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The relative commercial orientation of smallholder farmers in Nigeria

Household and crop value-chain analyses

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ABSTRACT

Increasing the productivity of commercially oriented smallholder farming households in Nigeria results in greater incomes for their households, which, in turn, can drive an expansion in local non-farm employment opportunities and raise incomes across rural communities. Appropriately targeting agricultural development efforts towards commercially oriented farming households has important second-round development benefits for rural economies. We use nationally representative data from the Nigeria General Household Survey Panel to examine the characteristics of households and their context that determine their level of commercial orientation in 2015/16. We then use the same dataset for crop-specific analyses of the factors associated with a household choosing to produce a specific crop, to sell any of their harvest of that crop, and, if they sold any of the crop, whether they sold more than half of their harvest. Twelve crops are examined.

We find that the commercial orientation of most smallholder farming households in Nigeria is not strong. One-third reported not making any crop sales, relying instead on household enterprises or wage employment to meet their cash needs. Another one-third reported selling less than one-third of the crops they harvested by value. For these households, any crop sales made seem to reflect the limited other options they have to obtain cash, rather than being part of a strategy of commercial production. A subsistence orientation still drives most crop production by smallholder farming households in Nigeria. The crop-specific analyses confirm that crop sales for many households are driven to an important degree by their lack of other income sources, rather than by actively seeking to produce significant commercial surpluses of a crop.

That this is the case reflects a range of deficiencies in the production and marketing of many of the crops. Improved crop production technologies are not commonly used, may not be readily available, or, if available, may prove challenging to employ profitably. Nigerian crop markets remain risky with no assurances that farmers will find buyers offering remunerative prices when they bring their produce to the market to sell. Continued investments to increase crop productivity and to improve the performance and reliability of crop value chains are needed if commercial considerations are increasingly to drive the crop choices of smallholder farming households, to provide incentives for higher crop productivity, and, through the increased crop income of commercially oriented farming households, to motivate expansion in local non-farm sectors and to raise incomes for all households in rural Nigerian communities.

Keywords: commercial orientation, smallholder farmers; value chains; Nigeria

1. INTRODUCTION

Whether smallholder farming households in Nigeria are commercially oriented in their agricultural production is an important consideration in planning and targeting both agricultural and broader rural economic development efforts at state and federal levels. Increasing the productivity of commercially oriented farmers results in greater incomes for their households. This increased income, in turn, increases their demand for the goods, services, and labor that can be supplied by other, often poorer, households in their community, expanding local non-farm employment opportunities and raising incomes for those other households (Haggblade, Hazell, & Reardon 2007; Mellor 2014, 2017). Appropriately targeting agricultural development investments and programs towards commercially oriented farming households has important second-round economic development benefits in their communities, effects which cannot be achieved without properly identifying such households.

The analyses reported in this paper were done to provide empirical evidence for guiding how government and other agricultural stakeholders might identify and best foster the development of commercially oriented smallholder farming households through investments in those households or in the crop value chains in which they might participate. Two sets of analyses were done.

First, we use nationally representative data from the first (2010/11) and third (2015/16) rounds of the Nigeria General Household Survey Panel (GHSP) to develop a three-category typology of rural households based on information on their crop production and crop sales. A set of descriptive tables exploring several dimensions of the characteristics of households in each category are presented. The typology is then used in a set of econometric analyses to identify what characteristics of households and their context determine:

- Their level of commercial orientation at the time of implementation of GHSP-3 in 2015/16 and,
- What may have driven any changes in their commercial orientation, positive or negative, between the time of implementation of GHSP-1 in 2010/11 and GHSP-3 in 2015/16.

The analyses of this typology of commercial orientation should permit planners to better identify the farmers most likely to respond positively to efforts to enhance the commercial returns to agricultural production, which should translate into enhanced rural economic development.

Second, we use the GHSP-3 dataset of 2015/16 to examine the crop choices of agricultural households. The Agricultural Promotion Policy (APP), the current agricultural development framework for the federal government, states among its objectives that of promoting private sector-led activities in agriculture to drive economic growth. Most such activities of private individuals and firms will be done as actors within the value chains for specific crops. Specific characteristics of the crops and the households that produce them will determine how suitable a crop is for any efforts to strengthen its value chain. For 12 crops commonly grown by smallholders, three sequential analyses are conducted, as data allows, to better understand the commercial potential of each:

- What characteristics of a household and its context result in a farming household choosing to produce the particular crop;
- If a household produces the crop, what characteristics determine whether any of the crop harvested is sold; and
- If a household sells any part of their harvest of the crop, what characteristics determine whether more than half of the crop harvested is sold.

The relative commercial attractiveness of crops will vary due to specific technical characteristics of the crop, agro-ecological constraints on where the crop might be produced, and market demand factors. These analyses seek to disentangle and identify what specific factors might need to be addressed to strengthen the value chain for each and make the crop more commercially attractive for smallholder farming households.

The next section of this paper provides some of the theoretical basis for focusing on the commercial orientation of farmers as an element in agricultural and rural economic development efforts. The third section describes the data used in the analysis and sketches the analytical methods used. The fourth and fifth sections present the results from the two sets of econometric analyses – the first set centered on the commercial orientation of smallholder farming households and the second on the determinants of production and sales for 12 crops. The last section concludes with some guidance for policy and program design based on insights gained from the analyses.

2. THEORETICAL PERSPECTIVES ON COMMERCIAL ENGAGEMENT OF SMALLHOLDER FARMERS

Commercially oriented smallholder farming as a pathway to sustainably increasing income, improving livelihood security, and attaining a decent standard of living has been widely discussed (Devaux et al. 2009; Fan et al. 2013; Ricketts et al. 2014). Smallholder farms constitute over 70 percent of farms in Africa with the majority of smallholder farming households being poor and food insecure (Ricciardi et al. 2018; Onyutha 2018). Nonetheless, several observers argue that a smallholder-led approach to economic development, particularly in rural areas, holds the best prospects for realizing structural economic transformation and significant poverty reduction in Africa (Giller et al. 2009; Stoian et al. 2012; van Loon et al. 2020). However, there are growing concerns as to the efficacy and sustainability of a smallholder-led economic growth strategy in Africa.

Unlike in developed economies, small scale farming in countries like Nigeria has traditionally delivered very low returns to labor (McErlean & Wu 2003; Alene et al. 2009; van den Ban 2011; McCullough 2017; Sheahan & Barrett 2017). This has adversely affected overall growth in production, improvements in livelihood outcomes, and rural economic development. In addition, several studies suggest that mounting population pressure and shrinking farm sizes critically impede sustainable development by hampering the achievement of broad-based and inclusive forms of farm income growth (Jayne et al. 2014, 2016). Unsustainable forms of agricultural intensification have also been identified as constraints to sustained improved productivity, greater revenue generation, and enhanced welfare for smallholder farmers, (Muyanga & Jayne 2019; Willy, Muyanga, & Jayne 2019).

Given these challenges, Collier and Dercon (2014) suggest that favoring smallholder farmers in strategies to achieve agricultural development and the structural transformation of rural economies may be “romantic”. One element of their critique is that an undifferentiated perspective on the capabilities and potential of smallholder farming households is not helpful. Evaluating the importance for rural economic development of commercially oriented smallholder farmers may provide a more encouraging perspective on whether this sub-set of smallholder farmers can be central agents of rural structural transformation in contexts like Nigeria.

The underlying driver of a shift from subsistence oriented to commercially oriented production by smallholder farming households is that as markets develop and strengthen, they allow households to increase their incomes by specializing in the production of those commodities that

generate for them the highest returns through sales. The greater income stream enables improved livelihood outcomes and household consumption patterns and, in aggregate, rural economic development (Devaux et al. 2018; Hainzer, Best, & Brown 2019; de Boer et al. 2019; Mabe et al. 2020). Focusing on commercially oriented smallholder production by connecting them more reliably with domestic and international markets has been considered by many observers to be an important means to achieve prosperity in smallholder farming systems (Mariyono 2019; von Braun 2005).

In the 1970s and 1980s, a large body of research claimed that commercially oriented smallholder farming has mainly negative effects on the welfare of the poor and on rural economic development. However, more recent studies have found much of this earlier research to be theoretically flawed by utilizing unrepresentative samples or ignoring confounding factors (von Braun, 1995; Pingali & Rosegrant, 1995; Murungweni, Tada, & Nhamo 2017). Later studies have demonstrated that, with few exceptions, commercially oriented smallholder farming benefits the poor by directly generating employment and increased agricultural labor productivity (Reardon et al. 2009; Mariyono 2019). Farmers' participation in increased crop marketing permits them to more readily invest to further improve their agricultural productivity and to augment their incomes in a virtuous cycle of economic development (Govere & Jayne 2003). There now is significant evidence of the importance of increasing the commercial orientation of smallholder farming systems. As a rural economic development strategy, continuing to focus on subsistence-oriented production, in contrast, will result in unsustainable livelihood outcomes and limited economic transformation in rural communities.

Factors that affect the commercial orientation of farmers

A range of studies have sought to identify factors that affect the commercial orientation of smallholder farmers. The factors considered include, among others, individual and household characteristics, access to institutional services, level of local investment in rural infrastructure and markets, and agro-ecological variables.

Among individual and household characteristics, education plays an important role in enabling farmers to make informed decisions to enhance productivity and possibly guide a transition from subsistence to commercially oriented farming practices (Gebremedhin & Tegegne 2012; Fischer & Qaim 2012). Improved literacy and numeracy influences skills acquisition and enhances access to and use of information, which encourages greater market participation (Arslan & Taylor 2009). Age may also foster or limit commercial production – studies have shown that older farmers are less commercially oriented, in part due to problems with mobilizing labor (Gebremedhin & Tegegne 2012; Kahan 2013).

In a situation of imperfect agricultural factor markets for labor, land, livestock, and farm equipment, ownership of such factors affects efficiency and productivity (Sadoulet & de Janvry, 1995, Gebremedhin & Tegegne 2012). For example, when land markets are imperfect, as in Nigeria, smallholders with larger landholdings generally are more commercially oriented (von Braun & Immink, 1994; Muyanga & Jayne 2019). Hence, household endowments of relevant factors for agricultural production are expected to positively affect the level of commercial orientation of smallholder farmers.

Beyond individual and household characteristics, infrastructural investments, such as improved physical marketplaces, enhanced communication, or denser and higher-quality road networks, can encourage farmers to move towards commercial agriculture (Gabre-Madhin 2001; Barrett 2007; Pender & Alemu 2007; Alene et al. 2008; Fan et al. 2013). Institutional services, including reliable access to agricultural extension services and credit facilities, can increase the benefits and reduce the probability of adverse consequences from commercialization processes. These services can

improve farmer skills and knowledge, connect farmers to markets and to improved agricultural technology, and reduce the severity of input supply and other finance-related constraints farmers face (Lerman 2004; Omiti et al. 2009; Olwande et al. 2015).

Finally, agro-ecological factors can also affect the commercial orientation of smallholder farmers. Local soil and climate conditions may be ill-suited for the production of crops that offer significant returns in the market, posing a significant challenge to smallholders seeking to increasingly participate in local markets. Climate change-induced shocks may increase production risks for smallholders. These changes in local conditions of production, in turn, may render too risky the commercially-focused agricultural activities many might otherwise pursue (Gutu, Emana, & Ketema 2012; Gebremedhin & Tegegne 2012; Boka 2017).

Determinants of changes in the commercial orientation of farmers

Several factors that may influence smallholder farming households to increase the degree of commercial orientation in their agricultural production have been examined by researchers. These include characteristics of individuals, households, farm production, relevant institutions, and the locality.

Mixed findings have been obtained on whether the characteristics of the heads of farming households are important drivers of these households increasing their engagement in commercially oriented production. Associations between the age of the household head and level of market engagement vary by study locale (Minot et al. 2006; Mathijs & Noev 2002), although generally households with older heads of household are found not to change their level of commercial orientation. In contrast, households with male heads are more likely to respond to commercial opportunities and increase their output for market sale (Cunningham et al. 2008; Hill & Vigneri 2014). Conceptually, we might assume that a more educated household head will enable a household to more profitably engage with markets. However, across a range of studies, increased educational attainment of the head is not uniformly associated with a greater propensity to engage in commercial agricultural production – findings have been obtained of both no associations (Balint 2004; Lerman 2004; Minot et al. 2006) and strong associations (Fischer & Qaim 2012; Adeoti, Oluwatayo, & Soliu. 2014). Another farmer characteristic that could motivate a transition to a greater commercial orientation is the risk aversiveness of the household head, both to production and to market risks. Kostov and Lingard (2004) noted that farmers that are highly sensitive to risk are likely to engage primarily in subsistence farming in an uncertain and risky environment.

Household characteristics can be important determinants of whether smallholder households transition in their farming from a subsistence to a more commercial orientation. Fredriksson et al. (2016) suggest that the propensity for a household to be more commercially oriented in its farming decreases with increasing household size and dependency ratios. Subsistence production can be seen as a higher priority when the number of consumers per worker within the household is higher as production will be directed preferentially towards household consumption rather than markets (Minot et al. 2006). Household access to farm inputs and assets, including livestock, land, farm labor (family and hired), and production inputs (seed, fertilizer, and pesticides), have been found to generally support increased commercial engagement by smallholders (Higgins et al. 2018). Off-farm income sources within the household can be important drivers of farming household adopting a more commercial orientation in their agricultural production. Such off-farm income reduces reliance on own-production for household food consumption and also improves household access to commercial farm inputs (Fredriksson et al. 2016). Such non-agricultural livelihoods also mitigate risks to household welfare by diversifying the income sources upon which the household relies.

Adoption of improved agricultural technologies is important in transforming smallholder households from a subsistence to a commercial orientation, as most such technologies provide or

safeguard higher production levels (Awotide, Karimov, & Diagne 2016). Whether using commercial inputs for particular crops is profitable will depend on prices in local input and output markets, so market strengthening is a necessary component of any efforts to increase the share of smallholder farmers engaged in commercial production. Similarly, institutional factors, such as access to credit and agricultural extension services have often been found to play critical roles in transforming subsistence focused smallholders to commercial producers (Omiti et al. 2009; Olwande et al. 2015).

Changes in agro-ecological conditions can play a role in the transition dynamics of smallholder farmers. Agriculture in sub-Saharan Africa is heavily dependent on rainfall, which can be erratic (Papaioannou & de Haas 2017). Areas with more reliable rainfall regimes generally have higher farm productivity from which to generate marketable surpluses (Boka 2017). Changes in rainfall patterns can affect the likelihood of farmers transforming their production from low productivity subsistence farming into higher productivity commercial farming (Gutu, Emanu, & Ketema 2012).

3. DATA AND METHODS

For this study on the commercial orientation of smallholder farming households in Nigeria, we rely on data collected through the General Household Survey Panel (GHSP). This household panel survey is an activity implemented by the National Bureau of Statistics of the Federal Government of Nigeria with the assistance of the Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) project of the World Bank. The GHSP sample is nationally representative. A household questionnaire is used to collect detailed information on the characteristics of the survey sample households and, if a farming household, a separate agricultural questionnaire is administered to collect details on the agricultural production of the sample household. Data from both questionnaires are used in the analysis here. For each survey round, the questionnaires are administered to each sample household twice – once after planting between August and October and a second time after harvest between February and April – with elements of the questionnaires changing to enable the collection of seasonally appropriate information.

Of the GHSP survey rounds, we primarily use data from the third round, GHSP-3, of 2015/16, but also draw on data from GHSP-1 of 2010/11.¹ We also benefited significantly from the extensive cleaning and analysis of the GHSP dataset by the Evans School Policy Analysis & Research Group (EPAR) of the University of Washington in Seattle, Washington, USA, relying on several of the variables that they produced as inputs for our analysis.²

The panel sample has 5,000 households, of which 2,872 households (57.4 percent) in the GHSP-1 survey round and 2,756 households (55.1 percent) in the GHSP-3 survey round reported having engaged in some sort of agricultural production in the previous year. Complete data for use in the analyses here was not obtained for all agricultural households in each round – in particular, full information on educational attainment was not available for all agricultural households in the sample. In the GHSP-1 round, 2,313 sample households and in the GHSP-3 round, 2,352 sample households had complete data for use in the analyses here.

¹ The data from all rounds of the GHSP are publicly available and can be downloaded from the online microdata library of the World Bank. For the round 1 (2010/11) dataset, see <https://microdata.worldbank.org/index.php/catalog/1002>; while for round 3 (2015/16), see <https://microdata.worldbank.org/index.php/catalog/2734>.

² See <https://epar.evans.uw.edu/research/agricultural-development-indicator-curation>.

Sample households that engaged in any agricultural production in either GHSP-1 (2010/11) or GHSP-3 (2015/16) are resident in 413 enumeration areas (EA) spread across Nigeria (Figure 1). The design of the survey sample involved the same ten households in each EA selected for the panel survey being interviewed in each survey round. The households were randomly selected for GHSP-1 in 2010/11 and interviewed again in subsequent rounds.

For our indicator of the commercial orientation of households engaged in agricultural production, we used the share of the value of all crops reported produced by the household that were sold. This variable was created by the EPAR group in their GHSP-3 analysis. The cumulative distribution of this measure was examined to determine boundary values for the household typology categories (Figure 2).

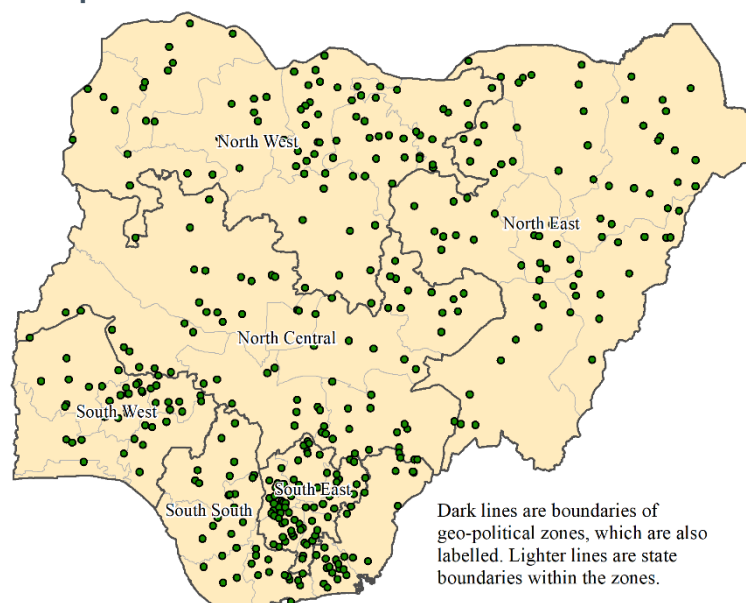
Based on this analysis, sample households were placed into one of three agricultural commercialization categories that we defined for the study:

- Those households that reported no sales of the crops they produced,
- Those that sold some crops, but less than one-third of their value, and
- Those that sold more than one-third of the value of the crops they produced.

The boundaries for these categories based on the share of the agricultural production of a household that was sold also are shown in Figure 2.

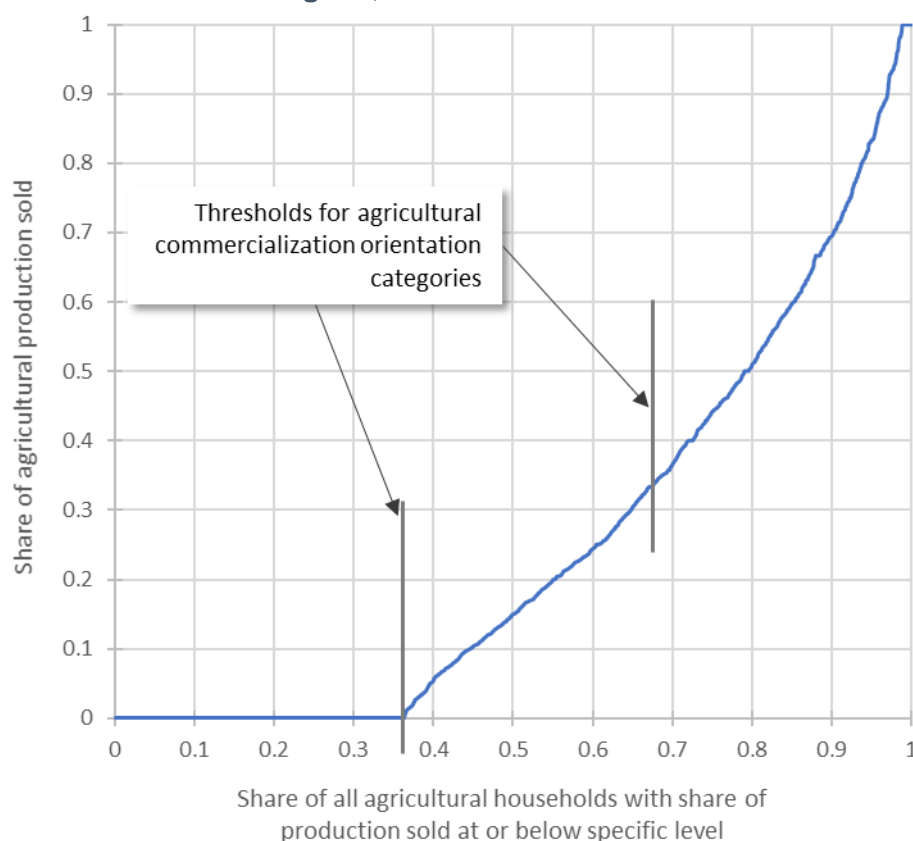
As seen in Table 1, in 2016/17 these three groups made up roughly equal shares of the national population that is engaged in some agricultural production. While most agricultural households are based in rural areas, households in both the category that made no sales and the most commercially oriented (more than one-third of value of production sold) category are more likely to be urban residents than are those in the somewhat commercial category (sales made, but less than one-third of value of production sold).

Figure 1: Enumeration areas in which are located Nigeria General Household Survey Panel sample households engaged in agricultural production



Source: Analysis of data from Nigeria GHSP rounds 1 and 3.

Figure 2: Cumulative distribution graph on share of agricultural production sold by agricultural households in Nigeria, 2015/16



Source: Unweighted analysis of GHSP-3. Observations: 2,756 households.

Table 1: Distribution of agricultural households in each agricultural commercialization category, by rural/urban and geo-political zone

Commercial-ization category	Sample house-holds	Share of Nigeria's agricultural population, %	Row totals for zones, % of households in category							
			Rural, %	Urban, %	North Central	North East	North West	South East	South South	South West
No sales	810	34.6	80.9	19.1	11.9	14.0	36.5	19.4	15.0	3.2
Sold less than one-third of production	726	30.9	91.3	8.7	20.5	18.5	26.4	18.5	13.8	2.1
Sold more than one-third of production	816	34.5	83.1	16.9	14.8	9.2	21.2	20.3	12.7	21.7
All agricultural HHs	2,352	100.0	84.9	15.1	15.6	13.7	28.1	19.4	13.8	9.2

Source: Weighted analysis of GHSP-3.

Disaggregating the agricultural households by geo-political zone, agricultural households are more likely to be commercially oriented in South East and South West, although it should be noted that only a small share of Nigeria's agricultural households are found in South West. Subsistence production without any sales is the dominant orientation of agricultural households in North West, which also has the highest share of agricultural households in Nigeria. Households that sold some of their production but less than one-third are the largest category in North Central and North East. The three categories are of similar size in South South, which also, like South West, has a relatively small share of Nigeria's agricultural households.

Stylistically, the characteristics associated with smallholder farming households in each category can be examined along the dimensions of consumption behavior, production objectives, and input use (Moti, Berhanu, & Hoekstra 2009). Here we sketch some of these expected

characteristics in the context of smallholder farming in Nigeria, drawing on our earlier theoretical discussion.

- In terms of consumption behavior, households in the category of no sales are likely to be subsistence farming households who are likely to struggle to feed themselves from their own production. However, some of these households engaging in solely subsistence production may do so as a secondary economic activity, being primarily engaged in more remunerative non-farm enterprises or wage employment. Households that sell less than one-third of their output rely primarily on own production for their consumption, even as they seek to generate surpluses for sale as one of several cash income sources for the household. Those households selling more of their output, while primarily reliant on own production for their food, are also likely to limit the range of crops they produce, purchasing some of the foods that their less commercially oriented neighboring farmers would grow themselves.
- The production objective of farming households making no sales is self-sufficiency for household consumption. Households in the intermediate category, while seeking to safeguard consumption through own production, will seek to produce some surpluses to increase household income. For the most commercially oriented smallholder households, while they produce much of the food they consume, profit maximization will be a central objective in their agricultural production.
- In terms of input usage, we expect input use levels to be directly associated with degree of commercial orientation. Households making no sales, except those with significant non-farm income sources, will tend not to use commercial agricultural inputs.

For our quantitative analyses, we draw on aspects of these stylized assessments of the characteristics of households in each category to identify potentially important explanatory variables. We use a common set of explanatory variables both for the household-level analyses linked to the three agricultural commercialization categories and for the crop-level analysis of production, sales, and a high level of sales. Tables presenting descriptive statistics on both the explanatory and dependent variables used in each model are included as part of the description of the results of these analyses in later sections of this paper.

Several quantitative methods are used to analyze the data from the GHSP sample households engaged in agricultural production.

- Tabulations of the demographic, educational, economic, and agricultural characteristics of GHSP-3 sample farming households, disaggregated by agricultural commercialization category.
- A multinomial logistic regression analysis to explore the determinants of a household being categorized in one of the three agricultural commercialization categories using data from GHSP-3. The dependent variable is a categorical variable with three values corresponding to the categories. The intermediate category of households that sold crops, but less than one-third of the value of crops that they produced is used as the base category. So, the results for the other two categories of households are with reference to membership in this intermediate category.
- An ordinary least squares (OLS) regression to explore the characteristics of the panel survey sample households at the time of the first round of the survey in 2010/11 that might determine changes in the share of the agricultural production that they sold between 2010/11 and the third round of the survey in 2015/16. As the dependent variable – the change in the share of agricultural production sold – is a continuous variable, an OLS regression is used.

- Logistic regressions are used for further investigation of determinants of changes in the share of the agricultural production sold between 2010/11 and 2015/16 and for the full set of crop-level analyses. The dependent variables for all of these analyses are dummy (0/1) variables, for which a logistic regression analysis is appropriate.
- ♦ Data on agricultural production and sales by survey households is used from both the first and third rounds of GHPS to assign each household to one of the three agricultural commercialization categories described earlier or to a fourth category of 'not engaged in agricultural production'. These four categories are used to create two dummy variables.
 - The first variable takes a value of one if a household between 2010/11 and 2015/16 became involved in agricultural production or, if already engaged in agricultural production, more commercially oriented, and a value of zero if the household remained in the same category in 2010/11 and 2015/16. In constructing this dummy variable, households that became less involved in either commercial agricultural production or in agricultural production altogether are not categorized, so this dummy variable only applies to a sub-set of the survey households.
 - Similarly, the second variable takes a value of one if a household became less involved in commercial agricultural production or, if already not commercially oriented, no longer engaged in agricultural production, and a value of zero if the household remained in the same category in 2010/11 and 2015/16. Households that became involved in agricultural production or, if already engaged in agricultural production, more commercially oriented are not categorized, so this dummy variable also only applies to a sub-set of the survey households.
- ♦ The crop-level analyses use dependent dummy (0/1) variables that indicate:
 - First, whether the agricultural household in round three (2015/16) produced the crop in question;
 - Second, if the household produced the crop in question, whether it sold any of the crop produced; and
 - Third, if the household sold the crop in question, whether the share of production sold was more than 50 percent.

The results of the crop-specific models are presented in the Appendix.³

As the GHSP sample is nationally representative, most of the analyses conducted use sample weights to generate population-level estimates. Any standard errors reported are adjusted to account for the clustered design of the sample.

³ The sub-sample for modeling any sales of a crop is smaller than that for modeling production of the crop and that for modeling a high level of sales is smaller than for modeling any sales. For some crops, the size of the sub-samples for the modeling of any sales or a high level of sales are quite small and have insufficient variation to provide meaningful results. The results of such models are not presented in the Appendix.

4. DRIVERS OF LEVEL OF COMMERCIAL ORIENTATION OF HOUSEHOLDS IN THEIR CROP PRODUCTION

Differences between households by agricultural commercialization category

Tabulations

In this section, tabulations are presented by agricultural commercialization category of the characteristics of the population of Nigeria that is engaged in any agricultural production.

The value of crops produced and sold, the use of inputs, land rental, and the hiring-in of farm labor for each of the three agricultural commercialization categories is presented in Table 2. The levels of crop production by value of the two categories of agricultural households that made any sales are quite similar, on average well over double that of farming households that made no sales. However, by definition the two categories differ in the value of crops they then sold – commercially oriented households (“More than one-third”) sold on average more than four times the value of the crops sold by households that sold a lower share of their harvest (“Less than one-third”). Commercially oriented households also had the highest crop production expenses.

Table 2: Overall crop production characteristics of households by agricultural commercialization category

Commercial-ization category	Avg. value crops produced, '000 ₦	Average value crops sold, '000 ₦	Average crop expenses, '000 ₦	Rented-in land, %	Hired-in labor, %	Purchased inorganic fertilizer, %	Purchased improved seed, %	Purchased pesticide, %
No sales	116	0	58	8.0	78.0	42.6	32.8	40.4
Less than one-third	303	42	86	7.7	86.5	47.1	36.4	53.4
More than one-third	260	167	110	12.3	80.9	41.0	39.8	49.1
All	223	71	85	9.4	81.6	43.4	36.3	47.4

Source: Weighted analysis of GHSP-3 and of the outputs from the analysis of the GHSP-3 dataset by the Evans School Policy Analysis & Research Group (EPAR) of the University of Washington. Observations: 2,352 households.

Note: In 2015/16, USD 1.00 ≈ Nigeria Naira (₦) 195.

With regard to input use, the differences are stronger between households that made no sales and households in the two commercial categories than between households in the two commercial categories. Only for renting-in land is the share of households that did so significantly higher for the more commercially oriented households. There is a significant difference in fertilizer use, but in this case somewhat commercial households are more likely to use the input than are the more commercially oriented – a pattern that would require more study to understand. None of the differences between the more commercially oriented and somewhat commercial households for use of the other inputs considered are statistically significant.

In terms of the specific crops produced by each category of agricultural households, it should be recognized that the agro-ecological suitability of a crop for a locale and the commercial potential of each crop are likely as much drivers of these patterns as are household characteristics (Table 3). Households that made no sales are significantly less likely than farmers in the commercial categories to produce maize, rice, yam, cassava, and banana and more likely to produce millet. Somewhat commercial households are significantly more likely than more commercially oriented households to produce sorghum, millet, cowpea, groundnut, and cassava and less likely to produce sweet potato and cocoa. There are no statistically significant differences in the share of households in the two commercial categories that produce maize, rice, yam, banana, and soyabean.

Table 3: Crops grown by agricultural commercialization category

Commercialization category	Maize, %	Rice, %	Sorghum, %	Millet, %	Cowpea, %	Ground-nut, %	Yam, %
No sales	39.9	7.9	41.5	30.9	33.5	10.0	19.8
Less than one-third	54.2	12.5	46.8	23.5	34.4	14.9	33.8
More than one-third	49.6	11.2	23.2	10.5	17.7	9.0	27.5
All	47.6	10.5	36.8	21.6	28.3	11.2	26.8
	Sweet potato, %	Cassava, %	Banana, %	Cocoa, %	Soyabean, %	Number of the 12 crops grown, avg.	
No sales	1.0	17.7	3.9	0.6	5.5	2.12	
Less than one-third	0.6	28.2	9.0	1.0	8.0	2.67	
More than one-third	2.8	21.2	11.4	11.9	5.8	2.02	
All	1.5	22.1	8.1	4.6	6.4	2.25	

Source: Weighted analysis of GHSP-3 and of the outputs from the analysis of the GHSP-3 dataset by the Evans School Policy Analysis & Research Group (EPAR) of the University of Washington. Observations: 2,352 households.

More commercially oriented households tend to produce a smaller number of crops than do households that sell a smaller share of their harvest. This suggests a degree of specialization in crop production by the more commercially oriented households. Such a pattern is in keeping with the households focusing primarily on the production of the crops for which they have a comparative advantage and relying on the market to obtain the other crops they require for household consumption.

Table 4: Other agricultural and economic characteristics of households by agricultural commercialization category

Commercialization category	Average farm size, ha	Farm size less than 1.0 ha, %	Farm size between 1.0 and 2.0 ha, %	Farm size between 2.0 and 4.0 ha, %	Owns livestock, %	TLUs owned, livestock owners only
No sales	0.73	78.5	11.5	7.1	69.0	1.5
Less than one-third	1.18	63.2	19.5	11.1	72.2	2.0
More than one-third	1.13	64.4	17.0	10.8	54.5	1.4
All	1.01	68.9	15.9	9.6	65.0	1.6
	Agricultural extension contact past season, %	Received loan of any kind, %	Receives income from household enterprise, %	Receives income from wages, %		
No sales	7.1	15.3	65.6	19.3		
Less than one-third	7.3	20.4	62.7	11.3		
More than one-third	10.0	21.9	60.8	15.9		
All	8.2	19.1	63.1	15.6		

Source: Weighted analysis of GHSP-3 and of the outputs from the analysis of the GHSP-3 dataset by the Evans School Policy Analysis & Research Group (EPAR) of the University of Washington. Observations: 2,352 households.

Note: TLU = Tropical Livestock Unit – sum of livestock owned by household using value of 0.9 per camel; 0.7 per horse or any head of cattle; 0.3 per donkey; 0.2 per pig; 0.1 per goat or sheep; and 0.01 per rabbit, fish, or any poultry.

Table 4 presents additional agricultural and economic characteristics of households in each category of our typology. Farm sizes are comparable between somewhat and more commercially oriented households, while households that made no sales have significantly smaller farms. Livestock ownership is least common among the more commercially oriented households and, for those households in this category that own livestock, they have smaller numbers of animals than do households in the other two categories. More commercially oriented households appear to specialize in crop production rather than combining crops and livestock.

Farming households that are more commercially oriented are more likely to interact with agricultural extension service providers of any sort (both public and private) than are other households. However, few agricultural households of any sort have such interactions, constraining

their access to potentially useful advice on both crop production and crop marketing. Access to credit of any sort (from both formal and informal sources) is similarly constrained, if about double the level of access to agricultural extension services. Households that sell any portion of their harvest are somewhat more likely to have received a loan in the past year than are households engaged in crop production for own use only and, so, made no sales.

In terms of non-agricultural livelihoods, households that made no sales are more likely than other households to receive income from self-employment through a household enterprise (Table 4). Having an alternative income source, to a degree, will enable these households to not need to rely on their farming activities to obtain cash. Wage incomes, although quite rare, are more common in households that made no sales and in more commercially oriented households and significantly less so among households that sold a lower share of their harvest (“Less than one-third”).

Table 5: Demographic characteristics of households by agricultural commercialization category

Commercial-ization category	Female-headed household, %	Head aged under 35 years, %	Head aged 35 to 64 years, %	Head aged 65 years or over, %	Household members, average number	Workers (age 15 to 64 years) in household, average
No sales	16.4	18.2	69.5	12.3	8.14	3.49
Less than one-third	13.7	17.6	68.0	14.3	8.40	3.56
More than one-third	15.1	16.1	65.8	18.0	7.52	3.24
All	15.1	17.3	67.8	14.9	8.01	3.42

Source: Weighted analysis of GHSP-3 and of the outputs from the analysis of the GHSP-3 dataset by the Evans School Policy Analysis & Research Group (EPAR) of the University of Washington. Observations: 2,352 households.

In terms of the sex and age of the household head or the size and number of workers in the household, somewhat surprisingly, few significant differences are observed between households across the three categories (Table 5).

Table 6: Maximum educational attainment of household members by agricultural commercialization category

Commercial-ization category	No public schooling, %	Some primary school, %	Some secondary school, %	Beyond secondary school, %
No sales	8.6	23.7	50.4	17.3
Less than one-third	6.4	25.2	53.3	15.1
More than one-third	4.5	23.5	52.9	19.0
All	6.5	24.1	52.2	17.2

Source: Weighted analysis of GHSP-3 and of the outputs from the analysis of the GHSP-3 dataset by the Evans School Policy Analysis & Research Group (EPAR) of the University of Washington. Observations: 2,352 households.

A similar pattern of relatively slight differences between categories is seen with regards to the maximum education level of members of the households in each (Table 6). The more commercially oriented households are no more likely to have members that achieved higher levels of education than are farming households that sold none of their agricultural produce.

The final tabular analysis by household category in Table 7 examines the degree to which households move over time between the three agricultural commercialization categories or out of agriculture altogether. This was done by categorizing all of the 5,000 panel survey households in the first (2010/11) and third (2015/16) rounds of the GHSP as to whether they engaged in any agricultural production and, if so, what share of their production they sold.

Table 7: Changes in agricultural commercialization category of all households between 2010/11 (GHSP-1) and 2015/16 (GHSP-3), table and column percent totals

Commercialization category in 2010/11 (GHSP-1)	Commercialization category in 2015/16 (GHSP-3)				
	Not in agriculture	No sales	Less than one-third	More than one-third	All
TABLE TOTALS:					
Not in agriculture	43.2	3.6	2.2	3.2	52.2
No sales	4.3	6.5	4.7	3.8	19.3
Less than one-third	1.8	3.8	4.4	3.0	13.0
More than one-third	3.2	3.1	3.4	5.8	15.5
All	52.5	16.9	14.7	15.9	100.0
COLUMN TOTALS:					
Not in agriculture	82.3	21.1	15.3	20.2	52.2
No sales	8.3	38.4	31.7	24.0	19.3
Less than one-third	3.4	22.2	29.9	19.1	13.0
More than one-third	6.1	18.2	23.1	36.7	15.5
All	100.0	100.0	100.0	100.0	100.0

Source: Weighted analysis of GHSP-1 and GHSP-3 and of the outputs from the analysis of the two GHSP datasets by the Evans School Policy Analysis & Research Group (EPAR) of the University of Washington. Observations: 5,000 households.

The changes between 2010/11 and 2015/16 in the share of households engaged in agricultural production and, if engaged in farming, selling any of the produce harvested are not large. With regards to participation in agricultural production, 9.3 percent of households produced crops in 2010/11 but no longer did so in 2015/16, whereas 9.0 percent that did not produce crops in 2010/11 reported engaging in agricultural production in 2015/16 – so a slight net movement out of agriculture by households over this period of 0.3 percentage points. Of the three categories of agricultural households, those that made no sales and those that were more commercially oriented saw both the largest numbers of households leaving agriculture altogether and the largest numbers of households that were not in agriculture in 2010/11 joining each category in 2015/16.

Among households that were engaged in agricultural production in both survey rounds, a greater share sold some of their crops in 2015/16 than did in 2010/11. However, most of those engaging in some sales in 2015/16 are not selling more than half of their harvest – of households that made sales in 2015/16 but did not do so in 2010/11, more in 2015/16 were members of the somewhat commercially oriented category (“Less than one-third”) than the most commercially oriented category. Nonetheless, the share of all households that sold more than one-third of their harvest rose from 15.5 percent in 2010/11 to 15.9 percent in 2015/16. The changes overall are towards greater participation in the market by those who continue to farm. However, these changes are small and, it can be expected, may not be sustained if either the households or the markets in which they participate suffer adverse economic shocks.

Multivariate assessment

Although few of the household characteristics tabulated show sharp differences between the agricultural commercialization categories, these tables may suggest some factors that drive a lower or a heightened commercial orientation to a household's agricultural production. More conclusive insights as to what may determine the category of agricultural commercialization into which each household falls can be obtained through a multivariate analysis that combines the various potential determinants considered. Here we use a multinomial logistic regression approach to identify what characteristics of households in the most commercially oriented (“More than one-third”) category and the “No sales” category, respectively, distinguish them from those of households in the somewhat commercially oriented (“Less than one-third”) category, our base case for the analysis.

Our dependent variable for this household-level analysis takes on one of three integer values based on the agricultural commercialization category into which a household falls. Our explanatory variables consist of information on the household, including on its demographic make-up, educational attainment, other livelihood activities pursued, land and livestock ownership, and location. Table 8 provides descriptive statistics on these variables.

Table 8: Descriptive statistics for variables used in multinomial logit analysis of factors associated with membership in agricultural commercialization category

		Mean	Standard error
Dependent variable: Agricultural commercialization category:			
	No sales of crops produced, 0/1	0.346	0.016
	Sold, but less than one-third of value of crops produced, 0/1 [base]	0.309	0.014
	Sold more than one-third of value of crops, 0/1	0.345	0.015
Explanatory variables:			
Demographic	Household size, number	8.01	0.098
	Workers-to-household members, ratio	0.453	0.006
	Female headed household, 0/1	0.151	0.009
	Age of household head		
	Less than 35 years, 0/1	0.173	0.010
	35 to 64 years, 0/1 [base]	0.678	0.011
	65 years or older, 0/1	0.149	0.010
Assets and livelihoods	Total cropped area of household, ha	1.12	0.085
	Livestock owned, TLU	1.06	0.113
	One or more member has wage employment, 0/1	0.156	0.010
	Has at least one household enterprise, 0/1	0.631	0.016
Education (maximum educational attainment in household)	No formal education, 0/1	0.065	0.012
	Some primary, 0/1	0.241	0.014
	Some secondary, 0/1 [base]	0.522	0.017
	Beyond secondary, 0/1	0.172	0.011
Market access	Distance to nearest town population of at least 20,000 persons, km	26.8	0.97
	Population density, 100 persons per sq.km.	13.6	1.77
Administrative and agro-ecological zones	North Central geo-political zone, 0/1 [base]	0.156	0.012
	North East, 0/1	0.137	0.012
	North West, 0/1	0.281	0.020
	South East, 0/1	0.195	0.011
	South South, 0/1	0.138	0.011
	South West, 0/1	0.092	0.008

Source: Weighted analysis of GHSP-3. Observations: 2,352.

Note: TLU = Tropical Livestock Unit (see note Table 4).

In Table 9, the results of the multinomial logit analysis are presented as relative risk ratios (RRR), which show how a one unit change in an explanatory variable will change the relative probability of an individual being in one employment category relative to the base category.⁴

⁴ Relative Risk Ratios (RRR) are analogous to odds-ratios used in bivariate logistic models, with an RRR>1.0 showing an increase in the relative probability of being in a particular employment category and an RRR<1.0 indicating the reverse (Long and Freese 2014). The base category of households for the multinomial logit model here is made up of those households that sold some of their crops, but less than one-third of the value produced. In addition, several explanatory variables have base categories, which further refine the base comparison category of households to those headed by individuals age 35 to 64 years of age with a maximum educational attainment level in the household being some secondary schooling and residing in the North Central geo-political zone. All relative risk ratios are expressed relative to this group of households.

For example, as shown in Table 9, a household being headed by a woman increases by 36.0 percent, i.e., 1.360 – 1.000, the probability of the household not making any sales of their crops relative to making some sales, but less than one-third of the value of crops produced. In contrast, having a female head of household does not significantly affect the probability of the household selling more than one-third of their agricultural production relative to making some sales, but less than one-third of the value of crops produced, as the coefficient for this variable for the model for more commercially oriented households is statistically not different from zero.

Table 9: Factors associated with membership in agricultural commercialization category, results of weighted multinomial logit analysis

	<u>Base category: Sold crops, but less than one-third of value produced</u>	No sales of crops produced		Sold more than one-third of value of crops	
		Relative risk ratio	Standard error	Relative risk ratio	Standard error
Demographic	Household size, no.	0.982	(0.019)	0.969	(0.022)
	Workers : household members, ratio	0.990	(0.308)	0.850	(0.260)
	Female headed household, 0/1	1.360 *	(0.242)	1.072	(0.171)
	Age household head [base: '35 to 64 years, 0/1']				
	Less than 35 years, 0/1	1.010	(0.157)	1.073	(0.177)
	65 years or older, 0/1	0.817	(0.138)	1.156	(0.204)
Assets and livelihoods	Total cropped area of household, ha	0.778 ***	(0.055)	0.995	(0.024)
	Livestock owned, TLU	0.994	(0.011)	0.972	(0.024)
	One or more member has wage employment, 0/1	1.899 ***	(0.360)	1.292	(0.261)
	Has at least one household enterprise, 0/1	1.094	(0.168)	0.925	(0.132)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']				
	No formal education, 0/1	1.423	(0.423)	0.990	(0.317)
	Some primary, 0/1	0.929	(0.161)	0.888	(0.164)
	Beyond secondary, 0/1	1.072	(0.184)	1.310	(0.225)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.003	(0.005)	1.003	(0.005)
	Population density, 100 persons per sq.km.	1.004	(0.003)	0.998	(0.003)
Administrative and ecological zones	Geo-political zone [base: "North Central, 0/1"]				
	North East, 0/1	1.604 *	(0.440)	0.757	(0.217)
	North West, 0/1	2.125 ***	(0.533)	1.295	(0.353)
	South East, 0/1	1.259	(0.328)	1.479	(0.463)
	South South, 0/1	1.455	(0.394)	1.243	(0.349)
	South West, 0/1	2.567	(1.512)	14.673 ***	(7.750)
Constant		0.775	(0.299)	0.991	(0.419)
Observations: 2,352 households; F(38, 312) = 3.79; Prob > F = 0.000; Pseudo-R2: 0.073.					

Source: Weighted analysis of GHSP-3.

Note: Observations: 2,352 households. *** p<0.01, ** p<0.05, * p<0.10. TLU = Tropical Livestock Unit (see note Table 4).

Although the choice of explanatory variables used in the multinomial model were informed by the research literature, only a few variables have statistically significant relative risk ratios in either the model for households that sold no crops or, particularly, that for more commercially oriented households. The demographic characteristics of a household are not associated with either the household making no sales or making higher levels of sales of the crops they produced. The only exception is that female-headed households have a significant (at $p < 0.10$ level) probability of not making any sales from their agricultural production.

There is a strongly negative association between the size of the cropped area of the household and the household being in the no crop sales category. An implication of this result is that households with a larger total area under crops are likely to sell some of their crops, likely due to having sufficient land on which to produce the crops their household requires plus some surplus. However, no evidence is provided in the model for more commercially oriented households that landholding size is associated with the sales of a large share of the crop production of the household.

Households with at least one member who has wage employment are more likely to engage in primarily subsistence production and make no crop sales. These households presumably are able to meet their cash needs through those wages, rather than needing to sell any of the crops that

they produce. However, this relationship is not seen for households which have a household enterprise. This may be due to the small or often seasonal nature of such enterprises. However, a better understanding of these relationships between crop commercialization and non-farm income sources would require further examination. Neither having any wage employment nor engaging in a household enterprise are significantly associated with a higher share of crop production being sold.

The absence of any association between maximum educational level within a household and the household's commercial orientation was unexpected, as commercial success generally requires knowledge to be able to sell produce profitably in what are sometimes complex markets.

No significant associations are seen between a household living in an area of higher population density or close to an urban population center and not engaging in any crop sales or, if making any sales, selling a large proportion of their production. This may be due to the other cash income opportunities than through agriculture alone in such areas, permitting households to rely on their farming for household consumption and using other incomes sources to meet cash needs.

We also see that where a household resides affects their level of commercial orientation in their farming. The geo-political zones proxy both for agro-ecological conditions that may constrain the crop choices of farming households as well as spatially-differentiated market and administrative characteristics across Nigeria. Significantly, agricultural households in North West and North East geo-political zones are likely not to sell any of their produce, retaining it for their own needs, while those in South West are quite likely to sell more than one-third of their harvest. The greater specialized agricultural marketing opportunities associated with the large urban population centers in South West and the more restricted opportunities in North West and North East likely drive these relationships.

Drivers of change in commercial orientation of farming households between 2010/11 and 2015/16

To further investigate the patterns shown in Table 7, a set of three analyses were done to explore the characteristics of the panel survey sample households at the time of round 1 of the survey in 2010/11 that might determine changes in the share of the agricultural production that they sold between 2010/11 and round 3 in 2015/16. The GHPS sub-sample used for these analyses are those sample households that were engaged in agricultural production in either round 1 or round 3, so is a slightly larger sample than was used in the analysis of agricultural households in round 3 alone in the previous section. The first analysis uses as the dependent variable in an ordinary least squares regression the difference in the share of agricultural production sold in 2015/16 from the share the household sold in 2010/11.⁵ The other two analyses are logistic analysis using as dependent variables dummy (0/1) variables derived from the direction of changes of households in their membership in the agricultural commercialization categories used earlier between rounds 1 and 3, adding a fourth category for households not engaged in agriculture in one of the two rounds. Households were categorized as to whether they changed from a less to a more commercially oriented category or from a more to less commercially oriented category. Two dummy variables were created for each trend direction.

Descriptive statistics for the three dependent variables, which are derived from both rounds 1 and 3 of the GHPS, and the explanatory variables, which are household characteristics reported in round 1 are presented in Appendix Table 1. The explanatory variables included in the model expand beyond those used in the earlier multinomial logit analysis of the factors associated with

⁵ For households that were not engaged in agricultural production for one of the two survey years, in computing the dependent variable, a value of zero was assigned as the share of their crop production sold in that year.

membership in agricultural commercialization category (Table 9) to include several household agricultural production characteristics, including crop choice and input use.

The results of the three analyses to gain insights on what might drive households to change the commercial orientation of their farming activities are presented in Table 10. The first column pair presents the results of the ordinary least squares (OLS) regression on the change in the share of crop production sold by the household between 2010/11 and 2015/16. The second and third column pairs present the results of the logistic regressions on direction of movement by households between agricultural commercialization categories between 2010/11 and 2015/16. The logistic regression results are presented as odds-ratios.⁶

In reviewing the results, we focus primarily on the OLS results, using the logistic regression result to provide additional insights. For the demographic characteristics of the sample households in 2010/11, none of them are significantly associated with the change in the share of agricultural production that was sold by the household between 2010/11 and 2015/16. The logistic regression results, however, suggest that households with a greater share of member being workers are unlikely to have moved to a less commercially oriented category between the two survey rounds.

Table 10: Factors associated with change in level of agricultural commercialization, results of weighted ordinary least squares regression and logistic analyses

	Change in share of agricultural production sold between 2010/11 and 2015/16		Change in agricultural commercialization category between 2015/16 and 2010/11			
	OLS coefficient	Standard error	In more commercially oriented category, 0/1		In less commercially oriented category, 0/1	
			Odds-ratio	Standard error	Odds-ratio	Standard error
Demographic						
Household size, no.	0.004	(0.003)	1.016	(0.021)	0.981	(0.019)
Workers : household members, ratio	0.005	(0.041)	0.934	(0.228)	0.517***	(0.117)
Female headed household, 0/1	-0.020	(0.028)	0.815	(0.152)	1.265	(0.217)
Age HH head [base: '35 to 64 yrs., 0/1']						
Less than 35 years, 0/1	-0.009	(0.028)	0.701*	(0.134)	0.887	(0.162)
65 years or older, 0/1	0.036	(0.022)	1.017	(0.140)	0.982	(0.137)
Assets and livelihoods						
Total cropped area of household, ha	0.001***	(0.000)	0.999	(0.004)	0.972	(0.018)
Livestock owned, TLU	0.000	(0.000)	1.001	(0.001)	0.998	(0.003)
One or more member wage employed, 0/1	0.020	(0.024)	0.735	(0.159)	0.990	(0.168)
Has at least one household enterprise, 0/1	-0.029*	(0.017)	0.657***	(0.070)	0.852	(0.103)
Education						
Maximum educational attainment [base: 'No data, 0/1']						
Primary or less, 0/1	0.010	(0.025)	1.331	(0.235)	1.021	(0.166)
Some secondary, 0/1	0.024	(0.027)	1.427*	(0.266)	1.187	(0.213)
Beyond secondary, 0/1	0.015	(0.034)	1.123	(0.298)	1.084	(0.262)
Agriculture						
Maize, produced, 0/1	-0.039*	(0.020)	0.728**	(0.097)	1.286**	(0.159)
Rice, produced, 0/1	-0.033	(0.028)	0.941	(0.205)	1.367	(0.279)
Sorghum, produced, 0/1	0.011	(0.024)	0.885	(0.161)	1.049	(0.186)
Millet, produced, 0/1	-0.041*	(0.024)	0.476***	(0.106)	1.099	(0.215)
Cowpea, produced, 0/1	-0.025	(0.023)	0.823	(0.149)	0.982	(0.164)
Groundnut, produced, 0/1	0.003	(0.027)	0.840	(0.177)	0.690*	(0.149)

⁶ Odds-ratios can be interpreted in a similar way to the relative risk ratio results of the earlier multinomial logit analysis. The odds-ratio is the chance of the dependent variable changing from 0 to 1 as a result of a one-unit positive change in the independent variable. In contrast to OLS models for which a statistically insignificant coefficient is zero, a statistically insignificant odds-ratio is one – that is, a one-to-one or even chance. Odds-ratios less than one represent an inverse relationship between the independent and dependent variable, while those greater than one suggest a direct relationship.

	Change in share of agricultural production sold between 2010/11 and 2015/16		Change in agricultural commercialization category between 2015/16 and 2010/11			
	OLS coefficient	Standard error	In more commercially oriented category, 0/1		In less commercially oriented category, 0/1	
			Odds-ratio	Standard error	Odds-ratio	Standard error
Yam, produced, 0/1	-0.009	(0.023)	0.726**	(0.118)	1.144	(0.184)
Sweet potato, produced, 0/1	-0.082	(0.061)	0.853	(0.348)	1.675	(0.639)
Cassava, produced, 0/1	0.020	(0.026)	1.181	(0.199)	1.560***	(0.248)
Banana, produced, 0/1	-0.119***	(0.041)	0.659	(0.193)	1.513*	(0.364)
Cocoa, produced, 0/1	-0.041	(0.086)	0.462	(0.217)	0.657	(0.268)
Soyabean, produced, 0/1	-0.072*	(0.040)	0.549*	(0.194)	1.477	(0.419)
Agricultural extension contact, 0/1	-0.067**	(0.026)	0.707*	(0.135)	1.433**	(0.243)
Received loan of some sort, 0/1	0.025	(0.018)	0.810*	(0.097)	0.837	(0.098)
Rented-in land, 0/1	-0.029	(0.034)	0.882	(0.184)	1.086	(0.199)
Hired-in labor, 0/1	-0.054***	(0.020)	0.735**	(0.105)	1.381**	(0.179)
Purchased fertilizer, 0/1	0.035*	(0.019)	1.006	(0.136)	0.852	(0.108)
Purchased improved seed, 0/1	-0.070***	(0.018)	0.765**	(0.089)	1.548***	(0.187)
Purchased pesticides, 0/1	-0.063***	(0.021)	1.178	(0.172)	1.285*	(0.170)
Market access						
Distance to town of 20,000 persons +, km	0.000	(0.001)	0.996	(0.004)	1.002	(0.003)
Population density, 100s of persons per sq.km.	-0.001*	(0.000)	0.994**	(0.003)	1.002	(0.002)
Administrative and ecological zones [base: "North Central" geo-political zone]						
North East, 0/1	0.100***	(0.037)	2.496***	(0.735)	1.324	(0.321)
North West, 0/1	0.133***	(0.035)	5.418***	(1.544)	0.938	(0.233)
South East, 0/1	0.071*	(0.038)	3.326***	(0.813)	1.275	(0.310)
South South, 0/1	0.028	(0.040)	2.228***	(0.614)	1.671**	(0.408)
South West, 0/1	-0.034	(0.055)	0.683	(0.223)	0.625	(0.183)
Constant	-0.013	(0.049)	0.724	(0.255)	0.641	(0.205)
Observations: 2,868; Prob > F = 0.000; R ² : 0.068.			Observations: 2,115; Prob > F = 0.000; Pseudo-R ² : 0.113.		Observations: 2,104; Prob > F = 0.000; Pseudo-R ² : 0.052.	

Source: Weighted analysis of data from GHSP-1 and GHSP-3.

Note: *** p<0.01, ** p<0.05, * p<0.10. OLS = Ordinary least squares regression. HH = household. TLU = Tropical Livestock Unit (see note Table 4).

Household with more cropland are likely to have increased the share of their crop production that they sold between 2010/11 and 2015/16. This is an encouraging result in that it may reflect improved incentives between the two survey rounds for smallholder households to use for market-directed production any land they have that is surplus to what they require to meet their own consumption needs.

Households that had a household enterprise in 2010/11 were likely to have reduced the share of their crop production that they sold and were unlikely to have moved to a more commercially oriented category in 2015/16. These results are aligned with what was seen in earlier results in that the propensity for a household to sell some of their produce is reduced if the household has other income sources. However, in the analyses here, wage employment in 2010/11 did not affect any changes in the share of crops that households sold.

Any relationship between educational attainment in 2010/11 and changes in the commercial orientation of a household between the two survey rounds are generally shown to be insignificant.

The OLS analysis highlights a number of agricultural characteristics of households in 2010/11 that are associated with a decline in the share of production that the household sold in 2015/16

relative to 2010/11. These include that the household produced maize, millet, banana, or soyabean. These crops may have seen market downturns after 2010/11, reducing incentives for households to produce those crops for sale in 2015/16. More investigations would be required to confirm this. In addition, whether the household hired-in labor, purchased improved seed or pesticides (including herbicides), or reported having contact with agricultural extension are associated with the household become less commercially oriented between 2010/11 and 2015/16. These are generally troubling findings, particularly on agricultural extension, as it suggests that agricultural advisory service providers in Nigeria are not especially effective in promoting commercial farming through advising smallholder households as to how they might more profitably engage with markets. The only agricultural variable associated (if weakly) with a rise in share of produce sold in 2015/16 relative to 2010/11 is whether the household purchased fertilizer in 2010/11. The logistic regression results generally confirm the patterns seen in the OLS, with the same variables that were significant in the OLS having statistically significant odds-ratios less than 1.0 for the model on households that became more commercially oriented and odds-ratios more than 1.0 for the model on households that became less commercially oriented.

In terms of market access, household resident in areas with a relatively higher population density tended to reduce the share of their agricultural produce that they sold and moved to less commercially oriented household categories. In terms of the geopolitical zones of Nigeria, relative to the changes in the share of produce sold in the base category zone of North Central, households in North East, North West, and South East zones all saw further increases in the share of their harvest that they sold in 2015/16 relative to 2010/11. The logistic analysis on households that became more commercially oriented confirms this result, and also suggests that households in South South also became more commercially oriented over this period.

The results presented in Table 10 provide a partial explanation of changes in the commercial orientation of agricultural households between 2010/11 and 2015/16 based on the characteristics of those households in 2010/11. However, changes in those characteristics; changes in the market conditions for the crops the households produce and, hence, the incentives for producing them; and changes in the broader set of local economic opportunities households might exploit would also be important for understanding what might result in smallholder farming households increasingly engaging in agricultural production that goes well beyond their own consumption needs. Our results, being based on a limited set of cross-sectional data on household characteristics alone, are more suggestive than conclusive.

5. FACTORS ASSOCIATED WITH HOUSEHOLD PRODUCTION AND SALES OF SPECIFIC CROPS

The specific production and market characteristics of crops grown by smallholder farming households in Nigeria are important to determining whether the smallholders might expand production of the crop to sell a significant share of their harvest. In this section of this paper, we summarize findings from a set of crop-specific models developed from the GHSP-3 dataset. These models examine in turn (and when possible) what factors are associated with a smallholder farming household producing a specific crop; with a smallholder household that produces a crop deciding to sell part of their production of the crop, and with a smallholder household that sells some of their crop deciding to sell more than half of their production of the crop.

Twelve crops are examined – maize, rice, sorghum, millet, cowpea, groundnut, yam, sweet potato, cassava, banana, cocoa, and soyabean. The sub-sample for the analysis is the same set of agricultural households from the GHSP-3 used in the earlier multinomial logit analysis of factors associated with membership in specific agricultural commercialization category (Table 9). The

same set of explanatory variables are used as in this earlier analysis (Table 8). For the 'Produce crop' models, we add into the set of explanatory variables two dummy variables corresponding to household membership in the 'No sales of crops produced' and the 'Sold more than one-third of value of crops' agricultural commercialization categories, with the base category being households that sold the crop, but less than one-third of the value of production. Seven additional agriculture related variables also are added to the specifications of all three models.⁷ Descriptive statistics on both the dependent variables for the crop-specific models and the additional explanatory variables are presented in Table 11.

Table 11: Descriptive statistics for variables used in logistic analyses of factors associated with production, sales, and high sale levels of selected crops, additional to those listed in Table 8

	Produce crop		Sold crop, if produced		Sold more than half of production, if sold any	
	Mean	Standard error	Mean	Standard error	Mean	Standard error
Dependent variables, by crop:						
Maize, 0/1	0.476	0.022	0.462	0.026	0.535	0.030
Rice, 0/1	0.105	0.014	0.564	0.049	0.505	0.064
Sorghum, 0/1	0.368	0.019	0.189	0.028	0.284	0.057
Millet, 0/1	0.216	0.019	0.158	0.028	0.287	0.058
Cowpea, 0/1	0.283	0.019	0.370	0.033	0.506	0.036
Groundnut, 0/1	0.112	0.011	0.488	0.042	0.523	0.061
Yam, 0/1	0.268	0.019	0.490	0.031	0.382	0.037
Sweet potato, 0/1	0.015	0.004	0.688	0.114	0.908	0.058
Cassava, 0/1	0.221	0.015	0.435	0.033	0.371	0.044
Banana, 0/1	0.081	0.010	0.151	0.038	0.570	0.149
Cocoa, 0/1	0.046	0.008	0.902	0.030	0.925	0.034
Soyabean, 0/1	0.064	0.009	0.627	0.062	0.603	0.077
Additional explanatory variables						
Agricultural commercialization categories						
'No sales of crops produced', 0/1	0.346	0.016				
'Sold, but less than one-third of value of crops produced', 0/1 [base]	0.309	0.014				
'Sold more than one-third of value of crops', 0/1	0.345	0.015				
Contact with agricultural extension, 0/1	0.082	0.010				
Received loan of any kind, 0/1	0.191	0.012				
Rented-in land, 0/1	0.094	0.096				
Hired-in labor, 0/1	0.816	0.013				
Purchased inorganic fertilizer, 0/1	0.434	0.020				
Purchased improved seed, 0/1	0.363	0.017				
Purchased pesticide, 0/1	0.475	0.020				

Source: Weighted analysis of GHSP-3. Observations (for 'Produce crop' and explanatory variable statistics): 2,352.

Based simply on the tabulations by crop in Table 11, a preliminary assessment can be made of the degree to which crops are produced for sale. The crops that are primarily destined for own consumption within the household are sorghum, millet, cowpea, and banana. Cocoa, sweet potato, soyabean, and rice show the highest share of production that is sold. Yam, groundnut, maize, and cassava are grouped at an intermediate level of sales. However, several of these marketed crops are not widely grown, which may limit their broad commercial potential – groundnut, rice, banana,

⁷ These agriculture variables, but from GHSP-1, were used in the analysis of factors associated with change in the level of agricultural commercialization of households between 2010/11 and 2015/16 (Table 10 and Appendix Table 1).

soyabean, cocoa, and sweet potato each are grown by less than 15 percent of agricultural households across Nigeria.

The results by crop for the logistic analyses are presented in the set of tables in the Appendix running from Appendix Table 2 to Appendix Table 13. With 12 crops and potentially three models for each, 36 analyses might be developed. However, for seven crops, the models on what factors determine whether household sell more than half of their harvest of those crops were not informative or performed poorly due to small sample sizes and insufficient variation in some of the explanatory variables used. These models are not presented in the tables in the Appendix. Such modeling challenges around crop sales are particularly seen for crops that generally are produced for subsistence or for crops that have quite small zones of production within Nigeria. For three crops, sweet potato, cocoa, and soyabean, similar challenges were also experienced in trying to develop models on what factors are associated with any sales of those crops.

Table 12 provides a summary by crop of the crop-specific model results that are detailed in the tables in the Appendix.

Table 12: Crop-specific summaries of logistic model results on factors associated with production, sales, and high sale levels of crop by agricultural households

Crop	Produced crop	Sold any crop, if produced	Sold more than half of production, if sold any
Maize	<ul style="list-style-type: none"> ▪ Larger households and those with younger heads more likely to grow maize. ▪ Households with enterprises less likely to produce. ▪ More likely to be produced by those with secondary education. ▪ More likely to be produced by those that sell some of their crops. ▪ Maize production strongly associated with use of commercial inputs and hiring-in labor, but not use of credit. ▪ Relative to North Central zone, more likely to be produced by households in South East, but less likely in North West, South South, and South West. 	<ul style="list-style-type: none"> ▪ If household has other non-agricultural income streams (enterprise; wage employment), unlikely to sell maize. ▪ Likely have secondary education. ▪ Have interacted with extension. ▪ Likely to use fertilizer and improved seed. Not pesticides. ▪ Likely to hire-in some labor. ▪ Households that sell some of maize generally located at some distance from urban centers. ▪ Households in the three southern zones more likely to sell their maize. 	<ul style="list-style-type: none"> ▪ Few factors separate sellers of small amounts of their maize from those that sell most of their production: ▪ Female-headed selling households unlikely to sell a large share of their maize. ▪ Unlikely to interact with agricultural extension. ▪ Maize sellers in South South and South West likely to sell much of their production, while those in North East tend not to do so.
Rice	<ul style="list-style-type: none"> ▪ No demographic characteristics associated with rice production. ▪ Larger landholders more likely to produce. ▪ More likely to be produced by those that sell some of their crops. ▪ Likely to rent-in some land. ▪ Likely to use pesticides. ▪ Production centered in northern zones. 	<ul style="list-style-type: none"> ▪ Larger landholders more likely to sell the rice they produce. ▪ If household has other non-agricultural income streams unlikely to sell any rice produced. ▪ Commercial production of rice centered in North West. 	<i>[Model not presented]</i>
Sorghum	<ul style="list-style-type: none"> ▪ Larger landholders and households with low educational attainment more likely to produce sorghum. ▪ Likely to sell some of their farm output, but not a large share. ▪ More likely than other farmers to be in contact with agricultural extension and to have obtained loans. ▪ Sorghum production is centered in North West and North East. 	<ul style="list-style-type: none"> ▪ Households with more workers as a share of members less likely to sell their sorghum. ▪ If household has other non-agricultural income streams unlikely to sell any sorghum. ▪ Commercial sorghum producers use pesticides in their farming. ▪ No zones shown to be centers of commercial sorghum production. 	<ul style="list-style-type: none"> ▪ Likely to also own livestock. ▪ Generally have some primary education. ▪ Likely to rent-in land. ▪ Tend not to use fertilizer or improved seed. ▪ Sorghum sellers in North East are unlikely to sell more than half of their production.

Crop	Produced crop	Sold any crop, if produced	Sold more than half of production, if sold any
Millet	<ul style="list-style-type: none"> Households with younger heads tend not to produce millet. Producers likely to derive income from a household enterprise of some sort. Households with low educational attainment more likely to produce. Likely to sell only a small share of their total farm output. Unlikely to rent-in land or use improved seed or pesticides. Millet production centered in North West and North East. 	<ul style="list-style-type: none"> Households that have more workers as a share of members are less likely to sell their millet. Households with elderly heads more likely to sell some of their millet. If millet-producing household has a household enterprise, unlikely to sell any millet. Producers who sell some of their millet very likely to use pesticide. 	<i>[Model not presented]</i>
Cowpea	<ul style="list-style-type: none"> Households with younger heads tend not to produce cowpea. Larger landholders more likely to produce. Households with low educational attainment more likely to produce. Likely to sell only a small share of their total farm output. No specific agricultural production features – input use, hired-in labor, etc. – define cowpea producers. Strongly centered in North West and North East; virtually absent in southern zones. 	<ul style="list-style-type: none"> Larger landholders more likely to sell some of cowpea produced. Sellers of cowpea also likely to own livestock. Indication that those producers with some secondary education more likely to engage in sales. No specific agricultural production features define cowpea sellers. Production of cowpea for any sales is centered in North East. 	<i>[Model not presented]</i>
Groundnut	<ul style="list-style-type: none"> Households with younger heads tend not to produce groundnut. Larger landholders more likely to produce. Likely to derive income from a household enterprise of some sort. Households with low educational attainment more likely to produce. Likely to sell some, but only a small share of total farm output. More likely than non-producers to have received a loan. No more likely than non-producers to use commercial inputs. Strongly centered in North East; virtually absent in southern zones. 	<ul style="list-style-type: none"> Larger landholders more likely to sell some of their groundnut. Sellers likely to own livestock. If groundnut producing household has a household enterprise, unlikely to sell their groundnut. Sellers more likely to have been in contact with agricultural extension than producers who do not sell. More likely use improved seed, but less likely to hire-in labor. No specific zone shown to be center of production for sale. 	<i>[Model not presented]</i>
Yam	<ul style="list-style-type: none"> Tend to have more workers as share of members than do non-producers. Households headed by women less likely to produce yam. Asset ownership or other income sources not determinants of production. Tend to have secondary education. Likely to sell some of total farm output, but not a large share. Use pesticide. Unlikely to use fertilizer. Centered in the South East. Uncommon in North East, North West, or South West. 	<ul style="list-style-type: none"> Yam sellers tend also to own livestock. Sellers also more likely to purchase fertilizer (although not clear if use it on their yam plots). No specific zone shown to be center of yam production for any sales. 	<ul style="list-style-type: none"> Sellers of large share of their yams unlikely to have any members with wage employment, but likely to have a household enterprise. Tend not to use hired-in labor or pesticide in their crop production. Yam producers in South South tend to sell much of their output.
Sweet potato	<p><i>[Models for 'Sold any crop, if produced' and 'Sold more than half of production, if sold any' are not presented.]</i></p> <ul style="list-style-type: none"> Very low prevalence of production among smallholder households, so model results are imprecise. <ul style="list-style-type: none"> Households with younger heads more likely to produce. If household has a household enterprise, unlikely to produce. Likely to have been in contact with agricultural extension. Tend to hire-in labor, but do not rent-in land. No zonal patterns of production evident, in part due to small sample of producers. 		

Crop	Produced crop	Sold any crop, if produced	Sold more than half of production, if sold any
Cassava	<ul style="list-style-type: none"> Households with younger heads tend not to produce cassava. Likely to sell some of total farm output, but not a large share. Likely to have obtained a loan. Unlikely to use fertilizer in their crop production. Production centered in South South. Unlikely to be produced in North East, North West, or South East. 	<ul style="list-style-type: none"> Households with elderly heads more likely to sell cassava. If has a household enterprise, unlikely to sell their cassava. Tend not to use pesticides. Despite being a production center, South South producers unlikely to sell any. South East producers are the same. North Central producers are most likely to sell some. 	<ul style="list-style-type: none"> Limited number of significant factors: <ul style="list-style-type: none"> Households with elderly heads. No use of fertilizer in their farming.
Banana	<ul style="list-style-type: none"> Smaller households more likely to produce. Likely to sell some of total farm output, but not a large share. Engage with agricultural extension. Do not use fertilizer in their farming. But do tend to use pesticide. Commonly produced in southern zones; rare in North East and North West. 	<ul style="list-style-type: none"> Larger producing households more likely to sell some of their banana. No other significant factors seen. 	[Model not presented]
Cocoa	<p>[Models for 'Sold any crop, if produced' and 'Sold more than half of production, if sold any' are not presented.]</p> <ul style="list-style-type: none"> Production primarily in South West, with some in South South. (So, do not include zone variables in model.) Smaller households and those with small share of members that work more likely to produce cocoa. Those headed by women and younger individuals unlikely to produce cocoa. Larger landholders likely to produce. All cocoa producers in sample had some education, but no clear relationship to educational attainment level. Households in most commercially oriented agricultural household category most likely to produce cocoa. Tend to receive agricultural extension advice and credit. Unlikely to report using hired-in labor. Unlikely to use fertilizer in farming, but very likely to use pesticide. 		
Soya-bean	<p>[Models for 'Sold any crop, if produced' and 'Sold more than half of production, if sold any' are not presented.]</p> <ul style="list-style-type: none"> Larger landholders more likely to produce soyabean. Unlikely to produce if has an income-generating enterprise. Producers tend to have secondary level of education. Commonly hire-in labor and use fertilizer in their farming. North West is center of production. Rare in southern zones. 		

Source: Authors' synopsis of Appendix Table 2 to Appendix Table 13.

For most agricultural households, sales of many of the crops examined is driven in part by their lack of other income sources. Quite consistently across the models for any sales, it was found that if a household had an enterprise that provided some income for the household or had a member with wage employment, the household was less likely to sell a portion of their crop harvest, retaining their production for own consumption. Only in one case do we see sales of a crop to be positively associated with the household having a non-farm income source as well – for the yam high-sales level model. All other models with significant odds-ratios for either the household enterprise or the wage employment variables show inverse relationships.

This suggests that most farming households remain quite subsistence oriented in their crop production – they are engaged in farming to meet in a direct manner the consumption needs of their households. They seemingly view self-sufficient production and limited dependence on the market as a way to meet their basic needs while minimizing risks to their welfare. The income generating possibilities of agriculture are not exploited by most agricultural households. If they sell any of their crops, it appears to be to meet household cash needs as they arise rather than as part of a market-focused strategy in their crop choices. The earlier analyses examining the determinants of smallholder households being in one of three agricultural commercialization categories or changes in those categories over time suggested that any commercial orientation

among such households is not widespread and is not deep-seated. We see the same in these crop-specific results.

That this is the case reflects a range of deficiencies in the production and marketing of many of the crops examined. These include in the availability of improved crop varieties and in the use of inorganic fertilizers to increase productivity – only for maize is a strong association seen between production of the crop and the farming household using improved seed and fertilizer in their farming. (Soyabean has a similar, if weaker, pattern of association between production and use of these inputs.) For production of the other crops, improved seed and fertilizer are not used, in part because the crops are not grown for commercial reasons, but possibly also because improved seed may not be available. Constrained access to other agricultural technologies that would improve crop productivity levels to generate harvests that exceed household consumption requirements also plays a role in the limited sales made by crop producers.⁸

However, weakness in the value chains of these crops also encourage a subsistence-first orientation in producers – Nigerian crop markets remain risky with no assurances that farmers will find buyers offering remunerative prices when they bring their produce to the market to sell. Where there are important food markets, such as near urban population centers in southern Nigeria, we find that producers of maize in those area are likely to sell most of their production. Although the southern zones are not the most highly suited areas of the country to produce maize – producers there are responding to strong and consistent market demand. However, such patterns are not seen with other crops. Continued investments in the value chains of other crops are needed if commercial considerations are to increasingly drive the crop choices of smallholder farmers and provide incentives for their achieving higher crop productivity.

Finally, an unexpected finding from the crop-specific analyses was that education levels within the household appears not to be an important driver of either the choice to produce a crop or to sell a crop if produced. Consistently achieving higher levels of crop productivity with improved technologies and obtaining greater commercial returns on that production in Nigeria's markets should be expected to be a knowledge-intensive endeavor. That returns to household investments in education in agricultural production or marketing are not apparent in the analyses here suggests the production and profitability levels for most smallholder farming households in Nigeria are likely far below their potential.

Although these criticisms of the commercial performance of smallholder farming households across Nigeria emerge from this national analysis of the 12 crops, it is also important to note some areas of success or where opportunities can be pursued.

- Maize is shown to be the crop that performs best for smallholders in serving both their own consumption and cash needs. It also is the crop to which commercial inputs are most likely to be applied to both raise productivity and protect production. Although maize has specific characteristics that make it commercially attractive for smallholders, which other crops do not have, efforts should be made to draw lessons for the future commercial development of those other crops from the development of the maize sub-sector in Nigeria over the past several decades.
- Rice and soyabean also show some successes, while groundnut would appear to have significant commercial potential, though currently neglected. Commercial rice production is strong in North West. Soyabean appears to be a nascent sector, but with potential to be an important commercial crop for smallholders. Groundnut has been an important smallholder crop in the past in Nigeria. The sizable global market that Nigerian smallholders supplied

⁸ It bears noting that the use of pesticides, which are generally seen as technologies that protect current production levels rather than increase productivity, is more common among producers of the crops examined than is use of improved seed or fertilizer.

decades ago has only grown since, suggesting continuing opportunities. For those that produce it, cocoa is an important commercial crop, if limited agro-ecologically in its production potential.

- The survey evidence shows that yam and banana are produced for somewhat local markets, reflecting both agro-ecological suitability and local diet preferences. As urban markets continue to expand in the southern areas where these crops are produced, incentives for their commercial production will also rise. A similar pattern, if not as strong, may be emerging for cowpea in northern zones.
- In contrast, cassava, sorghum, and millet seem from this analysis to primarily be produced for meeting household consumption needs, while the data from the GHSP-3 on sweet potato remains challenging to interpret due to the few households that reported producing the crop.

The crop-level logistic analyses provide a broad range of insights. However, being based on a cross-sectional set of national data for a very large and populous country, those insights admittedly will be somewhat shallow. Crop specific analysis using data collected from households producing the crop over time will provide more robust insights to better guide investments in both smallholder production of each crop and in the value chains those smallholders might more enthusiastically supply.

6. CONCLUSIONS

The level of commercial orientation of smallholder farming households in Nigeria is an important consideration for agricultural and rural economic development efforts. Increasing the productivity of commercially oriented farmers results in greater incomes for their households. This increased income can drive an expansion in local non-farm employment opportunities and raise incomes across rural communities, extending the benefits beyond the farmers alone. Appropriately targeting agricultural development towards commercially oriented farming households has important second-round economic development benefits in their communities, effects which cannot be achieved without properly identifying such households.

The analyses presented in this paper seek to identify approaches to best foster the development of commercially oriented smallholder farming households and the crop value chains in which they might participate. First, several econometric analyses are used to examine the characteristics of smallholder farming households and their context that may determine their level of commercial orientation in 2015/16 and what characteristics of the same households in 2010/11 might have driven any subsequent changes in their commercial orientation. Second, we conduct crop-specific analyses of the factors associated with a household choosing to produce a specific crop, to sell any of the harvest of that crop, and, if they sold the crop, whether they sold more than half of their harvest. Twelve crops are examined. These crop-specific analyses seek to identify what factors might need to be addressed to strengthen the value chain for each and to make the crop more commercially attractive for smallholder farming households.

We find that the commercial orientation of most smallholder farming households is not strong. One-third reported not making any sales of their crops, relying instead on household enterprises or wage employment to meet their cash needs. For many, any crop sales made seemed to reflect the limited other options households have to obtain cash, rather than being part of a strategy of commercial production. Significant factors associated with farming households not selling or reducing the share of their produce that they sell were identified in the analyses much more commonly than those that might drive households to consistently sell a significant share of their

output or increase the share sold. A subsistence orientation still drives most production by smallholder households in Nigeria.

The crop-specific analyses confirm that sales of many of the crops examined for many households are driven in part by their lack of other income sources, rather than by actively seeking to produce significant commercial surpluses of the crop. That this is the case reflects a range of deficiencies in the production and marketing of many of the crops examined. Improved production technologies for many of the crops are not used, may not be readily available, or, if available, may prove challenging to employ profitably. Nigerian crop markets remain risky with no assurances that farmers will find buyers offering remunerative prices when they bring their produce to the market to sell. Continued investments to increase crop productivity and to improve the performance and reliability of crop value chains are needed if commercial considerations are increasingly to drive the crop choices of smallholder farming households and to provide incentives for higher crop productivity.

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APPENDIX

Appendix Table 1: Descriptive statistics for variables used in ordinary least square regression and logit analyses of factors associated with changes in household agricultural commercial orientation between 2010/11 and 2015/16

			Mean	Standard error	
Dependent variables:					
Change in share of agricultural production sold between GHPS-1 (2010/11) and GHPS-3 (2015/16) [Observations: 2,868]			-0.007	0.011	
In <u>more</u> commercially oriented category in 2015/16 compared to 2010/11, 0/1 [Observations: 2,115 – those that became more commercially oriented or did not change categories.]			0.452	0.019	
In <u>less</u> commercially oriented category in 2015/16 compared to 2010/11, 0/1 [Observations: 2,104 – those that became less commercially oriented or did not change categories.]			0.448	0.016	
	Mean	Standard error	Mean	Standard error	
Explanatory variables, all from GHPS-1 (2010/11)					
Household size, no.	6.68	0.089	Agricultural extension contact, 0/1	0.103	0.011
Workers:household members, ratio	0.49	0.005	Received loan of some sort, 0/1	0.382	0.017
Female headed household, 0/1	0.107	0.081	Rented-in land, 0/1	0.081	0.008
Age of household head:			Hired-in labor, 0/1	0.402	0.020
Less than 35 years, 0/1	0.090	0.068	Purchased fertilizer, 0/1	0.403	0.021
35 to 64 years, 0/1 [base]	0.653	0.012	Purchased improved seed, 0/1	0.342	0.015
65 years or older, 0/1	0.223	0.011	Purchased pesticides, 0/1	0.313	0.019
Total cropped area of household, ha	1.41	0.250	Distance to nearest town with population 20,000 + persons, km	22.6	1.06
Livestock owned, TLU	2.35	0.707	Population density, 100 persons per sq.km.	12.9	1.59
One or more member has wage employment, 0/1	0.127	0.010	Geo-political zone:		
Has at least one HH enterprise, 0/1	0.434	0.016	North Central, 0/1 [base]	0.164	0.012
Max. educational attainment in HH:			North East, 0/1	0.125	0.009
No formal education, 0/1	0.060	0.007	North West, 0/1	0.315	0.016
Some primary, 0/1	0.223	0.010	South East, 0/1	0.184	0.011
Some secondary, 0/1 [base]	0.429	0.014	South South, 0/1	0.122	0.010
Beyond secondary, 0/1	0.135	0.009	South West, 0/1	0.091	0.007
Maize, produced, 0/1	0.311	0.020			
Rice, produced, 0/1	0.091	0.011			
Sorghum, produced, 0/1	0.354	0.020			
Millet, produced, 0/1	0.212	0.018			
Cowpea, produced, 0/1	0.239	0.017			
Groundnut, produced, 0/1	0.087	0.012			
Yam, produced, 0/1	0.254	0.018			
Sweet potato, produced, 0/1	0.012	0.003			
Cassava, produced, 0/1	0.198	0.015			
Banana, produced, 0/1	0.043	0.005			
Cocoa, produced, 0/1	0.033	0.007			
Soyabean, produced, 0/1	0.032	0.005			

Source: Weighted analysis of data from GHSP-1 and GHSP-3. Observations: 2,868 households.

Note: HH = household; TLU = Tropical Livestock Unit (see note Table 4).

Appendix Table 2: Maize – factors associated with household production, sales, and high sale levels

Explanatory variables		Produce maize		Sold maize, if produced		Sold more than half of maize, if sold any	
		Odds-ratio	s.e.	Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	1.034*	(0.021)	1.005	(0.026)	1.015	(0.037)
	Workers : household members, ratio	0.683	(0.198)	1.002	(0.448)	1.647	(0.912)
	Female headed household, 0/1	0.991	(0.164)	1.037	(0.223)	0.605*	(0.183)
	Age HH head [base: '35 to 64 years, 0/1']						
	Less than 35 years, 0/1	1.302*	(0.199)	1.100	(0.257)	1.000	(0.292)
	65 years or older, 0/1	1.080	(0.183)	0.981	(0.204)	1.250	(0.366)
Assets and livelihoods	Total cropped area of household, ha	1.016	(0.015)	1.001	(0.041)	1.042	(0.063)
	Livestock owned, TLU	1.001	(0.016)	0.999	(0.021)	1.033	(0.040)
	One + member has wage employment, 0/1	1.092	(0.205)	0.496***	(0.110)	0.971	(0.402)
	Has at least one household enterprise, 0/1	0.803*	(0.098)	0.518***	(0.095)	1.008	(0.256)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']						
	No formal education, 0/1	0.571*	(0.189)	0.431*	(0.211)	0.687	(0.520)
	Some primary, 0/1	0.668**	(0.105)	0.674*	(0.136)	1.636	(0.544)
	Beyond secondary, 0/1	0.918	(0.155)	1.014	(0.236)	1.108	(0.393)
Commercialization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']						
	No sales of crops produced, 0/1	0.645***	(0.102)	--	--	--	--
	Sold more than one-third value of crops, 0/1	0.945	(0.139)	--	--	--	--
Agricultural	Agric. extension contact past season, 0/1	1.178	(0.308)	1.707**	(0.440)	0.473*	(0.201)
	Received loan of any kind, 0/1	0.753**	(0.107)	0.979	(0.187)	0.938	(0.287)
	Rented-in land, 0/1	1.257	(0.259)	1.271	(0.353)	1.197	(0.429)
	Hired-in labor, 0/1	1.473***	(0.194)	1.586**	(0.293)	1.360	(0.406)
	Purchased inorganic fertilizer, 0/1	1.634***	(0.253)	1.361*	(0.237)	0.863	(0.251)
	Purchased improved seed, 0/1	1.334**	(0.171)	1.359*	(0.240)	0.978	(0.247)
	Purchased pesticide, 0/1	1.579***	(0.253)	0.623***	(0.108)	0.796	(0.274)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.003	(0.005)	1.013*	(0.007)	1.009	(0.009)
	Population density, 100 persons per sq.km.	0.998	(0.003)	0.995	(0.004)	1.008	(0.006)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]						
	North East, 0/1	1.074	(0.364)	0.792	(0.263)	0.250***	(0.133)
	North West, 0/1	0.575*	(0.169)	0.976	(0.367)	0.539	(0.265)
	South East, 0/1	2.336***	(0.675)	3.333***	(1.308)	1.774	(0.938)
	South South, 0/1	0.327***	(0.097)	7.711***	(3.628)	3.685**	(2.226)
	South West, 0/1	0.542*	(0.189)	13.296***	(6.489)	10.073***	(8.596)
Constant		0.621	(0.276)	0.413	(0.269)	0.397	(0.322)
Observations		2,352		1,160		551	
Model p-value		0.0000		0.0000		0.0002	
pseudo-R ²		0.115		0.150		0.158	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table 3: Rice – factors associated with household production and sales

Explanatory variables		Produce rice		Sold rice, if produced	
		Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	0.995	(0.027)	0.984	(0.057)
	Workers : household members, ratio	0.612	(0.329)	0.987	(1.024)
	Female headed household, 0/1	0.729	(0.208)	2.944	(2.974)
	Age HH head [base: '35 to 64 years, 0/1']				
	Less than 35 years, 0/1	1.044	(0.206)	0.604	(0.291)
	65 years or older, 0/1	0.931	(0.314)	2.121	(2.164)
Assets and livelihoods	Total cropped area of household, ha	1.200***	(0.083)	1.497**	(0.246)
	Livestock owned, TLU	0.999	(0.010)	0.999	(0.014)
	One + member has wage employment, 0/1	0.898	(0.227)	0.147**	(0.109)
	Has at least one household enterprise, 0/1	0.808	(0.168)	0.228***	(0.110)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']				
	No formal education, 0/1	0.558	(0.207)	0.441	(0.314)
	Some primary, 0/1	0.654*	(0.149)	0.547	(0.265)
	Beyond secondary, 0/1	0.842	(0.220)	0.873	(0.505)
Commercial-ization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']				
	No sales of crops produced, 0/1	0.773	(0.184)	--	--
	Sold more than one-third value crops, 0/1	1.407*	(0.256)	--	--
Agricultural	Agric. extension contact past season, 0/1	0.802	(0.316)	2.549	(1.792)
	Received loan of any kind, 0/1	1.254	(0.250)	1.249	(0.596)
	Rented-in land, 0/1	1.954**	(0.636)	1.769	(1.119)
	Hired-in labor, 0/1	1.041	(0.259)	1.662	(0.650)
	Purchased inorganic fertilizer, 0/1	1.146	(0.288)	1.375	(0.608)
	Purchased improved seed, 0/1	0.790	(0.210)	0.755	(0.332)
	Purchased pesticide, 0/1	2.473***	(0.656)	0.936	(0.448)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.000	(0.006)	0.999	(0.009)
	Population density, 100 persons per sq.km.	0.997	(0.004)	0.980	(0.014)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]				
	North East, 0/1	1.451	(0.528)	1.142	(0.617)
	North West, 0/1	1.330	(0.539)	4.977**	(3.503)
	South East, 0/1	0.464	(0.294)	4.464	(4.892)
	South South, 0/1	0.080***	(0.062)	0.830	(1.102)
	South West, 0/1	--	--	--	--
Constant		0.106***	(0.062)	0.970	(1.195)
Observations		2,180		250	
Model p-value		0.0000		0.2380	
pseudo-R ²		0.154		0.199	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Note: A model for sales of more than half of rice production is not presented due to poor model performance: observations = 136; Prob > F = 0.6102; and pseudo-R² of 0.221.

Appendix Table 4: Sorghum – factors associated with household production, sales, and high sale levels

Explanatory variables		Produce sorghum		Sold sorghum, if produced		Sold more than half of sorghum, if sold any	
		Odds-ratio	s.e.	Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	1.003	(0.026)	0.945	(0.041)	1.129	(0.086)
	Workers : household members, ratio	0.507	(0.217)	0.130**	(0.120)	9.766	(21.74)
	Female headed household, 0/1	0.695	(0.180)	0.815	(0.486)	0.271	(0.371)
	Age HH head [base: '35 to 64 years, 0/1']						
	Less than 35 years, 0/1	0.748	(0.147)	0.682	(0.239)	1.018	(0.700)
	65 years or older, 0/1	1.176	(0.264)	1.323	(0.414)	3.672	(3.485)
Assets and livelihoods	Total cropped area of household, ha	1.181***	(0.069)	1.058	(0.049)	0.979	(0.119)
	Livestock owned, TLU	1.003	(0.032)	0.976	(0.049)	1.399**	(0.228)
	One + member has wage employment, 0/1	0.930	(0.234)	0.347**	(0.164)	0.587	(0.977)
	Has at least one household enterprise, 0/1	1.215	(0.221)	0.298***	(0.073)	1.144	(0.892)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']						
	No formal education, 0/1	4.177***	(1.535)	0.660	(0.416)	2.677	(2.698)
	Some primary, 0/1	1.403*	(0.262)	0.669	(0.169)	4.515*	(3.698)
	Beyond secondary, 0/1	0.649*	(0.149)	0.924	(0.374)	0.441	(0.489)
Commercial-ization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']						
	No sales of crops produced, 0/1	0.619**	(0.136)	--	--	--	--
	Sold more than one-third value crops, 0/1	0.313***	(0.069)	--	--	--	--
Agricultural	Agric. extension contact past season, 0/1	1.868**	(0.530)	2.611**	(1.059)	4.177	(3.825)
	Received loan of any kind, 0/1	1.749**	(0.438)	1.309	(0.423)	1.675	(1.307)
	Rented-in land, 0/1	1.149	(0.450)	1.167	(0.477)	24.80***	(21.81)
	Hired-in labor, 0/1	1.014	(0.214)	0.904	(0.285)	0.988	(0.546)
	Purchased inorganic fertilizer, 0/1	0.944	(0.178)	1.287	(0.386)	0.195**	(0.131)
	Purchased improved seed, 0/1	1.069	(0.203)	0.982	(0.287)	0.238**	(0.165)
	Purchased pesticide, 0/1	0.926	(0.163)	1.862**	(0.526)	0.376	(0.270)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.010	(0.006)	1.004	(0.009)	1.022	(0.013)
	Population density, 100 persons per sq.km.	1.004	(0.003)	0.999	(0.004)	1.010**	(0.004)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]						
	North East, 0/1	2.590***	(0.791)	1.213	(0.584)	0.089**	(0.088)
	North West, 0/1	4.979***	(1.492)	1.632	(0.847)	0.644	(0.532)
	South East, 0/1	--	--	--	--	--	--
	South South, 0/1	--	--	--	--	--	--
	South West, 0/1	0.016***	(0.018)	10.214	(15.46)	--	--
Constant		0.587	(0.340)	0.769	(0.673)	0.059*	(0.097)
Observations		1,499		843		149	
Model p-value		0.0000		0.0002		0.2726	
pseudo-R ²		0.310		0.110		0.309	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table 5: Millet – factors associated with household production and sales

Explanatory variables		Produce sorghum		Sold millet, if produced	
		Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	1.045	(0.030)	0.931	(0.049)
	Workers : household members, ratio	0.550	(0.298)	0.029***	(0.032)
	Female headed household, 0/1	0.768	(0.204)	--	--
	Age HH head [base: '35 to 64 years, 0/1']				
	Less than 35 years, 0/1	0.603**	(0.125)	1.316	(0.513)
	65 years or older, 0/1	1.304	(0.378)	2.291**	(0.860)
Assets and livelihoods	Total cropped area of household, ha	0.994	(0.050)	0.888	(0.140)
	Livestock owned, TLU	1.017	(0.024)	1.060	(0.037)
	One + member has wage employment, 0/1	0.695	(0.182)	0.382	(0.318)
	Has at least one household enterprise, 0/1	1.421*	(0.293)	0.378***	(0.132)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']				
	No formal education, 0/1	3.732***	(1.353)	0.967	(0.566)
	Some primary, 0/1	1.761***	(0.382)	0.656	(0.215)
	Beyond secondary, 0/1	1.021	(0.278)	0.712	(0.444)
Commercialization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']				
	No sales of crops produced, 0/1	1.353	(0.305)	--	--
	Sold more than one-third value crops, 0/1	0.487***	(0.119)	--	--
Agricultural	Agric. extension contact past season, 0/1	1.298	(0.455)	1.946	(0.865)
	Received loan of any kind, 0/1	1.617*	(0.445)	1.859	(0.737)
	Rented-in land, 0/1	0.221***	(0.105)	1.397	(1.298)
	Hired-in labor, 0/1	0.855	(0.164)	0.623	(0.248)
	Purchased inorganic fertilizer, 0/1	0.950	(0.188)	0.881	(0.381)
	Purchased improved seed, 0/1	0.720*	(0.136)	1.583	(0.525)
	Purchased pesticide, 0/1	0.445***	(0.101)	5.033***	(1.917)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.002	(0.007)	0.985	(0.011)
	Population density, 100 persons per sq.km.	1.003	(0.004)	1.002	(0.002)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]				
	North East, 0/1	4.163***	(1.731)	1.259	(1.003)
	North West, 0/1	10.206***	(3.695)	0.714	(0.607)
	South East, 0/1	--	--	--	--
	South South, 0/1	--	--	--	--
	South West, 0/1	--	--	--	--
Constant		0.127***	(0.079)	2.122	(2.642)
Observations		1,327		473	
Model p-value		0.0000		0.0038	
pseudo-R ²		0.244		0.176	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Note: A model for sales of more than half of millet production is not presented due to poor model performance: observations = 72; Prob > F = 0.3402; and pseudo-R² of 0.532.

Appendix Table 6: Cowpea – factors associated with household production and sales

Explanatory variables		Produce cowpea		Sold cowpea, if produced	
		Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	0.970	(0.025)	0.966	(0.032)
	Workers : household members, ratio	0.837	(0.303)	0.356	(0.294)
	Female headed household, 0/1	0.912	(0.272)	1.893	(0.922)
	Age HH head [base: '35 to 64 years, 0/1']				
	Less than 35 years, 0/1	0.633***	(0.093)	0.813	(0.199)
	65 years or older, 0/1	0.782	(0.155)	1.145	(0.406)
Assets and livelihoods	Total cropped area of household, ha	1.048*	(0.026)	1.187**	(0.080)
	Livestock owned, TLU	0.996	(0.013)	1.104***	(0.034)
	One + member has wage employment, 0/1	1.175	(0.282)	0.675	(0.248)
	Has at least one household enterprise, 0/1	0.895	(0.141)	0.693	(0.154)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']				
	No formal education, 0/1	2.748***	(0.893)	0.406**	(0.157)
	Some primary, 0/1	1.693***	(0.318)	0.792	(0.197)
	Beyond secondary, 0/1	1.132	(0.276)	0.434**	(0.176)
Commercialization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']				
	No sales of crops produced, 0/1	0.898	(0.189)	--	--
	Sold more than one-third value crops, 0/1	0.522***	(0.087)	--	--
Agricultural	Agric. extension contact past season, 0/1	0.998	(0.257)	1.072	(0.481)
	Received loan of any kind, 0/1	0.906	(0.201)	0.970	(0.296)
	Rented-in land, 0/1	0.891	(0.271)	0.628	(0.308)
	Hired-in labor, 0/1	0.995	(0.198)	0.756	(0.142)
	Purchased inorganic fertilizer, 0/1	0.903	(0.153)	1.369	(0.345)
	Purchased improved seed, 0/1	1.030	(0.173)	1.213	(0.252)
	Purchased pesticide, 0/1	1.385	(0.289)	0.895	(0.244)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.008	(0.006)	1.005	(0.006)
	Population density, 100 persons per sq.km.	1.004	(0.004)	0.999	(0.002)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]				
	North East, 0/1	6.415***	(2.037)	4.042***	(1.438)
	North West, 0/1	4.688***	(1.424)	1.107	(0.414)
	South East, 0/1	0.198***	(0.108)	0.687	(0.693)
	South South, 0/1	0.004***	(0.004)	--	--
	South West, 0/1	0.118***	(0.071)	0.212	(0.241)
Constant		0.251**	(0.135)	0.760	(0.480)
Observations		2,352		636	
Model p-value		0.0000		0.0008	
pseudo-R ²		0.352		0.132	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Note: A model for sales of more than half of cowpea production is not presented due to poor model performance: observations = 244; Prob > F = 0.7549; and pseudo-R² of 0.072.

Appendix Table 7: Groundnut – factors associated with household production and sales

Explanatory variables		Produce groundnut		Sold groundnut, if produced	
		Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	1.009	(0.028)	1.013	(0.059)
	Workers : household members, ratio	0.869	(0.389)	3.211	(2.946)
	Female headed household, 0/1	0.772	(0.235)	0.635	(0.466)
	Age HH head [base: '35 to 64 years, 0/1']				
	Less than 35 years, 0/1	0.631**	(0.125)	1.042	(0.443)
	65 years or older, 0/1	0.773	(0.199)	0.605	(0.360)
Assets and livelihoods	Total cropped area of household, ha	1.085**	(0.035)	1.171*	(0.096)
	Livestock owned, TLU	1.004	(0.013)	1.150**	(0.068)
	One + member has wage employment, 0/1	1.249	(0.346)	0.680	(0.510)
	Has at least one household enterprise, 0/1	1.630**	(0.327)	0.336*	(0.193)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']				
	No formal education, 0/1	2.163**	(0.690)	0.416	(0.230)
	Some primary, 0/1	1.193	(0.249)	1.970	(0.860)
	Beyond secondary, 0/1	0.716	(0.187)	0.953	(0.551)
Commercial-ization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']				
	No sales of crops produced, 0/1	0.651*	(0.146)	--	--
	Sold more than one-third value crops, 0/1	0.906	(0.179)	--	--
Agricultural	Agric. extension contact past season, 0/1	0.793	(0.221)	3.589**	(2.177)
	Received loan of any kind, 0/1	1.824***	(0.406)	1.027	(0.456)
	Rented-in land, 0/1	0.668	(0.232)	0.347	(0.281)
	Hired-in labor, 0/1	0.953	(0.164)	0.542*	(0.199)
	Purchased inorganic fertilizer, 0/1	1.066	(0.193)	0.989	(0.333)
	Purchased improved seed, 0/1	0.851	(0.139)	1.861*	(0.623)
	Purchased pesticide, 0/1	1.172	(0.262)	1.380	(0.374)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.003	(0.005)	1.009	(0.009)
	Population density, 100 persons per sq.km.	1.003	(0.004)	1.002	(0.002)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]				
	North East, 0/1	3.508***	(1.184)	1.674	(0.899)
	North West, 0/1	1.519	(0.533)	0.750	(0.496)
	South East, 0/1	0.053***	(0.043)	--	--
	South South, 0/1	0.038***	(0.027)	2.059	(3.526)
	South West, 0/1	0.139***	(0.099)	--	--
Constant		0.072***	(0.040)	0.427	(0.399)
Observations		2,352		261	
Model p-value		0.0000		0.0424	
pseudo-R ²		0.237		0.147	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Note: A model for sales of more than half of groundnut production is not presented due to poor model performance: observations = 124; Prob > F = 0.7182; and pseudo-R² of 0.179.

Appendix Table 8: Yam – factors associated with household production, sales, and high sale levels

Explanatory variables		Produce yam		Sold yam, if produced		Sold more than half of yam, if sold any	
		Odds-ratio	s.e.	Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	1.003	(0.026)	1.000	(0.030)	0.973	(0.044)
	Workers : household members, ratio	1.808*	(0.609)	1.361	(0.533)	0.444	(0.324)
	Female headed household, 0/1	0.611***	(0.100)	0.804	(0.212)	0.826	(0.311)
	Age HH head [base: '35 to 64 years, 0/1']						
	Less than 35 years, 0/1	0.850	(0.170)	1.350	(0.451)	1.020	(0.494)
	65 years or older, 0/1	0.983	(0.180)	0.975	(0.269)	1.571	(0.642)
Assets and livelihoods	Total cropped area of household, ha	0.968	(0.029)	1.053	(0.086)	0.812	(0.142)
	Livestock owned, TLU	1.008	(0.011)	1.044*	(0.027)	1.011	(0.028)
	One + member has wage employment, 0/1	0.985	(0.178)	0.656	(0.170)	0.242***	(0.103)
	Has at least one household enterprise, 0/1	0.829	(0.118)	0.763	(0.154)	1.791**	(0.507)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']						
	No formal education, 0/1	0.237***	(0.130)	0.299	(0.426)	0.346	(0.617)
	Some primary, 0/1	0.684**	(0.130)	0.770	(0.184)	0.744	(0.274)
	Beyond secondary, 0/1	0.863	(0.160)	1.418	(0.358)	0.987	(0.412)
Commercial-ization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']						
	No sales of crops produced, 0/1	0.478***	(0.081)	--	--	--	--
	Sold more than one-third value crops, 0/1	0.555***	(0.096)	--	--	--	--
Agricultural	Agric. extension contact past season, 0/1	0.525*	(0.194)	1.328	(0.479)	2.391	(1.438)
	Received loan of any kind, 0/1	1.089	(0.156)	1.105	(0.244)	0.744	(0.229)
	Rented-in land, 0/1	0.729	(0.169)	1.710*	(0.546)	1.422	(0.521)
	Hired-in labor, 0/1	1.328*	(0.218)	1.278	(0.294)	0.337**	(0.148)
	Purchased inorganic fertilizer, 0/1	0.536***	(0.103)	1.593*	(0.404)	1.542	(0.520)
	Purchased improved seed, 0/1	1.195	(0.167)	1.017	(0.211)	0.925	(0.290)
	Purchased pesticide, 0/1	2.023***	(0.372)	1.188	(0.292)	0.541*	(0.173)
Market access	Distance to nearest town with population of more than 20,000 persons, km	0.999	(0.007)	1.000	(0.010)	1.009	(0.011)
	Population density, 100 persons per sq.km.	1.003	(0.003)	0.996	(0.004)	1.003	(0.007)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]						
	North East, 0/1	0.044***	(0.022)	1.272	(0.764)	1.055	(0.764)
	North West, 0/1	0.052***	(0.034)	0.562	(0.342)	0.346	(0.304)
	South East, 0/1	1.909*	(0.630)	0.552	(0.233)	0.686	(0.326)
	South South, 0/1	0.714	(0.249)	1.326	(0.589)	2.291*	(1.106)
	South West, 0/1	0.492*	(0.204)	1.505	(0.910)	2.073	(1.272)
Constant		0.937	(0.510)	0.745	(0.488)	2.347	(1.872)
Observations		2,352		676		337	
Model p-value		0.0000		0.0144		0.0379	
pseudo-R ²		0.277		0.074		0.153	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table 9: Sweet potato – factors associated with household production

		Produce sweet potato	
Explanatory variables		Odds-ratio	s.e.
Demographic	Household size, no.	1.044	(0.039)
	Workers : household members, ratio	0.269*	(0.193)
	Female headed household, 0/1	1.947	(1.055)
	Age HH head [base: '35 to 64 years, 0/1']		
	Less than 35 years, 0/1	2.418*	(1.274)
	65 years or older, 0/1	0.634	(0.316)
Assets and livelihoods	Total cropped area of household, ha	0.785	(0.200)
	Livestock owned, TLU	0.984	(0.048)
	One + member has wage employment, 0/1	0.819	(0.585)
	Has at least one household enterprise, 0/1	0.198***	(0.111)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']		
	No formal education, 0/1	0.553	(0.381)
	Some primary, 0/1	1.206	(0.537)
	Beyond secondary, 0/1	0.450	(0.234)
Commercialization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']		
	No sales of crops produced, 0/1	1.841	(1.371)
	Sold more than one-third value crops, 0/1	5.164**	(3.421)
Agricultural	Agric. extension contact past season, 0/1	5.069**	(4.067)
	Received loan of any kind, 0/1	1.030	(0.630)
	Rented-in land, 0/1	0.307**	(0.174)
	Hired-in labor, 0/1	2.755*	(1.606)
	Purchased inorganic fertilizer, 0/1	1.370	(0.767)
	Purchased improved seed, 0/1	0.761	(0.286)
	Purchased pesticide, 0/1	0.918	(0.431)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.003	(0.013)
	Population density, 100 persons per sq.km.	0.981	(0.016)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]		
	North East, 0/1	- -	- -
	North West, 0/1	0.303	(0.259)
	South East, 0/1	1.148	(1.049)
	South South, 0/1	0.299	(0.340)
	South West, 0/1	0.128	(0.169)
Constant		0.011***	(0.015)
Observations		1,984	
Model p-value		0.0000	
pseudo-R ²		0.222	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Note: Models for any sales of sweet potato and for sales of more than half of sweet potato production are not presented due to poor model performance. Model on sales: observations = 34; Model on sales of more than half of sweet potato production: observations = 24.

Appendix Table 10: Cassava – factors associated with household production, sales, and high sale levels

Explanatory variables		Produce cassava		Sold cassava, if produced		Sold more than half of cassava, if sold any	
		Odds-ratio	s.e.	Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	0.962	(0.024)	1.015	(0.038)	0.903	(0.069)
	Workers : household members, ratio	1.088	(0.376)	2.825*	(1.562)	1.398	(1.113)
	Female headed household, 0/1	1.265	(0.232)	0.964	(0.245)	1.051	(0.469)
	Age HH head [base: '35 to 64 years, 0/1']						
	Less than 35 years, 0/1	0.653**	(0.131)	1.664	(0.600)	0.593	(0.265)
	65 years or older, 0/1	0.894	(0.180)	2.180**	(0.669)	2.192*	(0.975)
Assets and livelihoods	Total cropped area of household, ha	1.008	(0.028)	0.945*	(0.030)	1.031	(0.180)
	Livestock owned, TLU	0.982	(0.020)	0.921	(0.052)	1.086	(0.086)
	One + member has wage employment, 0/1	1.009	(0.264)	0.746	(0.218)	0.658	(0.390)
	Has at least one household enterprise, 0/1	1.097	(0.199)	0.663*	(0.159)	0.950	(0.348)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']						
	No formal education, 0/1	0.707	(0.530)	0.583	(0.703)	--	--
	Some primary, 0/1	1.134	(0.217)	0.856	(0.266)	0.755	(0.411)
	Beyond secondary, 0/1	1.007	(0.223)	0.938	(0.309)	0.721	(0.383)
Commercialization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']						
	No sales of crops produced, 0/1	0.356***	(0.068)	--	--	--	--
	Sold more than one-third value crops, 0/1	0.454***	(0.096)	--	--	--	--
Agricultural	Agric. extension contact past season, 0/1	0.817	(0.288)	6.007**	(4.201)	0.563	(0.522)
	Received loan of any kind, 0/1	1.618**	(0.310)	1.125	(0.292)	2.167	(1.012)
	Rented-in land, 0/1	1.597*	(0.382)	0.809	(0.268)	1.604	(0.806)
	Hired-in labor, 0/1	1.082	(0.195)	1.298	(0.340)	0.666	(0.260)
	Purchased inorganic fertilizer, 0/1	0.575***	(0.114)	1.538	(0.496)	0.375**	(0.172)
	Purchased improved seed, 0/1	0.805	(0.135)	1.029	(0.280)	1.523	(0.676)
	Purchased pesticide, 0/1	0.819	(0.151)	0.486***	(0.118)	1.693	(0.737)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.008	(0.007)	0.988	(0.010)	1.006	(0.016)
	Population density, 100 persons per sq.km.	1.003	(0.004)	1.000	(0.004)	0.994	(0.005)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]						
	North East, 0/1	0.177***	(0.107)	0.270	(0.227)	1.485	(1.559)
	North West, 0/1	0.090***	(0.034)	0.530	(0.528)	2.830	(3.452)
	South East, 0/1	0.544*	(0.183)	0.153***	(0.097)	0.288	(0.252)
	South South, 0/1	12.627***	(3.983)	0.172***	(0.089)	0.523	(0.329)
	South West, 0/1	0.641	(0.206)	0.475	(0.332)	2.006	(1.868)
Constant		0.698	(0.381)	2.385	(2.172)	1.149	(1.429)
Observations		2,352		512		215	
Model p-value		0.0000		0.0219		0.1619	
pseudo-R ²		0.378		0.115		0.125	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Appendix Table 11: Banana – factors associated with household production and sales

Explanatory variables		Produce banana		Sold banana, if produced	
		Odds-ratio	s.e.	Odds-ratio	s.e.
Demographic	Household size, no.	0.900***	(0.036)	1.213**	(0.106)
	Workers : household members, ratio	0.767	(0.473)	3.313	(4.836)
	Female headed household, 0/1	0.830	(0.225)	1.821	(1.234)
	Age HH head [base: '35 to 64 years, 0/1']				
	Less than 35 years, 0/1	1.008	(0.318)	1.206	(1.147)
	65 years or older, 0/1	0.988	(0.282)	2.242	(1.584)
Assets and livelihoods	Total cropped area of household, ha	1.007	(0.025)	0.692	(0.192)
	Livestock owned, TLU	1.013	(0.033)	0.963	(0.060)
	One + member has wage employment, 0/1	1.183	(0.332)	0.347	(0.260)
	Has at least one household enterprise, 0/1	1.165	(0.277)	1.204	(0.753)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']				
	No formal education, 0/1	0.377	(0.460)	--	--
	Some primary, 0/1	1.156	(0.368)	1.029	(0.721)
	Beyond secondary, 0/1	1.141	(0.296)	1.557	(0.873)
Commercialization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']				
	No sales of crops produced, 0/1	0.331***	(0.102)	--	--
	Sold more than one-third value crops, 0/1	0.526**	(0.138)	--	--
Agricultural	Agric. extension contact past season, 0/1	2.221**	(0.855)	1.000	(0.662)
	Received loan of any kind, 0/1	0.997	(0.252)	1.506	(0.941)
	Rented-in land, 0/1	0.849	(0.414)	0.095	(0.182)
	Hired-in labor, 0/1	0.668	(0.165)	0.752	(0.423)
	Purchased inorganic fertilizer, 0/1	0.532**	(0.156)	0.311	(0.329)
	Purchased improved seed, 0/1	0.717	(0.173)	1.565	(0.940)
	Purchased pesticide, 0/1	2.899***	(0.974)	2.678	(1.589)
Market access	Distance to nearest town with population of more than 20,000 persons, km	0.989	(0.014)	0.999	(0.032)
	Population density, 100 persons per sq.km.	0.992	(0.005)	0.992	(0.014)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]				
	North East, 0/1	0.089**	(0.109)	--	--
	North West, 0/1	--	--	--	--
	South East, 0/1	17.949***	(17.47)	1.108	(2.323)
	South South, 0/1	9.115**	(8.933)	1.967	(4.797)
	South West, 0/1	17.547***	(15.78)	1.881	(4.405)
Constant		0.079*	(0.105)	0.014	(0.038)
Observations		1,810		164	
Model p-value		0.0000		0.1140	
pseudo-R ²		0.236		0.142	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Note: A model for sales of more than half of banana production is not presented due to poor model performance: observations = 24.

Appendix Table 12: Cocoa – factors associated with household production

		Produce cocoa	
Explanatory variables		Odds-ratio	s.e.
Demographic	Household size, no.	0.792***	(0.049)
	Workers : household members, ratio	0.335**	(0.175)
	Female headed household, 0/1	0.409*	(0.204)
	Age HH head [base: '35 to 64 years, 0/1']		
	Less than 35 years, 0/1	0.140***	(0.064)
	65 years or older, 0/1	0.702	(0.227)
Assets and livelihoods	Total cropped area of household, ha	1.051*	(0.028)
	Livestock owned, TLU	0.697	(0.279)
	One + member has wage employment, 0/1	0.513	(0.220)
	Has at least one household enterprise, 0/1	1.050	(0.325)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']		
	No formal education, 0/1	- -	- -
	Some primary, 0/1	1.355	(0.492)
	Beyond secondary, 0/1	1.456	(0.572)
Commercial-ization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']		
	No sales of crops produced, 0/1	1.416	(1.172)
	Sold more than one-third value crops, 0/1	18.39***	(10.77)
Agricultural	Agric. extension contact past season, 0/1	3.271**	(1.947)
	Received loan of any kind, 0/1	1.753*	(0.525)
	Rented-in land, 0/1	1.285	(0.518)
	Hired-in labor, 0/1	0.382***	(0.126)
	Purchased inorganic fertilizer, 0/1	0.089***	(0.043)
	Purchased improved seed, 0/1	0.583	(0.217)
	Purchased pesticide, 0/1	23.22***	(15.43)
Market access	Distance to nearest town with population of more than 20,000 persons, km	0.966*	(0.019)
	Population density, 100 persons per sq.km.	0.997	(0.005)
Constant		0.066***	(0.058)
Observations		2,222	
Model p-value		0.0000	
pseudo-R ²		0.511	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10.

Note: Model for any sales of cocoa or for more than half of cocoa production are not presented due to poor model performance: cocoa sales: observations = 66; Prob > F = 0.0068; and pseudo-R² of 0.562; sales of more than half of cocoa production: observations = 40. As cocoa production was only reported by sample households in South West zone and by a few households in South South zone, zonal variables not included in the model.

Appendix Table 13: Soyabean – factors associated with household production

Explanatory variables		Produce soyabean	
		Odds-ratio	s.e.
Demographic	Household size, no.	1.005	(0.037)
	Workers : household members, ratio	1.098	(0.782)
	Female headed household, 0/1	1.411	(0.722)
	Age HH head [base: '35 to 64 years, 0/1']		
	Less than 35 years, 0/1	0.770	(0.186)
	65 years or older, 0/1	0.821	(0.274)
Assets and livelihoods	Total cropped area of household, ha	1.111***	(0.033)
	Livestock owned, TLU	1.008	(0.011)
	One + member has wage employment, 0/1	0.938	(0.298)
	Has at least one household enterprise, 0/1	0.688**	(0.130)
Education	Maximum educational attainment in household [base: 'Some secondary, 0/1']		
	No formal education, 0/1	0.386**	(0.178)
	Some primary, 0/1	0.612*	(0.175)
	Beyond secondary, 0/1	0.358***	(0.128)
Commercial-ization orientation	Comm. category. [base: 'Sold, but less than one-third value crops produced, 0/1']		
	No sales of crops produced, 0/1	0.738	(0.171)
	Sold more than one-third value crops, 0/1	0.904	(0.262)
Agricultural	Agric. extension contact past season, 0/1	0.906	(0.361)
	Received loan of any kind, 0/1	1.460	(0.501)
	Rented-in land, 0/1	0.613	(0.307)
	Hired-in labor, 0/1	2.360***	(0.718)
	Purchased inorganic fertilizer, 0/1	1.694*	(0.491)
	Purchased improved seed, 0/1	1.329	(0.322)
	Purchased pesticide, 0/1	1.292	(0.333)
Market access	Distance to nearest town with population of more than 20,000 persons, km	1.008	(0.007)
	Population density, 100 persons per sq.km.	0.998	(0.004)
Administrative / ecological	Geo-political zone [base: "North Central, 0/1"]		
	North East, 0/1	1.531	(0.804)
	North West, 0/1	3.284***	(1.384)
	South East, 0/1	--	--
	South South, 0/1	--	--
	South West, 0/1	0.364	(0.291)
Constant		0.019***	(0.015)
Observations		1,499	
Model p-value		0.0000	
pseudo-R ²		0.125	

Source: Weighted analysis of GHSP-3. *** p<0.01, ** p<0.05, * p<0.10

Note: Models for any sales of soyabean and for sales of more than half of soyabean production are not presented due to poor model performance:

model on sales: observations = 132; Prob > F = 0.8752; and pseudo-R² of 0.182;

model on sales of more than half of soyabean production: observations = 73; Prob > F = 0.9106; and pseudo-R² of 0.370.

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