Differences in peri-urban and rural farm production decisions amid policy change in Nigeria

Differences in Peri-Urban and Rural Farm Production Decisions Amid Policy Change in Nigeria

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A B S T R A C T

Enhancing productivity and profitability of farm households were key focuses among Nigerian agricultural policymakers in their design of the Agricultural Transformation Agenda (ATA) of 2011 – 2015. There were several prominent policy initiatives and market development activities included in the ATA. The main direct effects of implementing them were increased public expenditures on subsidized fertilizer and seeds and increased average productivity among subsidy recipients. There were also indirect effects pertaining to greater awareness of agricultural development initiatives among the public and increased farm input availability. However, due to relatively greater physical and transportation infrastructure in urban relative to urban areas, we hypothesized in this that farm households in peri-urban regions nearest to markets were better positioned to benefit from such initiatives than were rural farm households. The empirical analysis in this article estimates differences among peri-urban versus rural farm households regarding their crop produce marketing and farm input purchase decisions during the period of ATA policy implementation. The results support the hypothesis that peri-urban farm households increased purchases of farm inputs to a greater degree than did rural farm households as well as crop sales values, but data limitations do not allow for determining causal reason for relatively higher crop sales values. Overall, the policy and market development activities appear to have achieved some intended outcomes among farm households in both peri-urban and rural areas, but that the impacts were most pronounced among households nearest to markets.

Keywords: Peri-urban, rural, farm household, agricultural markets, agricultural policy, Nigeria

1. Introduction

Policy mechanisms that can improve agricultural productivity in Sub-Saharan Africa (SSA), including the focus country of Nigeria, remain needed to improve the livelihoods and well-being of smallholder farmers and agricultural sector stakeholders. The main goal of the Nigerian Federal Ministry of Agriculture and Rural Development (FMARD) policy strategy called the Agricultural Transformation Agenda (ATA) of 2011 – 2015 was to enhance performance of agricultural businesses throughout the supply chains, including farmers, input dealers, and processors (FMARD, 2011). Regarding implementation, the ATA included a subsidy program called the Growth Enhancement Scheme (GES), which provided recipients with subsidized fertilizer and seeds that were distributed via independent input dealers (Liverpool-Tasie and Takeshima, 2013; Wossen et al., 2017; Benjamin et al., 2021). Implementation of the GES resulted in a relatively substantial increase in public expenditures on fertilizer, seeds, and other resources needed to facilitate the program (Nwoko et al., 2018). Other elements of the ATA were more indirect market development activities, including encouraging the usage of cassava flour in place of some imported wheat (Oxford Business Group, 2012) and facilitating investment in food processing via such initiatives as establishing Staple Crop Processing Zones (SCPZs) in regions of prominent crop production (FMARD, 2011).

However, the context regarding physical and transportation infrastructure is important for forming hypotheses regarding the effects of these policy initiatives and market development activities on stakeholder decisions and behavior. Most SSA countries, including Nigeria, are broadly characterized by a substantial infrastructural gap between urban and rural areas. Specifically, high-quality roads, electricity, and communications networks are most widely available in urban areas and rarely available in rural areas in SSA (McCormick, 1999).

Such infrastructural development advantages for urban areas can provide farmers and allied entities that are located nearby with benefits such as greater access to markets to sell their produce and purchase inputs needed for production, cheaper distribution, and better-quality storage for inventory management. Recent studies have found that such amenities translate into increased productivity. For example, Vandercasteelen et al. (2021) found that increased investment in milk processing facilities in the areas near Addis Ababa, Ethiopia was associated with substantial productivity increases among nearby dairy producers. Similar results have been found more broadly regarding relatively higher productivity and input usage among SSA farmers near urban areas than in rural areas due to better infrastructural and associated advantages (Damania et al., 2017; Vandercasteelen et al., 2018).

In this study, we hypothesized that such infrastructural and geographical context is important for interpreting the effects of policy and market development activity implementation among SSA governments. Our main hypothesis is that the infrastructural and associated advantages in urban areas led to greater policy "transmission" among peri-urban farmers than among more rural farmers. That is, the enhanced availability and affordability of farm inputs (e.g., herbicides) associated with implementation of the GES program are most likely translated into relatively greater purchases among peri-urban farm households than was the case for rural households.

In the empirical analysis we estimate the changes in the farm household crop sales values and purchases of farm inputs including fertilizer, herbicides, pesticides, and seeds and rentals of animal traction or farm machinery using data from the Living Standards Measurement Study Integrated Surveys on Agriculture (LSMS-ISA) program. The data used are for a survey wave conducted in 2012/13 and another one from 2015/16. Thus, the dataset period of 2012 – 2016

corresponds very closely with the dissemination and implementation of the ATA from 2011 – 2015. Against this background, the principal contribution of this study is that it provides evidence that the physical and transportation infrastructure advantages of urban areas result in policy initiatives reaching peri-urban recipients relative to those in rural areas.

2. Literature Review: Agricultural Policy in Nigeria and the Urban-Rural Divide in Sub-Saharan African Economic Development

Two contextual phenomena that underly the analysis in this study are the current institutional and physical infrastructure and recent agricultural policy interventions in SSA. While this analysis is focused on occurrences in Nigeria, there are similarities across countries throughout the continent regarding an economic structure characterized by a major infrastructure investment advantage in urban relative to rural areas (McCormick, 1999) and a renewed focus on agricultural policy implementation since 2000 (Malabo Montpellier Panel, 2021). We discuss key elements of the context of broader economic infrastructure in most SSA countries first.

2.1 Urban-Rural Divide in Sub-Saharan African Economic Development

The potential economic benefits of greater concentration of infrastructural development in urban areas relative to rural areas in SSA can be explained by theoretical logic and empirical evidence expounded in the literature pertaining to economic clustering and industrial policy.

Over a century ago, Marshall (1920) described the benefits of economic clustering to include the emergence of beneficial externalities associated with agglomeration, including the pooling of skilled labor, improved access to input and output markets, and knowledge and technology spillovers. Following along this logic, Krugman (1991) used empirical examples to portray how industry clusters are established in certain geographic locations, and how the establishment of one firm and the associated acquisition of labor and inputs and distribution of

outputs can create incentives for firms in the same industry to follow to take advantage of the just described benefits.

The logic of economic clustering can help explain industrial characteristics of the agricultural sector in SSA. Specifically, concentration of food processing and food commodity storage infrastructure in urban areas is common (Jayne, 1994). Additionally, McCormick (1999) argued persuasively that the benefits of clustering are likely relatively even more pronounced in SSA than other regions because electricity and high-quality transportation networks do not presently extend far beyond urban areas.

Results from several recently published papers demonstrate that the establishment of industrial clusters in certain geographic locations, and, specifically near urban areas, can influence production and productivity of farm households in the region. First, Damania et al. (2017) found that distance to urban areas among farm households in Nigeria is a key predictor of usage of modern farm inputs and practices. Vandercasteelen et al. (2018) explain that such proximity is important for influencing farm behavior because of improved access to inputs and more robust information sharing networks. Improved access to inputs is only one aspect that explains the linkages. Swinnen and Kuijpers (2019) describe how the overall development of a value chain in which urban food processors uptake outputs from farms is also a key driver of increased use of modern inputs and practices among farm households. Vandercasteelen et al. (2021) provide persuasive evidence that direct linkages between producers and processors, such as through formal or informal purchasing agreements, and not just indirect effects of proximity, explained adoption of productivity enhancing farm management practices among Ethiopian milk producers near Addis Ababa.

Regarding industrial policy, governments, including those in Nigeria and elsewhere in SSA, have in several instances used public resources to either directly building of transportation and facility infrastructure for manufacturing within a particular region or incentivizing private investment for the same via tax breaks, subsidies, and/or regulatory assurances. Such geographically concentrated investment areas that are facilitated by or with governments are commonly referred to as "Special Economic Zones" (SEZs) (UNCTAD, 2019). Evidence suggests that the best performing SEZs are those located near urban areas, presumably for the same reasons as discussed from economic clustering and associated spillover effects (Frick and Rodríguez-Pose, 2019). In the Nigeria case, where several SEZs are in or near the major commercial center of Lagos, there is evidence that provision of infrastructural and regulatory incentives the by federal and state governments have helped spur investments by private entities in several SEZs (Zeng, 2012).

In summary, the current industrial structure of many economies in SSA is characterized by substantially greater infrastructural investment in urban relative to rural areas due to agglomeration benefits. Additionally, governments have commonly played a direct role in forming this economic structure, with a principal example of such being in establishing SEZs. Within this context, governments of SSA countries have recently displayed a renewed interest in enhancing growth in the agricultural sector (Malabo Montpellier Panel, 2021). We next discuss the initiatives of Nigerian agricultural policymakers since 2010 that were implemented within the context of better transportation and facility infrastructure in urban relative to rural areas.

2.2 Nigerian Agricultural Policy from 2010 to 2020

The Agricultural Transformation Agenda (ATA) was the primary policy strategy of the Nigerian Federal Ministry of Agriculture and Rural Development (FMARD) between 2011 – 2015. The

main goal of the policy was to enhance agricultural commercialization (FMARD, 2011; Liverpool-Tasie and Takeshima, 2013). At the heart of the ATA was also the promotion of agriculture as a business, enhancing private sector investment in agriculture, reducing post-harvest losses as well as encouraging value addition. It also sought to enhance access to financial services and markets, especially among the most vulnerable (women and youth), as well as to develop rural infrastructure and institutions (FMARD, 2011; Babu et al., 2018). Specific indicators included in the policy strategy signaling achievement of this broader goal included greater usage of improved inputs (seed and fertilizer) among farm households, enhanced development of agricultural supply chains for both farm inputs and outputs, which included establishment of SCPZs for select crops, and increased farm productivity and overall production (FMARD, 2011).

The diagram in Figure 1 includes a list of the main policy initiatives implemented during the ATA period, and what the authors view as the main policies and market development activities associated direct and indirect effects of such policies. The two most direct policies implemented as part of the ATA were a fertilizer and seed subsidy program known as the Growth Enhancement Scheme (GES) and imposition of higher tariffs on rice imports. The GES scheme was designed to provide farmers greater access to and reduce the cost of fertilizer and seeds (specifically maize) via distribution through private agribusiness firms (Liverpool-Tasie and Takeshima, 2013; Wossen et al., 2017; Benjamin et al., 2021). The imposition of higher tariffs on rice were designed to protect and expand the operations of local rice processors, which indirectly could have increased local marketing opportunities for Nigerian rice farmers (Johnson et al., 2013). Our focus for this analysis is more so on the GES scheme than the tariff policy

since there is greater ability to link farmer subsidy recipients to the policy initiatives than is the case for the tariffs for which the linkages are more nebulous.

Ongoing concurrently with these policy initiatives were general market development activities such as encouraging blending of cassava in bread flour (Oxford Business Group, 2012) and facilitating food processing investment (FMARD, 2011). We describe these as general market development activities because, while they are referenced in the policy strategy documents, the evidence of actual actions implemented by bakers regarding encompassing cassava flour to replace some imported wheat or investments made specifically because of agricultural policymakers providing tax or regulatory incentives to increase investment in food processing facilities is sparse.

[Figure 1 about here]

Before describing the evidence that exists regarding actual implementation of the GES scheme, a main point we argue is that the direct effects of policies and market development activities implemented under the ATA are fewer than the indirect effects. Specifically, the implementation of the GES scheme, in which thousands of farmers were reached via mobile phones for receipt of their subsidized fertilizer and seed, required substantial resources for both promotion and distribution (Wossen et al., 2017). These promotion resources galvanized the discussion in the media and increased awareness of government support for the agricultural sector. The relative size of expenditures on the GES scheme compared to other initiatives help explain how it gained increased attention among the public in the years of implementation. Nwoko et al. (2018) document that 5-percent of total Nigerian federal government capital during 2011, the main year of GES implementation, were on agriculture, while this share was only

about 3-percent in both 2010 and 2012. Thus, the GES scheme represented a marked shift toward increased Nigerian federal government expenditures on agriculture.

Other market development activities included investor relations efforts to establish Staple Crop Processing Zones (SCPZs) in regions that have high production of certain priority crops (FMARD, 2011; FMARD, 2016). The establishment of SCPZs represent an attempt to create SEZs that are primarily for food processing, which, if established, would enhance market opportunities for farmers in economically relevant geographic region. Despite the policymaker attention to establish SCPZs in these policy documents, sparse evidence exists regarding whether such initiatives have been successful in increasing commercial engagement among farm households. The study by Ajeigbe et al. (2017) appears the closest to date regarding linking farm household behavior with SCPZ food processing investment. Specifically, they conducted an impact assessment for a development project funded by the African Development Bank (ADB) that was targeted for implementation within a Northern Nigeria SCPZ region. Their analysis showed that recipients of inputs and technical assistance under the program increased productivity, but it is uncertain whether the productivity gains would be achievable without the supplemental support provided by the ADB or a processing firm in the SCPZ (Ajeigbe et al., 2017). Notably, the analyzed SCPZ had several urban centers, including Kano, Gusau, Sokoto, and Birnin Kebbi. Hatzenbuehler et al. (2018) document for this same region that physical and transportation infrastructure is substantially better near urban areas than in rural areas.

In summary, via its Agricultural Transformation Agenda (ATA), the Nigerian FMARD implemented several policy and market development initiatives in the early 2010s, the most prominent of which was the GES scheme that provided farm households with subsidized fertilizer and seeds distributed by agribusinesses. The GES scheme represented a sizable increase

in federal government expenditures, enhanced direct linkages between the FMARD and farm households, and increased awareness of federal government support for agriculture among the public. Aligned efforts to increase investment in food processing via the establishment of SCPZs also increased public awareness of agricultural development activities. Overall, this set of policy initiatives and market development activities created increased vibrancy of the overall Nigerian agricultural economy during the implementation period of 2011 – 2015. However, within the context of considerable infrastructure advantage among urban relative to rural areas, we hypothesize that the farm households that benefited from the increased agricultural economic activity were those nearest to urban centers.

3. Research Question and Hypothesis

Based on the background of relatively greater physical and transportation infrastructure in urban relative to rural areas and a sizable increase in expenditures on farm input subsidy and Nigerian policymaker attention on expanding the agricultural sector during the ATA implementation period of 2011 – 2015, the question that this article investigates is whether peri-urban farm households were relatively more responsive to the changes in crop and farm input markets than were rural farm households. We hypothesize that peri-urban households were better positioned than rural households to benefit from improved availability of farm inputs, including fertilizer, herbicides, machinery, pesticides, and seeds, and so likely showed relatively larger changes in their farm input purchases. However, since fertilizer and maize seeds were subsidized, the increased usage of fertilizer and improved seeds may likely have not corresponded to greater expenditures on these inputs. Thus, the expected increases in purchases are more likely to have been observed for other non-subsidized inputs such as herbicides, machinery, and pesticides, due to substitution effects of having more funds available for their purchase due to not spending as

much on fertilizer. Regarding crop marketing, we hypothesize that the value of crop sales likely increased for some crops, such as cassava, due to the increased media attention among policymakers to increase their usage in bread making (Oxford Business Group, 2012). This may have incentivized farmers to increase area planted to cassava, and usage of the subsidized fertilizer and other non-subsidized inputs via substitution on such crops could have increased productivity. However, since the increased media attention and investment facilitation for other crops in SCPZs were indirect, and the linkages between entities in such supply chains were difficult to trace, we expect that there were differences in the changes in crop sales value across crops but are uncertain of which crops observed the largest changes. Thus, we included several staple crops, including cassava, maize, rice, and sorghum in the analysis to investigate cross-crop differences further.

4. Data and Methods

Since the research question and associated hypotheses pertain to determining whether there were differences in crop sales and/or crop production input purchases among different segments of the farm household population over a period of policy and market development activity implementation that took place over several years, the dataset needed to empirically test the hypotheses must have the study population and have a panel structure.

4.1 Dataset

The dataset used in the empirical analysis are from the Nigeria General Household Survey panel (GHS-panel), which is a nationally representative survey that was developed through collaboration between the Nigeria National Bureau of Statistics (NBS) and the World Bank Living Standards Measurement Study (LSMS) team under the Integrated Surveys on Agriculture (ISA) program (hereafter referred to as LSMS-ISA). The sample size for each GHS-panel survey

is about 5,000 households and has to date been implemented for four waves: wave 1, 2010/11, wave 2: 2012/13, wave 3: 2015/16, and wave 4: 2018/19. For this study, data from waves 2 and 3 were used because the time span of survey implementation for these two waves from 2012 – 2016 corresponds well with the implementation of the ATA between 2011 – 2015.

4.2 Variable Definitions and Descriptive Statistics

Since the key focus of this study is on determining differences among farm household behavior based on their peri-urban or rural status, the definition of what is "peri-urban" and what is rural is critical. For the purposes of this article, we define a household as peri-urban based on their being less than the median distance, or 62.7 kilometers (km), from a market. Correspondingly, rural households were equal to or more than 62.7 km from a market. It is important to note that the locations of households and their distances to markets are all data encompassed into the LSMS-ISA datasets.

The variable definitions for the "peri-urban" variable, other dependent variables, and household control variables, along with their descriptive statistics for the pooled sample across both waves 2 and 3 are included in Table 1. The households that were included in the pooled sample are those for which there was a record of at least one dependent variable category in both survey waves. The dependent variables are the gross value of crop sales and purchases of farm inputs, including fertilizer, herbicides, pesticides, seeds, and rental of animal traction services or farm machinery. For these variables, the estimated means and standard deviations (SD) show that the average value of crop sales, measured in USD terms and scaled for purchasing power parity (PPP), were over 600 USD, but with substantial heterogeneity across households as observed with SD of more than double the mean. Fertilizer and seeds were the most commonly purchased among the farm inputs, while only 3-percent of households rented farm machinery.

There was also substantial variation among households for several of the control variables. The average total consumption, also measured in USD terms and scaled for PPP was over 1,300 and the SD was nearly the same value. Since consumption is a proxy for income, these statistics imply that there was considerable heterogeneity in household income among the analyzed households.

[Table 1 about here]

4.3 Statistical and Regression Analysis

The first part of the statistical analyses included tests of changes in the mean values for the peri-urban and rural sample subsets, respectively, for each of the dependent variables across the survey waves. The changes in means were estimated and tested for statistical significance using traditional t-tests. We also implemented the same hypothesis tests via a regression analysis using a model with a general form of:

$$\Delta y = \alpha + \Pi X_{it-1} + \delta I_i + \varepsilon_i,$$

where for each household i, $\Delta y = y_{it} - y_{it-1}$, t is the survey wave, α is the intercept, Π is a vector of coefficients associated with the control variables, X_{it-1} is a vector of control variables lagged to the first wave, δ is coefficient for the peri-urban household variable, I_i is a dummy variable for which peri-urban households have a value of 1 while rural households have a 0 value, and ε_i is random error term. The data for the non-binary variables were transformed into logarithms for the regression analysis. Standard errors for the regression were clustered at the enumeration area level.

5. Results

The first set of results, displayed in Table 2, pertain to determining the changes in crop sales and purchases of farm inputs, including fertilizer, herbicides, pesticides, and seeds, as well as the

rental of animal traction services or farm machinery for the full sample of applicable farm households between wave 2 (2012/13) and wave 3 (2015/16). The results show that the value of crop sales increased on average for peri-urban farm households while they decreased for rural households. It is important to note that the format of the data do not allow for determining whether these changes were caused by variation in production quantities, crop mix adjustments, prices, or all the above. The results also show that the share of farm households that purchased fertilizer decreased slightly for both peri-urban and rural households. These results can be explained by there being subsidized fertilizer available for a portion of the observation period, which may have been stored for use in future years. There could be many other factors that could account for the lack of change in the share of households purchasing fertilizer, including uncertainty regarding whether the subsidies would remain in place. The shares of farm households that purchased herbicide and pesticides increased for both peri-urban and rural households, but to a statistically significantly higher degree among peri-urban households. This pattern applied for seeds and farm machinery rentals as well, but not to a statistically significant amount. Overall, the share of peri-urban farm households that purchased farm households increased between 2012 – 2016 for five out of six categories, while they increased for four out of six categories for rural households. Out of these categories, the increases for peri-urban households were statistically significantly higher for peri-urban households for three categories (two at the 5-perent significance level).

[Table 2 about here]

The study hypothesis tests via regression analysis results are included in Table 3 with each column representing an individual regression for each of the dependent variables of focus related to crop sales or farm input usage. The main variable of interest is the peri-urban dummy

variable for which the estimated coefficient represents the additional average change in the dependent variable for the peri-urban households relative to the rural households. It is important to note that the overall sample size was smaller for the regression analysis than the testing of differences in means due to some households not having requisite data for all control variables.

Regarding the results, the coefficient for the peri-urban variable is positive for four out of the seven evaluated categories, and statistically significant at the 10-percent level for two of the four categories, namely, crop sales and fertilizer purchased. The result for the value of crop sales corresponds well with those from the t-tests. The result for fertilizer purchased being statistically significantly higher for peri-urban relative to rural household for the regression analysis compared to the t-test analysis may be explained by a greater number of rural households being excluded for the regression analysis due to data issues. Additionally, since less than 30-percent of the pooled sample of households purchased herbicides or pesticides, any exclusion of households due to data requirements for the independent variables likely had a sizable impact on not observing statistically greater shares of peri-urban households purchasing herbicide or pesticide relative to rural households as was observed in the t-test analysis.

[Table 3 about here]

The sign and statistical significance of the control variables are largely consistent with expectations. The coefficient for total consumption, a proxy for income, was positive and statistically significant for the regressions of crop sales (1-percent significance level) and the likelihood of purchasing fertilizer, herbicides, and seeds (5-percent significance level). A higher amount of agricultural land was also positively correlated with each of these variables, although the statistical significance levels were only 5-percent for the value of crop sales and 10-percent for each of the input purchases.

6. Conclusions

This article examined the differences in the extent to which peri-urban and rural farm households in Nigeria adjusted their crop sales and farm input purchase patterns over the course of 2012 – 2016, during which there were substantial changes in agricultural policy, especially regarding the provision of subsidized fertilizer and seed, and market development activity implementation. The empirical results show that peri-urban farm households on average had larger increases in the value of crop sales than rural households. Additionally, while the shares of households that purchased several farm inputs, namely, herbicides and pesticides increased for both peri-urban and rural households, the increase was statistically significantly and greater for peri-urban households than rural households. These results were largely based on estimation of changes in means via t-tests, but the results, at least for crop sales, were largely validated by the regression analysis that had to exclude some households due to data limitations.

The results from this study are consistent with those from other studies that have found relatively greater productivity and modern input usage among farmers with closer proximity to urban centers in other SSA countries by Damania et al. (2017), Vandercasteelen et al. (2018), and Vandercasteelen et al. (2021). The contribution of this article is that it provides statistical evidence of relative differences in changes in farm household behavior regarding crop sales values and farm input purchases during a specific period of policy implementation.

There are several policy relevant implications that follow from these results. First, the main result that the policy priority to enhance crop marketing opportunities and modern input usage were successful to some extent in both peri-urban and rural regions, but that the increases were relatively larger in peri-urban areas, implies that additional resources and planning are needed for policy initiatives to “transmit” beyond peri-urban areas. Second, the main result of

larger changes in peri-urban areas is explained by the relatively better physical and transportation infrastructure in those regions, which allow both the agricultural input (e.g., fertilizer) and output (e.g., crop production) supply chains to operate with greater efficiency. Combining these two implications implies that future agricultural policy strategies that seek to increase their stakeholder participation beyond those households with the greatest access to markets will need to better account for existing supply chain characteristics and operations.

We close with a couple of qualifications and opportunities for future research. First, while this study examined the changes in the value of crop sales, there were insufficient data to disaggregate the analysis by crops or by regions. The background discussion on the promotion of certain crops in plans for expanded crop processing, such as encouraging inclusion of cassava flour into bread to displace some imported wheat and establishing SCPZs in regions that are relatively productive for some crops, implies that there is likely substantial heterogeneity regarding crop marketing potential for some crops and regions relative to others. We were unable to investigate the questions of which market development activities were relatively more effective in facilitating enhance supply chain linkages between farm households and processors due to data limitations, but doing so would help policymakers prioritize such activities in the future.

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Tables and Figure

Table 1
Descriptive statistics for the pooled sample of peri-urban and rural farm households in Nigeria in waves 2 and 3 of the LSMS-ISA dataset

		Mean	SD
Peri-urban household	Share of households that were located less than the median distance to a market of 62.7 km	0.49	.
	Dependent variables		
Value of crop sales	Gross value of crop sales for this household – measured in USD scaled for PPP	610.03	1341.14
Fertilizer purchased	=1 If the household purchased fertilizer	0.38	0.49
Herbicide purchased	=1 If the household purchased herbicide	0.29	0.45
Pesticides purchased	=1 If the household purchased pesticides	0.20	0.40
Seed purchased	=1 If the household purchased seed	0.28	0.45
Animal traction rented	=1 If the household rented animal traction	0.19	0.39
Farm machinery rented	=1 If the household rented farm machinery	0.03	0.18
	Household level control variables		
Household size	Number of household members	6.66	3.37
Farm household	=1 If the household is agriculture household	0.15	0.35
Contact with Extension	=1 if the household has contact with extension agent	0.07	0.25
Use financial services	=1 if the household used financial services	0.23	0.42
Off-farm work hours	Total hours in off-farm work	25.45	41.62
Total consumption	Total consumption per capita – measured in USD scaled for PPP	1344.83	1335.79
Agricultural land size	Agricultural land size (hectares)	1.04	1.46
N	Number of households	6,056	

Note: km is kilometers, SD is the standard deviation, and PPP refers to Purchasing Power Parity. Source: Nigeria National Bureau of Statistics (NBS) and World Bank (2018).

Table 2
Differences in the mean value of crop sales, farm input purchases and rentals among all peri-urban and rural farm households in Nigeria between 2012 – 2016.

	Peri-urban	Rural	Difference	p-value for difference
Value of crop sales	150.63	-222.24	372.87***	0.00
Fertilizer purchased	-0.00	-0.01	0.00	0.81
Herbicide purchased	0.04	0.02	0.02*	0.08
Pesticides purchased	0.04	0.02	0.02**	0.05
Seed purchased	0.03	0.02	0.01	0.35
Animal traction rented	0.01	-0.01	0.02**	0.04
Farm machinery rented	0.01	0.01	-0.01	0.23
N	1,482	1,546		

Note: *N* is the number of households. ***, **, * indicate t-test statistical significance at 1%, 5%, and 10% levels, respectively. Source: Nigeria National Bureau of Statistics (NBS) and World Bank (2018).

Table 3
Regression results for the estimation of changes in average value of crop sales and farm input purchases and rentals among all peri-urban and rural farm households in Nigeria between 2012 and 2016.

	Crop sales	Fertilizer purchased	Herbicide purchased	Pesticide purchased	Seed purchased	Animal traction rental	Farm machine rental
Household size	-0.11 (0.07)	0.02 (0.03)	0.00 (0.03)	0.07*** (0.03)	0.06* (0.03)	-0.03* (0.02)	0.03*** (0.01)
Farm household	0.07 (0.29)	-0.02 (0.04)	-0.02 (0.04)	0.01 (0.03)	0.11** (0.05)	-0.05** (0.03)	0.03* (0.02)
Contact with Extension	0.35 (0.24)	0.07** (0.03)	-0.03 (0.04)	0.05 (0.04)	0.05 (0.04)	0.04 (0.03)	-0.02 (0.02)
Use financial services	0.08 (0.18)	0.04* (0.03)	-0.02 (0.03)	0.01 (0.02)	0.02 (0.03)	0.02 (0.02)	0.01 (0.01)
Off-farm work hours	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00* (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
Total consumption	0.38*** (0.10)	0.03** (0.01)	0.04** (0.01)	0.02 (0.01)	0.04** (0.02)	0.01 (0.01)	0.00 (0.01)
Agricultural land size	1.12*** (0.17)	0.03* (0.02)	0.05* (0.02)	0.02 (0.02)	0.04* (0.02)	0.03 (0.02)	0.01 (0.01)
Peri-urban	0.28** (0.14)	0.04* (0.02)	-0.01 (0.02)	-0.01 (0.02)	0.02 (0.02)	-0.01 (0.02)	0.01 (0.01)
Intercept	0.66*** (0.12)	-0.11 (0.02)	0.07*** (0.02)	0.06*** (0.02)	0.04 (0.02)	-0.01 (0.01)	0.01* (0.01)
Adjusted-R^2	0.04	0.02	0.01	0.01	0.01	0.01	0.01
N				2,627			

Note: *N* is the number of households. ***, **, * indicate t-test statistical significance at 1%, 5%, and 10% levels, respectively. Standard errors clustered at the Enumeration Area level and are in parentheses below the estimates.
Source: Nigeria National Bureau of Statistics (NBS) and World Bank (2018).

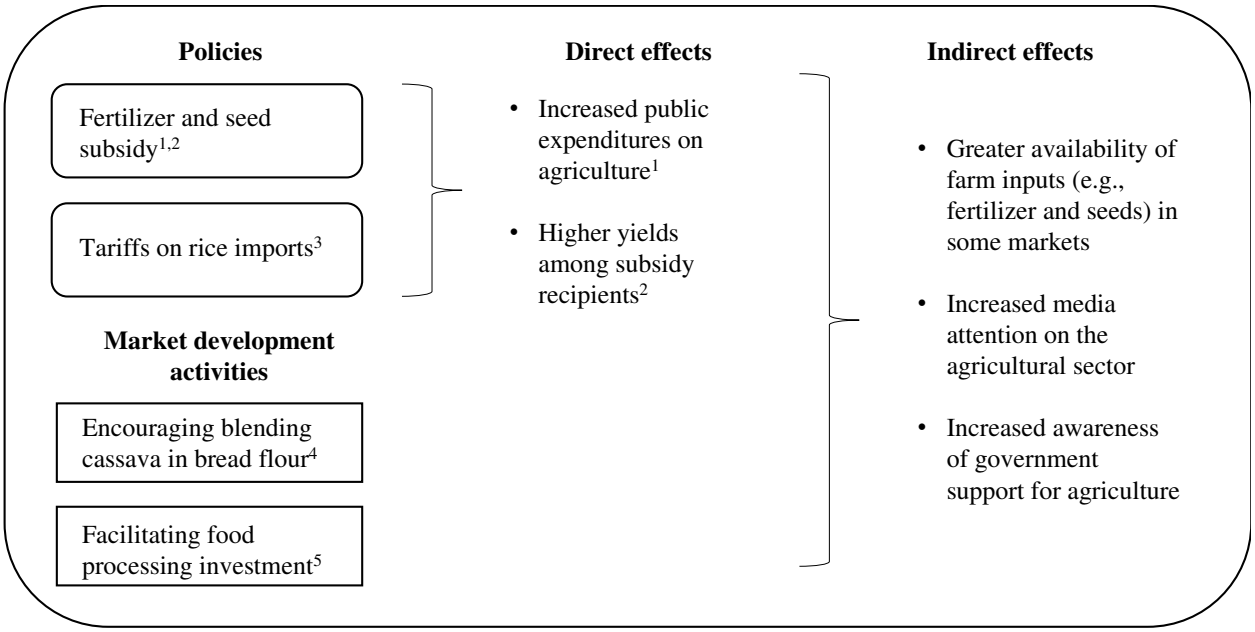

Fig. 1. Diagrammatic representation of the main agricultural policies and market development activities of the Federal Ministry of Agriculture and Rural Development in Nigeria between 2011 and 2015. Sources: [1]Liverpool-Tasie and Takeshima (2013); [2]Wossen et al. (2017); [3]Johnson et al. (2013); [4]Oxford Business Group (2012); [5]FMARD (2011); and authors.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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