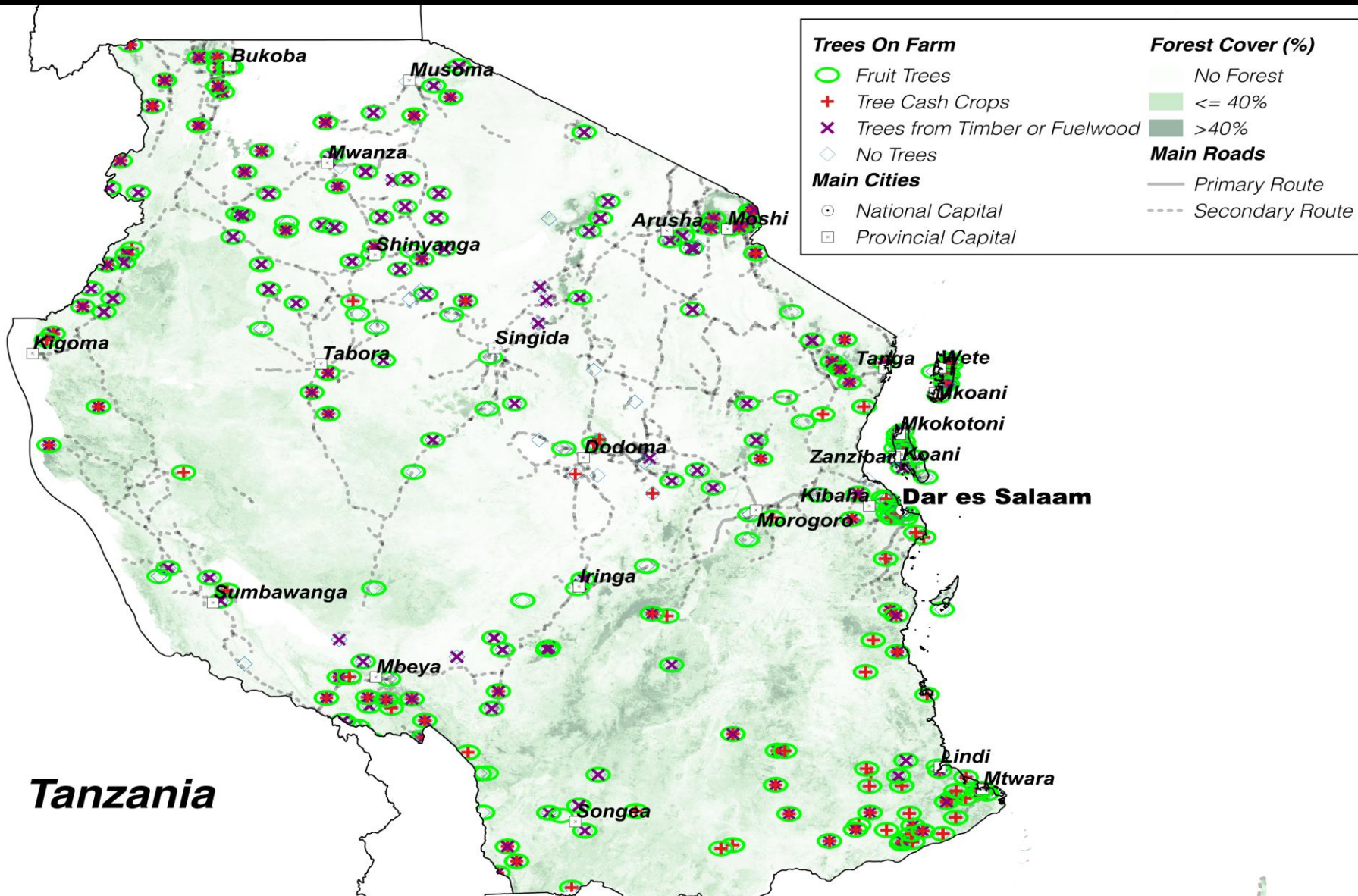
Spatial distribution of households with presence of on-farm trees



Nigeria

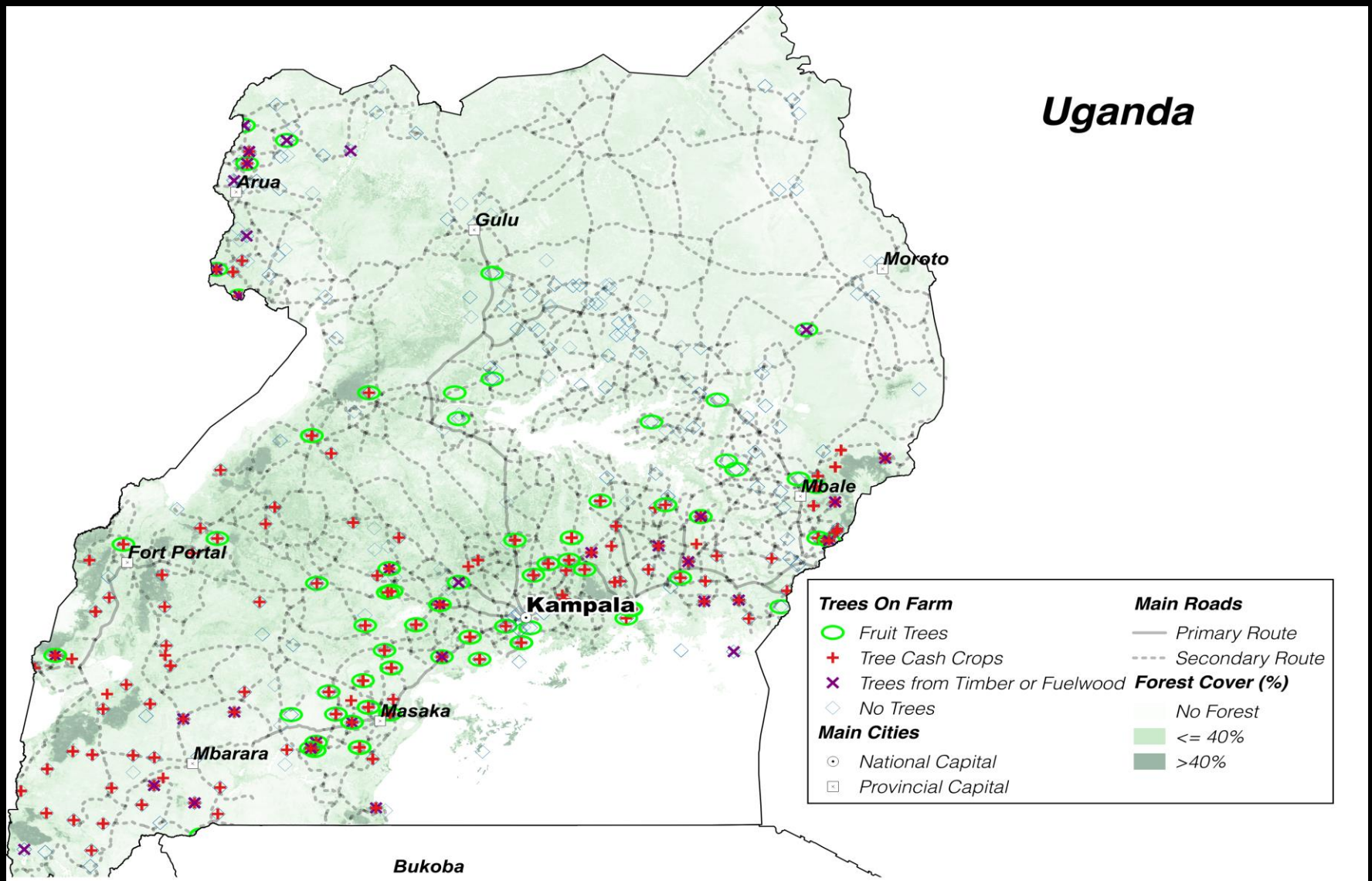
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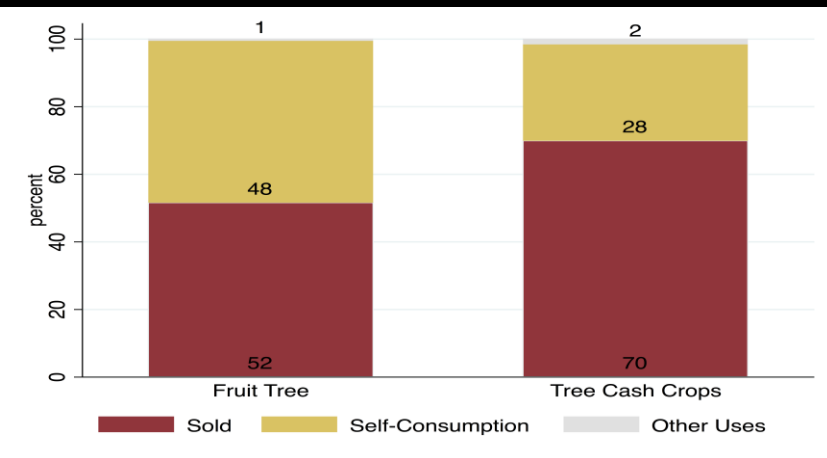
Household distance from nearest forest defined as 30% tree cover threshold

Country	Extent of tree cover (ha) by country (2000)	Percent tree cover relative to country land area (2000)	Households in our sample (#)	Share (%) of households with trees on farms within		
				10km of forest	20km of forest	50km of forest
Ethiopia	12,040,763	10.72	3,347	55.81	73.91	93.3
Malawi	1,521,741	16.17	9,936	85.87	100	100
Nigeria	10,033,216	11.13	2,602	36.33	46.51	59.7
Tanzania	26,42,2567	29.85	2,621	79.82	88.1	94.2
Uganda	7,768,069	37.83	1,814	91.85	98.02	100
<i>Overall</i>	6,272,758	17.95	20,320	58.47	68.91	77.05

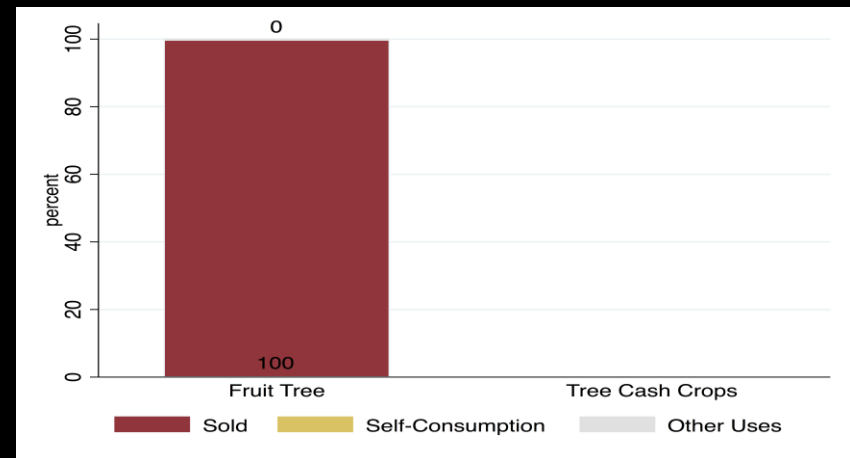
Note: To protect confidentiality household location coordinates in LSMS-ISA data are not exact, but rather based on a random distortion of 0-5km. Data on extent of tree cover by country and percent tree cover relative to country land area derive from Hansen et al. (2013). Note that “tree cover” is not the same as “forest cover” in these data. “Tree cover” refers to the biophysical presence of trees, which may be a part of natural forests or tree plantations. Information on household distance to forest are based on the authors' calculations from LSMS-ISA data sets (World Bank, 2015) and “MOD44B MODIS Vegetation Continuous Field Coll. 5–2000 through to 2010: Percent Tree Cover” (DiMiceli et al., 2011).

Share of tree products by use, by country

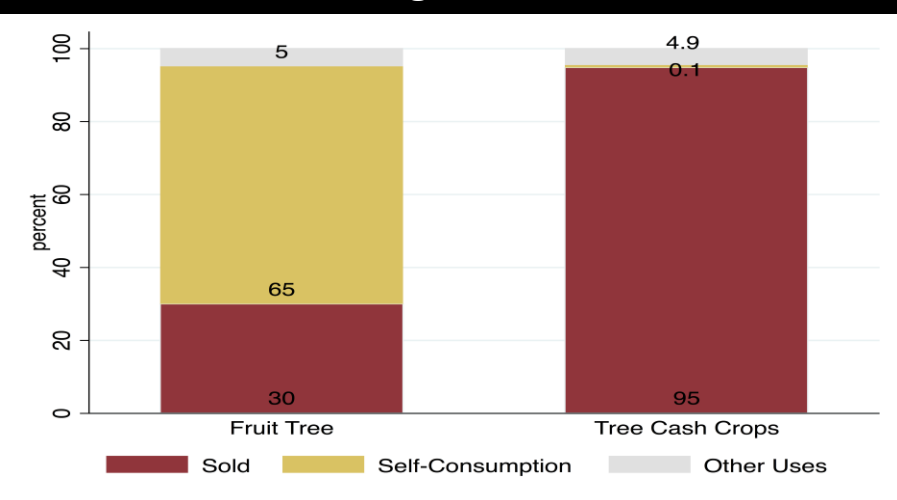
Ethiopia



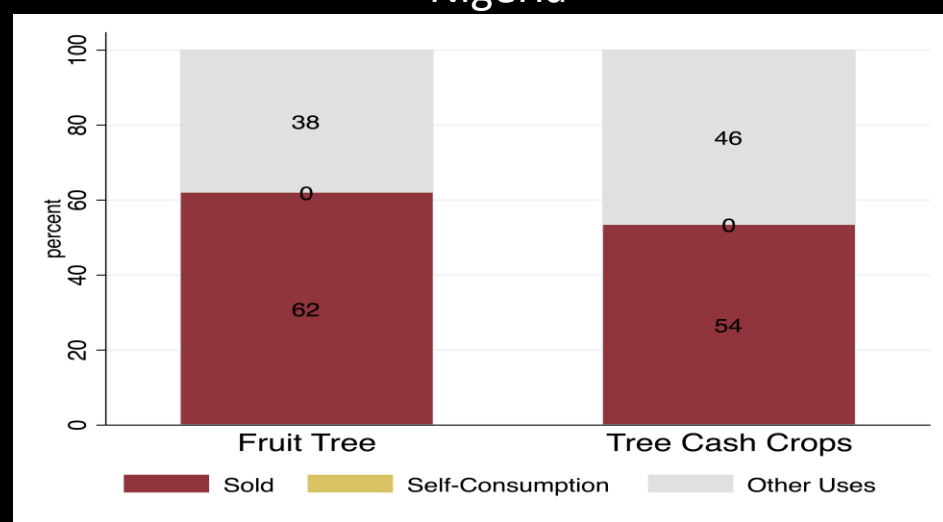
Malawi



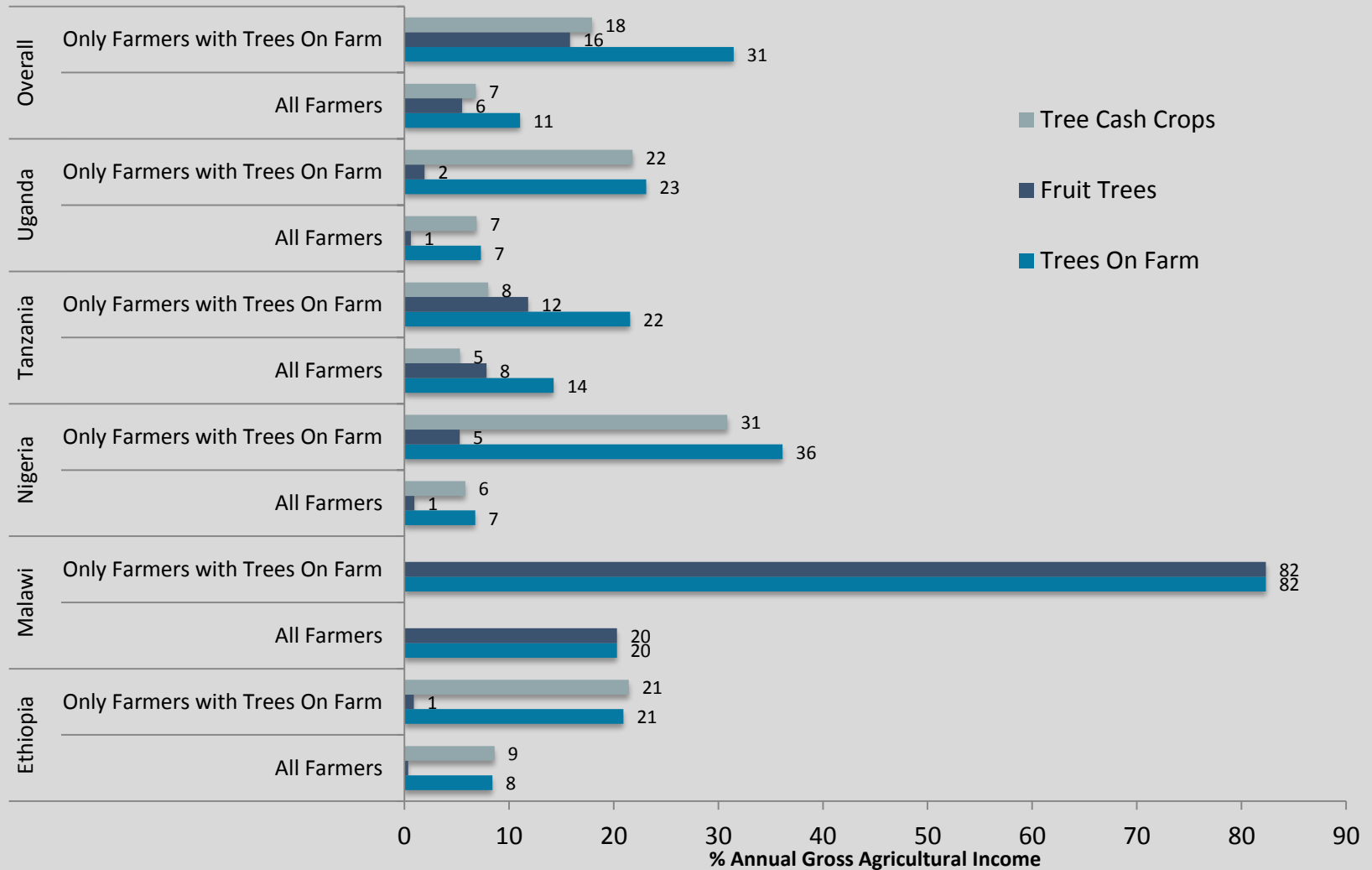
Uganda



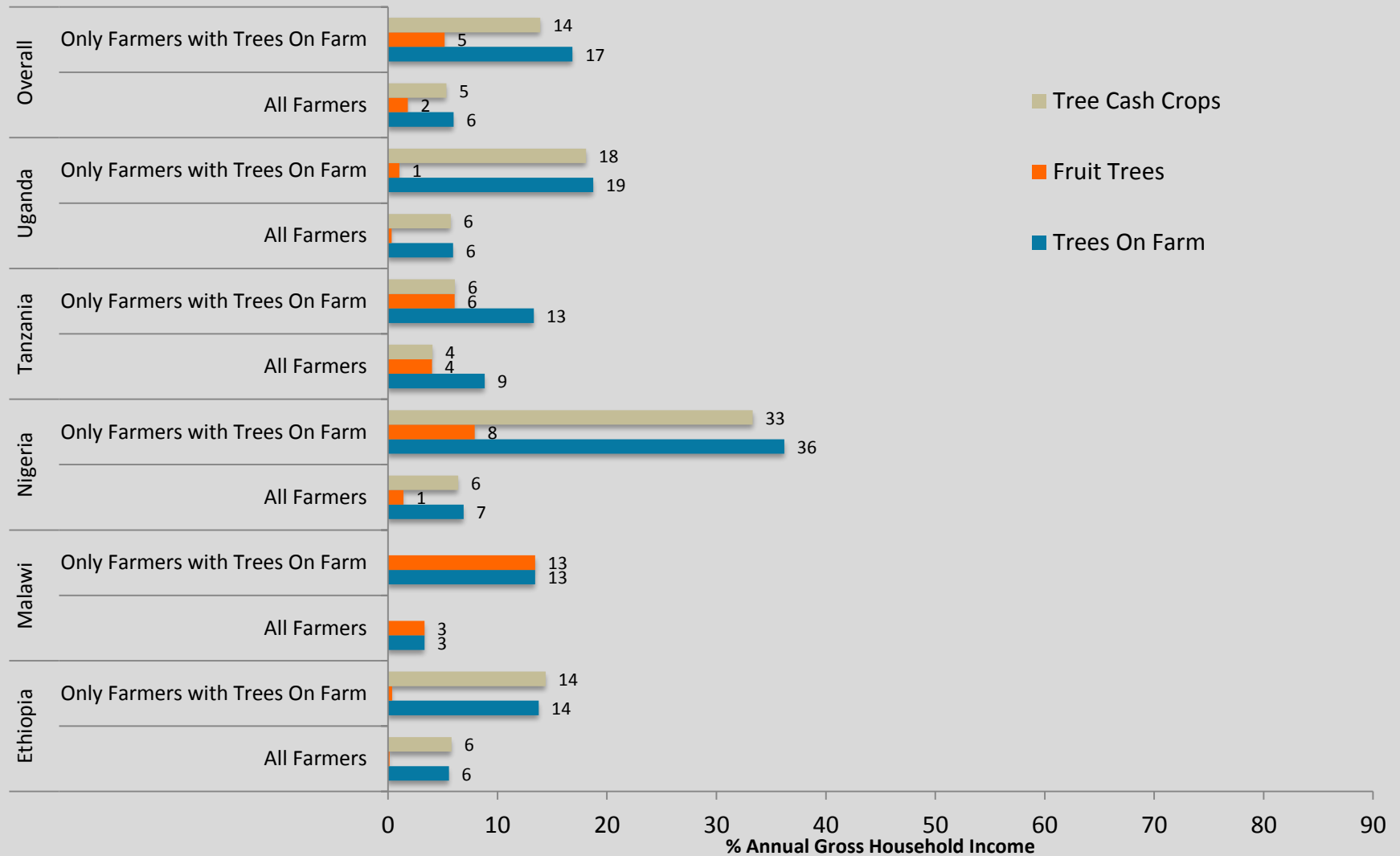
Nigeria



Contribution of Trees on Farms to Annual Gross Agricultural Income



Contribution of Trees on Farms to Annual Gross Household Income



Relationship of trees on farms and daily consumption per person

		Dependent Variable = Log. Real Daily Consumption per person (in 2011 PPP)			
		(I)	(II)	(III)	(IV)
<i>Ethiopia 2011-12</i>	Trees On Farm (yes = 1)	0.597*** [0.037]			
	Fruit Trees On Farm (yes = 1)		0.382*** [0.053]		
	Tree Cash Crops on Farm (yes = 1)			0.612*** [0.039]	
	Trees for Timber or Fuelwood on Farm (yes = 1)				0.132 [0.134]
<i>Malawi 2010-11</i>	Trees On Farm (yes = 1)	0.000 [0.031]			
	Fruit Trees On Farm (yes = 1)		-0.006 [0.010]		
	Trees for Timber or Fuelwood on Farm (yes = 1)				-0.323*** [0.103]
<i>Nigeria 2010-11</i>	Trees On Farm (yes = 1)	0.212*** [0.035]			
	Fruit Trees On Farm (yes = 1)		0.252*** [0.046]		
	Tree Cash Crops on Farm (yes = 1)			0.177*** [0.030]	
<i>Tanzania 2010-11</i>	Trees On Farm (yes = 1)	-0.002 [0.030]			
	Fruit Trees On Farm (yes = 1)		0.011 [0.010]		
	Tree Cash Crops on Farm (yes = 1)			0.032*** [0.011]	
	Trees for Timber or Fuelwood on Farm (yes = 1)				0.010 [0.010]
<i>Uganda 2010-11</i>	Trees On Farm (yes = 1)	0.010 [0.025]			
	Fruit Trees On Farm (yes = 1)		0.102*** [0.032]		
	Tree Cash Crops on Farm (yes = 1)			0.002 [0.010]	
	Trees for Timber or Fuelwood on Farm (yes = 1)				0.002 [0.021]

Note: Sampling weights and fixed effect were used for all regressions. * p<0.10 ** p<0.05 *** p<0.01.

Correlates of on-farm tree adoption

$$\text{TreesOnFarms}_{ivc} = \alpha_1 + \mathbf{HH}'_{ivc}\boldsymbol{\rho} + \mathbf{Assets}'_{ivc}\boldsymbol{\delta} + \mathbf{GeoClimate}'_{ivc}\boldsymbol{\gamma} + \sum_{k=1}^5 \theta_k dT_k + \varepsilon_{ivc}$$

$\text{TreesOnFarms}_{ivc}$

Presence or absence of any trees on a given household's

The share of landholdings with presence of trees

HH' - household characteristics

- Household size, number of children (<14 years old),
- Age of household head
- Dummy variable indicating a female headed household
- Household head level of formal education (in years).

Assets' - household assets

- Land owned (in hectares)
- Number of tropical livestock units

GeoClimate' - Household assets

- Average percentage of tree cover within 20 kilometers of each household
- Number of people per kilometer square within 20km of the household location
- Average percentage of fertile soil within 20 kilometers of each household
- Distance to the main market
- Annual mean temperature (C)
- Average annual precipitation (mm)

Multivariate analysis of adoption and management of trees on farms

	<i>Adoption Analysis (Probit)</i>			<i>Determinants of share of farmland with trees</i>		
	<i>Dep. Variable: Trees on farms (yes=1)</i>			<i>Dep. Variable: Share of farmland with presence of trees</i>		
	(I)	(II)	Shapley Value	(III)	(IV)	Shapley Value
<i>Household Controls</i>			0.011 (4.06%)			0.008 (2.76%)
Household Size	0.008 [0.006]	0.012** [0.005]		0.016** [0.007]	0.012* [0.007]	
Number of Children (<14 years old)	-0.002 [0.007]	-0.004 [0.007]		-0.010 [0.010]	-0.007 [0.009]	
Head's Age (years)	0.002*** [0.001]	0.002** [0.001]		0.003** [0.001]	0.004** [0.001]	
Head Female (yes=1)	-0.055*** [0.012]	-0.060*** [0.013]		0.006 [0.046]	-0.023 [0.032]	
Head education (years)	0.003 [0.003]	0.004 [0.003]		0.010* [0.005]	0.009* [0.005]	
<i>Assets and land</i>			0.004 (1.51%)			0.206 (64.46%)
Tropical Livestock Units (TLU)	-0.003 [0.002]	-0.002 [0.002]		-0.001 [0.001]	-0.001 [0.001]	
Land Owned (area - ha)	0.004 [0.004]	0.005 [0.004]		0.267*** [0.094]	0.263*** [0.094]	
<i>Geo- and climate variables</i>			0.033 (11.38%)			0.004 (1.28%)
Log Population Density around 20km (people/sqkm) (2010)	0.086** [0.035]	0.077*** [0.025]		0.166*** [0.055]	0.132*** [0.045]	
Tree Cover % within 20km (mean) (2010)	0.007*** [0.002]	0.007*** [0.002]		0.003 [0.003]	0.003 [0.003]	
Fertile Soil % within 20 km (mean) (2010)	-0.004 [0.072]	-0.020 [0.075]		0.134 [0.151]	0.134 [0.147]	
Log. Annual Mean Temperature (C)	0.027** [0.011]	0.033*** [0.012]		0.045** [0.022]	0.043* [0.022]	
Log. Annual Precipitation (mm)	-0.000 [0.000]	0.000 [0.000]		-0.000 [0.000]	-0.000 [0.000]	
<i>Country Fixed Effects</i>			0.099 (33.87%)			0.075 (23.56%)
Malawi	-0.273*** [0.043]	-0.258*** [0.026]		-0.150 [0.128]	0.026 [0.135]	
Nigeria	-0.398*** [0.061]	-0.433*** [0.055]		-0.306** [0.131]	-0.171 [0.134]	
Tanzania	0.124* [0.063]	0.105 [0.069]		0.820*** [0.146]	0.715*** [0.118]	
Uganda	-0.262*** [0.054]	-0.270*** [0.042]		0.260 [0.214]	0.365* [0.207]	
Mean Dependent Variable	0.290	0.290		0.243	0.243	
(Pseudo) R-Squared	0.207	0.258		0.306	0.320	
Observations	18,907	18,907		18,907	18,907	
District/Regional Fixed Effect	No	Yes		No	Yes	

Household characteristics

- Household size, number of children (<14 years old),
 - Positively relationship (0.012** [0.005]) (In particular, in tree Cash crops)
- Age of household head
 - Positively relationship (0.012** [0.005]). Consistent results throughout all countries and type of tree
- Head Female (yes=1)
 - Negative relationship (-0.06* [0.013])
- Household head level of formal education (in years)
 - Positive relation

Household assets

- Land owned (in hectares)
 - Positive relationship
- Number of tropical livestock units
 - No clear relationship

Geo-climate Determinants

- Relationship Tree Cover % within 20km (mean) (2010)
 - Consistent (on average, point estimates 0.007***[0.010])
- Population Density around 20km (people/sqkm) (2010)
 - Positive correlated
- Fertile Soil % within 20 km (mean) (2010)
 - No clear relation

Results are consistent by type of tree

Takeaways Points

- Trees are substantial income generators across rural Africa—and likely higher than our estimates (which are direct measures, but do not consider ecosystem services, etc.)
- Trees on farms are an important source of income for many rural households
 - Liquidity constraint
- Need for work to better estimate the contribution of trees outside forests & to explore the linkages between trees in and out of forests in terms of livelihoods

Policy Implication: more focus on trees outside forests & better data collection.

Lessons learned for future LSMS-ISA

- Community Module
 - Include question on presence of forest for all countries
 - Prices at local level for timber and non-timber forestry products
 - Standardized local management of forest

Household Module

- Specific question on materials for source of light
 - Follow up question on where timber products are generally gathered (in-farm or off-farm)
- Same for collection of charcoal and/or firewood
 - i.e. source of these products

Agricultural Module

- Follow up question on non-cultivated plots allocated to forest
 - e.g. gardens, non-productive trees
- Increase the number of plots listed in the crops
 - e.g. for ethiopia include Eucalyptus
- Standardized information on trees on farm
 - Area planted
 - Year of plantation
 - Number of trees

New Forestry Module

Codes and Data Set Available

<https://github.com/MythsAndFacts-Replication>



Agriculture in Africa: Telling Facts from Myths

Research program that is fact-checking some of the most commonly accepted characteristics about the current state of Africa's agriculture.

World Bank <http://www.worldbank.o...> Ichristiaensen@worldba...

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TreesOnFarm

TreesOnFarm-Project

● Stata



Thank you!

Acknowledgements: This article was written as part of the “Agriculture in Africa - Telling Facts from Myths” project, which revisits common wisdom about African agriculture and farmer livelihoods using household survey data collected under the World Bank Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) initiative. Funding from the Program on Forests (PROFOR) is gratefully acknowledged. The authors thank Karen Brooks, Frank Place, Laura Vang Rasmussen, Cristy Watkins, two anonymous reviewers, and participants at the “Myths and Facts” workshop at IFPRI in June 2015 and the Forests & Livelihoods: Assessment, Research, and Engagement (FLARE) Network Conference in Paris in November 2015 for helpful comments on earlier versions of the manuscript.