Transformation in the size and distribution of farmland operated by household and other farms in select countries of sub-Saharan Africa

Sarah K Lowder, Raffaele Bertini, Panagiotis Karfakis and Andre Croppenstedt

Invited paper presented at the 5th International Conference of the African Association of Agricultural Economists, September 23-26, 2016, Addis Ababa, Ethiopia

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Agricultural Development Economics Division, Food and Agriculture Organization of the United Nations, Italy
Sarah.lowder@fao.org

Abstract

For select countries in sub-Saharan Africa, we compare various sources of information on agricultural land in an attempt to determine what share of total agricultural land may be operated by corporate farms or government enterprises. We also combine various data on agricultural land and households in order to gain a better understanding of the number and distribution of household and non-household farms and farmland in sub-Saharan Africa and Asia. We also examine changes in farmland distribution among household farms for select countries in sub-Saharan Africa and Asia. Whereas most literature on changes in farm size focuses on the average farm size, we go beyond looking at averages to consider the entire distribution of household farms.

We find that a significant share of agricultural land is likely operated by non-household farms in a select set of African countries. There is a need to redouble efforts to conduct surveys of all farms as opposed to simply household farms; efforts such as the Agricultural Information System (AGRIS) are timely. LSMS and DHS data confirm the finding that average farm sizes have decreased in many countries of sub-Saharan Africa, although the decrease results from various types of changes in farmland distribution. Previous estimates of the number of farms in sub-Saharan Africa are out of date and we estimate that there are more than 77 million farms in that region.

Key Words: farm size; farmland distribution; household farm; land cover

Acknowledgements: The authors gratefully acknowledge assistance provided by colleagues in the FAO Statistics Division as well as the World Bank LSMS-ISA team. They helped the authors in better understanding the data sources used as well as provided national level extractions of FAO's Global land cover share data or GLC-SHARE.

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1. Introduction

In order to understand the transformation of the agricultural and rural sector in the developing world, it is essential to first have a comprehensive understanding of the agricultural landscape in low and middle income countries. However, results on productivity-related topics and other analysis are limited to household farms due to the profession relying largely on household surveys, which despite being a rich source of detailed information, do not include non-household farms (many of which are likely larger, commercial ventures or government-owned operations).

In this paper we combine various data on agricultural land and households in order to gain a better understanding of the number and distribution of household and non-household farms and farmland in sub-Saharan Africa and Asia. We also examine changes in farmland distribution among household farms for select countries in sub-Saharan Africa and Asia. Lastly, for select countries in sub-Saharan Africa, we compare various sources of information on agricultural land in an attempt to determine what share of total agricultural land may be owned by corporate farms.

2. Research questions

In order to understand the agricultural sector in many developing countries, agricultural and development economists often rely on household survey data. However, household farms are not representative of the entire agricultural sector in developing countries. Government owned farms and private corporate farms also play an important role and may operate a large share of the agricultural farmland in some countries. In this paper we compare various sources of information on agricultural land in an attempt to determine what share of total agricultural land is represented by non-household farms. This will help us better understand to what extent we are missing a large part of the picture when we rely on household survey data to examine the agricultural sector in developing countries.

FAO's *State of Food and Agriculture 2014: Innovation in Family Farming* (FAO, 2014a) used estimates from agricultural census reports to provide the most comprehensive overview to date of the number, average size and distribution of farms and farmland throughout the world. Of all regions considered information was most lacking for sub-Saharan Africa. This paper will draw on numerous datasets to improve our understanding of changes in the number and distribution of farms in sub-Saharan Africa as well as select Asian countries.

Numerous authors have considered the evolution of average farm size over time in various countries; all of the authors find that farm sizes have been decreasing in most African countries (Eastwood, Lipton and Newell, 2010; Hazell, *et al.*, 2010; Deininger and Byerlee, 2012; FAO, 2013; HLPE, 2013; Masters *et al.*, 2013; Adamopoulos and Restuccia, 2014; and FAO, 2014a). It's important to go beyond the average and consider the entire distribution of farmland by farm size. Some newer work by Jayne, et al (2014a and 2015) provides evidence

of the emergence of medium-scale investor farmers in a limited set of African countries. Jayne, Chamberlin and Headey, (2014b) show that in land-constrained African countries for which data are available, average farm size has decreased, and that in most, but not all, land abundant African countries, there has been an increase in average farm size.

The literature on average farm size over time (with the exception of Masters *et al.* (2013) and Jayne et al, (2014a and 2015)) relies mostly on agricultural census data. This is a problem, because for many countries in sub-Saharan Africa the coverage and methodology used for agricultural censuses is not uniform over time. Some of the change in average farm size from one period to the next may be attributed to variation over time in the coverage or methodology used for the agricultural census or census report. For example, although FAO recommends that countries sample all farms, that is not always the case and in the case of Ethiopia the 1990 round agricultural census considered all farms while the 2000 round was limited to farming households (Table 1); this change in sample coverage may be reason enough for the apparent decrease in average farm size for that country. In this paper we attempt to gain a better understanding of what has happened to distribution of household farms over time for select countries in Africa and other developing regions.

Table 1: Agricultural census – geographic scope and coverage, select countries

Country	Census round	Geographic scope	Coverage
Ethiopia	1990	National - excluding Eritrea, Tigray, Asab, & Ogaden	All farms
Ethiopia	2000	National, excluding some pastoral areas of the Afar and Somali Regional states	Households
Lesotho	1990	National	All farms
Malawi	1990	National	Households
Malawi	2010	Rural and peri-urban	Households

Sources: Various agricultural census reports and FAO, 2001.

This paper aims to answer the following questions:

1. What share of farmland is likely operated by non-household entities, ie corporations and government owned farms?
2. What is the distribution of farmland operated by household farms in sub-Saharan Africa and how can we supplement agricultural census data to get a more representative picture?
3. What do we know about the change in farmland distribution, average and median farm size over time in select countries of sub-Saharan Africa and Asia?
4. What is the number of farms in sub-Saharan Africa?

3. Data and methods

This paper relies on five data sources on farms and farmland. It considers agricultural census data as reported in the statistical annex of The State of Food and Agriculture 2014, LSMS data from the World Bank, DHS data from USAID, land use data from FAOSTAT and land cover data from GLC share. Lastly it compares estimates of total agricultural land area using agricultural census, DHS and LSMS data with estimates of agricultural land from the FAOSTAT land use database. There is wide variation among datasets in terms of the type of agriculture and farming unit considered. We outline key definitions here.

Agricultural census

This paper relies on data from numerous agricultural censuses, which are representative of all farms or farm households in a country. The Food and Agriculture Organization of the United Nations (FAO) has promoted the Programme for the World Census of Agriculture (WCA) since 1950 by providing governments with guidance on standard methodology and contents for their agricultural census. FAO recommends that the census consider farms of all types throughout a country and that it be conducted by using complete enumeration and/or sampling methods.

Agricultural holdings and agricultural area reported by the census include crop and livestock production only; holdings engaged in forestry or fisheries are only included if they are also engaged in crop and livestock production. Communal lands are generally not included in the agricultural census.

The FAO's theoretical definition of an agricultural holding is:

> "an economic unit of agricultural production under single management comprising all livestock kept and all land used wholly or partly for agricultural production purposes, without regard to title, legal form, or size. Single management may be exercised by an individual or household, jointly by two or more individuals or households, by a clan or tribe, or by a juridical person such as a corporation, cooperative or government agency''(FAO, 2005).

The agricultural holder is the person who makes strategic decisions regarding use of the farm resources and who bears all risks associated with the farm. The agricultural holder may undertake all management responsibilities or delegate day-to-day work management responsibilities to a hired manager. The difference between the hired manager and the agricultural holder (the manager of the holding) is that the former is a hired employee who implements the decisions of the agricultural holder while the latter makes all strategic decisions, takes all economic risks and has control over all production resulting from the agricultural holding (FAO, 2005).

Living Standards Measurement Study data

The World Bank and National Governments have collaborated for several decades on the collection, management, dissemination and analysis of Living Standards Measurement Study data. A comprehensive description of LSMS data and survey design is beyond the scope of this paper; for more detailed information about such surveys readers are referred to the World Bank (2015). This paper uses data on agricultural land from selected LSMS surveys for which relevant information on agricultural land distribution was likewise available. Some of the surveys are more recent and they are part of the LSMS-ISA program; that is, they include an extensive module on agriculture. Although there is variation among countries in terms of the land variable we present here, it is typically self-reported estimates of agricultural land cultivated for crops or livestock use. For example, in the case of Tanzania we consider LSMS data from 1993 as well as data from LSMS-ISA for 2013. The sum of the land area operated in both the rainy season and the dimba (dry) season are reported. Details are provided in the footnote to the relevant tables, but generally speaking operated area equals land cultivated and owned minus land rented out, plus land rented or sharecropped in. Fallow land is included.

Demographic and Health Surveys administered by USAID

A relatively less well known source of information on household participation in agriculture is that of the Demographic and Health Surveys administered by USAID and its partner organizations. Since 1984 USAID has implemented nationally representative household surveys on various health related concerns in over 70 developing countries throughout the world (ICF International, 2006). In the mid-2000s a question on ownership of agricultural land was included in some surveys. The question is as follows:

Sh 119:Does any member of this household own any agricultural land?

Sh 120: How many hectares of agricultural land do members of this household own?

(ICF International, 2012)

The interviewer's manual stipulates that "Agricultural land refers to land that is used for growing crops (the crops may be food for people, food for animals, or other non-food crops), raising animals, and grazing animals. In answering this question, common land used to graze animals but not owned by the household should not be included."

The DHS data are useful for compiling the share of the population that is involved in agriculture as well as average household size or the number of members of the household. By combining this information with population statistics from FAOSTAT we create rough expansion factors that allow us to estimate the number of households owning agricultural land as well as the total agricultural land in the country.

FAOSTAT land use data

The FAO provides widely cited data on agricultural land by land use at the country level through FAOSTAT. The data result from an annual survey sent to partners in Ministries of Agriculture. There are several land use categories, with the principal ones being reported for nearly all countries; they are arable land, permanent crops and permanent meadows and pastures. The sum of these three categories is total agricultural area; common land is included in the total agricultural area for most countries. According to FAOSTAT, definitions of the main categories of land use are as follow:

> Arable land - land under temporary agricultural crops (multiple-cropped areas are counted only once), temporary meadows for mowing or pasture, land under market and kitchen gardens and land temporarily fallow (less than five years). The abandoned land resulting from shifting cultivation is not included in this category. Data for "Arable land" are not meant to indicate the amount of land that is potentially cultivable.
>
> Permanent crops - land cultivated with long-term crops which do not have to be replanted for several years (such as cocoa and coffee); land under trees and shrubs producing flowers, such as roses and jasmine; and nurseries (except those for forest trees, which should be classified under "forest");
>
> Permanent meadows and pastures - land used permanently (five years or more) to grow herbaceous forage crops, either cultivated or growing wild (wild prairie or grazing land).

FAO's Global land cover share data or GLC-SHARE

The Global land cover share or GLC-SHARE Beta-release 1.0 database uses the best available land cover datasets taken from satellite imagery, considering national, regional and global databases in order to produce a high resolution (30 arc-second or ~1 sqkm) database describing 11 types of land cover globally (FAO, 2014b). The year of data varies according to the original source data chosen. The land cover types include artificial surfaces, cropland, grassland, tree covered areas, shrub covered areas, herbaceous vegetation, aquatic or regularly flooded; mangroves; sparse vegetation; bare soil, snow and glaciers, and water bodies. This paper refers to GLC-SHARE estimates of cropland, which includes herbaceous crops, woody crops and multiple or layered crops. Estimates of total cropland at the national level were extracted for countries in sub-Saharan Africa.

4. Findings

Non-household farms

In order to understand the agricultural sector in many developing countries, agricultural and development economists often rely on household survey data. However, household farms are not representative of the entire agricultural sector in developing countries. Government

owned farms and private corporate farms also play an important role and may operate a large share of the agricultural farm land in some countries. In this paper we compare various sources of information on agricultural land in an attempt to determine what share of total agricultural land is represented by non-household farms. This will help us better understand to what extent we are missing a large part of the picture when we rely on household survey data to examine the agricultural sector in developing countries.

FAO recommends that agricultural census consider farms of all types throughout a country. Whereas agricultural censuses are most often nationally representative of all farms, some other sources of information often used by the agricultural and development economics profession are not. Household income surveys, such as the Living Standard Measurement Study (LSMS) surveys (World Bank, 2015), are often used for studying agricultural activities in developing countries. The LSMS and some other household income and expenditure survey data are made widely available and provide a rich source of information at the household level on sources of income and expenditures as well as agriculture for many countries. However, a limitation of household surveys is that they are representative of farm households but not representative of all of the farms in a country. Household surveys generally do not include farms that are not family-owned (which are for the most part large farms) and thus underestimate the contribution of large farms. The possible implications are illustrated by the example of Guatemala, shown in Table 2. The agricultural census data reveal that, in Guatemala, a small number of very large farms (from 45.2 to more than 9,000 hectares) represent the minority (2%) of holdings, but the majority (57%) of farmland. Large farms are not reported by the household survey data, where the largest farm included encompasses 98.8 hectares. Clearly the agricultural census is key to our gaining a more comprehensive picture of the agricultural sector in Guatemala.

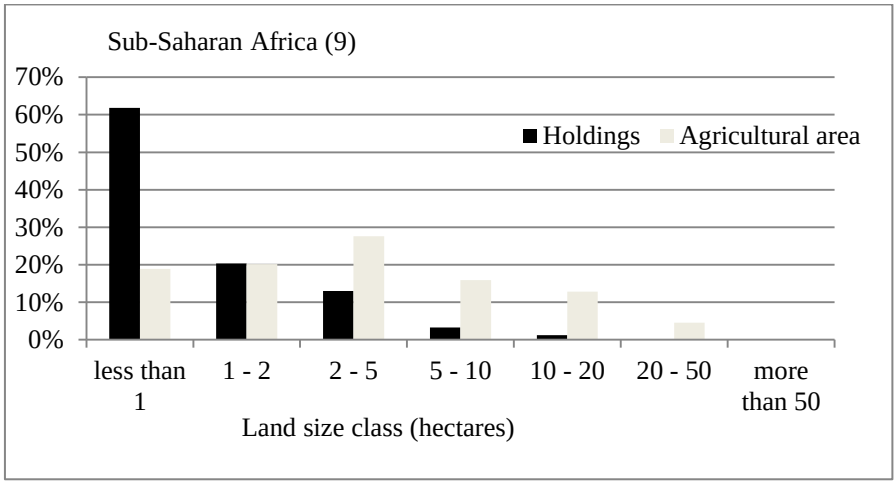
Table 2: Farmland distribution in Guatemala, agricultural census versus household survey

	Agricultural census, 2003		Household survey, 2006	
	Share of Holdings	Share of agricultural area	Share of Household farms	Share of Operated area
Farm size class:	(percentage)		(percentage)	
< 0.7 ha	45%	3%	50%	13%
0.7 - 1.4 ha	22%	5%	24%	19%
1.4 - 3.5 ha	19%	8%	20%	33%
3.5 - 7.1 ha	6%	6%	5%	18%
7.1 - 22.6 ha	5%	13%	1%	13%
22.6 - 45.2 ha	1%	9%	0%	3%
> 45.2 ha	2%	57%	0%	0%

Notes: For the household survey operated area equals land owned and used for crop production plus land share cropped or rented in minus land share cropped or rented out.
Sources: Lowder, Skoet and Raney, in press. *World Development*.

Information provided through agricultural census on farmland distribution in countries of SSA is limited. For most of the 9 countries for which we have such information (Figure 1), the agricultural census are limited to considering household rather than all farms. There are no sub-Saharan African countries for which we have both LSMS and agricultural census for the same country & for which the agricultural census sample is all farms. It is therefore unfortunately not possible to replicate the analysis presented for Guatemala in a country of SSA.

Figure 1: Farms and farmland distribution in sub-Saharan Africa, using agricultural census data



Source: Lowder, Skoet and Raney, in press. *World Development*.
Notes: Countries and survey years are: Burkina Faso, 1993;Congo, Dem. Rep of, 1990; Côte d'Ivoire, 2001; Ethiopia, 2001-2; Guinea, 1995; Namibia, 1996-7; Réunion, 2000; Senegal, 1998-9 and Uganda, 1991.

In order to assess the extent to which farmland in African countries is concentrated among non-household farms we therefore compare total agricultural operated area from the LSMS (using gps measures where available) to estimates of total cropland. Measuring total cropland is notoriously challenging (see, for example, See et al, 2015 and Fritz et al, 2015). We choose to consider two sources of cropland/ land cover information: total agricultural area reported in FAOSTAT and cropland extracted at country level from GLC share data.

We see that in 3 out of 4 cases the household farm operated area is much smaller than the arable land and permanent crops estimate from FAOSTAT as well as smaller than the cropland estimates extracted from GLC share data (Table 3). The discrepancy would suggest that reliance on household surveys to describe the agricultural sector of such countries misses a big part of the picture. A substantial share of agricultural land in Malawi, Nigeria and Uganda is unaccounted for by the LSMS surveys. This would suggest that a substantial share of agricultural land in those countries is operated by non-household farms which are likely to be large scale corporations, government enterprises or common lands. There is a need to redouble efforts for agricultural census sampling to cover all farms and all farmland.

Table 3: Estimates of total hectares of agricultural land using LSMS, FAOSTAT and GLC Share data

	LSMS-ISA amount of agricultural land	FAOSTAT, arable land and permanent crops	FAO Global Land Cover-Share, cropland area*
Malawi, 2011	2,566,237	3,735,000	4,687,700
Nigeria, 2010	11,396,574	41,700,000	34,636,100
Tanzania, 2013	15,025,512	15,650,000	14,647,200
Uganda, 2012	5,211,524	9,150,000	6,241,000

Notes: * For all sources the year is as indicated in column 1, with the exception of estimates extracted from the Global land cover share data which are for the year 2014. For LSMS-ISA the land amount is estimated using GPS measures when available, and self-reported estimates when GPS estimates are not available. Land amount is considered as the sum of the two seasons and outliers have not been replaced.
Sources: LSMS ISA surveys; FAO. (2015a) and FAO. (2014b).

To have a complete picture of the agricultural sector we need to understand the situation of both household and non-household farms. This means that efforts to improve existing agricultural censuses and initiatives such as FAO's Agricultural Information System (AGRIS) which aim to develop surveys of all farms are particularly timely (Fonteneau, 2016). It would seem appropriate to continue in a redoubling of efforts to encourage countries to sample all farms and not only households when conducting their agricultural census. Alternatively an additional non-household farm survey effort could be undertaken to complement existing LSMS and those agricultural censuses for which the sample is limited to household farms.

Farmland distribution in sub-Saharan Africa

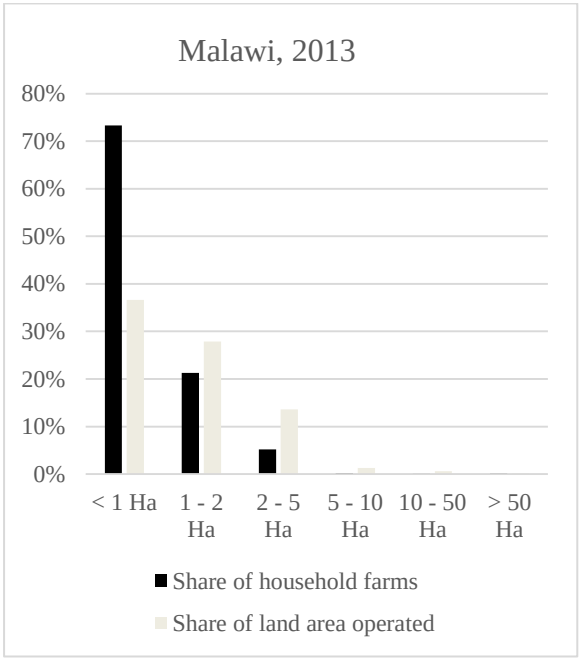
Information on farmland distribution in sub-Saharan Africa is extremely limited. Only 9 agricultural census reports from the 2000 and 1990 round provide estimates of hectares of agricultural area by farm size class. As seen earlier, the sample for many of those reports is limited to household rather than all farms. The agricultural censuses show that about 80 percent of farms in those countries are smaller than 2 hectares and they operate about 40 percent of the farmland (Figure 1).

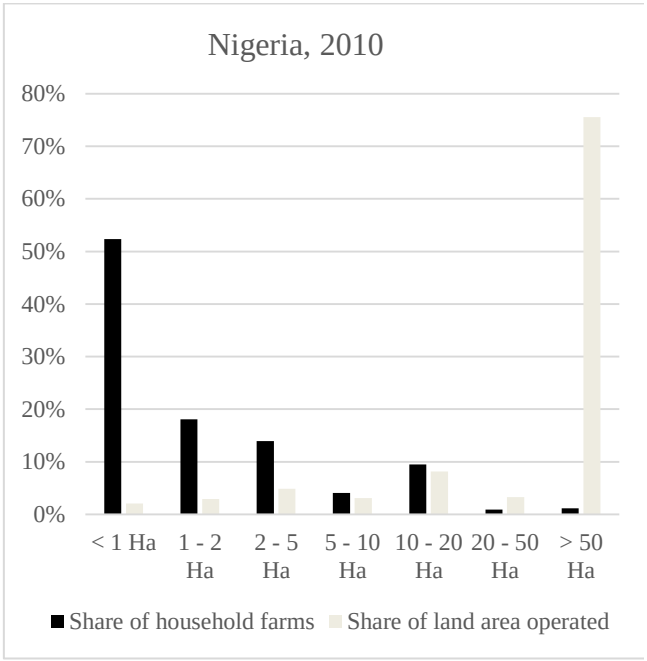
In order to gain a picture of farmland distribution that is more representative of the region we turn to additional data source, namely LSMS and DHS data. We consider farmland distribution using LSMS data for 4 countries in Sub-Saharan Africa (Figure 2). In Malawi, Tanzania and Uganda, we find a distribution that is similar to that of figure 1 above, with the share of farms smaller than 2 hectares being between 60 and 90 percent while the share of farmland operated by such farms is 25 to 60 percent. The distribution of farmland is very different for Nigeria, however, with about 70 percent of farms being smaller than 2 hectares and operating a mere 5% of the land. In Nigeria more than 70% of the farmland is operated by farms larger than 50 hectares in size. It would seem that the distribution of farmland found using LSMS data are for the most part similar to those in agricultural census reports and so

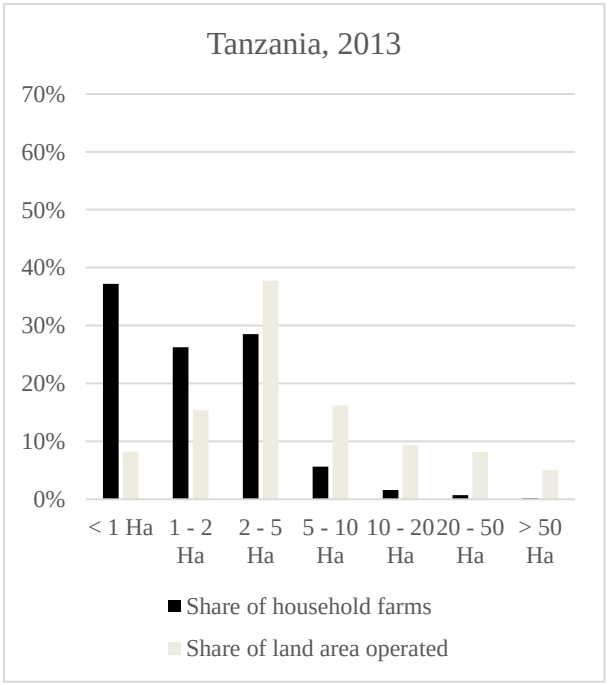
we could certainly use the LSMS to increase our sample size in producing estimates of distribution of household farmland for the region.

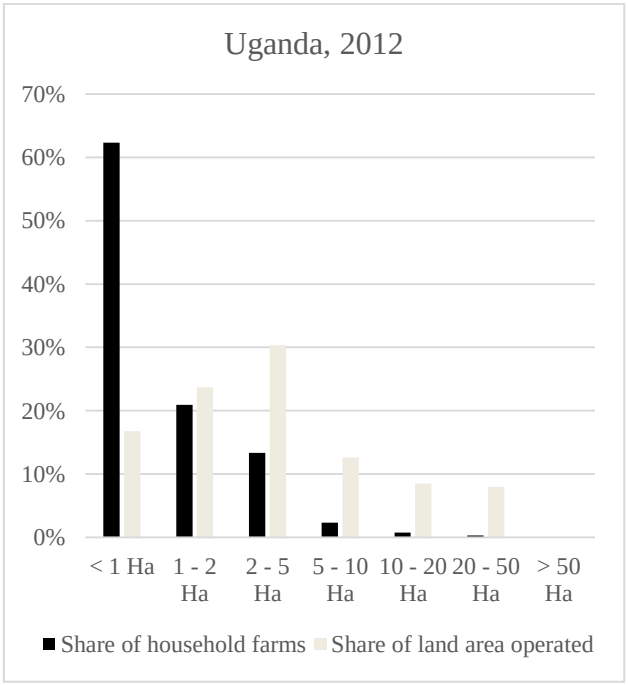
We also consider DHS data on households owning agricultural land in order to try to further increase the representativeness of our information on farmland distribution in sub-Saharan Africa. However, as shown in the Figure 3, the farmland distribution for African countries using DHS data appears different from that using the Agricultural Census or the LSMS data. The main feature of the DHS data is that the hectares reported per household is far larger. This is likely due to the survey instrument and the resultant variable. Whereas the agricultural census and LSMS are more focused on operated area regardless of ownership, the DHS reports agricultural land owned by the household regardless of whether it is under cultivation. We therefore conclude that we cannot combine DHS data with the other sources of information to create a region wide estimate of farmland distribution for the region. It would, however, appear that the DHS data on agricultural land owned are useful for other purposes; we use them to consider the change in farmland distribution over time as well as a proxy for the number of agricultural households.

Figure 2: Household farms and farmland distribution in select countries of sub-Saharan Africa



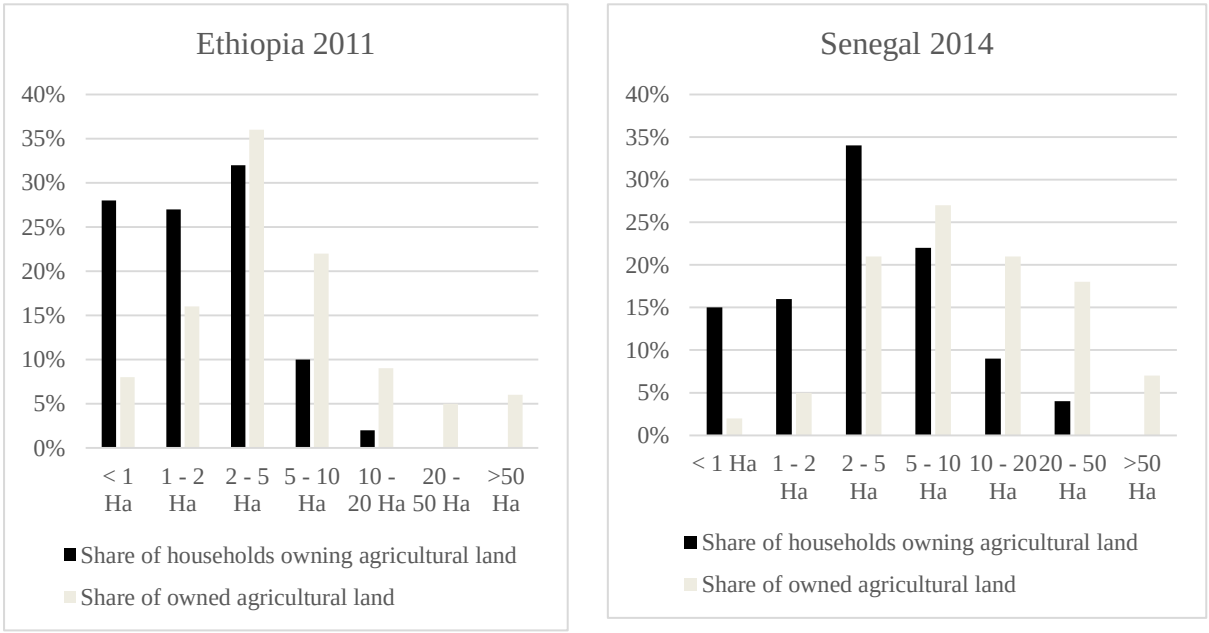






Source: Authors' compilation using LSMS data.

Figure 3: Household farms and farmland distribution in select countries of SSA



Source: Authors' compilation using DHS data.

Considering the agricultural area (area cultivated or owned) in the agricultural census as opposed to that of the DHS for 5 countries for which we have both ag census and DHS data we find that in all cases except Uganda the amounts of agricultural land owned by households and recorded in the DHS surveys is far larger than the amount reported in agricultural censuses and they imply a far larger average agricultural area per agricultural household (Table 4).

Given these results we are not able to combine the two data sources in our consideration of agricultural farmland distribution. The DHS data would seem more useful for our estimates of the change over time in distribution of agricultural land owned by households. We also use them to supplement estimates of the number of holdings in the region.

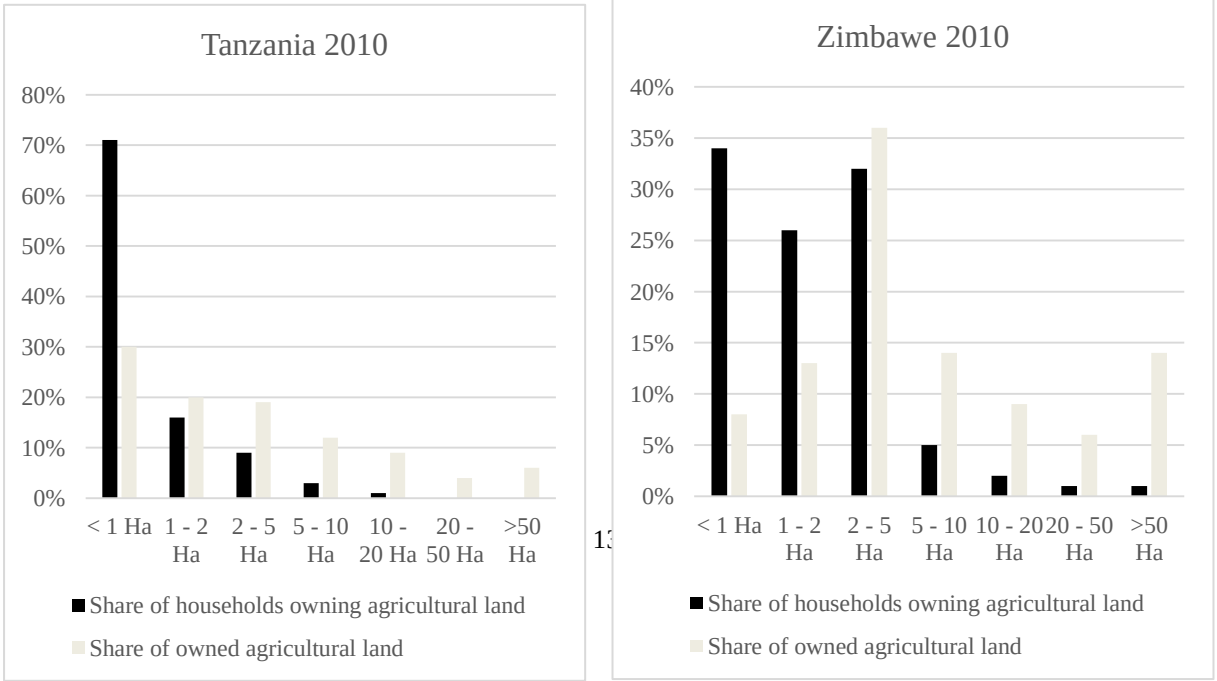


Table 4: Number of agricultural holdings/ households and total agricultural area

	year		agricultural holdings/ households		agricultural area (total, cultivated or owned)	
	Ag census	DHS	Ag census	DHS	Ag census	DHS
Côte d'Ivoire	2001	2012	1,117,667	1,873,106	4,351,663	15,231,063
Congo, Dem. Rep. of	1990	2014	4,479,600	7,506,235	2,387,700	31,886,770
Ethiopia	2001-2002	2011	10,758,597	11,730,165	11,047,249	38,249,289
Guinea	1995	2012	442,168	1,104,236	895,620	4,889,159
Uganda	1991	2007	1,704,721	4,388,770	3,683,288	6,433,218

Sources: Authors' compilation and calculation using various agricultural census reports and DHS datasets. The total agricultural area owned using DHS data was estimated by using population from FAOSTAT combined with the following information from the DHS: calculating the average hh size, the average amount of land owned per household, the share of hh owning agricultural land. This made it possible to go beyond shares (which is what DHS are designed to provide) in order to provide national estimates of the total area and total holdings.

Average operated area or average farm size and farmland distribution over time

Most studies of change in average farm size and farmland distribution over time (with the exception of Masters *et al.* (2013) and Jayne et al, (2014a and 2014b)) rely on agricultural census data. The evidence for countries in sub-Saharan Africa are quite patchy and limitations of considering agricultural census data to look at average farm size over time include possible variation among samples used over time for the same country. Most of the work is also limited to considering changes in average farm size over time, but the average is a limited measure which can result from numerous changes in farmland distribution. Little work has been done to consider changes in household farm size using LSMS or DHS for multiple periods. By using LSMS or DHS we can may ensure more comparable samples as well as consider not only the average, but also the median and the whole distribution.

In order to consider trends in average operated land area and farmland distribution over time we use LSMS data for which we have 2 surveys spanning more than a 5 year period. Considering Malawi, Nigeria and Tanzania we see a decrease in average area of land operated in both Malawi and Nigeria, but an increase in Tanzania (Table 5). Average area operated is a limited piece of information; it is preferable to consider the entire distribution of operated area when possible.

Table 5: Mean and median operated land area per household over time

		mean operated land area		median operated land area	
	Time period	earliest survey	latest survey	earliest survey	latest survey

Malawi	2004 - 2013	1.3	0.8	1.0	0.6
Nigeria	2004 - 2010	16.8	11.3	2.8	0.8
Tanzania	1993 - 2013	2.2	2.5	1.4	1.2

Note: These are based on self-reported estimates of plot area. Operated land area that is double- cropped is counted twice.
Source: Authors' calculations using various LSMS datasets.

Changes in farmland distribution over time for Malawi would suggest that from 2004 to 2013 the total number of holdings and total area cultivated (with double-cropped areas counted twice) both decreased (Table 6). There was an increase in the number and share of households operating less than 1 hectare, with the share of agricultural land cultivated on holdings less than 1 hectare increasing from 22 to 37% over the time period. Both the amount and share of land operated by households operating more than 5 hectares decreased to negligible amounts.

Table 6: Farmland distribution among household farms in Malawi from 2004 to 2013 using LSMS surveys

	2004				**2013**	
	Number of household farms	**Land Area operated**			**Number of household farms**	**Land Area operated**
< 1 Ha	1,600,275	650,048		< 1 Ha	2,090,320	1,045,098
1 - 2 Ha	675,604	933,716		1 - 2 Ha	605,983	794,185
2 - 5 Ha	347,974	982,957		2 - 5 Ha	147,064	388,695
5 - 10 Ha	44,349	288,587		5 - 10 Ha	6,143	36,521
10 - 50 Ha	9,074	117,160		10 - 50 Ha	1,740	18,312
total	2,677,275	2,972,469		total	2,851,250	2,282,811
	Share of household farms	**Share of land area operated**			**Share of household farms**	**Share of land area operated**
< 1 Ha	60%	22%		< 1 Ha	73%	37%
1 - 2 Ha	25%	31%		1 - 2 Ha	21%	28%
2 - 5 Ha	13%	33%		2 - 5 Ha	5%	14%
5 - 10 Ha	2%	10%		5 - 10 Ha	0%	1%
10 - 50 Ha	0%	4%		10 - 50 Ha	0%	1%

Sources: Authors' calculations using LSMS data from the World Bank.
Notes: For both surveys the sum of the land area operated in the rainy season and the dry season are reported. For Malawi 2004: land owned- land not cultivated – land rented out; Malawi 2013: land owned –land not cultivated – land rented out- land gave out for free+ land left forest+ land left for pasture + land used for other.

Changes in farmland distribution over time for Tanzania would suggest that from 1993 to 2013 the number of holdings and total area cultivated both nearly doubled (Table 7). There was an increase in the area cultivated by farms at both extremes of the distribution, with the

share of farmland operated by farms smaller than 1 hectare increasing marginally from 7 to 8%, and that of farms larger than 20 hectares increasing from 3% to 13% over the time period. The share of farmland operated by farms ranging from 1 – 10 hectares in size decreased from 81% to 69% of operated area over the time period. This change would suggest that the country saw a consolidation of household farms at the same time as there has been an increase in the number of very small farms.

Table 7: Farmland distribution among household farms in Tanzania from 1993 to 2013 using LSMS surveys

	1993				2013	
	Number of household farms	Area operated			Number of household farms	Area operated
< 1 Ha	996,519	585,002		< 1 Ha	2,451,115	1,270,104
1 - 2 Ha	1,148,476	1,596,699		1 - 2 Ha	1,730,862	2,380,369
2 - 5 Ha	1,092,166	3,257,027		2 - 5 Ha	1,880,628	5,848,818
5 - 10 Ha	225,369	1,476,402		5 - 10 Ha	368,973	2,503,873
10 - 20 Ha	53,685	714,745		10 - 20 Ha	105,913	1,442,112
20 - 50 Ha	8,431	211,144		20 - 50 Ha	46,584	1,260,933
50 - 100 Ha	0	0		50 - 100 Ha	3,995	293,497
100 - 200 Ha	0	0		100 - 200 Ha	3,781	491,928
total	3,524,647	7,841,019		total	6,591,850	15,491,634
	Share of household farms	Share of area operated			Share of household farms	Share of area operated
< 1 Ha	28%	7%		< 1 Ha	37%	8%
1 - 2 Ha	33%	20%		1 - 2 Ha	26%	15%
2 - 5 Ha	31%	42%		2 - 5 Ha	29%	38%
5 - 10 Ha	6%	19%		5 - 10 Ha	6%	16%
10 - 20 Ha	2%	9%		10 - 20 Ha	2%	9%
20 - 50 Ha	0%	3%		20 - 50 Ha	1%	8%
50 - 100 Ha	0%	0%		50 - 100 Ha	0%	2%
100 - 200 Ha	0%	0%		100 - 200 Ha	0%	3%

Sources: Authors' calculations using LSMS data from the World Bank.

Notes: For both surveys the sum of the land area operated in the rainy season and the dimba (dry) season are reported. For Tanzania, 1993 Land area operated= land cultivated and owned - land rented out + land rented in + land sharecropped in and for Tanzania, 2013 Land operated= land cultivated and owned - land rented out - land given out for free + land rented in + land fallow + land used for other.

DHS provide support for the claim that average farm sizes are decreasing in countries of sub-Saharan Africa. Average farm size decreased in recent years in Ethiopia, Senegal, Zambia and Zimbabwe, but increased slightly in Tanzania (Table 8). In all countries there was a decrease in median farm size as well, with the exception of Tanzania and Zambia where median farm size increased slightly.

Table 8: Mean and median agricultural land owned per household over time

		mean agricultural land owned		median agricultural land owned	
Country	time period	earliest survey	latest survey	earliest survey	latest survey
Ethiopia	2005 - 2011	4.1	3.3	3.0	2.0
Tanzania	2007 - 2010	1.3	1.5	1.0	1.0
Senegal	2012-2014	6.8	6.5	5.0	4.0
Zambia	2007 - 2013	3.9	3.5	1.0	1.6
Zimbabwe	2005 - 2010	4.4	2.4	2.0	1.2

Source: Various DHS surveys.

Looking at the full distribution of agricultural land owned in the two periods for each of the countries reveals the limitations of considering average land owned. Over the periods average hectares of agricultural land owned decreased in Ethiopia, Zambia and Zimbabwe, but as the result of very different processes (Table 8). Let's consider the cases of Ethiopia and Zambia. In Ethiopia the number of agricultural households stayed about the same and agricultural area decreased from 2005 to 2011, while in Zambia the number of agricultural households increased some and the agricultural area decreased somewhat from 2007 to 2013. In Ethiopia the share of agricultural households owning less than 2 hectares increased while the share owning more than 2 hectares decreased; meanwhile there was an increase in the share of agricultural area owned by households at the two extremes (those owning less than 5 hectares or more than 95 hectares) while there was a decrease in the share of agricultural land owned by households with holdings between 5 and 95 hectares. In Zambia there was a decrease in the share of number of households owning less than 1 ha and an increase in the share of households owning between 1 and 20 hectares. The share of households owning 20 - 95 hectares stayed about the same, while there was a decrease in the share owning more than 95 hectares. The share of area owned by households with less than 1 hectare and more than 95 hectares both decreased while the share owned by households with 1 – 50 hectares increased. In short, the decrease in average farm size in Ethiopia is largely the result of changes in the lower end of the distribution (an increase in the share of holdings between 0 and 2 hectares) while the decrease in average farm size in Zambia largely reflects changes in the upper end of the distribution (a decrease in the share of farms larger than 95 hectares).

Table 8: Change in farmland distribution, select African countries using DHS data

			Share of agricultural households or agricultural area, by farm size class							
			< 1 Ha	1 - 2 Ha	2 - 5 Ha	5 - 10 Ha	10 - 20 Ha	20 - 50 Ha	50 - 95 Ha	> 95 Ha
Ethiopia 2005	number of ag hh	11,474,514	22%	22%	35%	16%	4%	1%	0%	0%
	ag area in hectares	46,718,048	5%	11%	33%	28%	14%	7%	1%	0%

Ethiopia 2011	number of ag hh	11,730,165	28%	27%	32%	10%	2%	0%	0%	0%
	ag area in hectares	38,249,289	8%	16%	36%	22%	9%	5%	2%	4%
Senegal 2012	number of agr hhs	994,870	14%	14%	36%	22%	9%	4%	1%	0%
	agr area in hectares	4,412,558	2%	4%	21%	26%	19%	20%	6%	2%
Senegal 2014	number of agr hhs	1,067,929	15%	16%	34%	22%	9%	4%	0%	0%
	agr area in hectares	3,560,577	2%	5%	21%	27%	21%	18%	4%	3%
Tanzania 2007/2008	number of ag hh	6,018,358	72%	18%	8%	2%	1%	0%	0%	0%
	ag area in hectares	7,723,617	35%	25%	20%	10%	6%	4%	0%	1%
Tanzania 2010	number of ag hh	6,664,226	71%	16%	9%	3%	1%	0%	0%	0%
	ag area in hectares	10,214,406	30%	20%	19%	12%	9%	4%	2%	4%
Zambia 2007	number of ag hh	1,520,793	53%	19%	16%	7%	2%	2%	0%	1%
	ag area in hectares	6,001,347	11%	10%	15%	15%	10%	14%	5%	21%
Zambia 2013	number of ag hh	1,699,907	39%	23%	23%	9%	4%	2%	0%	0%
	ag area in hectares	5,962,581	7%	11%	24%	21%	16%	15%	4%	0%
Zimbawe 2005	number of ag hh	1,746,484	50%	24%	16%	4%	1%	7%	0%	0%
	ag area in hectares	7,615,430	8%	11%	14%	6%	2%	59%	0%	0%
Zimbawe 2010	number of ag hh	1,765,441	34%	26%	32%	5%	2%	1%	1%	0%
	ag area in hectares	4,237,059	8%	13%	36%	14%	9%	6%	14%	0%

Source: Various DHS surveys.

Changes in average farm size and farmland distribution in Asian countries

LSMS with agricultural modules are available for a smaller share of Asian countries than for countries in sub-Saharan Africa. We nevertheless are able to consider evidence on farmland distribution for Bangladesh and Nepal. In Bangladesh average operated area increased slightly from 2005 to 2010 and in Nepal it decreased slightly from 1996 to 2003 (Table 9).

Table 9: Mean and median operated land area per household over time, Bangladesh and Nepal

		mean operated land area		Median agricultural land owned	
	Time period	earliest survey	latest survey	earliest survey	latest survey
Bangladesh	2000 - 2005	0.8	1.0	0.4	0.2
Nepal	1996 - 2003	1.0	0.9	0.6	0.6

Source: Authors' calculations using various LSMS data.

In Bangladesh the number of farm households increased, but agricultural expansion occurred more rapidly. The increase in average operated area per household results from an increase in the share of farms larger than 2 hectares as well as an increase in the share of the farmland operated by those farms (Table 10). In Nepal the slight decrease in average farm size results from the increase in the share of farmland operated by farms smaller than 5 hectares and decrease in the share of farmland on farms larger than 5 hectares (Table 11).

Table 10: Farmland distribution among household farms in Bangladesh 2000- 2005

	2000				2005	
	Number of household farms	**Area operated**			**Number of household farms**	**Area operated**
< 1 Ha	8,823,847	3,303,735		< 1 Ha	9,677,933	2,265,809
1 - 2 Ha	1,441,617	1,946,559		1 - 2 Ha	1,802,354	2,573,453
2 - 5 Ha	543,675	1,524,900		2 - 5 Ha	1,417,813	4,292,242
5 - 10 Ha	38,867	271,612		5 - 10 Ha	341,985	2,307,292
10 - 20 Ha	19,343	314,968		10 - 20 Ha	69,719	921,241
20 - 50 Ha	40,324	1,135,593		20 - 50 Ha	14,127	389,537
total	10,907,672	8,497,368		total	13,323,930	12,749,575
	Share of household farms	**Share of area operated**			**Share of household farms**	**Share of area operated**
< 1 Ha	81%	39%		< 1 Ha	73%	18%
1 - 2 Ha	13%	23%		1 - 2 Ha	14%	20%
2 - 5 Ha	5%	18%		2 - 5 Ha	11%	34%
5 - 10 Ha	0%	3%		5 - 10 Ha	3%	18%
10 - 20 Ha	0%	4%		10 - 20 Ha	1%	7%
20 - 50 Ha	0%	13%		20 - 50 Ha	0%	3%

Source: Authors' calculations using various LSMS data.

Table 11: Farmland distribution among household farms in Nepal from 1996 to 2003

	1996				2003	
	Number of household farms	**Area operated**			**Number of household farms**	**Area operated**
< 1 Ha	1,990,002	846,503		< 1 Ha	4,061,074	1,801,539
1 - 2 Ha	615,683	854,882		1 - 2 Ha	1,278,766	1,754,217
2 - 5 Ha	310,206	910,424		2 - 5 Ha	469,389	1,286,883
5 - 10 Ha	48,372	331,030		5 - 10 Ha	48,439	326,524
10 - 20 Ha	10,222	141,735		10 - 20 Ha	4,992	84,201
20 - 50 Ha	6,539	161,784		20 - 50 Ha	0	0
total	2,981,024	3,246,358		total	5,862,661	5,253,365
	Share of household farms	**Share of area operated**			**Share of household farms**	**Share of area operated**
< 1 Ha	67%	26%		< 1 Ha	69%	34%
1 - 2 Ha	21%	26%		1 - 2 Ha	22%	33%
2 - 5 Ha	10%	28%		2 - 5 Ha	8%	24%
5 - 10 Ha	2%	10%		5 - 10 Ha	1%	6%
10 - 20 Ha	0%	4%		10 - 20 Ha	0%	2%
20 - 50 Ha	0%	5%		20 - 50 Ha	0%	0%

Source: Authors' calculations using various LSMS data.

Preliminary results from DHS would indicate that the average and median amounts of agricultural land owned by households decreased slightly or stayed about the same in recent years in Bangladesh, Cambodia and Nepal (Table 12).

Table 12: Mean agricultural land owned per agricultural household over time, select Asian countries

		mean operated land area		Median agricultural land owned	
	Time period	earliest survey	latest survey	earliest survey	latest survey
Bangladesh	2007 - 2011	0.7	0.6	0.3	0.3
Cambodia	2010-2014	2.7	2.6	2.0	1.0
Nepal	2006 - 2011	0.8	0.6	0.7	0.6

Source: Authors' calculations using various DHS surveys

Total number of farms in sub-Saharan Africa

Of the more than 570 million farms worldwide identified in FAO's State of Food and Agriculture 2014 report, only about 51 million or about 9 percent were located in sub-Saharan Africa. However, of all of the regions considered, information was most incomplete for sub-Saharan Africa. For several countries in sub-Saharan Africa estimates of the number of holdings were quite out of date, with, for example, the most recent estimates for Nigeria and Zimbabwe being the estimates provided from the 1960 round agricultural censuses. This paper supplements such estimates with information from LSMS survey data and data from Demographic and Health surveys (DHS). Considering a mere 6 LSMS surveys we see that

the total number of household farms is 32 million and for a sample of 20 countries that have DHS surveys, the total number of household farms is 65.5 million (Table 13). We use the following step-wise procedure to combine all sources in order to have a more recent and complete estimate of the number of farms in sub-Saharan Africa.

1. Use the LSMS or DHS estimate of number of farm households for countries that have such estimates.
2. For countries that have both LSMS and DHS estimates use the smaller of the two.
3. For countries without LSMS or DHS estimates use the agricultural census estimate.

By combining all sources, we estimate that there are 77 million farms in 43 countries of sub-Saharan Africa; this is significantly more agricultural holdings/ households than the estimate of 51 million we found when considering only agricultural census estimates. This results from the DHS and LSMS surveys being more recent than the agricultural censuses. It is of course likely to also be affected by the different measures used by each data source.

Table 13: Estimated number of agricultural holdings or household farms, by country in sub-Saharan Africa, by source								
	Estimate using multiple sources		Agricultural census as reported in FAO, 2014*		Living Standards Measurement Study (LSMS)		Demographic Health Surveys (DHS) ****	
Country	Number of holdings/ household farms	Source, year	Number of holdings (# countries)	year	Number of household farms (# countries)	year	Number of household farms (# countries)	year
Sub-Saharan Africa	**76,914,986 (43)**		**51,309,185 (42)**		**31,951,654 (6)**		**65,496,123 (20)**	
Angola	1,067,230	Census, 1970	1,067,230	1970				
Benin	836,389	DHS, 2012	408,020	1990			836,389	2012
Botswana	51,264	Census, 2004	51,264	2004				
Burkina Faso	886,638	Census, 1993	886,638	1993				
Burundi	1,639,178	DHS, 2010	..	..			1,639,178	2010
Cameroon	925,895	Census, 1970	925,895	1970				
Cape Verde	44,506	Census, 2004	44,506	2004				
Central African Rep.	303,901	Census, 1980	303,901	1980				
Chad	366,475	Census, 1970	366,475	1970				
Comoros	81,601	DHS, 2012	52,464	2004			81,601	2012
Congo	318,968	DHS, 2012	143,235	1980			318,968	2012
Côte d'Ivoire	2,071,249	DHS, 2012	1,117,667	2001			2,071,249	2012
Dem. Rep. of the Congo	7,714,462	DHS, 2014	4,479,600	1990			7,714,462	2014
Eritrea	..	..	..	..				
Ethiopia	10,758,597	Census, 2001-2002	10,758,597	2001-2002				
Gabon	71,074	Census, 1970	71,074	1970				
Gambia	69,140	Census, 2001-2002	69,140	2001-2002				
Ghana	3,018,287	DHS, 2011	1,849,800	1980			3,018,287	2011
Guinea	840,454	Census, 2000-2001	840,454	2000-2001				
Guinea-Bissau	84,221	Census, 1988	84,221	1988				
Kenya	4,322,409	LSMS, 2005	2,750,013	1980	4,322,409	2005**		
Lesotho	224,487	DHS, 2009	337,795	1999-2000			224,487	2009
Liberia	121,745	Census, 1970	121,745	1970				
Madagascar	3,592,964	DHS, 2013	2,428,492	2004-2005			3,592,964	2013
Malawi	2,228,510	LSMS, 2011	2,665,565	2006-2007	2,228,510	2011**	2,518,848	2010
Mali	805,194	Census, 2004-2005	805,194	2004-2005				
Mauritania	99,644	Census, 1980	99,644	1980				
Mauritius	..	..	..	..				
Mozambique	4,324,571	DHS, 2012	3,064,715	1999-2000			4,324,571	2011
Namibia	233,184	DHS, 2013	102,357	1996-1997			233,184	2013
Niger	2,017,182	LSMS, 2011	669,332	1980	2,017,182	2011**	6,531,184	2012
Nigeria	14,216,700	LSMS, 2010	308,000	1960	14,216,700	2010**	19,952,665	2010
Réunion	7,623	Census, 2010	7,623	2010				
Rwanda	1,674,687	Census 2007-2008	1,674,687	2007-2008				
Sao Tome and Principe	12,477	DHS, 2009	13,882	1990			12,477	2009
Senegal	437,037	Census 1998-1999	437,037	1998-1999			1,067,929	2014
Seychelles	4,685	Census, 2002	4,685	2002				
Sierra Leone	223,265	Census, 1980	223,265	1980				
Somalia	..	..	..	..				
South Africa	1,093,000	Census, 2000	1,093,000	2000				
Sudan (former)	..	..	..	..				
Swaziland	73,745	Census, 1990	73,745	1990				

Togo	696,273	DHS, 2014	429,534	1996			696,273	2014
Uganda	4,900,770	DHS, 2011	3,833,485	2002	4,468,866	2010-11***	4,900,770	2011
United Rep. of Tanzania	3,173,452	DHS, 2012	4,901,837	2002-2003	4,697,987	2009**	3,173,452	2012
Zambia	1,715,180	DHS, 2013	1,305,783	2000			1,715,180	2013
Zimbabwe	1,939,935	DHS, 2010	437,589	1960			1,939,935	2010

Notes: ".." indicates no estimates available from agricultural censuses. * FAO, 2014. The State of Food and Agriculture 2014. ** FAO, 2015b. A data portrait of smallholder farmers. *** Deininger, Xia and Savastano, 2015. ****Authors' calculations using various DHS surveys.

Conclusions

Ongoing work to survey all farms and make microdata available (eg. AGRIS) deserves prioritization if we wish to study the entire agricultural sector.

We must continue to insist that agricultural censuses and surveys sample or enumerate all farms, not simply households.

Average and median household farm size has decreased in most sub-Saharan African countries considered.

There is also limited evidence of consolidation in some African countries.

References

Adamopoulos, T., & Restuccia, D. (2014). The size distribution of farms and international productivity differences. *The American Economic Review*, 104 (6), 1667 - 1697.

Deininger, Xia and Savastano. (2015). Smallholders' Land Ownership and Access in Sub-Saharan Africa A New Landscape? *World Bank Policy Research Working Paper 7285*. Washington, DC: World Bank.

Deininger, K., & Byerlee, D. (2012). The Rise of Large Farms in Land Abundant Countries: Do They Have a Future? *World Development*, 40(4), 701–714.

Eastwood, R., Lipton, M., & Newell, A. (2010). Farm size. In P.L. Pingali, & R.E. Evenson (Eds.), Handbook of agricultural economics. North Holland: Elsevier.

FAO. (2001). Supplement to the Report on the 1990 World Census of Agriculture. FAO Statistical Development Series 9a. Rome: FAO.

FAO. (2013). 2000 World Census of Agriculture: Analysis and International comparison of the results (1996 - 2005). FAO Statistical Development Series 13. Rome: FAO.

FAO. (2014). *The State of Food and Agriculture 2014: Innovation in family farming*. Rome: FAO.

FAO. (2014b). *Global Land Cover SHARE (GLC-SHARE) database Beta-Release Version 1.0 - 2014.* Rome, FAO. Available at: http://www.glcn.org/databases/lc_glcshare_downloads_en.jsp

FAO. (2015a). FAOSTAT. Retrieved from http://faostat.fao.org/site/291/default.aspx

FAO. (2015b). A data portrait of smallholder farmers: An introduction to a dataset on small-scale agriculture. Retrieved from fao.org/economic/esa/esa-activities/esa-smallholders/dataportrait/en/

Fonteneau, F. (2016). Agriculture Integrated Survey (AGRIS). Agenda Item 6.2. Twenty sixth session of the FAO's Asia and Pacific Commission on Agricultural Statistics. Thimpu, Bhutan, 15-19 February, 2016.

Fritz, S., et al. (2015). "Mapping global cropland and field size." Glob Chang Biol **21**(5): 1980-1992.

Government of Guatemala. 2004. IV Censo Nacional Agropecuarios. Características generales de las fincas censales y de productoras y productores agropecuarios (Resultados Definitivos). Tomo I. Guatemala City: Instituto Nacional de Estadística.

Government of Guatemala. 2006. Encuesta Nacional de Condiciones de Vida. Guatemala City: National Institute of Statistics.

Hazell, P., Poulton, C., Wiggins, S., & Dorward, A. (2010). The future of small farms: Trajectories and policy priorities. *World Development*, 38(10), 1349–1361.

HLPE. (2013). *Investing in smallholder agriculture for food security.* A report by The High Level Panel of Experts on Food Security and Nutrition (Vol. 6). Rome: FAO.

ICF International. 2006. Guide to DHS Statistics. Calverton, Maryland, U.S.A.: ICF International

ICF International. 2012. Demographic and Health Survey Interviewer's Manual. MEASURE DHS Basic Documentation No. 2. Calverton, Maryland, U.S.A.: ICF International

Jayne, T.S, A. Chapoto, N. Sitko, C. Nkonde, M. Muyanga, and J. Chamberlin. (2014a). Is the scramble for land in Africa foreclosing a smallholder agricultural expansion strategy? Journal of International Affairs, 67, 35-53.

Jayne, T.S, Chamberlin, J., and Headey, D. D. (2014b). Land pressures, the evolution of farming systems, and development strategies in Africa: A synthesis. *Food Policy*, 48, 1–17.

Jayne, T.S, J. Chamberlin, L. Traub, N. Sitko, M. Muyanga, F. K. Yeboah, C. Nkonde, W. Anseeuw, A. Chapoto, and R. Kachule. (2015). Africa's changing farmland ownership: the rise of the emergent investor farmer. Plenary paper presented at the 29th Triennial International Conference of Agricultural Economists, August 13, 2015, Milan, Italy.

Larson, D. F., Otsuka, K., Matsumoto, T., & Kilic, T. (2014). Should African rural development strategies depend on smallholder farms? An exploration of the inverse-productivity hypothesis. *Agricultural Economics*, *45*(3), 355-367.

Lowder, Sarah, Jakob Skoet and Terri Raney, in press. "The Number, size and distribution of farms, smallholder farms and family farms worldwide." *World Development*.

Masters, W. A., Djurfeldt, A. A., De Haan, C., Hazell, P., Jayne, T., Jirström, M., & Reardon, T. (2013). Urbanization and farm size in Asia and Africa: Implications for food security and agricultural research. *Global Food Security*, *2*(3), 156-165. doi: 10.1016/j.gfs.2013.07.002

See, L., et al. (2015). "Improved global cropland data as an essential ingredient for food security." *Global Food Security* 4: 37-45.