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Wholesale markets of vegetables and fish in Nigeria: dynamic, feeding and employing millions, but challenged

[version 1]

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Abstract

Wholesale markets (WMs) in Nigeria play a critical role in the country's food system; however, they remain underexplored in policy discourse. Drawing on a detailed survey of WMs across diverse regions and governance regimes in Nigeria, this study reveals their substantial contributions and challenges. We show that WMs handle large volumes of food, serve as key outlets for thousands of farmers, and generate extensive employment for women and youth, while fostering the proliferation of service-providing enterprises. Firms in these markets exhibit dynamism in terms of growth in trade volumes, firm numbers, and inclusive employment, with notable variation across commodities such as tomatoes, green leafy vegetables, and fish, as well as across rural and urban contexts. Despite these strengths, WMs face significant infrastructural deficits, including inadequate water and sanitation facilities, which limits their efficiency and resilience. The scale and vibrancy of these markets underscore their importance to policymakers, and their challenges highlight the need for targeted investments and reforms. We identify gaps in current policy approaches and propose actionable strategies to strengthen WMs as engines for inclusive agricultural transformation.

Keywords

Wholesale markets, Agrifood value chain, Green leafy vegetables



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1. Introduction

The agri-food value chain (AVC), particularly the midstream segments (wholesalers/traders, processors, and logistics) are of great importance to food security. They are important because they are the main interface of farmers with markets, condition farm profitability and risk, and thus form the incentives and capacity of farmers to make investments in farm productivity. They are also important because they condition the food prices, access, and stability of food supply to consumers, as most agricultural output transits via the midstream to urban consumers (who constitute around 60% of national food consumption in Africa) and rural food purchases (which represent about 60% of rural food consumption in Africa) (Liverpool-Tasie et al. 2021; Dzanku et al. 2024).

Although there is still a dearth of field research on individual actors (such as urban wholesalers and rural traders), the dearth is more acute for wholesale markets (WMs). WMs are spaces where the great majority of the 100's 1000s wholesalers congregate to buy and sell, and 3rd party logistics (3PLS) such as truckers and motorbikes gather to facilitate those transactions.

WMs are important in the aggregate, as they are the main funnels of food movement in Africa. That movement is massive: in Africa each year 1.1 billion tons of food are bought and sold (of the 1.3 billion tons produced). A single WM is very important for local food security. As we show for Nigeria, a single WM feeds 100's of the 1000s of consumers and buys from thousands of farmers; employs 1000s of small firm owners and laborers; and is a node for farm input sales. The economic and employment impacts of WMs radiate out into cities and rural towns, where they are usually based, and out to the farms and villages that supply them.

Despite their importance, WMs are largely absent from African public debate and the research literature, part of the "Hidden Middle" that Reardon (2015) terms the midstream sectors. We believe this neglect is due to several factors: (1) the food security debate is focused on the farm, with short shrift given to the midstream; (2) the debate generally casts the midstream as a "missing middle"; (3) WMs are usually the responsibility of municipal governments, and not the national government, so fall outside the national debates; (4) when WMs figure in national debates, they are seen as the domain of exploitative traders; donors and governments are usually thus keen to "cut out the middleman," to get farmers to sell direct to consumers in short circuits and recently promote alternatives to WMs and other organic AVC development by setting up SEZs and agroparks.

We draw on our unique dataset generated in a primary survey of 299 WMs in eight states in the North and South of Nigeria. The survey focused on WMs trading of tomatoes, GLVs, and fish. It involved interviews with market administrators and other informants concerning volumes moved in the markets, the numbers of traders and 3PLS enterprises, other services such as toilets and water and waste clean-up supplied to traders and other clients of the WM, and governance (such as the gender of leadership and whether leaders are elected). WMs include both government and private/informal WMs.

Using the data, we address several research questions: (1) To what extent do WMs contribute to food security in Nigeria (in purchases and sales of these products, as well as jobs generated in trading, logistics, and so on); (2) How inclusive is that contribution in terms of engagement of women and youth? (3) What challenges do WMs face (e.g., infrastructure and public services)? (4) What government, private sector, and donor actions best support inclusive development of WMs?

The remainder of this paper is organized as follows. Section 2 discusses the development of WMs and their role in the food economy in developing regions. Section 3 describes the methods and samples used in the Nigerian WM survey. Section 4 presents the descriptive findings of our Nigerian WM survey: volumes, growth, employment, inclusion, and infrastructure challenges. Section 5 presents the regression findings on growth, employment, and inclusion. Section 6 concludes with support-action implications.

2. Development of WMs and their roles in developing regions

WMs are aggregation points that have more than one aggregating enterprise, such as wholesalers (take possession) or brokers (receive a commission to arrange a transaction between a buyer and supplier). A WM can take several forms: (1) private trader-run or government-run, (2) large or small, (3) in a city or a rural town or highway intersection, (4) roof-covered or uncovered, enclosed or open, and (5) weekly, seasonal, or permanent.

WMs reduce transaction costs by bringing together buyers and sellers. This reduces search costs and allows bulk loads (thus reducing fixed costs) to produce sent long distances. This potentially allows farmers to sell at higher prices than in local village markets, where the effective demand is weaker because many local farmers produce the same products.

Reardon et al. (2021) showed that over the decades, in developing regions, the spread of WMs has been correlated with urbanization and road development. For fresh produce and fish, WMs started as “truck markets” on the outskirts of towns; they were gradually established in city centers, with an increasing number of cities and towns getting WMs. The initial urban WM was often set up by the municipal government; the official market was soon outgrown by the growing city, and informal WMs spread over the city along the main roads. Sometimes, the WM started as a rural periodic market at a road intersection and then developed and became permanent and continuous, sometimes becoming the starting point of a new town. For example, in Dar es Salaam in Tanzania in the 1970s, when the city had a population of 200,000, there was an official WM in the center and truck markets in villages ringed around it. Fifty years later, the city expanded to more than 8 million, and there were at least 15 fresh-produce WMs in the city spreading out from the center along the cardinal axes.

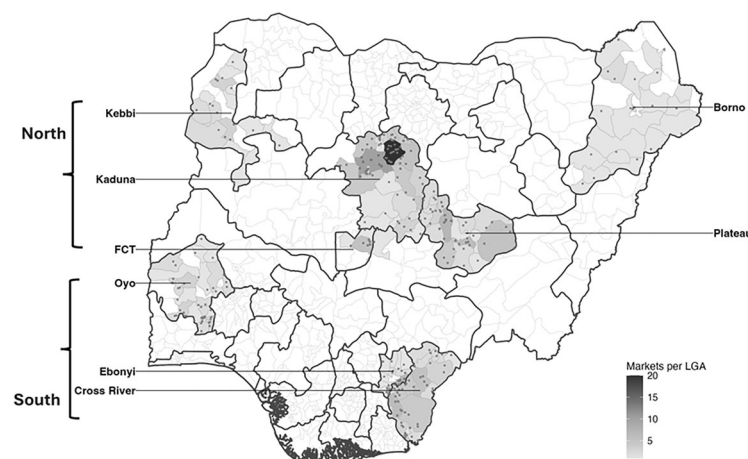
Fresh-produced WMs in Africa and Asia were initially anchored in emerging cities with produce brought directly by farmers or traders from peri-urban areas (Tollens 1997; Moustier et al. 1999). As the cities grew, the WMs needed to source from much further, and the AVC spatial length has grown, such as for tomatoes and even GLVs in Nigeria (Liverpool-Tasie et al. 2025). This is similar to London’s having to move from sourcing just around it in the 1400s to sourcing from all over the UK and Europe by the 1700s, as the city grew. With the longer AVCs, urban wholesalers at first sourced from rural traders and then progressively obviated the latter and “disintermediated” - sourcing directly from farmers with the produce fetched by 3PLS (Reardon et al. 2021). This has made the WMs both poles of trader agglomeration and 3PLS clustering.

3. Methods and sample for the Nigeria WM survey

We used a multistage approach to identify WMs across the study states, as shown in Figure 1. First, preliminary lists of WMs were compiled from official government sources including state departments of agriculture, export promotion councils, chambers of commerce, and market development or management agencies. These lists were then supplemented through targeted online searches and verification through field visits. During the field visit, a systematic snowball sampling strategy was used to ensure the inclusion of all relevant WMs.

In each state, fieldwork began at the Local Government Authority (LGA) headquarters, given that LGAs typically have a formal responsibility for market oversight. In each LGA, the survey team identified the WMs serving the headquarters and the surrounding communities. At each site, the team met with WM leadership (such as commodity association heads or market management committees) to verify whether the market met the study’s operational definition of a WM, defined as a location where at least two wholesalers traded any of the study commodities. Wholesalers were defined as intermediaries who procure products—either by taking possession or acting on commission—from suppliers such as farmers, processors, or other wholesalers, and who sell or deliver these products to non-final users including processors, retailers, or other wholesalers.

In addition to WM leadership, the survey team engaged with wholesalers, retailers, and processors to identify additional wholesale trading locations for the study commodities. This iterative process was continued until no new markets were identified. The listing and verification were conducted over a 12-month period to account for potential seasonal variations



Source: Authors, adapted from Osuntade et al., 2025

Figure 1. Study states and markets. Source. Data collected by the authors.

in the market operations. After completing the listing, validation meetings were convened in each state, bringing together three representatives from each identified WM, along with officials from the state and LGA governments. During these meetings, conducted in local languages, participants reviewed the compiled market lists and maps to verify the completeness and identify any missing markets.

The final census yielded 299 wholesale markets, which formed the universe of study sites. Data were collected between July and December 2023 through structured focus group discussions in each market. Focus groups were composed of stakeholders with extensive knowledge of market organization and history, including market executives (e.g., chairpersons, treasurers), poverty-level leaders (e.g., heads of tomatoes, fish, or GLV associations), long-established traders, and women and youth representatives. All participants provided written informed consent to participate in the study.

Data were collected electronically by enumerators using the SurveyCTO platform on tablets. They checked the responses for internal consistency and facilitated group consensus, where the responses differed. The resulting dataset comprises market-level information for all 299 wholesale markets, 471 product-level governance observations across the three commodities, and 617 observations about different products moving through the markets. The questionnaire captured information on market infrastructure, trader composition, location characteristics (rural or urban, and proximity to towns), market management structures, selection processes for leadership positions, and the prices, quantities, sources, and flows of the three study products through the market.

4. Descriptive findings of our Nigeria WM survey: volumes, growth, employment, inclusion, and infrastructure challenges

a) An average WM moves large volumes of food from many farmers to many consumers

Table 1 presents the findings concerning WM volumes and overall primary employment in 2023, showing that the markets are major linchpins of food movement and employment.

First, the average WM buys and sells a huge amount of food per year, each supplying large numbers of consumers (via retailers who buy from wholesalers mainly based on the WMs). In the north, where the great majority of tomatoes are grown, the WM averages 11,527 tons of tomatoes per year.¹ As the average Nigerian consumes 10 kg of fresh tomato per year (Parkhi et al. 2023), one Northern WM supplies the fresh tomato consumption of 1.1 million people, about 6% of Lagos, a city of 17 million, the largest city in Sub-Saharan Africa. Fish WMs primarily sell dried and smoked fish.

Table 1. Volumes traded and the number of actors in wholesale markets in 2023.

	Tomato	GLV	Fish	Tomato	GLV	Fish
	North			South		
Tons per day in a typical market in high season	63 (64)	27 (35)	21 (49)	19 (36)	7 (20)	35 (87)
Tons per day in a typical day in the low season	24 (48)	14 (25)	6 (10)	14 (65)	2 (5)	9 (44)
Tons/year/wholesale market	11,527	2,885	4,971	3232	1554	5,293
Wholesalers/market (typical day)	100 (143)	38 (36)	77 (104)	29 (26)	28 (32)	29 (26)
Retailers/market (typical day)	94 (187)	61 (64)	117 (213)	37 (30)	41 (54)	55 (51)
	North			South		
Allied businesses/market		531(864)		177 (234)		
Number of market observations	147	146	81	68	118	57

Source: Authors calculations from wholesale market survey. Standard deviations are in parentheses.

¹Volumes moves through markets on a typical day were winsorized at 95% on the top to address outliers before aggregation to the amount moved over a year. The amount moved in a year is a function of the amount moved on a typical day and the number of days a week the market is open during the low and high seasons.

Table 1 shows that the average fish WM in the two regions moved around 5,000 tons per year. Liverpool-Tasie et al. (2021) showed that the average Nigerian consumed 5 kg/year of dried and 8.7 kg/year of smoked fish, summing to 13.7 kg. Thus, a fish WM feeds around 365,000 people, about 2% of Lagos (which also receives fresh fish deliveries from fish farm areas and the sea). The GLV WMs had an annual average of 2220 tons. Snoek et al. (2022) noted that urban Nigerians consume approximately 5 kg of GLVs per capita per year. Thus, one GLV WM supplies approximately 444,000 individuals.

Second, an average WM is important as a node of primary employment of a cluster of actors - wholesalers, retailers, hired laborers, processors, third-party logistics enterprises (3PLS), farm input stores, ambient and cold storage facilities, point of sale providers (for immediate cash withdrawals), traders of jerrycans (for water), baskets, plastic crates, and other packaging materials, and spinoffs of food service and other services. These are important to direct employment but are also catalysts of growth in towns and cities where the WMs are located, as well as services to farmers supplying the WMs.

b) An average WM is a large (and growing) cluster of small enterprises & employment

Table 1 shows that the average WM dealing in tomatoes in the north generates substantial direct employment in tomato distribution per se: 100 tomato wholesalers and 94 tomato retailers. The overall WM (including all products) employs 444 allied businesses, as noted above. This amounted to 63,800 enterprises across 147 markets. Each of these enterprises employs individuals. This employment comprises approximately 1070 employees for tomato wholesalers and retailers, derived as follows: Table 3 shows that a tomato WM's 100 tomato wholesalers and 94 tomato retailers are composed of:

61% (61% x 194 = 118) nano-scale firms (with 1–2 employees, hence an average of 1.5); thus, 178 employees;

31% (60) microscale firms (3-9 employees, hence an average of six employees), thus 360 employees;

6.8% (14) small-scale firms (10-49 employees, hence an average of 30 employees); thus, 407 employees;

0.5% (1) medium-scale firm (50-199 permanent employees; hence, an average of 125 employees); thus, 125 employees. Assuming that allied businesses have a similar size distribution as wholesalers and retailers, 444 allied firms have 2449 employees ($444/194 \times 1070 = 2449$).

Thus, just 147 tomato WMs in the North have direct employment of 157,290 workers in wholesale and retail and 360,000 workers in allied firms. Thus, just in the tomato plus allied firms portion of the 147 markets, this adds to 517,000 workers, a substantial employment effect in the poor northern region. Thus, there are 28,518 wholesale (15,000) and retail (13,000) MSMEs in the markets and another 65,268 allied firms' MSMEs for a total of about 93,000 just from those in the North region tomato WMs.

In addition to direct employment, WMs indirectly employ many farm households and farm-hired workers. This can be illustrated again in the case of the tomato WM in the North. Each WM handles an average of 11,527 tons of tomatoes per year, which represents procurement from approximately 1921 farms; the latter figure is based on a Kaduna tomato farm averaging 6 tons per year (1 ha with 6 tons per hectare). These 1921 farms employed household members as well as hired laborers. On one hand, based on our parallel tomato farm survey, we know that each of the 1921 tomato farms employs approximately five family members in production activities. This means that one WM indirectly employs 9606 tomato farm family members. The 147 tomato WMs in the North thus employ indirectly 1.4 million tomato farm family members.

On the other hand, our parallel farm survey shows that in the north (Kaduna state), a tomato farm hires 150 person-days per ha per season (and typically has one season). Thus, the 1921 Kaduna tomato farms hired 288,150 person-days. Assuming that each worker works for about 100 days (the effective length of the season), this implies that each WM indirectly employs via farm suppliers 2881 farm workers. Multiplying 147 tomato WMs with 423,580 farm workers.

The grand total of indirect farm sector employment for the tomato WMs of the North is 1.4 million farm family workers and 0.4 million hired workers to make 1.8 million farm laborers, a vast number relying on the derived labor demand of the tomato trading sector.

The volume of employment in fish WMs is roughly 80% of that in tomato markets for wholesalers and retailers, with allied businesses 50% more (as this includes processors (more common in fish markets), purveyors of fuel for smoking/drying the fish, etc.), and the tendency for fish to sell other products. WM for fish to sell other products, which may explain the higher number of allied businesses.

The GLV markets are also important employers. There are roughly half the number of wholesalers and retailers, as in tomato WMS, but equivalent to allied business enterprises. The size of the markets and employment of South WMs is roughly half to a third of that of the North markets for tomatoes, GLV, and fish. This is primarily because the southern markets are mainly in consumption cities rather than in production areas where larger volumes are moved.

Table 2 shows rapid growth in the average WM over the past decade. This belies the conventional wisdom of stagnation and stasis in the midstream. We see growth in both the volume traded and the number of allied businesses.

First, the high season volume of tomatoes and GLV in the WMs grew by 139% and 131%, respectively, over a mere 10 years. While there was growth in the South WMs for tomato (33%) and GLV (36%), this was only a quarter of the North WM growth rate. This could be because the North WMs are supplying more than just the South markets and are likely selling increasing amounts to both the North and other areas in Nigeria (as exports of tomatoes are negligible). This is most explicable for tomatoes, as the north is the main production area. It is less clear why GLVs grew so fast in the North, which could be due to urbanization and GLV consumption in the North “catching up” with the South over time (as GLVs are typically not sent further than the state where they are grown or the neighboring state, but not, like tomatoes, the length of the country). Fish WMs in both the North and the South grew equally quickly at approximately 65%.

Second, the growth in the number of wholesalers in the GLV WMs in the North and South was similar to the growth in volumes. This suggests scale-neutral growth. In modest contrast, wholesalers of tomatoes and fish proliferated a little faster than volumes grew, but not by much, suggesting only a slight de-concentration. The exception was a third faster growth of volumes in the fish WMs of the South, suggesting concentration (average scale increase).

Third, in all products and regions, the number of retailers expanded significantly less quickly than volumes, suggesting some concentration in that segment. However, these are still nano or small retailers, so this does not signify a shift to large retailers.

Fourth, in the North, allied businesses, such as truckers, multiplied substantially less quickly than volumes. This suggests a concentration and scale increase; for example, the shift from motorcycles to trucks in logistics. In contrast, in the south, the number of businesses grew somewhat more quickly than volumes, which could indicate the start-up of small transport firms serving retailers in those cities or fetching fish and GLVs from farmers in peri-urban areas. The outlier is a 10-fold greater increase in the number of businesses in north fish WMs than in volumes.

Table 2. Growth in the study markets between 2013 and 2023.

	Tomato	GLV	Fish	Tomato	GLV	Fish
	North			South		
Growth (in 10 years from 2013-23) (%) in high season volume (2023/2013)	160 (278)	131 (140)	66 (101)	48 (89)	48 (71)	72 (95)
Growth (in 10 years) in the quantity delivered (%) in low season	184 (522)	185 (242)	92 (171)	52 (108)	42 (90)	31 (73)
Growth (in 10 years) in the number of wholesalers in high season	153 (306)	124 (132)	84 (157)	37 (63)	34 (54)	40 (45)
Growth (in 10 years) in the number of wholesalers in low season	164 (258)	123 (149)	76 (130)	53 (66)	37 (58)	68 (160)
Growth (in 10 years) in the number of retailers in high season	103 (114)	115 (119)	66 (89)	38 (54)	43 (51)	39 (55)
Growth (in 10 years) in the number of retailers in low season	83 (72)	112 (139)	62 (87)	40 (50)	40 (54)	42 (52)
Growth (in 10 years) in the number of businesses	207 (2154)			52 (68)		
Number of observations	147	146	81	68	118	57

Source: Wholesale market survey.

c) An average WM is small-enterprise, woman, and youth-inclusive, and increasingly so

Table 3 shows the growth in employment and enterprises by name and share of MSME by enterprise size. The markets are dominated by nano- and micro-scale firms. The following results were obtained.

First, very small firms are highly dominant in the North WMs. Nano-scale enterprises (with 1-2 employees) are dominant, accounting for 61 %, 85%, and 72% of all enterprises in the WMs over tomatoes, GLVs, and fish, respectively. The micro-scale firms (3-9 employees) comprise most of the rest, with 31, 14, and 27% in the North. In GLV and fish WMs, there are very few small-scale (10-49 employees) firms and no medium or large firms. Only tomato WMs have a small number of firms larger than nano and small, with only 6.8% small firms, 0.5% medium, and no large firms.

Second, in the North, the main tendency was for the shares of the size strata to remain the same over the decade, with some decrease in the nano and some increase in the micro, which corroborates the modest concentration noted above. In the South, the overwhelming tendency is for shares to stay the same.

Table 4 shows the shares of women and youth in the ownership of the enterprises in the WMs and how those shares changed over the past 10 years. The main finding is that there is a growing substantial inclusion of women and youth. This contradicts the myth that WMs are a concentration of elite, large, and male-owned firms. The following points stand out.

First, the share of woman-owned firms is higher in the South than in the North, averaging 20% versus stunning 75%. This difference is expected, given the cultural differences between regions. Moreover, the share is higher for GLV than for tomatoes or fish, given that the investment requirements to enter GLV-related activities are lower. Furthermore, GLV wholesale is often concentrated during the early hours of the day for a few hours, and is completed by noon.

Second, the share of firms that are youth-owned is substantial and slightly higher in the North than in the South (42% vs. 35%). This might be because the North is a major production zone for tomatoes, so that entry costs (due to proximity of farms) are less high than the primary long-distance trade and concomitant entry costs associated with tomatoes in the South.

Third, despite entry costs, the share of WMs having shares of woman-owned firms has increased over the past decade and is highest in tomatoes in the North, at 64%, versus only 32% with stasis in the women's share. The share of WMs with an

Table 3. Growth in employment and firms by numbers and shares of wholesaler and retailer MSMEs by stratum.

	Tomato	GLV	Fish	Tomato	GLV	Fish
	North			South		
Nano-scale (1-2 employees) %	61	85	72	28	49	24
Micro-scale (3-9 employees) %	31	14	27	87	89	87
Small-scale (10-49 permanent employees) %	6.8	0.3	1.3	13	10	13
Medium-scale (50-199 permanent employees) %	0.5	0	0	0.15	0.5	0.3
Large (200 or more permanent employees) %	0	0	0	0	0	0
Share nano-scale increased over last 10 yrs	9	7	8	7	5	6
Share nano-scale decreased over last 10 yrs	39	26	49	3	8	23
Share nano-scale stayed the same over 10 yrs	53	68	43	90	88	72
Share micro-scale increased over the last 10 yrs	41	25	49	3	9	21
Share micro-scale decreased over the last 10 yrs	9	7	8	7	3	5.5
Share micro-scale remained the same over 10 yrs	50	68	44	90	89	73.5
Share small-scale increased over last 10 yrs	13	1.5	8	0	0	2
Share small-scale decreased over last 10 yrs	7	1.5	1	0	3	0
Share small-scale remained the same over 10 yrs	80	97	91	100	97	98
Number of observations of WMs	147	146	81	68	118	57

Source: Wholesale market survey.

Table 4. Women and youth engagement in Nigerian food wholesale markets.

	Tomato	GLV	Fish	Tomato	GLV	Fish
	North			South		
Share of firms that are woman-owned	17	29	14	76	83	67
Share of firms that are youth owned	46	45	34	32	38	34
Share woman-owned firms increased over 10 yrs	64	57	35	19	32	48
Share woman-owned firms decreased	4	3	42	5	10	8
Share of woman-owned firms stayed the same	32	40	23	76	59	44
Share youth-owned firms increased over 10 yrs	20	35	19	7	19	49
Share youth-owned firms decreased	5	3	5	12	1	8
Share youth-owned firms remained the same	75	62	76	81	80	43
	147	146	81	68	118	57

Source: Wholesale survey.

increase in women in GLVs is also substantial at 57%. The image is inverted in the south. Most progress has been sharpest in fish-related firms in the South, where 48% of the WMs had an increase in women's share, much more than in other products. The latter result in the South was mirrored in the youth results: there were relatively low shares of WMs experiencing climbs in the share of youth-owned firms in total, except for fish in the South.

d) An average WM has severe infrastructure challenges re hygiene, security, and energy

Table 5 shows the following for toilets and water infrastructure: First, toilet access was poor in WMs in both regions. Only 49% and 41% of the WMs have toilets despite the constant large crowds of sellers, allied businesses, and customers, respectively. The ratio of traders to toilets is huge – 400 to 1 in the North and 834 to 1 in the south.

Second, in both the North and South, there are severe problems with access to water. In the North, only 5% have piped-in water, but only 5% have no water. The main water sources were wells (43%) and boreholes (29%). This means that 72% of markets require the vast throngs to go to a few fixed points and queue for water, and 24% have to bring or purchase water in a Japanese (a plastic or metal water holding container). The situation is similar in the south. Only 3% had piped-in water, and only 1% had no water. Again, 72% is from boreholes (54) and wells (20), but only 11% is from jerricans.

Table 5. Market infrastructure in the study markets.

	North	South	Overall
Market has a toilet (1/0)	49	41	46
Trader toilet ratio (conditional)	400	834	555
Market has security (1/0)	71	69	70
Trader security guard ratio (conditional)	458	522	482
Market has electricity from the grid (1/0)	26	41	32
Average number of hours per day (conditional)	6.6	4.5	5.5
Main water source in the market			
No water (1/0)	5	1	4
Pipe borne water (1/0)	5	3	4
Borehole (1/0)	29	54	39
Well (1/0)	43	20	25
Water in Jerricans (1/0)	24	11	19
Stream/river (1/0)	3	19	9
Other/Specify (nearby communities) (1/0)	2	0	1
Number of observations	181	118	299

Source: Author calculations.

Surprisingly, 19% of the WMs used river water. In the South, where there are heavy rains and flooding, open wells and river sources can be silted and contaminated.

Table 5 shows for security services (such as guards), that most (71 and 69% in the North and South) have them. However, conditional on having guard service, the level of service is scant, as the ratio of traders to guards is huge (458 versus 522), amounting to very limited access.

5. Regression analysis

5.1 The regression models

Our first set of regressions are ordinary least squares regressions to identify the factors associated with growth in wholesale market activities over a 10-year period between 2013 and 2023. We estimate:

$$\Delta Y_i = \alpha_i + \beta X_i + \varepsilon_i \quad (1)$$

where ΔY_i is the change in outcome Y for market i between 2013 and 2023.

Our outcome variables Y_i are (1) the quantity of our study products delivered to each market on a typical day in the high season, (2) the number of wholesalers, (3) the number of retailers, and (4) the number of allied businesses. X_i is a vector of WM characteristics, including: (1) location of the WM (in a rural vs. non-rural area; in the north vs. the south); (2) the age of the market; (3) the size of the market (number of wholesalers plus retailers); (4) governance (i.e., whether market leaders are selected by election vs. by appointment or hereditary appointments, and whether there are women in the market leadership committee); (5) product (tomatoes, GLV, or fish); (6) level of development in the state measured by the state mean light radiance at night, where radiance levels are measured in nanowatts per square centimeter per steradian. We included the initial conditions for each dependent variable to test for evidence of growth convergence over a 10-year period.

Our second set of regressions uses the multinomial probit model (MNP) to understand the factors associated with the growth of enterprises in WMs. This model is appropriate for our discrete dependent variables, which take on one of the three responses for the share of businesses. For each category of business (woman-owned enterprises, youth-owned enterprises, and nano-, micro-, and small-scale enterprises), WMs noted if the share of each kind of business had (1) increased, (2) decreased, or (3) remained the same over the past 10 years. While the MNP model is frequently motivated by using a latent variable framework, we apply it in this context, where:

$$P(Y_i = j) = P(X_i \beta_j + \varepsilon_{ij} > X_i \beta_k + \varepsilon_{ik} \forall k \neq j) \quad (2)$$

where j is each of our three possible change outcomes for market i , $P(Y_i = j)$ is the probability that market i reported outcome j , and X_i is a vector (the same as that used for the growth equations above) of market characteristics likely to affect the outcomes. This can be rewritten in terms of the differenced error terms in:

$$\eta_{ik} = \varepsilon_{ik} - \varepsilon_{ij}$$

where:

$$P(Y_i = j) = P(\eta_{ik} < X_i(\beta_j - \beta_k) \forall k \neq j) \text{ or } P(Y_i = j) = P(\varepsilon_{ij} - \varepsilon_{ik} > X_i \beta_k - X_i \beta_j \forall k \neq j)$$

We assume that the vector of error differences $\eta_i = (\varepsilon_{i1} - \varepsilon_{iJ}, \dots, \varepsilon_{i(J-1)} - \varepsilon_{iJ})$ follows a multivariate normal distribution with a mean of zero and a derived covariance matrix Ω . The probability becomes a multidimensional integral over the multivariate normal density. Because this integral does not have a simple analytical form, a direct maximum likelihood estimation is difficult. We simplify this by assuming that the error terms are independent of the outcome. This becomes a product of the univariate normal cumulative distribution function. The explanatory variables used here are identical to those in the first set of regressions, capturing location, scale, governance, and state-level economic development. Though we do not have variation in many explanatory variables, we control for initial conditions and include levels of the explanatory variables at the initial period where possible. With due recognition of the limitations of our data, we do not interpret our findings as causal; we believe they reflect meaningful correlations.

5.1.1 The WM growth regression findings

Table 6 shows the results of the regressions on the factors associated with growth in the WMs. We discuss the significant results by column (left-hand-side variable).

Table 6. Regressions of factors associated with growth in wholesale markets.

Variables	(1) Growth of WM volume	(2) Growth in the number of wholesalers	(3) Growth in the number of retailers	(4) Growth in the number of allied businesses
WM in a rural area	-1.236 (13.436)	22.992 (15.998)	5.690 (9.073)	-165.735 (176.501)
WM in the North	37.540*** (9.501)	64.578*** (9.941)	64.592*** (8.081)	269.998 (232.183)
Age of the WM (decades)	-1.615 (1.157)	-4.220** (1.821)	-2.874*** (0.983)	6.986 (11.774)
Number of traders of all types present in the WM on a typical day (100)	-0.278** (0.109)	-0.053 (0.153)	-0.125 (0.108)	-0.054 (0.547)
WM leaders are selected by election (1/0)	17.228 (15.510)	44.222** (19.198)	13.676 (9.203)	204.679 (192.463)
WM has at least one-woman leader	-11.450 (9.408)	-9.835 (11.242)	-1.347 (8.598)	317.824 (321.049)
WM sells tomatoes	60.528*** (21.058)	61.557** (27.746)	11.376 (12.338)	-295.889 (304.077)
WM sells GLV	-47.517 (30.840)	-59.336* (34.961)	10.036 (13.411)	-267.661 (246.789)
WM's State's mean light radiance at night	-34.137 (36.871)	-6.081 (56.025)	-10.276 (32.349)	-579.319 (716.882)
Base values of dependent variables	-0.051* (0.026)	-0.410*** (0.097)	-0.171*** (0.053)	-0.163 (0.126)
Constant	56.075*** (18.464)	63.856*** (19.108)	38.736*** (12.219)	319.906 (247.203)
Observations	615	572	531	603

Robust standard errors in parentheses.

***p < 0.01,

**p < 0.05,

*p < 0.1.

First, growth in WM volumes is positively associated with being in the North and negatively associated with the size of the market (proxied by the number of traders of all types), positively associated with tomatoes, and negatively associated with WMs that started the decade already larger (with a negative coefficient for higher base value). These results are as expected given that the north is the main region for tomatoes and a major region for fish except for the inverse association of the volume gain and the number of traders present. This could be because smaller traders crowd in and increase the number of transactions, but it could be that larger traders drive overall volume growth in the markets. This could also be because there is greater scope for growth in markets with fewer traders. With many traders of all types, there is less scope for new entrants compared to those with fewer people.

Second, growth in the number of wholesalers is correlated with the WM being in the North; with the WM being established more recently, with leaders being elected, selling tomatoes but negatively with selling GLVs, and again negatively with the base (initial) value. The unexpected result is the negative effect of GLVs (compared to fish), which could be because rather than a GLV section in a WM becoming larger and there is instead a cropping up of new WMs of GLVs as it is a product traded at short distances, and thus having many WM points closer to spreading retail conglomerations as cities spread out is preferable to having an increase in wholesalers at an established WM.

Third, growth in the number of retailers is associated positively with WM being in the north, negatively with the age of the WM, and negatively but weakly with the base value. This confirms the dominance of growth in the relatively poor northern region of Nigeria, which is a major producer of horticultural products.

5.1.2 Employment and small-scale inclusion regressions

Table 7 shows multinomial results for the correlates of change in the share of female and youth owned businesses. The following points are significant.

First, WMs' experience of an increase in the share of woman-run firms was negatively associated with the North, positively with women leaders present, negatively with tomato, and positively with GLV. All these are as expected, confirming women's inclusion in the growth in WMS and their tendency to be engaged in the GLV value chain. It also informs the importance of female presence in the markets and female representation in leadership.

Areas with good infrastructure are less likely to have female-owned enterprises. Thus, good infrastructure supports female enterprises remaining the same or not decreasing.

Second, WM's experience of a hike in the share of youth-owned firms is strongly associated with the North. The share of youth-owned enterprises is most likely to remain the same for WMs selling tomatoes and GLV, compared to fish. The share is less likely to decrease for both products compared to fish and tomatoes, and the dominance of youth enterprises remaining the same is clear. This share is unlikely to increase or decrease. This finding implies that the inclusion of youth enterprises in WMs is not a recent phenomenon. Hikes in youth-owned enterprises are more likely in areas with higher youth-owned enterprises, initially indicating that growth is supported by the presence of other youths able to support other youths. Decrease was less likely in markets with elected market leaders, and youth businesses were more likely to be maintained in WMs selling tomatoes and GLVs. Again, night-lights as a proxy for infrastructure were mainly a factor in youths holding their shares.

Table 8 shows the results for growth, decline, and stasis of shares on a firm scale. First, WM's experience of an increase in the share of nano scale firms was mainly driven by GLVs (positively) and tomatoes (negatively, as expected). It is difficult to interpret the factor of market age in this stratum. In contrast, the decrease in the nano-share was associated with the north, with a female leader, and negatively with GLV and night lights. This appears to mean that infrastructure allowed nano firms to "crowd in" to the sector perhaps by reducing transaction costs. However, it could be that the positive effect on the share's decrease in the North is due to an opposite tendency for market expansion to bring about competition, which makes it difficult for nano firms to keep up. This needs to be explored in more depth.

Second, the North's association with the rise of the share of micro and small firms would seem to corroborate the latter point about the squeezing out of the nano firms; hence, a concentration but still of a small-scale sector. The exception is the GLV market, where the nano share increased and the others declined. GLVs are low-entry barrier products, so it could be that it is a "startup" sector for entrepreneurs or a refuge sector for the capital-poor. Interestingly, night lights were associated with a decrease in the rate of increase of small firms (the largest among the nano, micro, and small firms), which could imply that, in some cases, infrastructure helps the capital-poor enter and gain share. However, this requires further investigation.

Table 7. Multinomial results about the drivers of change in the share of female and youth owned businesses.

	Rural	North	Age	Number of traders	Mkt Leaders elected	Any leader female	Tomato	GLV	Night lights	Initial base
Female-owned businesses										
Share increased	0.017 (0.035)	-0.144*** (0.054)	-0.000 (0.001)	0.001 (0.001)	0.047 (0.036)	0.087** (0.039)	-0.119*** (0.043)	0.139*** (0.049)	-0.186 (0.130)	-0.004*** (0.001)
Share decreased	-0.025 (0.018)	0.072** (0.029)	-0.000 (0.000)	0.001*** (0.000)	0.005 (0.017)	-0.008 (0.019)	0.017 (0.021)	-0.070*** (0.023)	-0.133*** (0.045)	0.002*** (0.000)
Share stayed the same	0.008 (0.038)	0.071 (0.059)	0.001 (0.001)	-0.002** (0.001)	-0.052 (0.039)	-0.079* (0.042)	0.102** (0.048)	-0.070 (0.053)	0.319** (0.131)	0.003*** (0.001)
Observations	573	573	573	573	573	573	573	573	573	573
Youth-owned businesses										
Share increased	-0.001 (0.040)	0.190*** (0.044)	0.005 (0.007)	0.000 (0.001)	0.003 (0.040)	-0.048 (0.044)	-0.095* (0.055)	-0.014 (0.055)	-0.163 (0.113)	0.006*** (0.001)
Share decreased	-0.011 (0.025)	0.027 (0.029)	0.002 (0.003)	0.000 (0.000)	-0.045* (0.027)	0.018 (0.029)	-0.119*** (0.024)	-0.089*** (0.025)	-0.067 (0.066)	-0.000 (0.000)
Share stayed the same	0.012 (0.039)	-0.217*** (0.042)	-0.007 (0.006)	-0.001 (0.001)	0.042 (0.038)	0.030 (0.042)	0.214*** (0.052)	0.103** (0.051)	0.229** (0.110)	-0.005*** (0.001)
Observations	571	571	571	571	571	571	571	571	571	571

Standard errors in parentheses.

***p < 0.01,

**p < 0.05,

*p < 0.1.

Table 8. Multinomial results about the drivers of change in the share of different sizes of trading businesses.

	Rural	North	Age	Number of traders	Mkt Leaders elected	Any leader female	Tomatoes	GLV	Night lights	Initial base
Nano firms										
Share increased	-0.031 (0.021)	0.024 (0.022)	0.005** (0.002)	-0.000 (0.000)	-0.006 (0.020)	0.011 (0.020)	-0.054** (0.024)	0.047* (0.025)	-0.101 (0.063)	-0.002*** (0.000)
Share decreased	-0.045 (0.033)	0.216*** (0.038)	-0.006 (0.006)	0.000 (0.001)	-0.010 (0.034)	-0.156*** (0.039)	-0.041 (0.047)	-0.134*** (0.044)	-0.194* (0.109)	0.002*** (0.001)
Share stayed the same	0.076** (0.037)	-0.240*** (0.041)	0.001 (0.006)	0.000 (0.001)	0.017 (0.038)	0.145*** (0.042)	0.095* (0.050)	0.087* (0.048)	0.295** (0.119)	0.000 (0.001)
Micro firms										
Share increased	-0.021 (0.034)	0.214*** (0.039)	0.002 (0.006)	0.000 (0.001)	0.016 (0.035)	-0.168*** (0.039)	-0.029 (0.049)	-0.156*** (0.045)	-0.166 (0.109)	-0.002*** (0.001)
Share decreased	-0.039* (0.021)	0.029 (0.021)	0.001 (0.003)	-0.001* (0.000)	-0.010 (0.020)	0.016 (0.019)	-0.030 (0.026)	0.023 (0.024)	-0.154** (0.074)	0.002*** (0.000)
Share stayed the same	0.060 (0.037)	-0.243*** (0.040)	-0.003 (0.006)	0.001 (0.001)	-0.006 (0.038)	0.152*** (0.041)	0.059 (0.051)	0.133*** (0.048)	0.320*** (0.118)	-0.000 (0.001)
Small firms										
Share increased	-0.041*** (0.016)	0.059** (0.029)	-0.009** (0.004)	0.000 (0.000)	-0.020 (0.017)	-0.066*** (0.025)	0.030 (0.020)	-0.057*** (0.021)	-0.087*** (0.031)	0.008*** (0.002)
Share decreased	0.015*** (0.006)	0.007 (0.008)	0.002*** (0.001)	0.000** (0.000)	0.017** (0.008)	0.013 (0.008)	-0.003 (0.006)	-0.008 (0.008)	0.002 (0.010)	0.002*** (0.000)
Share stayed the same	0.027* (0.016)	-0.066** (0.029)	0.007* (0.004)	-0.000 (0.000)	0.003 (0.018)	0.054** (0.025)	-0.026 (0.021)	0.065*** (0.022)	0.085*** (0.031)	-0.010*** (0.002)
Observations	574	574	574	574	574	574	574	574	574	574

Standard errors in parentheses.

***p < 0.01,

**p < 0.05,

*p < 0.1.

6. Conclusions and implications for policies and donor programs

Based on a detailed WM survey in Nigeria, we have shown that WMs move large amounts of food, are a market for masses of farmers, employ many people, favor employment of women and youth, and the proliferation of small enterprises, yet also suffer from substantial infrastructural constraints such as toilets and water access. They are dynamic in terms of the growth of volumes and small firms and women and youth employment, varying over products such as tomatoes, GLVs, and fish, over regions, rural and urban, and governance regimes in the markets.

The dynamism and massive activity of markets argue for their being or becoming important to policymakers. Their challenges suggest concern, as well as the need to invest in overcoming obstacles. Below, we explore gaps in the policy approach to date and suggest policy and program implications based on our findings.

a) Governments' inadequate approach to WMs despite their importance

Because WMs are largely in the purview of municipal governments, many of them were last attended to when they were set up mainly in the 1970s and the 1980s and not updated since; one has not seen in Africa what Reardon and Gulati (2008:34) document to have happened in parts of Asia often at grand scale, such as in Taiwan:

Taiwan's Nanmen Wetmarket Modernization Program. In 1979, the Taipei city government modernized its 105-year-old Nanmen wetmarket and turned it into a clean "shopping emporium" with standardized signboards, refrigeration, and other amenities. In 1998, the national government launched a five-year program to upgrade traditional food and vegetable markets (and solve the problem of illegal markets) throughout Taiwan using the Nanmen program as a model.

Instead of focusing on supporting existing AVCs, in general, the donor (and sometimes government) initiatives focus on going around the WMs and the wholesalers/traders in them – by focusing on direct farmer marketing, short supply chains, common in Rome agencies, European donors. The problem is that these initiatives do not reorient national AVCs as is hoped (they are sidelines); they are too small to affect basic food security; they often fail or are artificially kept going.

When donor and government initiatives focus on WMs, they are often not focused on the basic infrastructure and service challenges noted above. Instead, they tend to be training or one-off assistance such as NGOs building some toilets, or assistance with governance (when most WMs studied had developed forms of governance even elective), and recently, focusing on eye-catching second-generation improvements such as WM digitalization (found in Europe and Asia), which are being done by countries that already solved the more basic infrastructural challenges that plague WMs in places like Nigeria.

b) Needed policy orientation

There is an urgent need for policy advocacy based on empirical research results concerning the role and dynamism of WMs. Policy makers should be aware of several issues.

- The importance of WMs in national food security. They need to know that WMs are growing dynamically and that traders are constrained by challenges, but respond to incentives. We have observed that governments say they think these markets are traditional and stagnant, which implies that investments are wasted.
- The large constraints on WMs hold them back from their potential because of the challenges noted above and understand that the main needs are infrastructural.
- There are large differences over WMs and they need a differentiated approach.
- The foregone benefits and the incurred damage from not investing urgently are large.
- Governments - national, state, and municipal - need to work without WMs to grow this key pivot of the food economy.

c) Needed specific policies and programs to undertake

There are several specific policies and programs that would be most beneficial to undertake.

- Facilitate private sector investments in WMs such as for services.
- **Undertake infrastructure investments at scale, leveraging the private sector investments** (Swinnen 2025) such as blended finance for toilets, water and waste management, and electricity.
- **As much as possible strategize and act below the national level and focus on municipal strategies and inter-state collaborations and learnings** for both specific WMs and networks of WMs.
- Where donors and multilateral African institutions and national governments are moving ahead with agroparks and SEZs, **leverage agropark initiatives to support - not compete with or undermine – WMs.**
- **Pursue at first intermediate technology for WMs in terms of communications, information, storage, etc., and leave to second generation efforts digitalization of WMs.** For the latter to succeed, logistics must be in place and improving the latter is the first step to take; the veneer of digitalization on dilapidated old markets like in Abuja is not useful.
- **Support networks of market leaders** to share experiences and pinpoint needed investment strategies.

Ethical approval and consent statement

All studies in this project involving humans were approved by the Michigan State University Institutional Review Board and were conducted in accordance with local legislation and institutional requirements. This project has the Michigan State University IRB Study ID: STUDY00007403 and was determined as exempt Category: Exempt 2ii. All participants provided written informed consent to participate in the study.

Data availability statement

Data will be made available on request.

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