EVANS SCHOOL OF PUBLIC POLICY & GOVERNANCE

UNIVERSITY *of* WASHINGTON

Evans School Policy Analysis and Research (EPAR)

Tracking agricultural transformation with rural household typologies: Findings from Ethiopia, Nigeria, and Tanzania

Travis W. Reynolds, Didier Alia,
Pierre Biscaye, David Coomes,
Stanley Wood, C. Leigh Anderson

Professor C. Leigh Anderson, Principal Investigator   December 28, 2020

Abstract

Recent research has used typologies to classify rural households into categories such as "subsistence" versus "commercialized" as a means of targeting agricultural development interventions and tracking agricultural transformation. Following an approach proposed by Alliance for a Green Revolution in Africa, we examine patterns in two agricultural transformation hallmarks – commercialization of farm output, and diversification into non-farm income – among rural households in Ethiopia, Nigeria, and Tanzania from 2008-2015. We classify households into five smallholder farm categories based on commercialization and non-farm income levels (Subsistence, Pre-commercial, Transitioning, Specialized Commercial, and Diversified Commercial farms), as well as two non-smallholder categories (Largeholder farms and Non-farm households). We then summarize the share of households in each of these categories, examine geographic and demographic factors associated with different categories, and explore households' movement across categories over time. We find a large amount of "churn" across categories, with most households moving to a different (more or less commercialized, more or less diversified) category across survey years. We also find many non-farm households become smallholder farmers – and vice versa – over time. Finally, we show that in many cases increases in farm household commercialization or diversification rates actually reflect decreased total farm production, or decreased total income (i.e., declines in the denominators of the agricultural transformation metrics), suggesting a potential loss of rural household welfare even in the presence of "positive" trends in transformation indicators. Findings underscore challenges with using common macro-level indicators to target development efforts and track progress at the household level in rural agrarian communities.

1. Introduction

Theories of structural transformation suggest that economic development occurs in part through rural transformation, as labor moves out of lower productivity (and primarily rural) agriculture into higher productivity (and generally more urban) industry and services sectors (Barret et al., 2010). This transformation of rural economies – driven by a combination of "push- " and "pull-factors" – has been seen as a key component of broader economic growth and serves as the foundation for longstanding growth models (Lewis, 1955; Rostow, 1960; Ranis and Fei, 1961; Kuznets, 1973; Chenery and Syrquin, 1975; Johnston and Kilby, 1978). Past research has used national income accounts data to examine 36 patterns in economic transformation across countries (Gollin et al., 2002; Caselli, 2005; Restuccia et al., 2008; McMillan et al., 2014; Diao et al., 2017), in many cases finding aggregate patterns consistent with structural transformation theories (Young, 2013; Gollin et al., 2014; McMillan and Headey, 2014). But other researchers have observed that conclusions around the effects of rural transformation on households depend in part on the scale of analysis, including whether aggregate macro-economic indicators like GDP per capita are used (Barrett et al., 2010), or more micro-level indicators linked to individual or household well-being (Bernstein, 2010; Belton and Filipski, 2019).

Rural transformation includes the process by which a food system moves from being subsistence-oriented and primarily farm-based into one that is more productive, commercialized, and increasingly comprised of off-farm

agrifood activities (Timmer, 1988; Jayne et al., 2018). This shift within the agricultural sector has been the focus of multiple recent studies (Jayne et al., 2010; 2011; 2019a; 2019b; McMillan and Headey, 2014; Bachewe et al., 2018), including a growing number that use new sources of household-level data to better understand its drivers (Bosc and Bélières, 2015; Hicks et al., 2017; Parvathi et al., 2019; Jayne et al., 2019c; Wineman et al., 2020). However, while some Asian economies have experienced a shift from low-productivity subsistence agriculture into higher-productivity market-oriented farming and off-farm employment, this transformation has not occurred in sub-Saharan Africa (Binswanger-Mkhize et al., 2010; Barrett et al., 2017). In many African countries large shares of the labor force have remained in low-productivity agriculture (Davis et al., 2017) or moved from agriculture into low productivity off-farm informal sectors (McMillan et al., 2014). Moreover, even where increased intensification and commercialization of agriculture occurs at the national level, it can mask adverse effects – including worsening inequality – for some rural communities and households (Edelman and Wolford, 2017; Akram-Lodhi and 59 Kay, 2008). Such findings raise questions around the degree to which common macro-level transformation indicators focused on commercialization of agricultural production, or expansion of off-farm income sources, can effectively track progress at the household level in rural agrarian communities.

Building on these ongoing debates, this paper contributes to an expanding body of scholarship on rural and agricultural transformation in sub-Saharan Africa. Drawing on three waves of household survey data from Ethiopia, Nigeria and Tanzania over the period 2008-2015, we empirically examine the degree to which a typology classifying rural households according to levels of (i) farm product commercialization and (ii) non-farm income sources might serve to identify subsets of rural households useful for monitoring agricultural transformation, and for targeting rural development interventions. We focus on a subset of farm-households with particularly limited resources, referred to as smallholder farmers or small-scale producers, that are the focus of various policy initiatives (Alia et al., 2019).[1]

We draw on a farm household typology advanced by the Alliance for a Green Revolution in Agriculture (AGRA), an organization founded in 2006 with the stated goal of transforming African agriculture from subsistence-oriented farming into more productive, market-oriented farm systems. Consistent with the themes that underpin other rural household typologies, AGRA published a report in 2017 on the state of African agriculture using two indicators to categorize smallholder households: commercialization, calculated as the value of farm production sold divided by the total farm value produced, and income diversification, calculated as the share of non-farm income in total household income (AGRA, 2017). Using these two indicators, AGRA proposed five categories of farmers: Subsistence, Pre-Commercial, Transitioning, Specialized Commercial, and Diversified Commercial. In this paper, we first summarize the aggregate share of rural households in the different AGRA categories – as well as two non-smallholder categories (Largeholder farms and Non-farm households) – across Ethiopia, Nigeria, and Tanzania over time. We then examine whether AGRA categories are geographically clustered in a manner that might reveal geographic patterns in household status and/or support targeting of rural development efforts. We also summarize farm management and demographic characteristics of households within each category, asking whether these categories group subsets of households with similar profiles. Finally, to assess whether this typology can be robustly used for tracking agricultural transformation, we examine patterns in household movement away from Subsistence and Pre- Commercial status to more commercialized and/or more diversified farming, or to non-farm livelihoods, over time.

Findings reveal some differences in geographic distribution and in household characteristics across AGRA categories, but we also observe a great deal of "churn" over time among the categories, with most households moving to a different (more or less commercialized, more or less diversified) category across survey waves. We also find many non-farm households become smallholder farmers – and vice versa – over time. This suggests typologies that classify rural households based on a snapshot of livelihood portfolios at a single point in time may mis-characterize livelihood strategies which, more often than not, involve a shifting portfolio of own-

consumption and commercialization, and of on-farm and off-farm income activities. Moreover, although increasing commercialization and income diversification over time is often associated with increasing household incomes (which may reflect households becoming more prosperous commercialized farmers, or accessing higher earnings through the non-farm economy (Dorward et al., 2009)), in many other cases increases in these metrics actually reflect decreased total farm production or decreased total income (i.e., declines in the denominators of the commercialization and diversification metrics). This raises questions around how a typology based on commercialization and income diversification – well-established metrics of agricultural transformation at the national level – can be effectively applied to track progress at the household scale.

The remainder of this paper is organized as follows: Section 2 provides background on the application of rural household typologies, and the factors hypothesized to relate to agricultural transformation and transitions away from subsistence farming. Section 3 describes our methods for classifying households according to the AGRA typology, along with our empirical strategy. Section 4 provides descriptive findings on households in each category by country, followed by a description of patterns in household-level movements across categories over time. Section 5 concludes with a discussion of study findings and implications.

2. Background

2.1. Typologies for tracking transformation trends

Past research has sought to develop rural household typologies to characterize and explain patterns in livelihoods and to monitor transformation processes. The World Bank World Development Report on Agriculture (2008) identifies five "livelihood strategies," classifying rural households according to the relative importance of income from agriculture, labor, and migration. Dorward et al. (2009) conceptualize smallholder farmers as either "hanging in" (remaining in low productivity agriculture), "stepping up" (becoming more commercialized farmers), or "stepping out" (exiting agriculture to the local non-farm economy or through migration), arguing that a household's selection among these three options reflects the intersection of local natural resource potential, local market opportunities, and prevalence of poverty. In the longer term, Dorward et al. (2009) argue, successful agricultural transformation will lead most rural households to "step out." Another typology by Christen and Anderson (2014) classifies smallholder farmers as "noncommercial smallholders" focused on subsistence production and survival; "commercial smallholders in loose value chains" with some surplus to sell but also reliant on own-production; and "commercial smallholders in tight value chains" who are characterized by reliable incomes from the sale of high-value outputs. More recently Anderson et al. (2019) identify three different segments of smallholder households, namely "subsisting", "commercializing", and "diversifying", with the latter category explicitly considering non-farm livelihood strategies alongside farm production. Similarly, the 2019 Pathways to Prosperity report by the Mastercard Foundation proposes a "Rural Pathways Model" whereby vulnerable subsistence farmers are presumed to follow one or more development trajectories consisting of either increasing productivity and commercialization on-farm, or alternatively transitioning (diversifying) to non-farm sectors and urban labor markets (Shakhovskoy et al., 2019).

This study applies a commercialization- and income diversification-based typology to a sample of rural households in Ethiopia, Nigeria, and Tanzania as an illustration of the challenges to applying household typologies based on common agricultural transformation indicators for the study of rural agricultural communities both within and across countries over time. Though we focus on the AGRA (2017) typology in three specific sub-Saharan African countries, we expect the results of this exercise to also be relevant for other similar typologies based on similar metrics, in a range of country contexts.

2.2. Correlates of transformation in sub-Saharan Africa

To guide our examination of the possible demographic and geographic correlates of movement across the AGRA categories, we draw on a wealth of literature that has explored factors associated with rural households' market access and agricultural commercialization in low-income countries, and with household participation in off-farm income-generating activities (Pingali and Rosegrant, 1995; FAO, 1998; Barrett et al., 2001; Lanjouw and Lanjouw, 2001). Research over the past decade using the Food and Agriculture Organization (FAO) Rural Income Generating Activities (RIGA) database[2] has shown that rural households in many low-income countries are increasingly diversifying their income portfolios away from agriculture (sometimes referred to as deagrarianization (Belton and Filipski, 2019)). But specialization in farming has remained the norm in many African countries (Winters et al., 2009; Davis et al., 2010). Davis et al. (2017) examine patterns across 22 low- and middle-income countries (LMICs) and find that households in sub-Saharan Africa on average have higher shares of on-farm income (63% versus 33% in other developing regions) and lower shares of non-farm wage income (8% versus 21% in other regions), and that on-farm income accounts for more than 50% of household incomes in all but one sub-Saharan country (Kenya, at 48%) and more than 80% of household incomes in some countries (including Ethiopia and Nigeria).

Bosc and Bélières (2015) emphasize that agricultural transformation processes are a function of both macroeconomic structural changes in the economy and microeconomic shifts in farming systems. At the farm-household level, Davis et al. (2017) highlight geography – including local agricultural potential, as well as distance to markets and urban centers – as key variables linked to strategies around agricultural specialization versus diversification in rural African households. Others have found that a combination of factor endowments and wealth play a role in rural farm-households' on-farm productivity and level of 173 participation in off-farm economic activities. Pingali and Rosegrant (1995) cite the rising opportunity costs of family labor and increased market demand for agricultural products due to economic growth and urbanization as key determinants of increasing commercialization in LMICs. More recently, Bachewe et al. (2018) find access to modern inputs, education, and extension services are key contributors to expanding agricultural production and commercialization in Ethiopia.

The broader literature on income diversification across LMICs suggests that both "push" and "pull" factors drive households to seek off-farm employment (Barrett et al., 2001; Ellis, 2000; Reardon, 1997). "Push" factors include land shortages, risk and seasonality of agricultural production, low on-farm income, and the failure (or absence) of input and credit markets. "Pull" factors include increased opportunities and profitability in the non-farm sector. But such influences can be mediated by a range of farm and household attributes, including household demographics (notably gender), education, and asset holdings (Bedemo et al., 2013; Shifa, 2016; Mueller et al., 2018; Dedehouanou and McPeak, 2019). Davis et al. (2017) emphasize that, while greater assets and income are often associated with greater off-farm employment in low-income countries, in sub-Saharan Africa some degree of income diversification is common at all income levels.

Even with a considerable literature on agricultural transformation and rural livelihoods in sub-Saharan Africa, many unresolved questions remain (Ecker, 2018; Jayne et al., 2018; Vandercasteelen et al., 2018). Key among these are questions around the degree to which typologies grouping rural households according to levels of farm product commercialization and income diversification might allow for the targeting of development interventions (as proposed by AGRA (2017)) and the monitoring of agricultural transformation processes. This analysis uses household-level data to tackle this question in Ethiopia, Nigeria, and Tanzania, drawing on multiple waves of panel survey data from 2008 to 2015. 196 All three countries have seen national level declines in agricultural employment (AgEmp) and in the share of agricultural production in national GDP (AgGDP/GDP) consistent with a structural transformation, alongside increasing agricultural intensification (as

proxied by aggregate cereal crop yields (Cr1Yld)) since the late 2000s (Figure 1). Our study examines whether such national-level patterns are reflected at the household level.
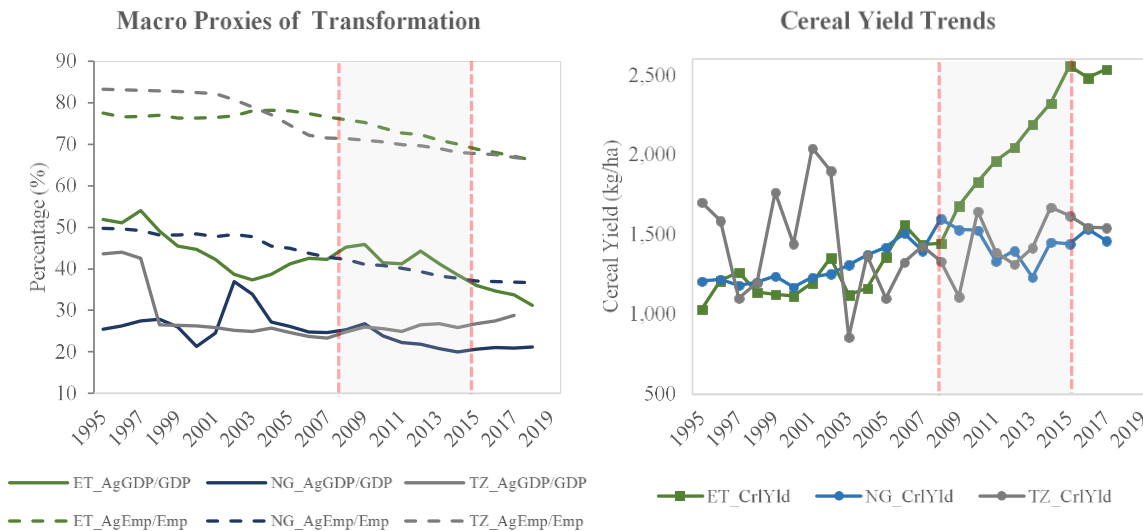

Figure 1. Macro-level indicators of transformation in Ethiopia, Nigeria, and Tanzania (World Bank, 2020). All have seen declines in agricultural employment (AgEmp) and in the share of agricultural production in national GDP (AgGDP/GDP) consistent with a structural transformation, alongside increasing cereal crop yields (Cr1Yld) since the late 2000s. Vertical lines denote start and end dates of the LSMS-ISA household survey data used for the analysis.

3. Data, variables, and analytical approach

3.1.1 Data

We draw on household survey data from the Integrated Surveys on Agriculture in the World Bank's Living Standards Measurement Study (LSMS-ISA). We use three waves of panel data from each country; each dataset comprises observations that were collected on a biannual basis. Data for the Ethiopia Socioeconomic Survey (ESS) were collected in 2011, 2013, and 2015; for the Nigeria General Household Survey - Panel (GHS) in 2010, 216 2012, and 2015; and for the Tanzania National Panel Survey (NPS) in 2008, 2010, and 2012.

Many of the variables for the analysis are from LSMS-ISA data cleaned and curated by the Evans School Policy Analysis and Research Group (EPAR, 2019).[3] All variables are constructed at the household level, and we convert all monetary variables to USD$ 2016 Purchasing Power Parity (PPP for Private Consumption) for comparison across countries and across survey waves. Other variables were gathered from supplemental geospatial data accompanying the World Bank LSMS-ISA datasets, including the households' distance to the nearest market, as defined by the USAID Famine Early Warning Systems Network (FEWS Net). We further incorporate a measure of potential land productivity – the suitability of currently available land for pasture and rainfed crops – as measured by the Food Insecurity, Poverty and Environment Global GIS Database (FGGD) (Van Velthuizen, 2007), as well as additional market access variables drawn from the HarvestChoice spatial data repository (HarvestChoice, 2016).

3.2 Sample

We include rural households with some level of agricultural production in any of the three waves, thereby including those that entered or exited agriculture over the course of the panel survey. The number of observations ranges from 3,219 to 3,466 for Ethiopia, from 3,172 to 3,380 for Nigeria, and from 2,063 to 3,219 for Tanzania. Specific sample sizes in any given survey wave vary due to attrition, households entering and exiting rural areas, and, in Tanzania, split-off households tracked over waves 2 and 3.[4] The sample used to analyze transitions over time consists of households present and with complete responses in all three waves, including 2,812 households in Ethiopia, 2,957 in Nigeria, and 1,687 in Tanzania.

3.3. Analytical approach

Following the approach proposed in AGRA (2017), we classify smallholder farms (defined as households with any crop or livestock production, and with a reported landholding less than 4 ha in size) according to (i) level of farm product commercialization (gross value of farm sales divided by gross value of total farm production) and (ii) share of total household income from non-farm income sources (net non-farm income divided by net total household income) (Figure 25). Subsistence households sell under 5% of farm production and earn under 33% of income from non-farm sources. Pre-Commercial households sell between 5-50% of farm production and earn under 33% of household income from non-farm sources. Specialized Commercial households sell over half of farm production while still earning under 33% of income from non-farm sources. Those in the Transitioning category sell under 50% of farm production and earn over 33% of household income from non-farm sources. Diversified Commercial households sell over 50% of farm production and earn over 33% of household income from non-farm sources.

		Share of farm sales [Commercialization] *(value of farm sales / total value of farm production)*		
		Low (< 5%)	Medium (5 - 50%)	High (> 50%)
Share of non-farm income [Diversification] *(net non-farm income / net total household income)*	Low (< 33%)	Subsistence	Pre-Commercial	Specialized Commercial
	High (> 33%)	Transitioning		Diversified Commercial

Figure 2. A Typology of small farms, from AGRA (2017)

In addition to these five AGRA categories, we include two additional categories: Non-Farm households that put no land to use in agriculture and had no livestock activities, and Largeholder households that hold more than 4 ha of agricultural land, for a total of seven categories. These additional categories are used to compare against smallholder farm-households in each AGRA category and to examine the characteristics 260 of households that increased their landholdings (became Largeholders) or exited agriculture (became Non-Farm households) between waves.

We first calculate the proportion of households in each of the seven categories for each country by wave to examine how these shares vary across countries and over time.[6] Following Hazell et al. (2017), we then examine the spatial distribution of smallholder farmer categories across geographies within countries. Specifically, we consider the location of Subsistence households versus more commercialized and diversified farm-households in relation to other geospatial variables including potential land productivity (Van Velthuizen, 2007) and market access (HarvestChoice, 2016). We then report descriptive statistics by country and AGRA category for a range of market access, farm management, and household characteristics. Finally, we examine

patterns in households' movement from category to category across survey waves. We focus especially on movements out of the low-commercialization, low-diversification categories of Subsistence and Pre-Commercial in an effort to understand the degree to which households appear to be "stepping up" or "stepping out" (Dorward et al., 2009) across countries and over time.

4. Results

4.1. Distribution of AGRA categories across countries and over time

The proportion of households in each of the seven categories for Ethiopia, Nigeria, and Tanzania are presented in Figure 3. In Ethiopia, the share of households in each category varies markedly across the three survey waves. AGRA categories representing less commercialized and less diversified households (Subsistence and Pre-Commercial) comprise nearly 55% of farm-households by wave 3, while Transitioning, Specialized Commercial, and Diversified Commercial categories shrink over the same period. The share of Largeholders is small in Ethiopia and relatively steady across waves, while there is a decrease of 5 percentage points in the share of households in the Non-Farm category from wave 1 to wave 2, suggesting more rural households enter agriculture over time than exit.
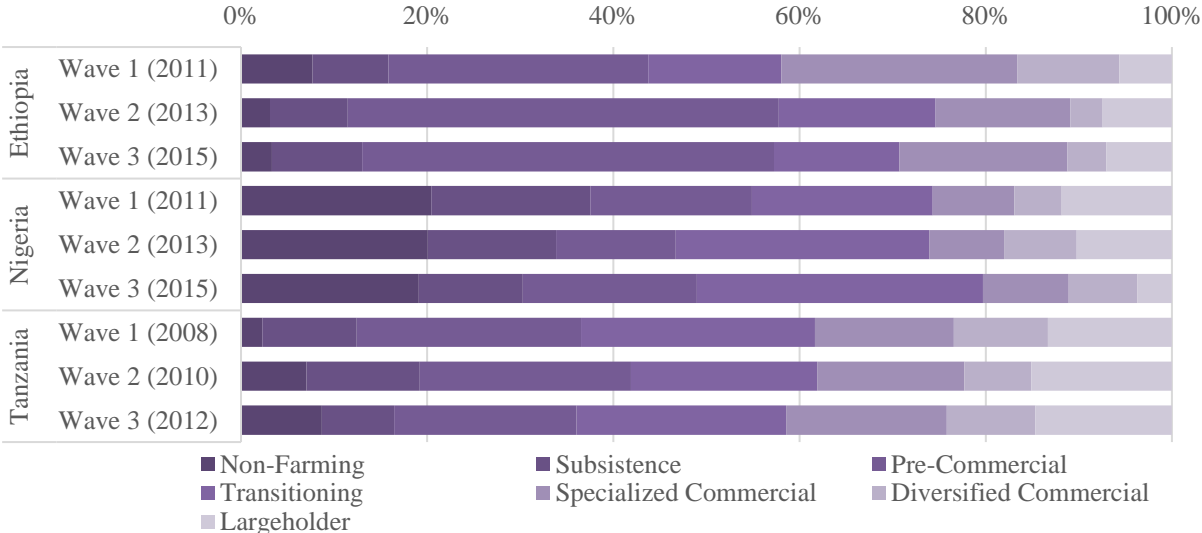

Figure 3. Share of households in each AGRA category by country and over time

In Nigeria we see some patterns more consistent with an agricultural transformation, with the share of Subsistence households decreasing from 17% of households in wave 1 (2011) to 11% in wave 3 (2015), while the Transitioning category increases by more than 12 percentage points over the same time period. The Non-Farm category also decreases slightly; this category is the largest in 2011 (20% of households), but in 2015, the Transitioning category is the largest by far (31% of households). The Diversified Commercial, Specialized Commercial, and Pre-Commercial categories all had small or inconsistent changes between waves 1 and 2 and waves 2 and 3. Notably in Nigeria, the Largeholder category declines substantially between wave 1 and wave 3, from 12% of households to only 4%, suggesting estimates of the prevalence of smallholder agriculture in Nigeria in any given survey year might not be generalizable to other time periods.

Tanzania is the only country where we observe an increase 299 in the Non-Farm category (i.e., net households "stepping out" of agriculture) over time, more than quadrupling from 2% to 9% between wave 1 (2008) and

wave 3 (2012). The Subsistence category also declines from a high of 12% (in wave 2) to 8% in wave 3, though there is only a modest decrease in the share of Subsistence households in Tanzania from wave 1. There are also fewer Pre-Commercial farmers in wave 3 (19%) versus wave 1 (24%), while the share of Transitioning, Specialized, and Diversified Commercial households fluctuates across the 3 waves. These aggregate trends may suggest Subsistence households in Tanzania are moving toward increased commercialization, diversification, or exiting from agriculture, while the other AGRA categories exhibit both increases and decreases across the three survey waves.
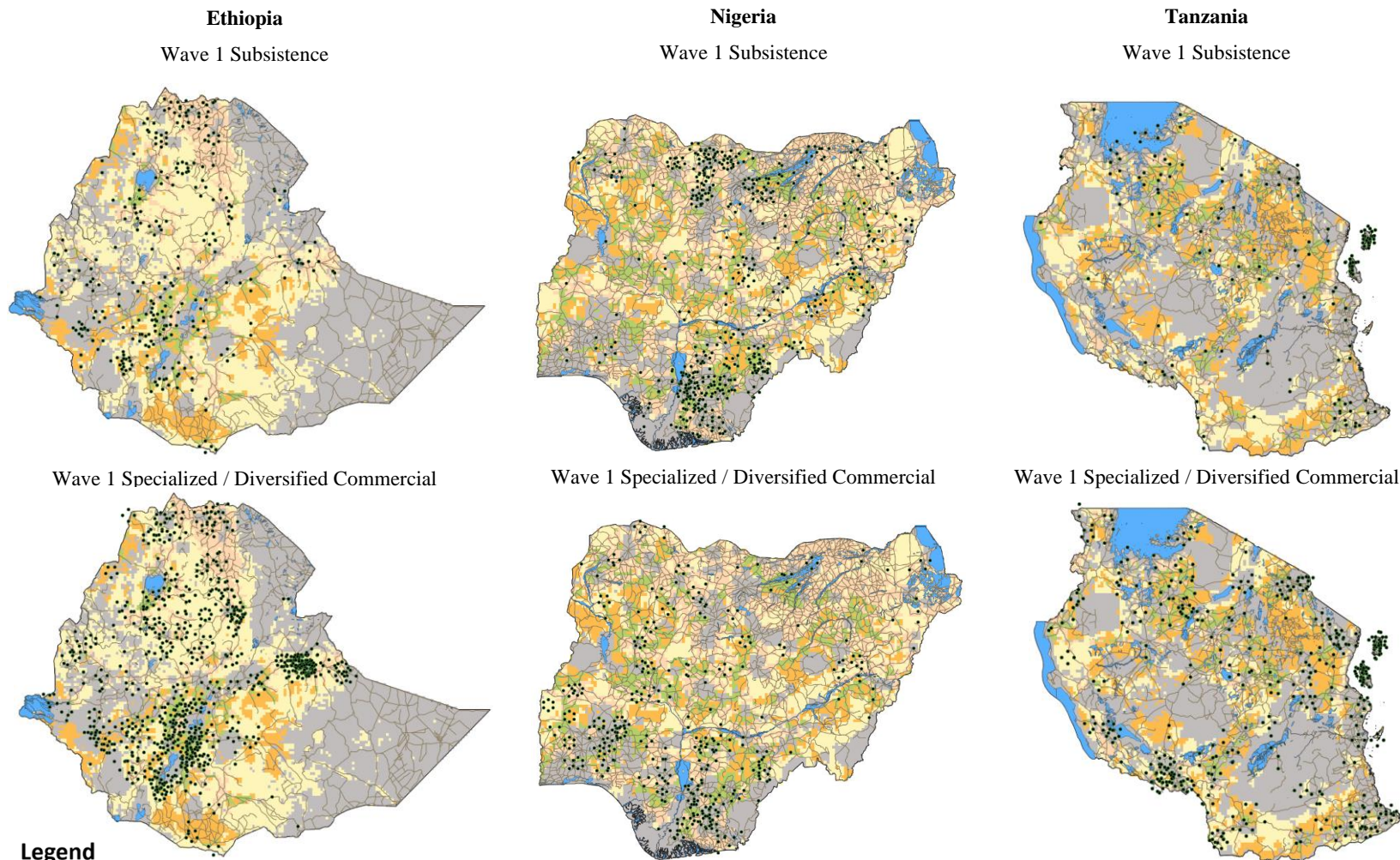
Ethiopia has the greatest volatility in AGRA categories across the three survey waves, with a large (16 percentage point) increase in the Pre-Commercial category alongside steep declines in Specialized, Diversified, and Non-Farm households. Additionally, unlike Nigeria and Tanzania Ethiopia shows no trends of moving toward greater commercialization and/or income diversification, or toward smallholders' exit from agriculture. On the contrary, in Ethiopia there are more households classified as either Subsistence or Pre-Commercial over time, fewer Specialized or Diversified Commercial households over time, and some evidence of greater entry into farming than exit. In Nigeria we also observe slightly more entry into farming than exit, with the share of Non-Farm households declining from 21% to 19% from 2011 to 2015. Combined with a decline in the share of Largeholder farmers over time, the end result is that there are more smallholders overall in Nigeria in wave 3 than in waves 1 or 2. Tanzania emerges as the only country in which the overall share of smallholder farmers (all categories) declines over time.

4.2. Geographic location of AGRA categories across countries and over time

As summarized above, in aggregate the AGRA 323 categories appear to show some volatility in classifications of rural households across survey waves in each country. As further illustration of this, Figures 4A and 4B show the spatial distribution over time of three of the AGRA categories grouped into (i) Subsistence households and (ii) Specialized Commercial and Diversified Commercial households (combined, both with relatively higher rates of commercialization but varying in income diversification).

In Ethiopia, Subsistence households in wave 1 are scattered across the country, while Specialized and Diversified Commercial households are relatively more clustered around urban centers and major transportation corridors (often on low productivity / high market access land) in the North and East, or in the high productivity / high market access land in the southern Rift Valley. This distribution is largely unchanged in Ethiopia in wave 3. In contrast, in Nigeria there are clear geographic clusters in wave 1 – with Subsistence households concentrated in low productivity / high market access land in the North, Specialized and Diversified households in high productivity / high market access land in the West, and both Subsistence and Specialized / Diversified households found on high productivity / high market access land in the South. But these patterns are not stable across waves. By wave 3, both Subsistence and Specialized / Diversified households are on low productivity / high market access land in the North and high productivity / high market access land in the South, in similar proportions. In Tanzania both groups are geographically scattered in both waves, though in wave 3 we see more clustering of Specialized / Diversified households in the North on high productivity / high market access land and in the South on low productivity / high market access land around market centers.

Taken together, such spatial patterns might suggest potential for geographic targeting to reach more commercially oriented (Specialized or Diversified) producers near market centers, as advocated by Hazell et al. (2017). But the variation in 346 spatial distributions across survey waves raises questions around the degree to which targeting would be effective, as households move across AGRA categories over time.

Ethiopia

Wave 1 Subsistence

Nigeria

Wave 1 Subsistence

Tanzania

Wave 1 Subsistence

Wave 1 Specialized / Diversified Commercial

Wave 1 Specialized / Diversified Commercial

Wave 1 Specialized / Diversified Commercial

Legend

— Major road

Cropland mask

▪ Non-cropland

▪ Water

Ag. potential – Market access

▪ Hi-Hi

▪ Hi-Lo

▪ Lo-Hi

▪ Lo-Lo

Figure 4A. Spatial distribution of rural households in Subsistence (top row) versus Specialized or Diversified Commercial (bottom row) farm categories, wave 1 in Ethiopia, Nigeria, and Tanzania. Land suitability maps reflect agricultural potential under a low-input scenario (Van Velthuizen, 2007) overlaid with travel time to a marketing center with at least 100,000 people (HarvestChoice, 2016). Gray areas are non-cropland including protected areas, forested areas, urban areas, desert, and other non-cropland.

Note: Domains defined by agricultural potential and distance to market (2-hour threshold). Lo-Hi means low agricultural potential and high market access.

Ethiopia

Wave 3 Subsistence

Nigeria

Wave 3 Subsistence

Tanzania

Wave 3 Subsistence

Wave 3 Specialized / Diversified Commercial

Wave 3 Specialized / Diversified Commercial

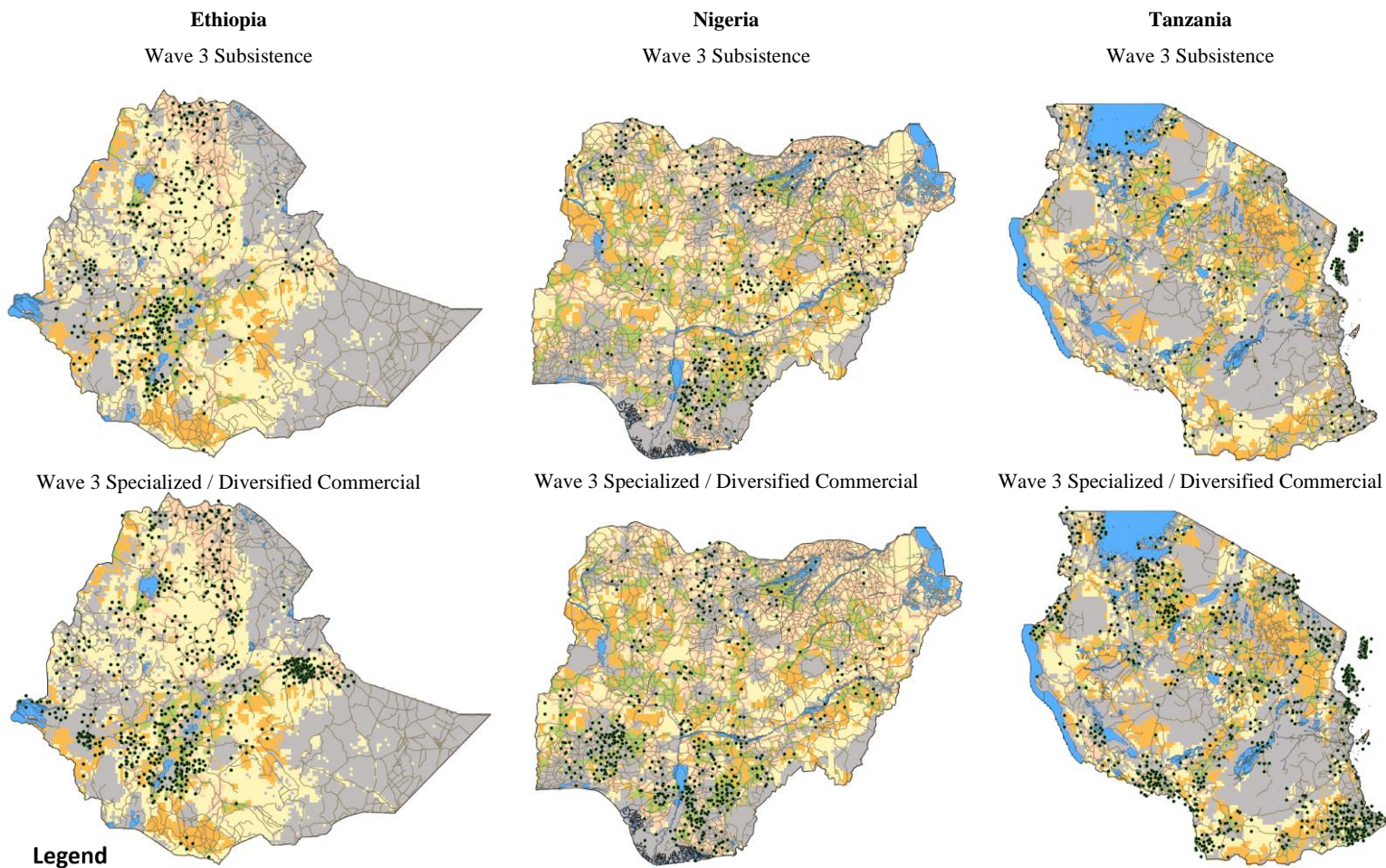Wave 3 Specialized / Diversified Commercial

Legend

— Major road

Cropland mask

⬜ Non-cropland

🟦 Water

Ag. potential – Market access

🟩 Hi-Hi

🟧 Hi-Lo

🟧 Lo-Hi

🟨 Lo-Lo

Figure 4B. Spatial distribution of rural households in Subsistence (top row) versus Specialized or Diversified Commercial (bottom row) farm categories, wave 3 in Ethiopia, Nigeria, and Tanzania.

Note: Other map features identical to Figure 3A.

4.3. Farm-household characteristics by AGRA category

We next examine households within each of the seven AGRA categories to look for patterns in farm, demographic and geographic characteristics. Table 1 reports mean values for a set of variables for Ethiopia, Nigeria, and Tanzania, with data pooled across the three survey waves. Included are the two measures used in the AGRA typology – farm commercialization and income diversification, including the numerator and denominator of each – as well as land and market characteristics, farm management, and household characteristics.

Differences in commercialization and diversification measures across AGRA categories in large part reflect the definitions imposed by the AGRA typology. However, in Table 1 we also see that Subsistence and Pre-Commercial farms are not always the lowest-income households as measured by average total income. Rather, in Ethiopia the Non-Farm and Specialized Commercial categories are on average the lowest-income groups. And in Tanzania, the average total incomes of Pre-Commercial and Specialized Commercial households are similar.

Consistent with the patterns seen in Figures 4A and 4B, in Table 1 we note variation in land productivity potential and market access is more pronounced across countries than across AGRA categories within countries. While Subsistence households are somewhat less likely to occupy high productivity / high market access land in Ethiopia and Nigeria, this pattern does not hold in Tanzania. When further considering productivity as measured by LSMS-ISA survey responses (value of output / unit input), households in the Largeholder category have among the lowest land productivity and the highest labor productivity on average across countries. And when considering market distance as reported in the surveys, in Ethiopia and Tanzania, Subsistence farms on average have the greatest distance to market. But overall there are few clear patterns in either land productivity potential or farmer-reported land productivity and market access variables.

Among farm asset and farm management characteristics, the Subsistence category has among the lowest rates of improved seed use and credit use across all three countries, consistent with past studies of barriers to agricultural transformation (Bachewe et al., 2018). Other patterns are less clear. Transitioning households in Nigeria and Tanzania have the smallest landholding, while Pre-Commercial farms have the highest rates of livestock ownership across all three countries. Lastly, in Ethiopia and Tanzania Non-Farm households are younger on average, and across all three countries more likely to have a female household head, to have some formal education, and to have fewer household members.

Table 1A. Summary descriptive statistics (means) by AGRA category: Ethiopia							
Ethiopia	Non-Farm Households	Subsistence Farmers	Pre-Commercial	Transitioning	Specialized Commercial	Diversified Commercial	Largeholder
Farm Product Commercialization (proportion)	---	0.01	0.26	0.18	0.69	0.72	0.33
Farm Value Sold (USD$ 2016 PPP)	---	33	537	171	988	517	1211
Farm Value Produced (USD$ 2016 PPP)	---	1713[†]	2151[†]	823	1470[†]	744	4301[†]
Off-Farm Income Diversification (proportion)	---	0.04	0.04	0.69	0.04	0.69	0.12
Non-Farm Income (USD$ 2016 PPP)	---	57	87	886	68	1008	499
Total Income (USD$ 2016 PPP)	1271	1520	1819	1455	1280	1513	3771
Land Potential – Market Access (proportions)							
High-High	0.15 [e,f]	0.15 [c,d,e,f]	0.19 [b,e,f]	0.21 [b,e,f]	0.27 [a,b,c,d]	0.29 [a,b,c,d]	0.19
High-Low	0.08 [e]	0.08	0.11	0.10	0.13 [a]	0.13	0.14
Low-High	0.36 [e,g]	0.27	0.29 [g]	0.32 [g]	0.25 [a]	0.29	0.18 [c,d]
Low-Low	0.42	0.50 [c,d,e,f]	0.41 [b,e,f]	0.37 [b,f]	0.35 [b,c,g]	0.30 [b,c,d,g]	0.49 [e,f]
Land Productivity (USD$ 2016 PPP/ha)	---	2272	1672	1522	2256	2365	805
Labor Productivity (USD$ 2016 PPP/day)	---	6.32	6.38	3.38	4.29	2.45	7.76
Distance to Nearest Market (km)	65	74	61	61	61	61	79
Farm Assets & Management							
Agricultural Land Size (ha)	---	1.17	1.47	0.93	1.07	0.77	9.84
Households with Livestock (proportion)	---	0.85	0.96	0.84	0.93	0.87	0.97
Tropical Livestock Units in Household	---	2.12	2.97	1.77	2.22	1.49	6.35
Fertilizer Use (proportion)	---	0.56	0.65	0.53	0.54	0.39	0.69
Improved Seed Use (proportion)	---	0.18	0.26	0.24	0.20	0.12	0.33
Credit Access (proportion use in EA)	0.14	0.14	0.14	0.15	0.14	0.14	0.14
Credit Use (proportion use among households)	0.12	0.06	0.12	0.13	0.10	0.14	0.13
Household Characteristics							
Female-Headed Household (proportion)	0.50	0.27	0.15	0.29	0.16	0.23	0.13
Age of Household Head (years)	45	49	46	48	45	45	48
Education of Household Head (1=any)	0.44	0.27	0.34	0.34	0.39	0.40	0.39
Number of Household Members	3.37	5.39	6.16	5.43	5.83	5.48	7.74
Sample N (pooled 3 waves)	837	798	3180	1449	1603	670	473

[†] It is possible for the value of farm production to exceed a household's total income if the household incurred expenses related to farm operations (e.g., input purchases) or experienced losses in non-farm income.

[a-g] Superscripts denote significant differences in farm and household characteristics across the seven rural household categories at the 95% level based on pairwise comparisons of marginal linear projections; means in a given column differ in a statistically significant manner from (a) Non-farm, (b) Subsistence, (c) Pre-commercial, (d) Transitioning, (e) Specialized, (f) Diversified, (g) Largeholder.

Nigeria	Non-Farm Households	Subsistence Farmers	Pre-Commercial	Transitioning	Specialized Commercial	Diversified Commercial	Largeholder
Table 1B. Summary descriptive statistics (means) by AGRA category: Nigeria							
Farm Product Commercialization (proportion)	---	0.00	0.25	0.11	0.73	0.74	0.26
Farm Value Sold (USD$ 2016 PPP)	---	13	559	141	1547	1009	1064
Farm Value Produced (USD$ 2016 PPP)	---	1485[†]	2377[†]	1081	2191[†]	1394	3367
Off-Farm Income Diversification (proportion)	---	0.03	0.05	0.78	0.05	0.75	0.32
Non-Farm Income (USD$ 2016 PPP)	---	79	139	3991	183	3747	2110
Total Income (USD$ 2016 PPP)	4516	1251	2104	4711	1859	4705	4757
Land Potential – Market Access (proportions)							
High-High	0.43 [f,g]	0.35 [c,d,e,f]	0.43 [b,f,g]	0.44 [b,f,g]	0.45 [b,f,g]	0.53 [a,b,c,d,e,g]	0.28 [a,c,d,e,f]
High-Low	0.02 [b,c,d,e,g]	0.09 [a,d,f]	0.11 [a,d,f]	0.05 [a,b,c,g]	0.07 [a,f]	0.03 [b,c,e,g]	0.15 [a,c,e]
Low-High	0.43	0.41 [c]	0.33 [b]	0.41	0.40	0.39	0.37
Low-Low	0.12 [g]	0.14 [e,f]	0.13 [f]	0.10 [f,g]	0.08 [b,g]	0.05 [a,b,c,d,g]	0.19 [d,e,f]
Land Productivity (USD$ 2016 PPP/ha)	---	6343	6068	3927	4957	3564	1015
Labor Productivity (USD$ 2016 PPP/day)	---	15.98	15.49	8.56	14.54	11.61	19.78
Distance to Nearest Market (km)	66	65	70	62	76	70	81
Farm Assets & Management							
Agricultural Land Size (ha)	---	0.90	1.14	0.90	1.07	0.98	13.94
Households with Livestock (proportion)	---	0.66	0.77	0.65	0.59	0.61	0.80
Tropical Livestock Units in Household	---	2.21	2.20	0.99	1.77	1.06	2.68
Fertilizer Use (proportion)	---	0.37	0.44	0.49	0.37	0.36	0.47
Improved Seed Use (proportion)	---	0.03	0.07	0.05	0.05	0.08	0.03
Credit Access (proportion use in EA)	0.02	0.01	0.01	0.02	0.01	0.01	0.01
Credit Use (proportion use among households)	0.02	0.00	0.00	0.01	0.00	0.03	0.01
Household Characteristics							
Female-Headed Household (proportion)	0.30	0.16	0.14	0.12	0.16	0.14	0.02
Age of Household Head (years)	51	51	49	48	51	50	47
Education of Household Head (1=any)	0.70	0.48	0.49	0.70	0.48	0.69	0.54
Number of Household Members	5.13	6.17	6.68	7.56	6.00	6.75	8.09
Sample N (pooled 3 waves)	1612	1360	1604	2344	778	594	951

[†] It is possible for the value of farm production to exceed a household's total income if the household incurred expenses related to farm operations (e.g., input purchases) or experienced losses in non-farm income.

[a-g] Superscripts denote significant differences in farm and household characteristics across the seven rural household categories at the 95% level based on pairwise comparisons of marginal linear projections; means in a given column differ in a statistically significant manner from (a) Non-farm, (b) Subsistence, (c) Pre-commercial, (d) Transitioning, (e) Specialized, (f) Diversified, (g) Largeholder.

Table 1C. Summary descriptive statistics (means) by AGRA category: Tanzania							
Tanzania	Non-Farm Households	Subsistence Farmers	Pre-Commercial	Transitioning	Specialized Commercial	Diversified Commercial	Largeholder
Farm Product Commercialization (proportion)	---	0.01	0.26	0.16	0.77	0.75	0.49
Farm Value Sold (USD$ 2016 PPP)	---	18	465	182	1529	1153	2227
Farm Value Produced (USD$ 2016 PPP)	---	1193	1986	824	1954	1496	4346
Off-Farm Income Diversification (proportion)	---	0.04	0.05	0.75	0.05	0.72	0.23
Non-Farm Income (USD$ 2016 PPP)	---	74	136	8904	132	11068	4450
Total Income (USD$ 2016 PPP)	5101	1380	2090	9665	1972	12359	8425
Land Potential – Market Access (proportions)							
High-High	0.48 [b,c,e,f,g]	0.33 [a,d]	0.32 [a,d]	0.40 [b,c,g]	0.32 [a]	0.35 [a,g]	0.26 [a,d,f]
High-Low	0.28	0.36 [d]	0.36 [d]	0.29 [b,c,g]	0.35	0.31	0.42 [d]
Low-High	0.10 [d]	0.18	0.15	0.16 [a]	0.12	0.15	0.10
Low-Low	0.14 [g]	0.14 [e,g]	0.17	0.16 [e]	0.21 [b,d,g]	0.18	0.22 [a,b,e]
Land Productivity (USD$ 2016 PPP/ha)	---	678	914	724	1257	1085	503
Labor Productivity (USD$ 2016 PPP/day)	---	3.87	6.98	4.75	10.15	8.58	9.93
Distance to Nearest Market (km)	136	147	134	135	125	124	162
Farm Assets & Management							
Agricultural Land Size (ha)	---	1.04	1.41	1.20	1.67	1.47	8.61
Households with Livestock (proportion)	---	0.59	0.78	0.68	0.74	0.73	0.89
Tropical Livestock Units in Household	---	3.74	2.52	0.71	1.65	1.32	5.50
Fertilizer Use (proportion)	---	0.05	0.12	0.10	0.21	0.24	0.17
Improved Seed Use (proportion)	---	0.13	0.23	0.25	0.28	0.30	0.31
Credit Access (proportion use in EA)	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Credit Use (proportion use among households)	0.03	0.00	0.00	0.02	0.01	0.03	0.01
Household Characteristics							
Female-Headed Household (proportion)	0.37	0.35	0.25	0.31	0.20	0.18	0.12
Age of Household Head (years)	37	50	49	47	46	44	51
Education of Household Head (1=any)	0.78	0.60	0.66	0.74	0.74	0.84	0.74
Number of Household Members	3.06	5.01	5.24	5.27	5.19	5.05	7.51
Sample N (pooled 3 waves)	907	749	1431	1684	1150	696	1057

[†] It is possible for the value of farm production to exceed a household's total income if the household incurred expenses related to farm operations (e.g., input purchases) or experienced losses in non-farm income.

[a-g] Superscripts denote significant differences in farm and household characteristics across the seven rural household categories at the 95% level based on pairwise comparisons of marginal linear projections; means in a given column differ in a statistically significant manner from (a) Non-farm, (b) Subsistence, (c) Pre-commercial, (d) Transitioning, (e) Specialized, (f) Diversified, (g) Largeholder.

4.4. Household transitions – Shifts in livelihood portfolios over time

We next examine patterns in households' movement from category to category over time. Hazell et al. (2017) summarize the household-level transitions that might be expected over time in the context of an agricultural transformation, arguing that "*over time […] Subsistence farms should become Transition, Pre-commercial or Commercial farms, or exit farming altogether; that many Transition farms should become Commercial farms or successfully move to the Non-Farm economy; that Commercial small farms should either prosper as such, or transform into [Largeholder] farms; and that Pre-Commercial farmers should either succeed in becoming Commercial farmers or diversify and become Transition farmers*."

Table 2 shows movement by rural households from wave 1 to wave 3 across the seven categories over time in each country. There is limited evidence to suggest households in the low commercialization, low-off-farm income categories are consistently transitioning toward increased commercialization, increased diversification, or non-farm livelihoods over time in any of the three countries. On the contrary, moves from one category to another across survey waves are highly varied, with some Subsistence and Pre-Commercial households "stepping up" or "stepping out," but many other households "falling back" into the less commercialized, less diversified farm categories over time.

In Ethiopia, a majority of households across all AGRA categories 406 in wave 1 enter a different category by wave 3, with the exception of Pre-Commercial where 55% of those in this category in 2011 remain Pre-Commercial in 2015. Most categories show instability over time – Largeholders are the only other category where more than a third of households in wave 1 remain in the same category by wave 3 (39%). Pre-Commercial is the most common wave 3 category (24% to 55% of all wave 1 categories become Pre-Commercial by wave 3), but most wave 1 AGRA categories are scattered across several other categories by wave 3. We also find more than 70% of Non-Farmers in wave 1 subsequently enter farm categories in wave 3 – ranging from Subsistence to Largeholders – suggesting entry (or re-entry) into agriculture may be common. The broad pattern of declining shares of commercialization and off-farm income over time, especially among Specialized and Diversified Commercial and Transitioning households, may reflect barriers Ethiopian farmers face in accessing markets and non-farm work (Bedemo et al., 2013; Shifa, 2016). Transitioning and Pre-Commercial households are the two groups with the greatest chances of "falling back" into Subsistence status in Ethiopia. In Nigeria there is a large Non-Farm category across survey waves, with roughly 20% of the rural population engaged in livelihoods outside agriculture. While more households stay in the same AGRA category across waves in Nigeria than Ethiopia, there is still substantial movement, with less commercialized / diversified households likely to become more commercialized / diversified over time, and vice versa. Unlike in Ethiopia, most Largeholders in Nigeria in 2010 become smallholders (either Transitioning or Pre- Commercial) by 2015. Again, Pre-Commercial households are the most likely category to "fall back" into Subsistence (19%), though in Nigeria the next most likely group to "fall back" into Subsistence is Largeholders (11%).

In Tanzania Largeholder households are common, and 428 households tend to stay in this category across waves. Smallholder categories in Tanzania are more volatile, but on average there is increasing or steady commercialization and off-farm income across all categories, with the exception of Diversified Commercial households in 2008, who have roughly equal chances of remaining Diversified Commercial or becoming Pre-Commercial, Transitioning, or Specialized Commercial by 2012. Unlike with Ethiopia and Nigeria, "falling back" into Subsistence appears relatively uncommon among smallholders in Tanzania – the wave 1 categories most likely to become Subsistence in wave 3 are Non-Farm households (15%) and Transitioning (8%).

Even the apparently high level of movement across AGRA categories from wave 1 to wave 3 in Table 2 masks further transitions back and forth across categories over the course of the three survey waves (Appendix A). For example, in any given country / year, between 7% and 17% of rural household are classified as Subsistence

(Figure 3). But in further analyses (not shown) looking across years, less than 1% of households in Ethiopia or Tanzania are in the Subsistence category in all three survey waves, along with just 1.1% of Nigerian households. In other words, in almost all countries and all years, the majority of households classified as Subsistence using the AGRA typology would not be classified in this category in a different survey wave. Conversely, the proportion of rural households falling into the Subsistence category at least once over the three survey waves is much higher: fully 23% of rural households in Ethiopia, 32% in Nigeria, and 21% in Tanzania. These results suggest a classification based on a sample of rural households from any given year might substantially underestimate the number of households in vulnerable positions – likely to fall into Subsistence – at a given point in time.

Table 2: Household movement across categories

Ethiopia

Wave 1 Category (2011)	Wave 3 Category (2015)						
	Non-farmers	Subsistence	Pre-Commercial	Transitioning	Specialized Commercial	Diversified Commercial	Largeholder
Non-farmers	0.28	0.08	0.24	0.15	0.13	0.08	0.04
Subsistence	0.02	0.19	0.47	0.11	0.14	0.02	0.05
Pre-Commercial	0.01	0.12	0.55	0.09	0.16	0.02	0.05
Transitioning	0.06	0.11	0.31	0.28	0.11	0.09	0.04
Specialized Commercial	0.01	0.10	0.50	0.08	0.24	0.02	0.05
Diversified Commercial	0.03	0.06	0.30	0.26	0.20	0.13	0.03
Largeholder	0.00	0.04	0.36	0.04	0.16	0.01	0.39

Nigeria

Wave 1 Category (2011)	Wave 3 Category (2015)						
	Non-farmers	Subsistence	Pre-Commercial	Transitioning	Specialized Commercial	Diversified Commercial	Largeholder
Non-farmers	0.74	0.03	0.02	0.13	0.02	0.05	0.00
Subsistence	0.16	0.17	0.26	0.24	0.11	0.05	0.01
Pre-Commercial	0.10	0.19	0.31	0.20	0.13	0.05	0.02
Transitioning	0.12	0.06	0.11	0.52	0.05	0.11	0.03
Specialized Commercial	0.12	0.09	0.25	0.19	0.22	0.06	0.08
Diversified Commercial	0.15	0.07	0.09	0.40	0.11	0.15	0.04
Largeholder	0.16	0.11	0.20	0.30	0.08	0.05	0.10

Tanzania

Wave 1 Category (2008)	Wave 3 Category (2012)						
	Non-farmers	Subsistence	Pre-Commercial	Transitioning	Specialized Commercial	Diversified Commercial	Largeholder
Non-farmers	0.38	0.15	0.05	0.21	0.05	0.14	0.03
Subsistence	0.05	0.18	0.22	0.28	0.17	0.05	0.07
Pre-Commercial	0.03	0.07	0.32	0.19	0.19	0.07	0.13
Transitioning	0.05	0.08	0.15	0.40	0.14	0.12	0.06
Specialized Commercial	0.00	0.05	0.24	0.12	0.32	0.11	0.16
Diversified Commercial	0.02	0.04	0.13	0.23	0.22	0.24	0.12
Largeholder	0.00	0.03	0.09	0.08	0.10	0.05	0.64

Note: Values reflect the percent of households within each AGRA category in wave 1 who either remain in that category in wave 3 (bordered cells) or transition to another category. Shaded cells highlight the wave 3 category with the highest percentage for each wave 1 group. To construct this table, we retained households that remained in the sample for all waves and applied population weights from the first survey wave.

4.5. Numerator and denominator effects on AGRA classifications and transitions over time

Our analysis thus far has highlighted a high degree 451 of churning in the AGRA categories across waves, with many households moving back and forth between categories over time. But we also note that in some cases, increases in the two AGRA metrics might be driven by decreasing farm production or by decreasing farm income. This could reflect the high degree of volatility in agricultural production and prices faced by farmers (Collier and Dercon, 2014). Table 3 summarizes the sources of increases or decreases in commercialization and diversification scores across countries between waves 1 and 3, broken down by the numerator and denominator of the AGRA metrics.

The sample here is restricted to households in Subsistence or Pre-Commercial categories in wave 1, and the table shows the AGRA categories in which these households are classified in wave 3. In all three countries we find that among households appearing to be "stepping up" or "stepping out" of Subsistence or Pre-Commercial status, increased commercialization is often at least in part attributable to decreased farm value produced. Anywhere from 30% (for those becoming Specialized households in Ethiopia) to 66% (for those becoming Transitioning households in Nigeria) of wave 1 Subsistence or Pre-Commercial households who see greater commercialization over time also experience decreased farm value produced. Similarly, among wave 1 Subsistence or Pre-Commercial households that see increasing off-farm income diversification over time, for more than 15% of households across AGRA categories in Tanzania, and more than 30% of households in Ethiopia and Nigeria, observed increases in income diversification are at least partly driven by declining total household incomes.

A closer look at transition patterns (not shown) reveals that 66% of Subsistence and Pre-Commercial households in Ethiopia who saw an increase in commercialization from wave 1 to wave 3 experienced an increase in both the numerator and the denominator of this indicator. But 22% had an increase in commercialization due to a decrease in farm value produced, and another 12% saw a decrease in both the numerator and the denominator. This mirrors patterns in Nigeria and Tanzania, where more than 40% of Subsistence and Pre-Commercial households who saw an increase in commercialization from wave 1 to wave 3 experienced a decrease in the denominator (i.e., a reduction in total farm value produced). Similarly, across countries, households classified as increasing off-farm income diversification very often experience decreased total income (i.e., a reduction in the denominator of the AGRA metric). Among Subsistence and Pre-Commercial households with an increase in off-farm income diversification from wave 1 to wave 3, 26% or more had decreased total income (35% in Ethiopia, 53% in Nigeria, 484 and 26% in Tanzania). Such patterns may confound household commercialization and diversification associated with economic opportunity (e.g., enhanced productivity and market access, leading to greater commercialization and off-farm income) with household commercialization and diversification associated with distress (e.g., failed crops leading to reduced farm income, increased reliance on off-farm sources, and the sale of farm assets to purchase food) (Ellis, 2000). Decreases in commercialization or diversification can also be misleading using these metrics: it is fairly common for a decrease in commercialization or a decrease in diversification to reflect a decrease in both numerator and denominator (i.e., clear livelihood losses), but also very common for a decrease in either commercialization or diversification to reflect increases 493 in both the numerator and denominator (i.e., clear livelihood gains even in the absence of expected transitions).

Table 3: Numerator and Denominator Changes in Commercialization and Diversification							
Ethiopia	**Non-farming**	**Subsistence**	**Pre-Commercial**	**Transitioning**	**Specialized**	**Diversified**	**Largeholder**
Increased Commercialization (W3-W1)	--	0.21	0.60	0.49	1.00[1]	1.00[1]	0.65
Increased Farm Value Sold (W3-W1)	--	0.31	0.71	0.41	0.92	0.79	0.75
Decreased Farm Value Produced (W3-W1)	--	0.39	0.30	0.63	0.30	0.58	0.16
N	7	141	469	99	180	23	41
Nigeria							
Increased Commercialization (W3-W1)	--	0.40	0.75	0.59	1.00	1.00	0.65
Increased Farm Value Sold (W3-W1)	--	0.40	0.72	0.59	0.84	0.80	0.61
Decreased Farm Value Produced (W3-W1)	--	0.65	0.45	0.66	0.51	0.53	0.49
N	56	193	314	238	132	50	24
Tanzania							
Increased Commercialization (W3-W1)	--	0.93	0.93	0.94	1.00	1.00	0.94
Increased Farm Value Sold (W3-W1)	--	0.91	0.93	0.91	0.94	0.91	0.85
Decreased Farm Value Produced (W3-W1)	--	0.70	0.54	0.63	0.38	0.33	0.51
N	18	69	145	123	111	43	64
Ethiopia	**Non-farming**	**Subsistence**	**Pre-Commercial**	**Transitioning**	**Specialized**	**Diversified**	**Largeholder**
Increased Diversification (W3-W1)	--	0.70	0.78	1.00[1]	0.72	1.00[1]	0.66
Increased Off-farm Income (W3-W1)	--	0.75	0.79	0.84	0.72	0.84	0.62
Decreased Total Income (W3-W1)	--	0.39	0.36	0.54	0.36	0.60	0.28
N	9	141	469	99	180	23	41
Nigeria							
Increased Diversification (W3-W1)	--	0.48	0.58	1.00	0.50	1.00	0.69
Increased Off-farm Income (W3-W1)	--	0.49	0.63	0.92	0.53	0.81	0.64
Decreased Total Income (W3-W1)	--	0.52	0.38	0.40	0.55	0.37	0.36
N	56	193	314	238	132	50	24
Tanzania							
Increased Diversification (W3-W1)	--	0.75	0.77	1.00[1]	0.76	1.00[1]	0.82
Increased Off-farm Income (W3-W1)	--	0.78	0.76	0.99	0.79	0.95	0.84
Decreased Total Income (W3-W1)	--	0.43	0.39	0.15	0.39	0.16	0.24
N	18	69	145	123	111	43	64

[1] By definition, 100% of Subsistence or Pre-Commercial households experienced increased commercialization if they became Specialized or Diversified Commercial over time; similarly, 100% saw increased diversification if they became Transitioning or Diversified Commercial.
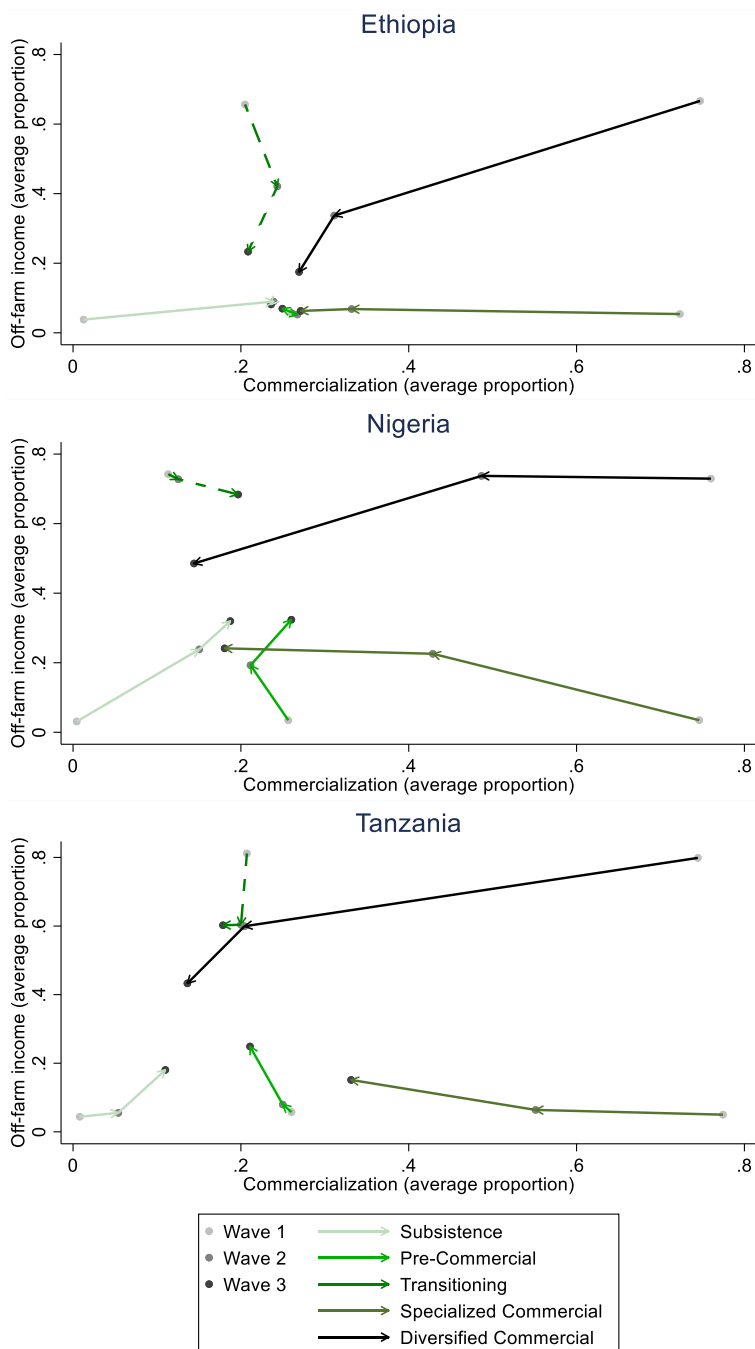
Ethiopia

Nigeria

Tanzania

Legend:
- Wave 1
- Wave 2
- Wave 3
- Subsistence
- Pre-Commercial
- Transitioning
- Specialized Commercial
- Diversified Commercial

Figure 5. Shifts over time (from wave 1 to wave 3) in mean farm commercialization and off-farm income diversification for households within each AGRA category.

4.6. "Churning" and homogenization of AGRA categories over time

As a final illustration of the potential for a rural household typology based on measures of commercialization and diversification to lead to flawed conclusions, Figure 5 tracks the mean rates of farm commercialization (x-axis) and off-farm income diversification (y-axis) for each AGRA category over time. Each line in the figure corresponds to a fixed group of households from wave 1, showing the mean commercialization and off-farm income levels of that group over time. (For simplicity, we focus on the five AGRA smallholder farmer categories, omitting Non-Farm and Largeholders.)

Across most categories, we see clear 516 trends of homogenization across the three survey waves; i.e., groups of farmers that are distinct in commercialization and off-farm income sourcing in wave 1 are close to indistinguishable by these two measures in wave 3. For example, in Ethiopia the households that were classified as Subsistence in wave 1 had a mean commercialization rate of only 1%, and a mean off-farm income share of 3% in that base year. But these same households had a mean commercialization rate of 28% by wave 3, and a mean off-farm income share of 14%. Meanwhile those classified as Specialized Commercial or Diversified Commercial (AGRA categories with high shares of commercialization) had a mean commercialization share of 74% in wave 1, but a mean commercialization share of only 35% by wave 3. And those classified as Transitioning or Diversified Commercial (AGRA categories with high shares of off-farm income) in wave 1 in Ethiopia had a mean off-farm income share of 69% in that base year, but a mean off-farm income share of only 32% by wave 3. This pattern suggests that when we observe increasing farm product commercialization and off-farm income diversification rates among Subsistence households over time, such trends might at least in part be attributable to regression toward the mean (Davis 2008), rather than serving as evidence of low-diversification households "stepping up" or "stepping out".

5. Discussion and Conclusion

If the seven household categories considered here are used to track agricultural transformation at the national level, findings in Tanzania might be considered broadly consistent with the theorized transitions from low-productivity subsistence farming towards more commercial farming or non-farm work (Timmer, 1988; Jayne et al., 2018). In Ethiopia, however, we see no such trends, and in Ethiopia, Nigeria, and Tanzania alike, we find considerable movement of individual households across categories over time, reflecting both increases and decreases in commercialization and off-farm income from one 540 wave to the next. The lack of household-level evidence of transitions away from subsistence farming, as predicted by Hazell et al. (2017), might reflect barriers to a sustained agricultural transformation in sub-Saharan Africa (McMillan and Headey, 2014) variously attributed to climate change and market and institutional risks and uncertainty (Woldenhanna and Oskam, 2001; Collier and Dercon, 2014; Shimeles et al., 2018). But our results also suggest that efforts to categorize rural households in typologies according to farm commercialization or non-farm income sources may be hampered by the substantial year-to-year variability in smallholder production and livelihood experiences, and by the tenuous links between commercialization and diversification metrics and household livelihood gains.

Many rural livelihood strategies in sub-Saharan Africa involve a shifting portfolio of own consumption and sales, and of on-farm and off-farm income activities (Barrett et al., 2001; Binswanger-Mkhize et al., 2010; Davis et al., 2017). These diverse portfolios over time defy classification using simple commercialization and diversification measures (Tittonell et al., 2020). As noted by Shakhovskoy et al. (2019), vulnerable subsistence farmers might follow different development pathways in a given context – either increasing productivity and commercialization on-farm, or diversifying to non-farm sectors and urban labor markets – and several of these pathways can also be two-way, with some successful rural off-farm entrepreneurs or urban migrants choosing to return to agriculture as a livelihood-enhancing strategy at any given time. In part as a result of such complexity, we see heavy "churn" over time among rural household categories based on farm product commercialization and off-farm income diversification rates, and thus we do not find many clear differences in geographic distribution or in farm and household characteristics associated with categories from the AGRA typology.

We further find that although increasing 562 commercialization and off-farm income diversification is often associated with increasing household incomes, in many cases, increases in these metrics actually reflect decreased farm production or decreased total household income (i.e., decreases in the denominators). Ellis (2000) distinguishes between diversification of necessity versus diversification by choice, noting how factors relating to seasonality, risk exposure, labor markets, credit access, and household asset portfolios can all lead rural households to diversify as a coping response, rather than as a sign of successful transformation. More recently Amare and Shiferaw (2017) find that non-farm income can have positive, negative, or zero association with indicators of farm productivity and agricultural intensification. Important questions thus remain around when and how increasing commercialization and increasing reliance on off-farm income sources might reflect positive or negative trends in rural household welfare.

Agricultural transformation has long been studied at the country-level (Barrett et al., 2010), but the increasing availability of large household survey panel datasets allows for more detailed examination of the household-level transitions that underlie aggregate economic changes (Bosc and Bélières, 2015; Davis et al., 2017; Belton and Filipski, 2019). Our findings underscore considerable challenges with using household typologies based on commercialization and diversification metrics alone to target development interventions. Our findings also highlight how aggregate shifts in commercialization and off-farm income associated with country-level agricultural transformation may mask substantial heterogeneity among rural households within and across countries over time.

References

Alia, D., Anderson, C.L., & Reynolds, T.W. (2019). Who is a smallholder farmer? Features and implications of alternative definitions with an application to household survey data in Nigeria, Tanzania, and Ethiopia. *EPAR Technical Report #356*. Evans School of Public Policy & Governance, University of Washington.

Anderson, J., Karuppusamy, R., Neumann, P., Miller, H., & Tamara, R. (2019). Smallholder households: Distinct segments, different needs. *CGAP Focus Note No. 111*, April 2019. http://cgap.org/sites/default/files/publications/2019_04_Focus_Note_Smallholder_Households_Distinct_Segments_Different_Needs.pdf

Alliance for a Green Revolution in Africa (AGRA). (2017). *Africa Agriculture Status Report 2017:The Business of Smallholder Agriculture in Sub-Saharan Africa (Issue No. 5)*. Nairobi, Kenya: AGRA.

Akram-Lodhi, A. H., & Kay, C. (Eds.). (2012*). Peasants and Globalization: Political Economy, Agrarian Transformation and Development*. London: Routledge.

Amare, M., and Shiferaw, B. (2017). Nonfarm employment, agricultural intensification, and productivity change: empirical findings from Uganda. *Agricultural Economics*. 48 (2017), 59-72.

Bachewe, F.N., Berhane, G., Minten, B., & Taffesse, A.S. (2018). Agricultural transformation in Africa? Assessing the evidence in Ethiopia. *World Development*, 105, 286-298.

Barrett, C.B., Christiaensen, L., Sheahan, M., & Shimeles, A. (2017*). On the Structural Transformation of Rural Africa*. Washington, D.C.: The World Bank.

Barrett, C.B., Carter, M.R., & Timmer, C.P. (2010). A century-long perspective on agricultural development. *American Journal of Agricultural Economics*, 92(2), 447-468.

Barrett, C.B., Reardon, T., & Webb, P. (605 2001). Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. *Food Policy*, 26(4), 315-331.

Bedemo, A., Getnet, K., Kassa, B., & Chaurasia, S. (2013*). Off-farm labor supply decision of adults in rural Ethiopia: Double hurdle approach. *Journal of Agricultural Economics and Development*, 2(4), 154-165.

Belton, B., & Filipski, M. (2019). Rural transformation in central Myanmar: By how much, and for whom?. *Journal of Rural Studies*, 67, 166-176.

Bernstein, H. (2010). *Class Dynamics of Agrarian Change*. Sterling, VA: Kumarian Press.

Binswanger-Mkhize, H.P., McCalla, A.F., & Patel, P. (2010). Structural transformation and African agriculture. *Global Journal of Emerging Market Economics*, 2, 113–152.

Bosc, P.M., and Bélières, J.F. (2015). Transformations agricoles: un point de vue renouvelé par une mise en perspective d'approches macro et microéconomiques. *Cahiers Agricultures*, 24(4), 206-214.

Caselli, F. (2005). Accounting for Cross-Country Income Differences," in P. Aghion and S. Durlauf, Eds. *Handbook of Economic Growth, Vol. 1. Elsevier, Ch. 9* (pp. 679-741).

Chenery, H., and Syrquin, M. (1975). *Patterns of Development*. Oxford University Press, London.

Christen, R., and Anderson, J. (2014). *Segmentation of smallholder households: Meeting the range of financial needs in agricultural families (Focus Note 85)*. Washington, DC: Consultative Group to Assist the Poor (CGAP).

Collier, P., and Dercon, S. (2014). African agriculture in 50 years: smallholders in a rapidly changing world? *World Development*, 63, 92-101.

Davis, B., Di Giuseppe, S., & Zezza, A. (2017). Are 627 African households (not) leaving agriculture? Patterns of households' income sources in rural Sub-Saharan Africa. *Food Policy*, 67, 153-174.

Davis, B., Winters, P., Carletto, G., Covarrubias, K., Quiñones, E.J., Zezza, A., Stamoulis, K.,Azzarri, C., & DiGiuseppe, S. (2010). A cross-country comparison of rural income generating activities. *World Development*, 38(1), 48-63.

Davis, C. (2008). Regression to the mean. *Wiley Encyclopedia of Clinical Trials*. Hoboken: John Wiley & Sons, Inc.

Dedehouanou, S.F., and McPeak, J. (2019). Diversify more or less? Household income generation strategies and food security in rural Nigeria. *The Journal of Development Studies*, 1-18.

Diao, X., McMillan, M., & Rodrik, D. (2017). *The recent growth boom in developing economies: A structural change perspective (No. w23132)*. National Bureau of Economic Research.

Dorward, A., Anderson, S., Bernal, Y. N., Vera, E. S., Rushton, J., Pattison, J., & Paz, R. (2009). Hanging in, stepping up and stepping out: livelihood aspirations and strategies of the poor. *Development in Practice*, 19(2), 240-247.

Ecker, O. (2018). Agricultural transformation and food and nutrition security in Ghana: Does farm production diversity (still) matter for household dietary diversity? *Food Policy*, 79, 271-282.

Edelman, M., & Wolford, W. (2017). Critical agrarian studies in theory and practice. *Antipode*, 49(4), 959-976.

Ellis, F. (2000). The determinants of rural livelihood diversification in developing countries. *Journal of Agricultural Economics*, 51(2), 289-302.

Evans School Policy Analysis & Research Group (EPAR). (2019). *Agricultural Development Indicator Curation: EPAR Technical Report #335*. Evans School of Public Policy & Governance, University 650 of Washington. Retrieved 15 August 2019 from https://evans.uw.edu/policy-impact/epar/research/agricultural- development-indicatorcuration

FAO (Food and Agriculture Organisation of the United Nations). (1998). *The State of Food and Agriculture 1998* (FAO Agriculture Series No. 31). Rome: FAO.

Gollin, D., Lagakos, D., & Waugh, M.E. (2014). The agricultural productivity gap. *The Quarterly Journal of Economics*, 129(2), 939-993.

Gollin, D., Parente, S., & Rogerson, R. (2002). The role of agriculture in development, American Economic Review, 92, 160-164.

HarvestChoice. (2016). Travel Time to Markets in Africa South of the Sahara. Harvard Dataverse,V2. International Food Policy Research Institute (IFPRI) and University of Minnesota, Washington, DC. doi:10.7910/DVN/YKDWJD

Hazell, P., Wood, S., Bacou, M., & Dey, B. (2017). Operationalizing the Typology of Small Farm Households. In *Africa Agriculture Status Report: The Business of Smallholder Agriculture in Sub-Saharan Africa* (Issue 5). Nairobi, Kenya: Alliance for a Green Revolution in Africa (AGRA).

Hicks, J., Kleemans, M., Nicholas, Y.L., & Miguel, E. (2017). Reevaluating Agricultural Productivity Gaps with Longitudinal Microdata. NBER Working Paper 23253.

Jayne, T.S., Benfica, R., Yeboah, F.K., & Chamberlin, J. (2019a). Agricultural Transformation and Africa's Economic Development. In *African Economic Development* (pp. 349-375). Emerald Publishing Limited.

Jayne, T.S., Snapp, S., Place, F., & Sitko, N. (2019b). Sustainable agricultural intensification in an era of rural transformation in Africa. *Global Food Security*, 20, 105-113.

Jayne, T. S., Muyanga, M., Wineman, A., Ghebru, H., Stevens, 673 C., Stickler, M., & Nyange, D. (2019c). Are medium-scale farms driving agricultural transformation in sub-Saharan Africa?. *Agricultural Economics*, 50, 75-95.

Jayne, T., Chamberlin, J., & Benfica, R. (2018). Africa's unfolding economic transformation. *Journal of Development Studies*, 54, 777-787.

Jayne, T.S., Haggblade, S., Minot, N., & Rashid, S. (2011). Agricultural commercialization, rural transformation and poverty reduction: what have we learned about how to achieve this? In *Synthesis Report Prepared for the African Agricultural Markets Program Policy Symposium, Alliance for Commodity Trade in Eastern/Southern Africa*, April (pp. 20-22).

Jayne, T.S., Mather, D., & Mghenyi, E. (2010). Principal challenges confronting smallholder agriculture in sub-Saharan Africa. *World Development*, 38(10), 1384-1398.

Johnston, B., and Kilby, P. (1978). *Agriculture and Structural Transformation: Economic Strategies in Late-developing Countries*. Oxford University Press.

Kuznets, S. (1973). Modern economic growth: findings and reflections. *American Economic Review*, 63, 247-258.

Lanjouw, J.O., and Lanjouw, P. (2001). The rural non-farm sector: Issues and evidence from developing countries. *Agricultural Economics*, 26(1), 1-23.

Lewis, W. (1955). The Theory of Economic Growth, Homewood: R.D. Irwim. McMillan, M., and Headey, D. (2014). Introduction–understanding structural transformation in Africa. *World Development*, 63, 1-10.

McMillan, M., Rodrik, D., & Verduzco-Gallo, I. (2014). Globalization, structural change, and productivity growth, with an update on Africa. *World Development*, 63, 11-32.

Mueller M., Doss, C., & Quisumbing, A. (695 2018). Youth migration and labour constraints in African agrarian households. *The Journal of Development Studies*, 54(5), 857-894.

Parvathi, P., Amare, M., Nguyen, T.T., & Barrett, C.B. (2019). Signalling change: Micro insights on the pathways to agricultural transformation. IFPRI Discussion Paper.

Pingali, P.L., and Rosegrant, M.W. (1995). Agricultural commercialization and diversification: processes and policies. *Food Policy*, 20(3), 171-185.

Ranis, G., and Fei, J.C. (1961). A theory of economic development. *The American Economic Review*, 51(4), 533-565.

Reardon, T. (1997). Using evidence of household income diversification to inform study of the rural nonfarm labor market in Africa. *World Development*, 25(5), 735-747

Restuccia, D., Yang, D.T., & Zhu, X. (2008). Agriculture and aggregate productivity: A quantitative cross-country analysis. *Journal of Monetary Economics*, 55, 234-250.

Rostow, W.W. (1960). *The Stages of Economic Growth: A Non-Communist Manifesto*, Cambridge: Cambridge University Press.

Shakhovskoy, M., Colina, C., & Clason Höök, M. (2019*). Pathways to Prosperity: Rural and Agricultural Finance State of the Sector Report.* Mastercard Foundation, United States Agency for International Development, and Small Foundation.

Shifa, M. (2016). Determinants of land and labour market participation decisions in rural Ethiopia. *Journal of African Development*, 18(2), 73-90.

Shimeles, A., Verdier-Chouchane, A., & Boly, A. (2018). Introduction: Understanding the Challenges of the Agricultural Sector in Sub-Saharan Africa. In *Building a Resilient and Sustainable Agriculture in Sub-Saharan Africa* (pp. 1-12). Palgrave Macmillan, Cham.

Timmer, C.P. (1988). The Agricultural Transformation. In 717 H. Chenery and T.N. Srinivasan, Eds.,*Handbook of Development Economics*. Vol. 1. Amsterdam: North-Holland, pp. 275-331.

Tittonell, P., Bruzzone, O., Solano-Hernández, A., López-Ridaura, S., & Easdale, M. H. (2020). Functional farm household typologies through archetypal responses to disturbances. *Agricultural Systems*, 178, 102714.

Vandercasteelen, J., Beyene, S.T., Minten, B., & Swinnen, J. (2018). Cities and agricultural transformation in Africa: Evidence from Ethiopia. *World Development*, 105, 383-399.

Van Velthuizen, H. (2007). *Mapping Biophysical Factors that Influence Agricultural Production and Rural Vulnerability* (No. 11). Rome: Food and Agriculture Organization of the United Nations (FAO), and International Institute for Applied Systems Analysis (IIASA).

Wineman, A., Alia, D.Y., & Anderson, C.L. (2020). Definitions of "rural" and "urban" and understandings of economic transformation: Evidence from Tanzania. *Journal of Rural Studies*, 79, 254-268.

Winters, P., Davis, B., Carletto, G., Covarrubias, K., Quiñones, E.J., Zezza, A., Azzarri, C., & Stamoulis, K. (2009). Assets, activities and rural income generation: evidence from a multicountry analysis. *World Development*, 37(9), 1435-1452.

Woldenhanna, T., and Oskam, A. (2001). Income diversification and entry barriers: evidence from the Tigray region of northern Ethiopia. *Food Policy*, 26(4), 351-365.

World Bank. (2008). *World Development Report on Agriculture*. Washington, D.C.

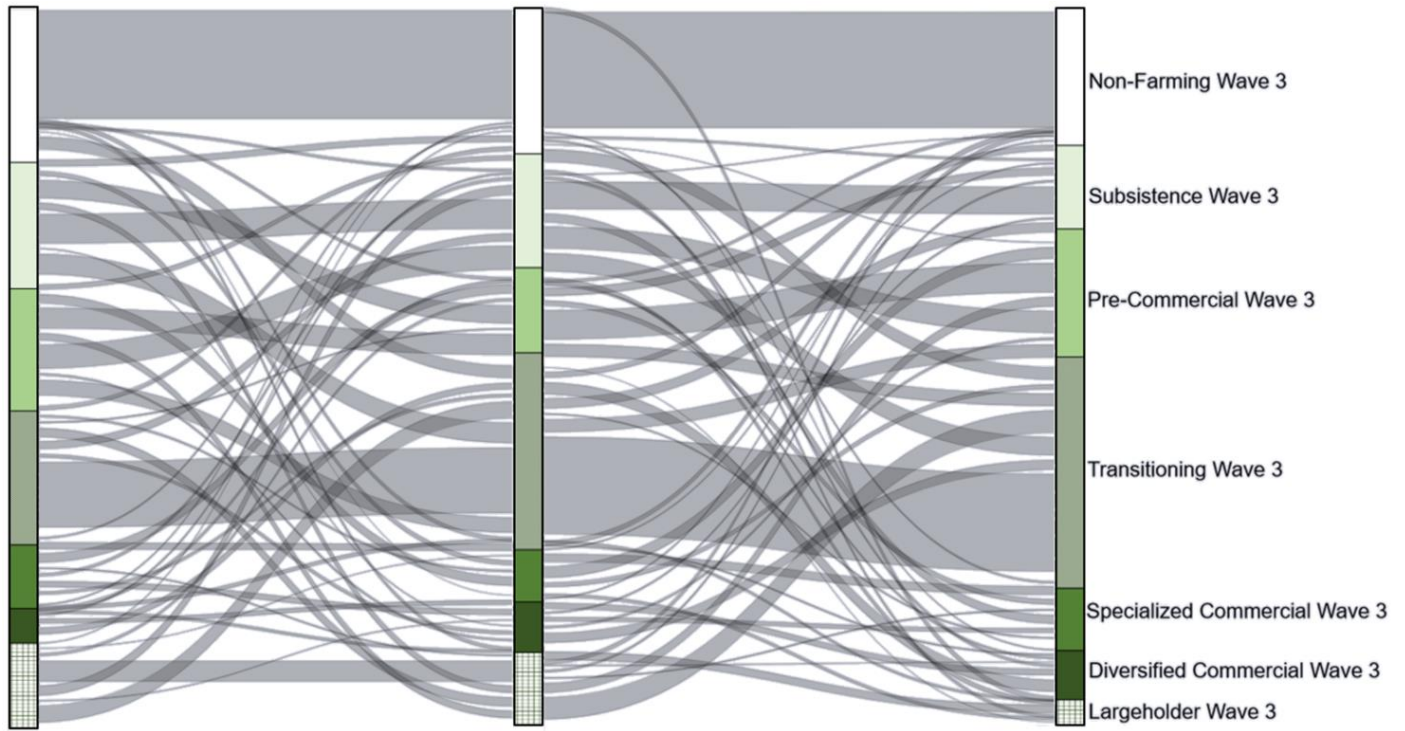World Bank. (2020). *World Bank Data Catalog*. Retrieved 24 September 2020 from https://datacatalog.worldbank.org/public-licenses#cc-by

Appendix

Figure A1. Transitions across AGRA categories over time in Ethiopia, Nigeria, and Tanzania.
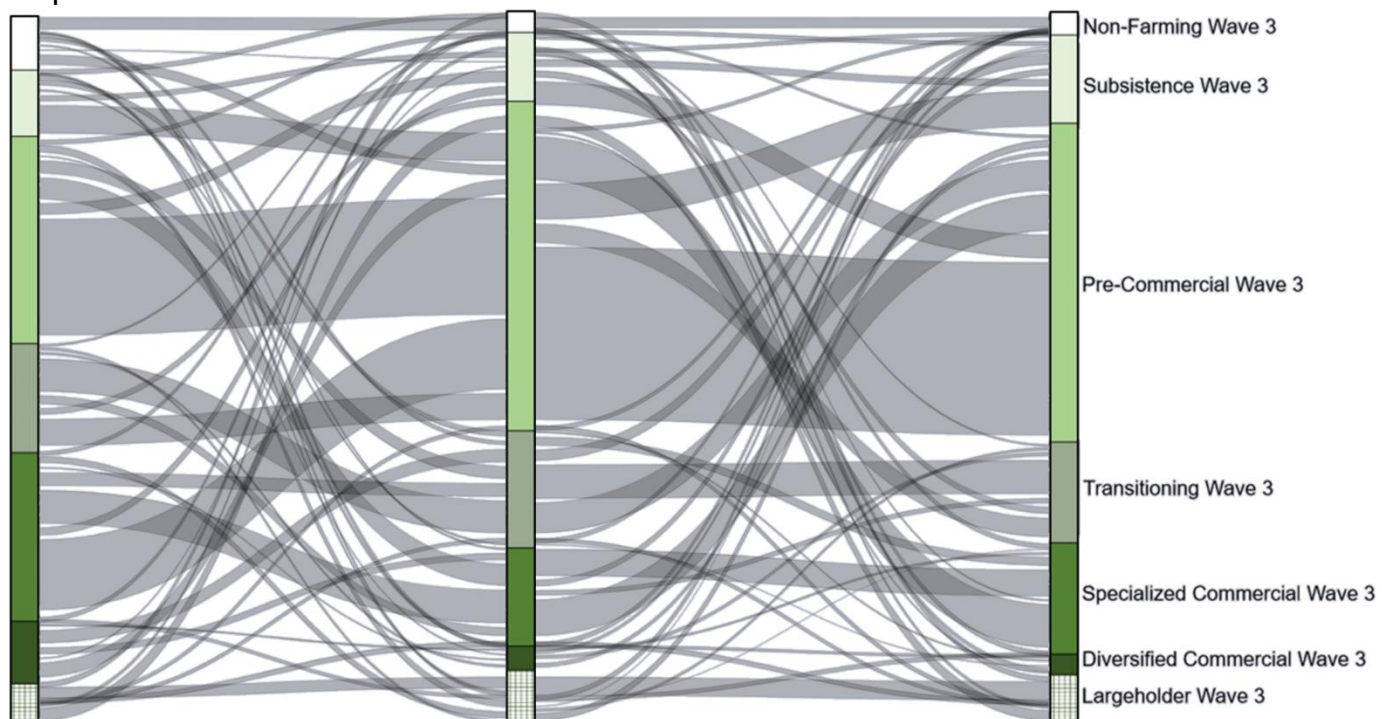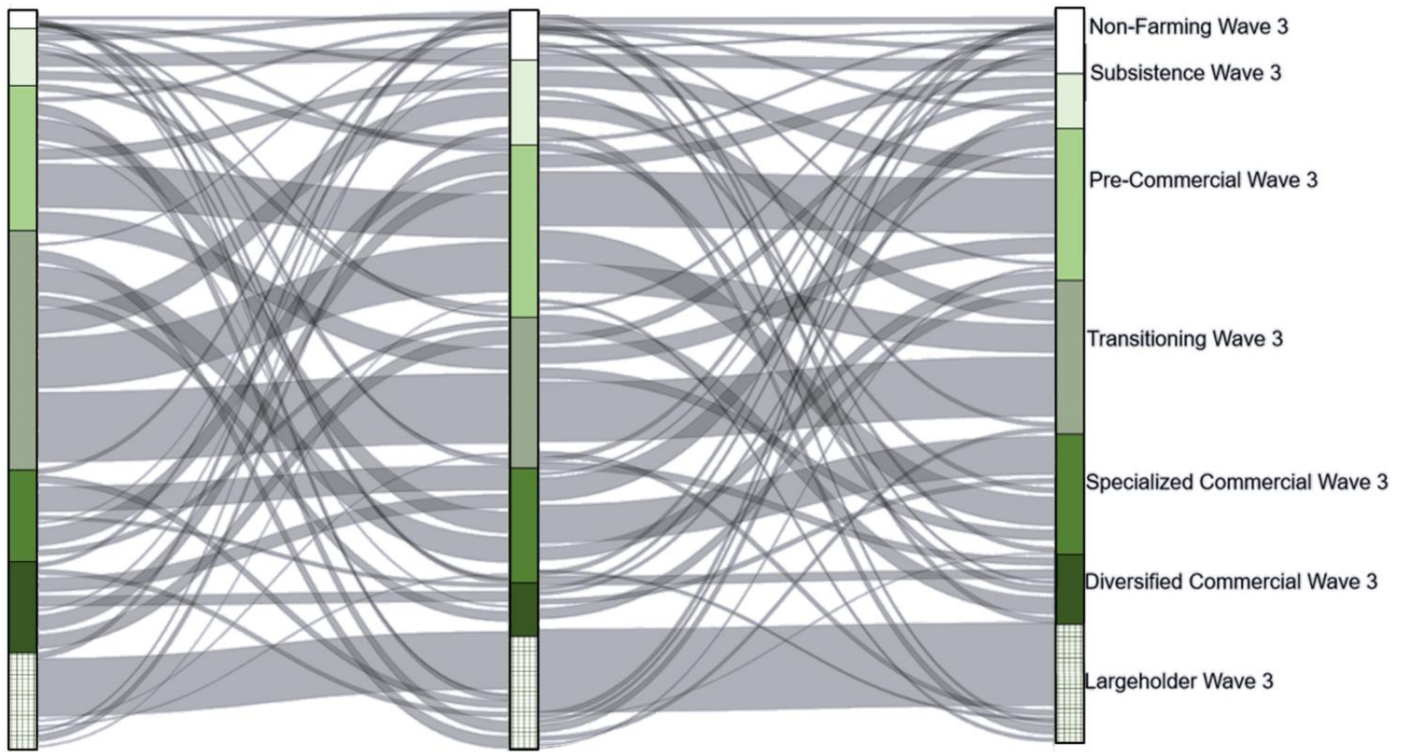
Ethiopia

Nigeria

Tanzania

Note: The columns represent survey waves 1 (left), 2 (middle), and 3 (right).

Tables and Figures Legends

Figure 1. Macro-level indicators of transformation in Ethiopia, Nigeria, and Tanzania (World Bank, 2020). All have seen declines in agricultural employment (AgEmp) and in the share of agricultural production in national GDP (AgGDP/GDP) consistent with a structural transformation, alongside increasing cereal crop yields (Cr1Yld) since the late 2000s. Vertical lines denote start and end dates of the LSMS-ISA household survey data used for the analysis.

Figure 2. A typology of small farms, from AGRA (2017).

Figure 3. Share of households in each AGRA category by country and over time.

Figure 4A. Spatial distribution of rural households in Subsistence (top row) versus Specialized or Diversified Commercial (bottom row) farm categories, wave 1 in Ethiopia, Nigeria, and Tanzania. Land suitability maps reflect agricultural potential under a low input scenario (Van Velthuizen, 2007) overlaid with travel time to a marketing center with at least 100,000 people (HarvestChoice, 2016). Gray areas are non-cropland including protected areas, forested areas, urban areas, desert, and other non-cropland. *Note*: Domains defined by agricultural potential and distance to market (2-hour threshold). Lo-Hi means low agricultural potential and high market access.

Figure 4B. Spatial distribution of rural households in Subsistence (top row) versus Specialized or Diversified Commercial (bottom row) farm categories, wave 3 in Ethiopia, Nigeria, and Tanzania. *Note*: Other map features identical to Figure 3A.

Figure 5. Shifts over time (from wave 1 to wave 3) in mean farm commercialization and off-farm income diversification levels within each AGRA category.

Table 1A. Summary descriptive statistics (means) by AGRA category: Ethiopia.

Table 1B. Summary descriptive statistics (means) by AGRA category: Nigeria.

Table 1C. Summary descriptive statistics (means) by AGRA category: Tanzania.

Table 2. Transitions of rural households in Ethiopia, Nigeria, and Tanzania across AGRA categories over time (wave 1 to wave 3).

Table 3. Proportion of households within wave 1 Subsistence and Pre-Commercial AGRA categories experiencing increased commercialization and diversification since wave 1, considering numerator and denominator effects.

Endnotes

[1] Alia et al. (2019) synthesize a large literature on rural farm typologies, showing that a range of criteria including land and livestock holdings and reliance on family labor are commonly applied to disaggregate rural households into "smallholder" and "non-smallholder" categories. In this paper we adopt a land-based definition: a smallholder is a rural household with crop or livestock production, and with landholdings less than 4 hectares (including zero land in the case of livestock-only smallholders).
[2] The RIGA database is constructed from the Living Standards Measurement Study (LSMS) and other household surveys made available by the World Bank and FAO.

[3] Detailed indicator construction decisions and publicly available Stata code to reproduce these datasets are available at: https://evans.uw.edu/policy-impact/epar/research/agriculturaldevelopment-indicator-curation.

[4] The TNPS is the only survey to track split-off households in addition to the originally sampled households.

[5] The original figure from AGRA (2017) included an error related to the definition of the importance of farm sales. We have recreated this figure with the correct definition.

[6] The Stata code used in this analysis is available from the authors upon request.