Feed the Future Innovation Lab for Food Security Policy

Policy Research Brief 25 January 2017

Nigeria Agricultural Policy Project

Growth and Transformation of Food Systems in Africa: Evidence from the Poultry Value Chain in Nigeria*

Saweda Liverpool-Tasie, Bolarin Omonona, Awa Sanou, Wale Ogunleye, Samantha Padilla, and Thomas Reardon

Introduction

The domestic poultry subsector in Nigeria is experiencing a dynamic growth and transformation. In just one decade, the volume of feed used in Nigeria increased by 600% from 300 thousand to 1.8 million tons. Using data from multiple sources, this brief presents some key findings from an initial exploration of this dynamic subsector. We combine data from secondary sources including the United Nations' Comtrade data, FAO data and earlier empirical studies in Nigeria to information gathered through a rapid reconnaissance of the poultry subsector in the Ibadan area in 2015 and 2016[1] for our descriptive analysis. This is supported by an empirical analysis using a nationally representative panel dataset on agricultural production and household consumption in Nigeria in 2010 and 2012.

Policy Implications

- It is important that efforts towards addressing illegal smuggling of poultry products be accompanied with at least equal measures to ensuring the sustainable growth of domestic poultry production in the country.
- Given the predominance of small holder activity in the North, programs designed to help small chicken producers are at least as important in the North as in the South to address poverty and food security concerns.
- The boom in chicken and egg demand as incomes rise and urbanization proceeds is best availed where there is significant concentration of a relatively well-off middle class.

Key Findings

- Increased consumption of poultry products in Nigeria is occurring alongside rapid urbanization and growth in the industry.
- Illegal imports appear to be far smaller than commonly supported by conventional wisdom.
- The north has about 60% of the share of small farmers' chicken holdings versus 40% in the south. However, the majority of the rapidly increasing number of medium and large scale poultry farms tend to be located in the south west.
- Both consumption and production of chicken in southern Nigeria are concentrated near the major urban and peri-urban centers.
- There is active engagement in the Nigerian poultry sub sector by a much broader set of actors than traditionally perceived. Though facing different challenges and ability to maintain large bird holding sizes, females and males as well as the young and the old are currently actively involved in the sub-sector.
- There is a huge data gap in available field survey data on the poultry value chain in Nigeria. There is huge variation in the apparent organization and likely structure, conduct and performance of the poultry value chain in northern and southern Nigeria. However, there is limited information about the behavior of actors all along the value chain.

[1] This involved 10 visits to poultry farms (small, medium, and large) production and marketing operations and perceptions of in the Ibadan area where farm managers were interviewed about their the dynamics of the subsector over the last 15-20 years.

FEED THE FUTURE The U.S. Government's Global Hunger & Food Security Initiative
USAID FROM THE AMERICAN PEOPLE
MICHIGAN STATE UNIVERSITY
INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE IFPRI
FMARD FEDERAL MINISTRY OF AGRICULTURE AND RURAL DEVELOPMENT

- Further increase in demand for eggs and chickens with increased income and urbanization in Nigeria requires significant investment in rural infrastructure, probably especially rural feeder roads.
- Policies designed to support the successful participation of women and young adults have the potential to reduce youth unemployment, improve livelihoods, and reduce poverty rates.
- The growth of the sub-sector would benefit from a more nuanced approach in terms of the targeting of specific demographic groups.

The Nigerian Context

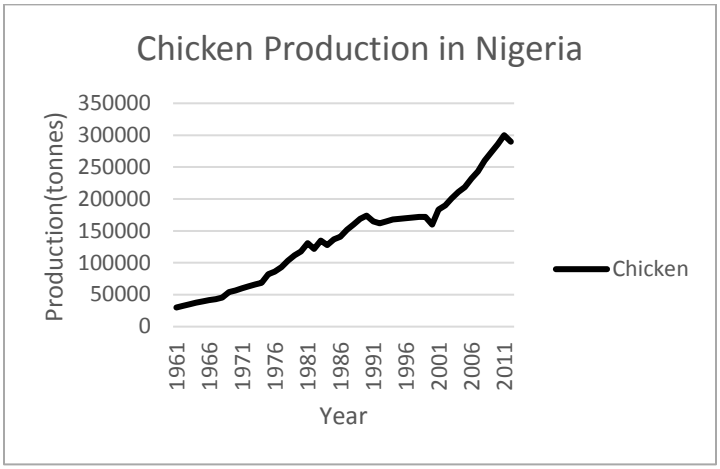
Urban and Rural Households' Diets Are Rapidly Transforming

Nigeria, like other countries in Sub Saharan Africa, is often perceived to have traditional food habits narrowly limited to grains, root staples, and sauces, with rural households relying mainly on home-consumption from own-farming but not market purchases. Yet, there is a clear trend of diversification beyond staples into horticulture, animal proteins, and dairy. Animal proteins alone account for about 15% and 20% of the food budget in rural and urban areas respectively. As incomes rise, it is expected that Nigerians will eat more red meat, chicken, and fish. According to Sahel Capital (2015) based on OECD data, Nigeria's poultry meat consumption per capita in 2014 was about 1.41kg (Our calculations from LSMS survey data put this at about 2kg in 2010). This compares to about 7kg in Ghana, over 30kg in South Africa, and over 40kg in the USA. Additionally, consumption patterns are not homogeneous across regions. Indeed, a look at the LSMS-ISA data reveals that the north consumes more chicken (about a third more) and (one fifth more) per person, but less eggs (one fifth less) and (two third less), compared with the South in 2010 and 2012 respectively.

Meeting Current and Future Meat Demand: Imports vs. Domestic Production

The increased consumption is occurring alongside rapid urbanization and growth in the industry. The country has two avenues to respond to increased meat consumption: imports and domestic production. Nigeria enacted a ban on the import of poultry products in 2003, although anecdotal and empirical evidences indicate that it still occurs. This implies that there is a huge potential for growth of the domestic poultry sub-sector as shown in Figure 1. Additional computations from the LSMS-ISA further demonstrate that egg output grew 300% (three-fold) from 1980 to 2012, while chicken output grew 220% (2.2 times) from 1980 to 2008.

Figure 1. Chicken Production in Nigeria



Source: Authors generated from FAOStat data. Notes: Chicken is defined as "Fresh, chilled or frozen. May include all types of poultry meat if national statistics do not report separate data" (FAOStat).

The Landscape of the Poultry Sub-sector

The Volume of the Feed Industry Skyrocketed as a Result of the Growth of the Poultry Sub-Sector

The volume of the industry grew from 300 thousand to 1.8 million tons—a 600% climb in just one decade (see Figure 2)! It is driven both by massive investments in large feed mills such as Chi Farms and Zartech in southwest Nigeria and in a growing number of small- and medium enterprises dispersed in chicken production areas (CAC 2016). Most of the maize (a key ingredient in feed) is produced in the north but serves feed mills across the entire nation.

Figure 2. Maize Use for Feed in Nigeria

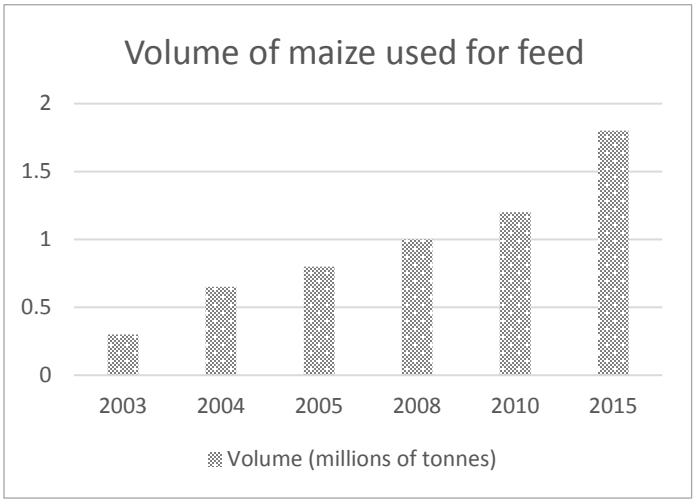
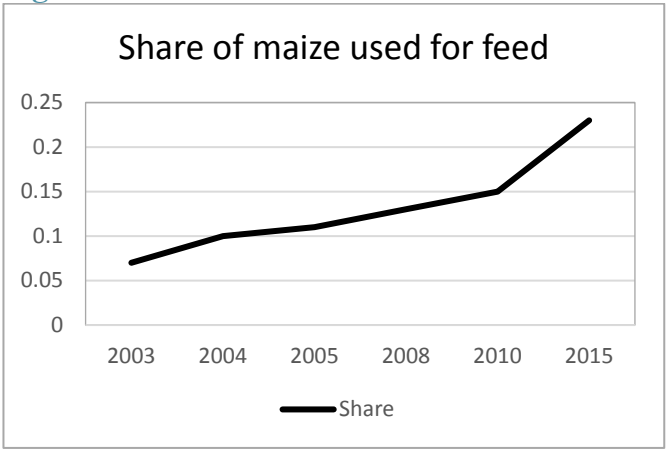


Figure 2. cont.



Source: Authors generated from United States Department of Agriculture (USDA).

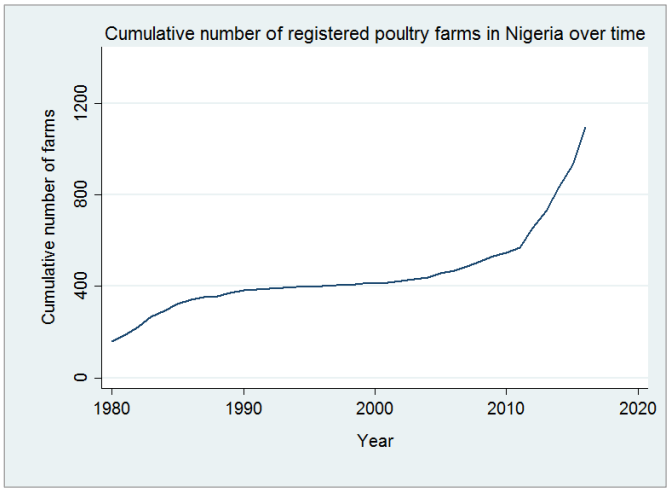
Imports Constitute a Far Smaller Proportion of Poultry Supply Than Purported by Conventional Wisdom

Contrary to the idea that Nigeria is inundated with illegal imports of poultry products, the study finds that domestic production is able to cover about 85% of domestic consumption, and (illegal) imports appear to likely be only about 15% of consumption. This finding is quite different from the Poultry Association of Nigeria, which claims that 800 million (frozen) chickens are smuggled per year into Nigeria (The Poultry Site 2015). This seems implausible for two reasons: first, 725 million is about two times higher than total estimated consumption of 360 million birds in 2012 per the LSMS-ISA data[2]; second, it seems logistically infeasible to smuggle such a large number of frozen birds over the border.

The North Has a Larger Share of Small Farmers' Holdings Compared to the South and Poultry Farming Is a Rural/Peri-Urban Activity

Though population shares of the six geopolitical zones in the country are roughly similar, the study shows that the north has about 60% of the small farmers' chicken holdings versus 40% in the south. This was surprising given the conventional wisdom that the majority of chicken production in Nigeria is in the southwest and the idea that as the north is poorer, it would have far lower holdings of chickens. However, we do find that the majority of the medium- and large-scale farms (which appear to be growing rapidly—see Figure 3) are largely in southwest Nigeria. The descriptive analysis further supports that 90% of the chickens are produced in rural areas and only 10% in urban areas.

Figure 3. Cumulative Number of Registered Poultry Farms in Nigeria over Time



Source: Authors generated from the Nigerian (CAC 2016) list of registered poultry farms in Nigeria. Note: Farms still undergoing registration are excluded. Note: The study relies on data available from the Nigerian Corporate Affairs Commission (CAC) to show that medium/large poultry farms had a brief emergence in the 1980s and stagnated for the 1990s and 2000s at about 400 farms. Then, around 2008, there was at first a gradual, and then from 2010, a steep take-off of farms to reach about 1,000 by 2015.

In the South, both Consumption and Production Are Relatively Spatially Concentrated in Urban and Peri-Urban Centers

In the south, the study finds evidence that both consumption and production are relatively spatially concentrated toward the big demand magnets of the urban and peri-urban areas. In particular, the share of chicken holdings plummet as one moves from near the town (at 40%) to about 25% far from the town. In contrast, the direction of this differentiation is reversed in the north—increasing from a share of total holdings of 27% near the town to about 40% far from the town.

While Adults between 35 and 60 Are the Most Active, the Involvement of Young Adults (24-35) Is Worthy of Attention

Across Nigeria, adults between ages of 35 and 60 are the most active age group in poultry farming. However, young adults (24-35) are quite active, accounting for between 15% and 20% of bird owners across both years in the north. As

[2] It is more than three times higher than the governments consumption projections of about 200 million birds based on data drawn from various sources including the federal ministry of agriculture and rural development, Nigerian Bureau of Statistics, Central Bank, commercial bank project analysis, FAO and USDA GAIN (FMARD 2016)

an aside note, the second most active age group in the south are those 60 years and over. The share of this age group engaged in poultry production in the south is almost double that of their northern counterparts. This indicates that poultry farming may be an attractive retirement activity in the south.

Female Participation in the Poultry Sector Is Substantial

More than 50% of the households engaged in poultry farming in the south are headed by female; much higher than in the north. However an important observation is that a significant proportion (50% or more) of smallholder female poultry farmers in Nigeria are not the heads of household and this is more pronounced in the northern part of the country where between about 60% and 90% of the female poultry farmers are not the heads of household.

Highlights from the Econometric Analysis

The study leverages on the panel structure of the LSMS-ISA data and a panel data double-hurdle model (see Box 1.) to more consistently identify key factors affecting engagement in the Nigerian sub-sector by various actors. Given the active participation of household members besides the head in the poultry sub-sector, we supplement an empirical analysis at the household level with an additional analysis of the determinants of the extent of engagement in poultry production in Nigeria at the *individual level.*

Households headed by young adults (25-34) and adults between 35 and 60 are more likely to engage in poultry farming compared to those in 15-24 years old range. This indicates that there is active participation among young adults in poultry production in this region. With increasing concerns about youth unemployment and the need to encourage the younger generation to engage in agriculture, these results indicate that the livestock sub-sector might be an avenue for promoting such engagement. An effort to understand the challenges faced by this specific group of actors in the sub-sector is thus, necessary to develop appropriate programs.

While female-headed households might be less likely to engage in poultry production, women as a whole are more likely to be engaged in the poultry sub-sector in Nigeria. Similarly, retired household members 60 years and above (not necessarily household heads) are more likely to be engaged in the sub-sector. The empirical results reveal significant differences between the determinants of engagement and extent of poultry production, in the north versus the south. For example, in northern Nigeria, while females are not significantly less likely to engage in poultry production compared to male-headed households, conditional on engaging in poultry production, they tend to hold significantly fewer birds. This indicates that while there might not be barriers to entry along gender lines, women likely face differential opportunities to grow their bird holdings, worthy of further exploration.

Box 1. A Technical Note on the Econometric Analysis

We model farmers' behavior using the traditional agricultural household model of Singh, Squire, and Strauss (1986). Households can be shown to make consumption and production decisions (including crop and livestock choices) as part of the solution to a constrained utility maximization problem given household resource constraints and prevailing prices.

Consequently, we can express the output supply function for the household as:

$$Q_{it} = f(P_{kt}, \boldsymbol{P_{at}}, \boldsymbol{Z_{it}}, \boldsymbol{K_{it}}) \quad (1)$$

Where Q_{it} refers to the quantity of chicken supplied to the market by household i in time t. P_{kt} refers to the price of chicken in Naira per chicken in time t, P_{at} is a vector of input prices in time t (including maize which is a key ingredient in chicken feed), $\boldsymbol{Z_{it}}$ is a vector of controls that are likely to affect the quantity of chicken produced such as household characteristics and production conditions. $\boldsymbol{K_{it}}$ is a vector of household income and asset endowment in time t.

The population model that we estimate follows the unobserved effects model in Wooldridge (2010). For a random draw in the cross section for observation i we estimate the following equation:

$$Y_{it} = \boldsymbol{X_{it}\beta} + v_{it}, \quad t = 1, \dots, T \quad (2)$$

$$v_{it} = c_i + u_{it} \quad (3)$$

where Y_{it} represents the total number of bird holdings in household i in time t. $\boldsymbol{X_{it}}$ represents a vector of observable explanatory variables that affect household's decision to engage in the poultry sub-sector such as the market price for chickens and other household specific factors. The error term v_{it} is composed of two parts; unobserved heterogeneity (c_i), which reflects time invariant factors such as household preferences and ability that affect

individual's production decisions and u_{it} which are the unobserved time-varying shocks affecting poultry production. $\boldsymbol{\beta}$ is a vector of parameters to be estimated.

It is highly probable that these time invariant unobserved characteristics (c_i) are correlated with some of the observed variables included as explanatory variables in our model. For example, an unobserved characteristic such as farmer's ability or social network likely affects their access to extension services (an explanatory variable for livestock production) as well as their productivity and extent of engagement in poultry production. As such, we need to allow for "arbitrary correlation between the unobserved effect, c_i and the observed explanatory variables$\boldsymbol{X_{it}}$" (Wooldridge 2010). If we use ordinary least squares (OLS) estimation method to find the determinants of production in (2), the estimated parameters would be inconsistent. A fixed effects (FE) estimation method or a Correlated Random Effects (CRE) estimation method can be used to correct for such endogeneity introduced by the time invariant characteristics (Wooldridge 2010). The FE estimation ensures consistency of the estimated parameters by controlling for unobserved characteristics within a household in a given year.

One disadvantage of the FE estimation is that we cannot recover the coefficient on key time invariant observable characteristics that explain production decisions such as farmer geographic location or cultural preferences. Furthermore, FE with non-linear models are known to produce inconsistent estimates as they treat the unobserved effects c_i as N parameters to estimate, leading to the incidental parameters problem (for fixed T). However, CRE models deal effectively with time invariant unobserved heterogeneity in both linear and non-linear panel data method and allow us to recover the coefficient of time invariant characteristics. Furthermore, Wooldridge (2010) argues that the CRE estimation is preferred over the FE estimation in the case of nonlinear models generally. We adopt the CRE method since it allows us to deal effectively with unobserved time invariant factors and estimate coefficients on time invariant observed variables (Wooldridge 2010).

Another challenge associated with estimating the extent of engagement in poultry production is that a significant number of the households in Nigeria do not have any bird holdings. While a Heckman selection approach might be considered appropriate in this context where many households report owning zero chickens, the Heckman approach is intended for situations where the zero chicken holdings are unobserved values, such as in the case of wage rate models where the sample includes unemployed persons. In this situation, a corner solution model is more appropriate than a selection model since the opportunity to own chickens is open to all, but likely due to market and agronomic conditions, many households choose not to hold any birds. Thus, the zeros in the data reflect households' optimal choice rather than a missing value. Therefore, this paper uses the Double Hurdle (DH) model proposed by Cragg (1971) to address situations such as ours with a corner solution.

Consequently, we model hurdle 1 to capture the factors that affect a farmer's decision to engage in poultry production or not and if he or she decides to produce chickens, hurdle 2 considers the number of birds held. The maximum likelihood estimator (MLE) in the first hurdle can be obtained using a probit estimator. Then the MLE for hurdle 2 can be estimated from a truncated normal regression. We apply this within the context of panel data to get consistent parameters. Consequently, the first hurdle is estimated using the CRE Probit model. Each regression equation includes a set of explanatory variables as well as the time averages of the explanatory variables. The second stage is estimated using a CRE truncated normal regression where the time variables of all explanatory variables are also included as additional controls in the second stage regressions.

The Way Forward

The diverse set of actors in the poultry sub-sector calls for a more nuanced approach to supporting the sector's growth. Further analysis is necessary to understand the differential factors affecting the successful participation of various specific population groups in Nigeria. This will be critical to develop appropriate strategies to support the sub-sector. Finally, this study confirms that there is a huge data gap and variation in the apparent organization and likely structure, conduct, and performance of the poultry value chain in northern and southern Nigeria. A better understanding of the behavior of actors all along the value chain for accurate policy analysis requires the collection of more data. Consequently, next steps include the design and implementation of *stacked surveys* where data will be systematically collected from representative samples along all the segments of the chicken and eggs value chains in Nigeria.

References

Corporate Affairs Commission. 2016. Registered Farms Directory. Retrieved on October 10, 2016 from http://publicsearch.cac.gov.ng:8080/comsearch/test.php.

Cragg, J.G. 1971. Some Statistical Models for Limited Dependent Variables with Application to the Demand for Durable Goods. *Econometrica* 39.5: 829-844.

FAOSTAT. Statistical Database. Retrieved on September 15, 2016 from http://faostat3.fao.org/home/.

Federal Ministry of Agriculture and Rural Development (FMARD). 2016. Agricultural Road Map for Nigeria. Government official document. Abuja: FMARD.

LSMS-ISA. Nigeria Data. Retrieved on September 6, 2016 from http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/EXTLSMS/0,,contentMDK:23635560~pagePK:64168445~piPK:64168309~theSitePK:3358997,00.html.

Singh, I., Lynn Squire, and John Strauss (eds). 1986. Agricultural Household Models. Baltimore. MD: The Johns Hopkins University Press.

The Poultry Site. 2015. "Nigeria Poultry Industry Faces Losses from Smuggling." May 28, 2015. The Poultry Site. Retrieved on October 20, 2016 from http://www.thepoultrysite.com/poultrynews/35148/nigeria-poultry-industry-faces-losses-from-smuggling/.

Sahel Capital Newsletter. 2015. "An Assessment of the Nigerian Poultry Sector." No. 11. Lagos, Nigeria. Retrieved on September 27, 2016 from http://www.sahelcp.com/files/Sahel%20Newsletter,%20Volume%2011.pdf.

UN Comtrade. International Trade Statistics Database. Retrieved on September 28, 2016 from http://comtrade.un.org/.

USDA. Several Years. Global Agricultural Information Network (GAIN) Reports for Several Years. Washington, DC: USDA.

Wooldridge, J.M. 2010. Correlated Random Effects Models with Unbalanced Panels. East Lansing: MSU.

* This brief is based on Liverpool-Tasie S., B.T. Omonona, A. Sanou, W.O. Ogunleye, S. Padilla, and T. Reardon. 2016. *Growth and Transformation of Chicken and Eggs Value Chains in Nigeria.* Feed The Future Nigeria Agricultural Policy Project Report No.2. East Lansing: Michigan State University.

About authors

Liverpool-Tasie is Assistant Professor at Michigan State University (MSU); Omonona is Professor at University of Ibadan; Sanou and Padilla are PhD students at MSU; Ogunleye is a PhD student at the University of Ibadan, Nigeria; Thomas Reardon is Professor, Distinguished Faculty and AAEA Fellow at MSU.

This Research Paper was prepared for USAID/Nigeria by Michigan State University (MSU), Federal Ministry of Agriculture and Rural Development (Nigeria), and the International Food Policy Research Institute (IFPRI) under the USAID/Nigeria funded Food Security Policy Innovation Lab Associate Award, contract number AID1-620-LA-15-00001.

This research is made possible by the generous support of the American people through the United States Agency for International Development (USAID) under the Feed the Future initiative. The authors wish to thank Patricia Johannes of MSU for her formatting and editing assistance. The contents are the responsibility of study authors and do not necessarily reflect the views of USAID or the United States Government.

Published by the Department of Agricultural, Food, and Resource Economics, Michigan State University, Justin S. Morrill Hall of Agriculture, 446 West Circle Dr., Room 202, East Lansing, Michigan 48824