Cost structure, competition and employment along aquaculture value chains in Nigeria

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Front cover, page 8, Nhuong Tran/WorldFish.

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Executive summary

Fish is an integral part of diets in Nigeria. The per capita annual fish consumption in the country is estimated at 9 kg, which is substantially lower than that of the global average (20 kg), but similar to the average in sub-Saharan Africa (9 kg). In 2017, domestic production from both aquaculture and capture fisheries contributed about 70% of all fish consumed in Nigeria, while 30% was imported. Aquaculture has recorded the fastest growth rate in Nigeria's agricultural sector, growing at 13.6% per year since 2000 and contributing substantially to economic development (FAO 2020). The sector contributes 4.5% of the country's gross domestic product, plays a crucial role in meeting both current and future demand for fish and contributes substantially to reducing poverty, generating employment and increasing incomes.

At the same time, the government increasingly recognizes the need to regulate aquaculture production activities to ensure supply of quality and safe fish products to meet demand. To that end, Nigeria's Federal Department of Fisheries and Aquaculture began the process of certification and standardization of fisheries and aquaculture products in 2009. As part of this process, operational guidelines and criteria for certification of aquaculture products in the country were developed. To increase both safety and consumer confidence by standardizing operations of fish farms and introducing traceability from production to marketing, the government has drafted a voluntary quality, safety and sustainable certification scheme targeting large-scale aquaculture producers for export markets. Furthermore, Nigerian stakeholders are exploring the possibility of applying ecolabeling standards for African aquaculture developed by the African Organization for Standardization.

In this report, we summarize our findings from a value chain survey of relevant stakeholders in Nigeria to better understand the aquaculture industry's post-production cost composition, market competition environment, and employment more fully. Furthermore, we present findings related to the demand for safety certified fish. Our findings show that costs regarding fish transportation are disproportionally high, market competition is imperfect, labor employment differs substantially among services (processing, retailers, wholesalers) and states, and demand for seafood safety certification is significant.

Key questions

- What are the key leverage points along the fish value chain to enhance the contribution of aquaculture to smallholder producers' livelihoods, nutrition, and women and youth empowerment?
- What are the key intervention points to better engage the private sector toward improving the contribution of fish to the Nigerian people?
- Are consumers willing to pay for seafood safety certifications?

Introduction

Although Nigeria is the second-largest producer of aquaculture products in Africa, its post-harvest value chains are not well understood. The dynamics of aquaculture value chain configurations and functionality are critically important to the design of national policies regarding food security, safety and efficiency. Furthermore, the health burden of foodborne illnesses is a major concern in developing countries. Foodborne illnesses caused 420,000 deaths and 33 million disability adjusted life years worldwide in 2010—and Africa suffered most (Havelaar et al. 2015; Jaffee et al. 2019). The cost of foodborne illnesses in Nigeria is estimated at USD 3.6 billion annually (WHO 2015). Certification of seafood safety could substantially address foodborne illnesses by providing monetary incentives to limit harmful and careless practices among producers, traders and retailers along the whole aquaculture supply chain.

To efficiently expand aquaculture while retaining profitability and sustainability, a firm understanding of the supply chain is necessary, including post-harvest. There are many gaps in data available for Nigerian aquaculture, including on post-harvest losses, financial performance, outcomes disaggregated by gender and age, and food safety practices. A better understanding of the financial efficiency of fish markets, post-farmgate prices, and their implications for value chain performance as well as national food and nutrition security in Nigeria is critical to support policies and decision-making to ensure economically viable fish value chains.

Concern among consumers and regulators about the safety and environmental sustainability of seafood has led to the enforcement of stringent requirements in the Global North, including voluntary standards overseen by private third-party certification bodies (Tran et al. 2013). While such standards may constitute barriers to participation in export markets by small-scale aquaculture producers, they have also catalyzed upgrades to production and post-harvest handling practices of some value chain actors in developing countries. However, in most developing countries, particularly in sub-Saharan Africa, it is not yet understood whether consumer demand for seafood safety certification can be harnessed to generate positive returns for producers. Answering this question not only requires an assessment of the premium that consumers are willing to pay for seafood safety, but also a solid understanding of how farmed fish value chains operate. These insights are needed to equip aquaculture policies, programs and projects to design better incentive schemes for quality improvement while generating positive payoffs along farmed fish value chains.

In response to the need for a greater understanding of farmed fish value chains and demand for seafood safety, WorldFish, in partnership with International Food Policy Research Institute, Swedish University of Agricultural Sciences, and Lagos State University, has undertaken a study entitled "Demand for seafood safety and environmental sustainability certification standards in sub-Saharan Africa: The case of Nigeria." The study, funded by the CGIAR Research Program on Policies, Institutions, and Markets, provides descriptive insights into cost composition, competition and employment along farmed fish value chains and quantitative evidence about demand for aquaculture certification in Nigeria. This document serves as a summary of our findings.

Cost composition

A survey conducted in four states in Nigeria: Rivers, Ogun, Lagos and Delta, covering producers, processors, wholesalers and retailers, indicated that labor and transportation account for about 65% of the total variable costs along the post-farmgate segments of farmed fish value chains. This suggests substantial employment creation along the value chains. The high share of transportation cost in total variable costs indicates the need to invest in improved transportation infrastructure to maximize returns from commercial aquaculture production.

Figure 1 summarizes the average variable cost structure, in percentage terms, of each actor along the fish value chain. The major variable costs along the fish value chain consist of labor, transportation, rent and land lease, electricity and government fees. Labor constitutes the greatest cost along for all value chain actors, at 67%–70% of total costs. This implies significant income generation through employment in aquaculture. Particularly in Ogun, 78%–87% of the total cost by actors along the value chain went into the local labor market. While the labor intensity suggests aquaculture could continue to create jobs, it also reflects opportunities for efficiency gains that could help economize the sector and make it more competitive overall.

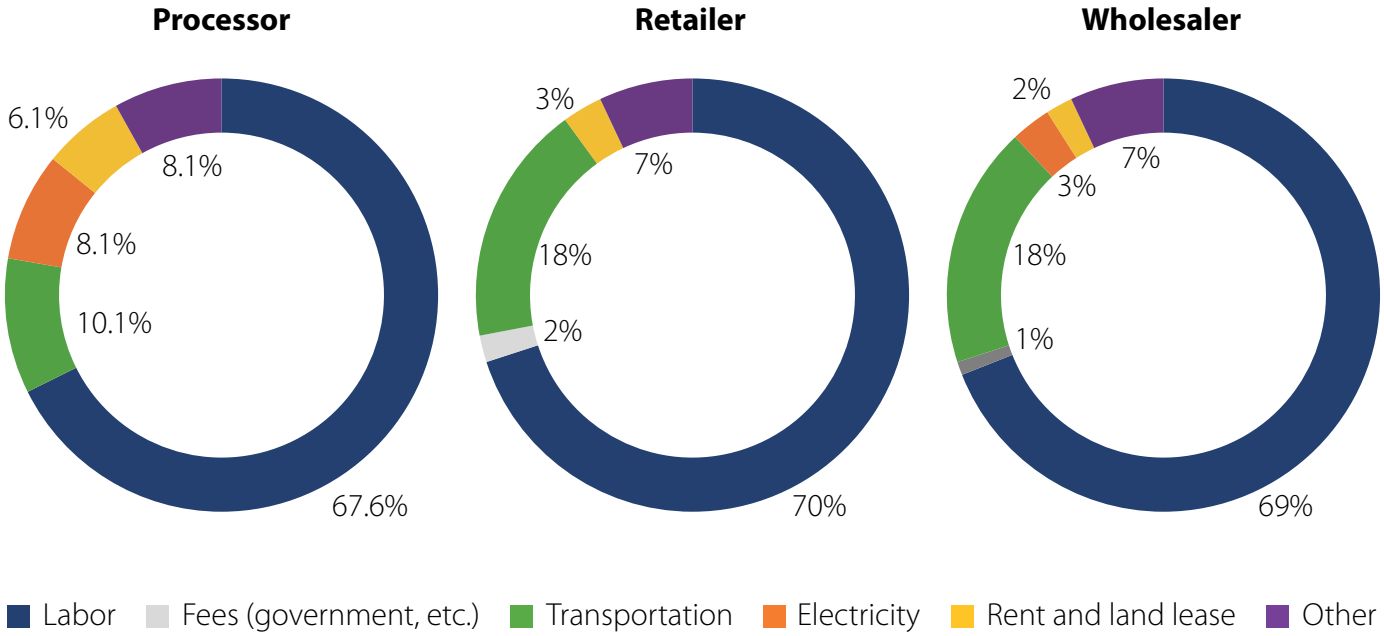

Figure 1. Average cost structure by actor (%).

Transportation is the second-largest variable cost along the value chain, accounting for 10%–18% of the total cost for each actor type. in Delta state, the cost structures of retailers and wholesalers are rather different than in other regions, with transportation accounting for the largest portion of the total cost (48% and 87%, respectively), followed by market space rent, land lease and government fees. This indicates that transportation infrastructure in these regions may be insufficient and in need of investment to reduce costs and improve efficiency. The cost of market space rent and land lease is another considerable cost for actors in all regions, averaging 2%–6% of the total cost, with the highest percentage (36%) for processors in Delta state. The cost of electricity only applies to processors and wholesalers in the value chain, accounting for an average of 8% and 3% of the total cost for processors and wholesalers, respectively. This is especially so for processors operating in an urban region like Lagos who spent 12% of the total cost on electricity (NGN 52±122/kg).

In terms of the average total cost for a kilogram of products sold, as summarized in Figure 2, processors generally have the highest variable costs, spending an average of NGN 192±270/kg of products sold, followed by retailers (NGN 73±68/kg) then wholesalers (NGN 26±25/kg). Increased relative costs of fish processing may be due to the skills-based nature of fish processing (i.e. fish cleaning, smoking, drying, etc.). The highest total cost is of processors in Lagos, averaging NGN 429±428/kg, over two-fold the costs of processors in other regions. This may be due to several factors, including higher wages, the methods used and higher utility prices. The actors in Delta state have the lowest operating cost of all regions, with processors spending NGN 53±94/kg, retailers NGN 10±9/kg and wholesalers NGN 7±5/kg.

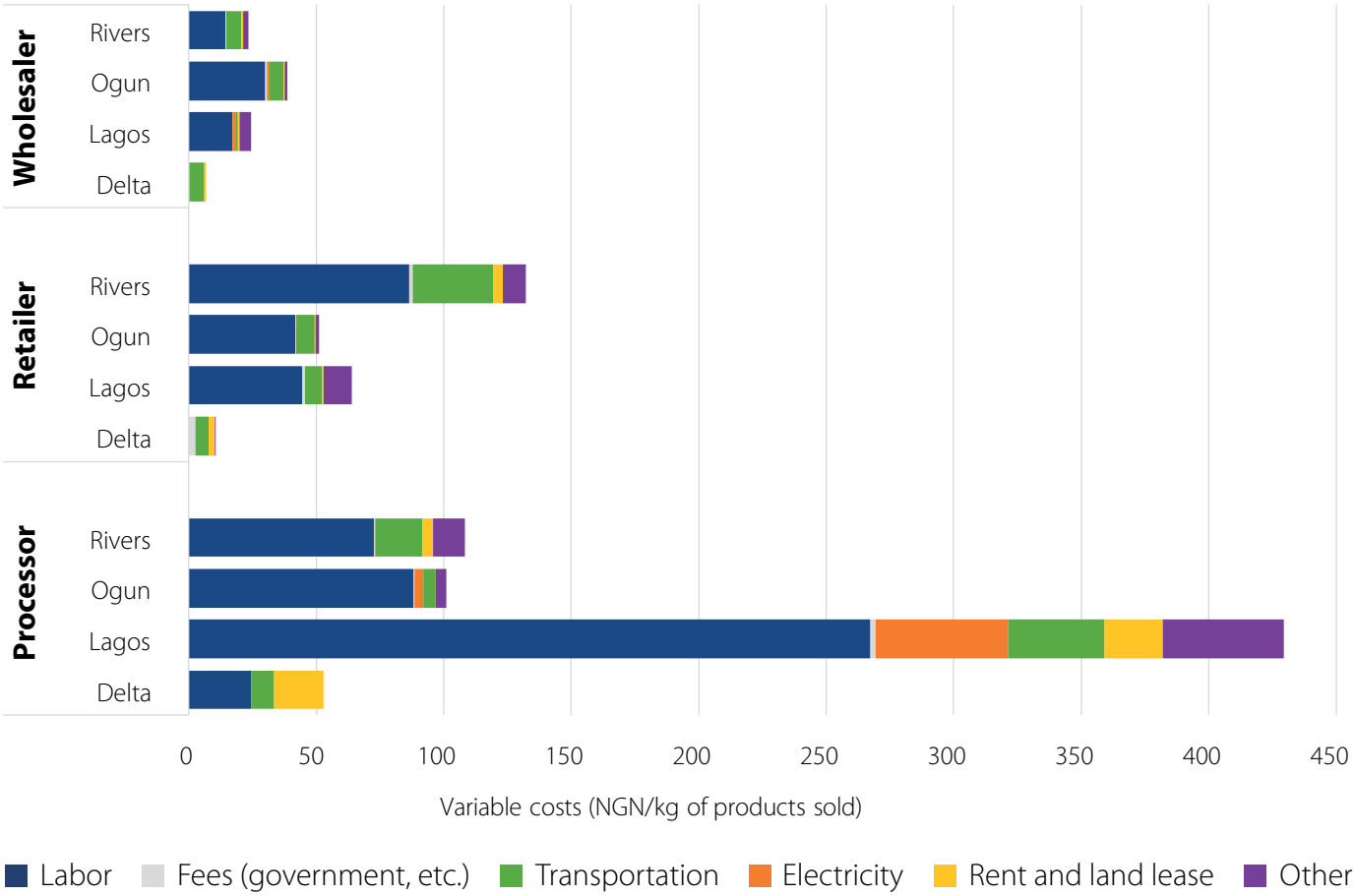

Figure 2. Variable costs by actor and states.

Competition

To measure the degree of market competition, we applied the four-firm concentration ratio (CR4), defined as the percentage of fish products sold by the four actors that sell the greatest volumes in their category (Dillon and Dambro 2018). A CR4 statistic must be interpreted with reference to some scale that connects it to levels of market competition (Dillon and Dambro 2018). A common rule of thumb is that a CR4 ratio below 20 is consistent with substantial or perfect competition, a range of 20–60 suggests possible non-competitive behavior, and greater than 60 indicates a high likelihood of some degree of market power (Dillon and Dambro 2018).

Figure 3 visualizes the concentration ratio of the largest four firms (CR4) and eight firms (CR8) along the fish value chain. The CR4 of all fish products on the market ranged from 27% to 59%, indicating a range from a somewhat uncompetitive market to monopolistic competition in the study regions. The retailer and wholesaler markets in Rivers and the processor market in Ogun are the worst in terms of market competition, with 49%–59% of products sold by the four largest firms, showing a loose oligopoly market structure. The wholesaler market in Lagos has a slightly better degree of market competition among other markets, with CR4 at 27% and CR8 at 44%. The concentration ratios of the eight largest firms further affirm a certain degree of market power among all markets of all regions, with CR8 ranging from 44% to as high as 71% in the wholesaler market in Rivers. The competition of catfish markets generally followed the same patterns as the market for all products, as catfish products are the main commodities traded along the fish value chain. Tilapia markets are dominated by only a few players along the value chain, as the market is rather undeveloped.

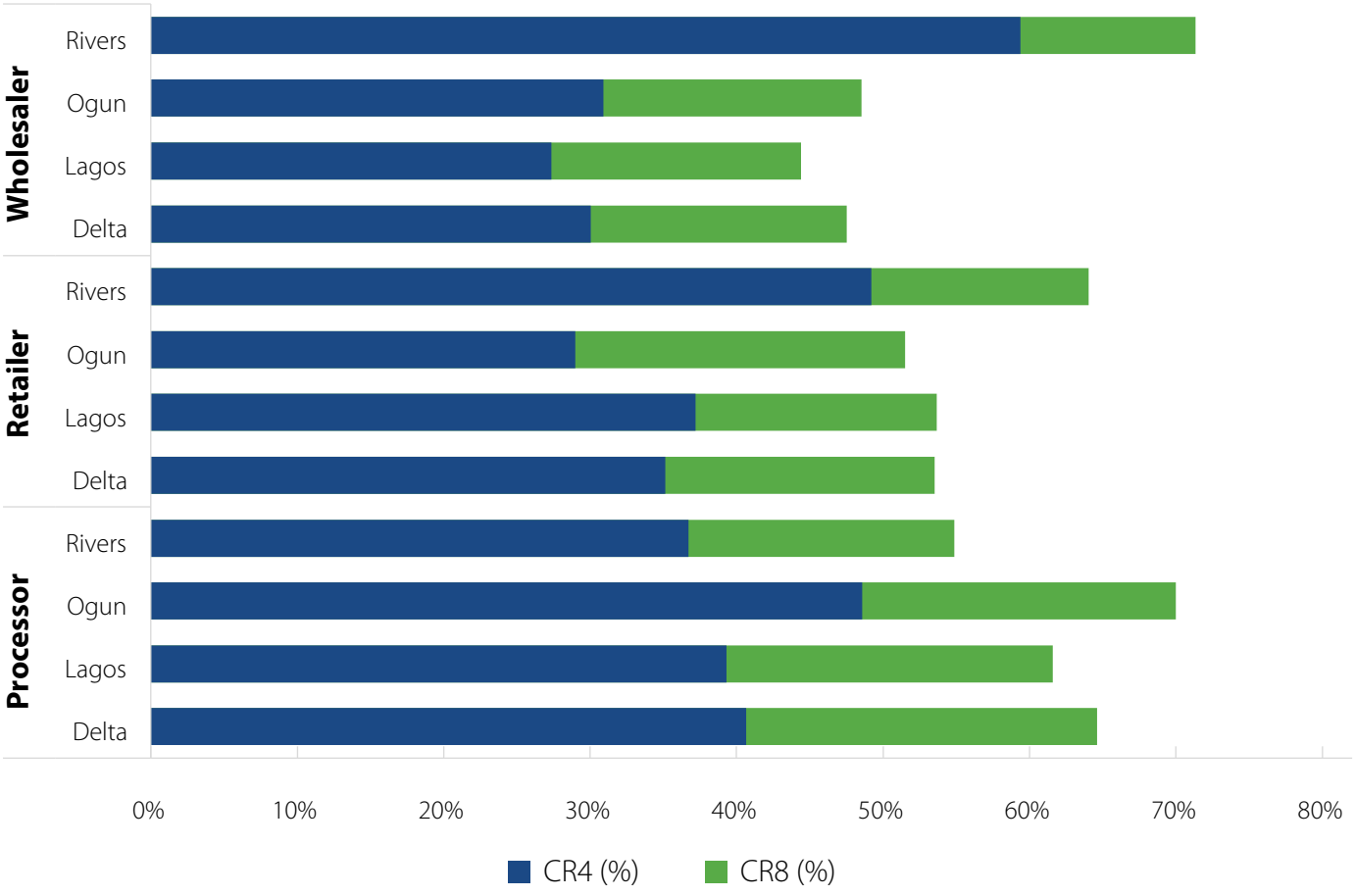

Figure 3. Percentage of production attributed to the top four (CR4) and top eight (CR8) firms.

Employment

The survey further measured employment along the fish value chain, disaggregating by gender and age category. These categories varies across the different segments of the value chain. At the production stage, aquaculture operations in Nigeria are male dominated. However, women's participation in aquaculture activities increases considerably at the post-farmgate stages of the value chain. At the retailer level, more women are employed than men for all age categories. A similar pattern is observed at the processor level, although the differences are not as wide as those observed at the retailer level. More men than women are employed at the wholesale stage, except for the 36–45 age category, where four times as many women are employed as men.

Figure 4 summarizes hiring tendencies along the fish value chain in different regions. On average for all regions, processors are the most dependent on labor with 78% of them hiring labor, followed by wholesalers (65%) and retailers (38%). Firms at all stages of the value chain generally hire one to three laborers. Compared with different regions, the actors along the value chain in Lagos are most likely to employ workers: 100% of processors, 72% of retailers and 97% of wholesalers in this region did so. In contrast, retailers in Delta and River states are least dependent on labor, with only 17% of them using hired labor. This contrast may be due to economic differences as well as discrepancies in post-production distribution. For instance, consumers in Delta and River states may be less reliant on traditional retail or wholesale sellers and instead receive fish through other means.

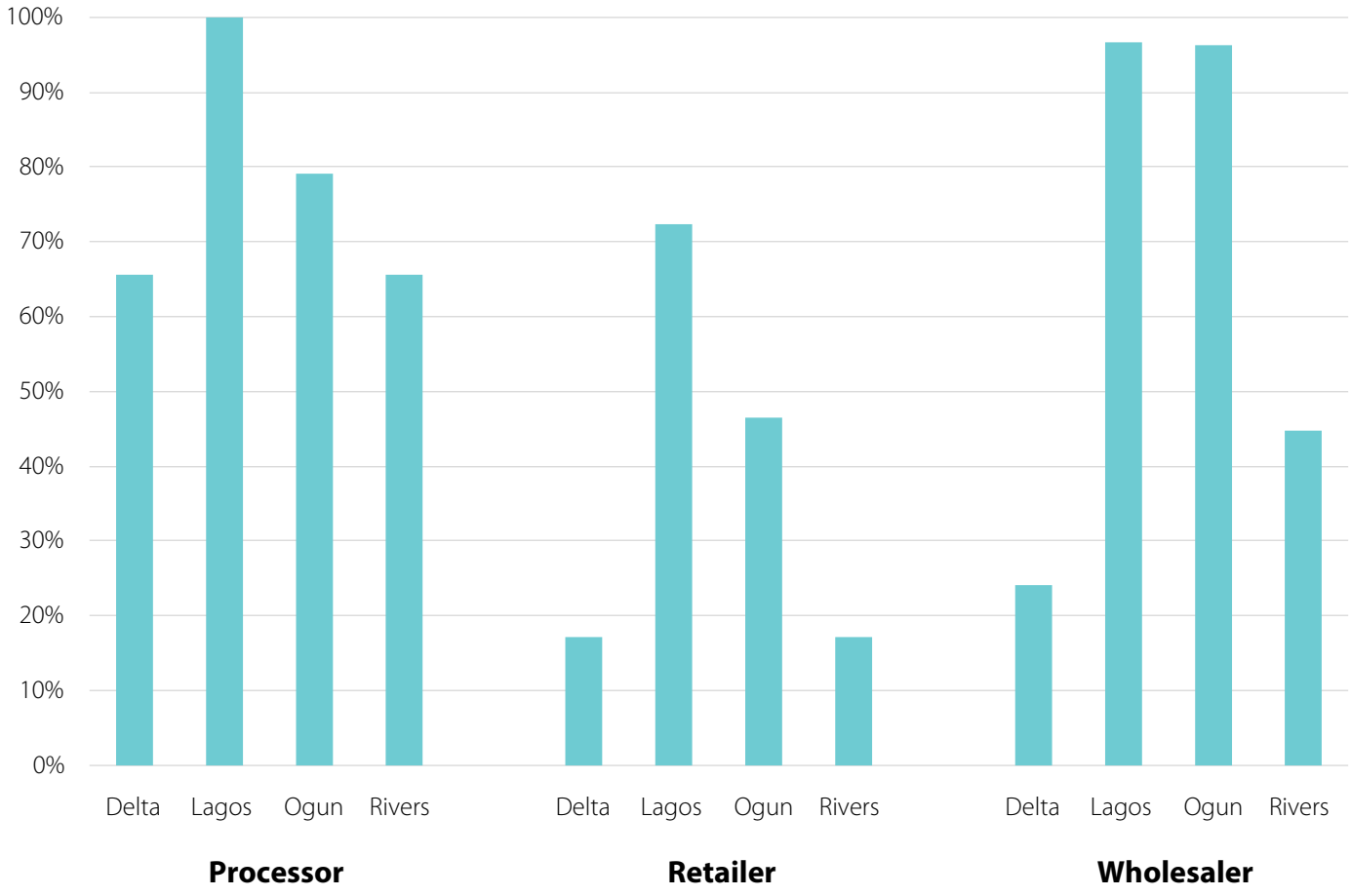

Figure 4. Percentage of respondents with employed labor.

Female laborers make up more than half the labor force along the fish value chain, particularly at the retail stage, where they make up 91% employees, ranging from 83% to 97% across different regions. The gender makeup of the labor force in the processor and wholesaler segments is more evenly distributed, with an average of 52% female laborers. The labor market for the processing and wholesaler segments in Rivers state has less gender-inclusivity than other regions, with less than 40% female employment. This is in stark contrast to the labor force in fish production, which is made up of 85% males (Tran et al. 2020). Youth laborers are more likely to be employed in processing, which has an average of 29% youth labor. Ogun has the highest rate of youth laborers participating in processing and wholesale, at around 40%. Rivers has the least amount of youth labor involved in the value chain, with only 13% in processing, 2% in retail and none in wholesale.

Processing generates most of the employment along the value chain, with an average of 41±139 employees per every metric ton of product sold, followed by retail, which creates 12±15 employees per metric ton, then wholesale, creating 4±4 employees per metric ton. Processing employment in Delta state, where 72±269 employees are created for each metric ton of product sold, is especially significant, followed by processing in Lagos (43±64 employees). The large labor force related to fish processing may represent the difficulty of the trade and the need for many specialized individuals. Fish processing is also where the most uncertainty lies in terms food safety and nutritional composition. For comparison, retail generates less than half the employment provided by processing, with a range of 7 to 18 employees per metric ton in different regions.

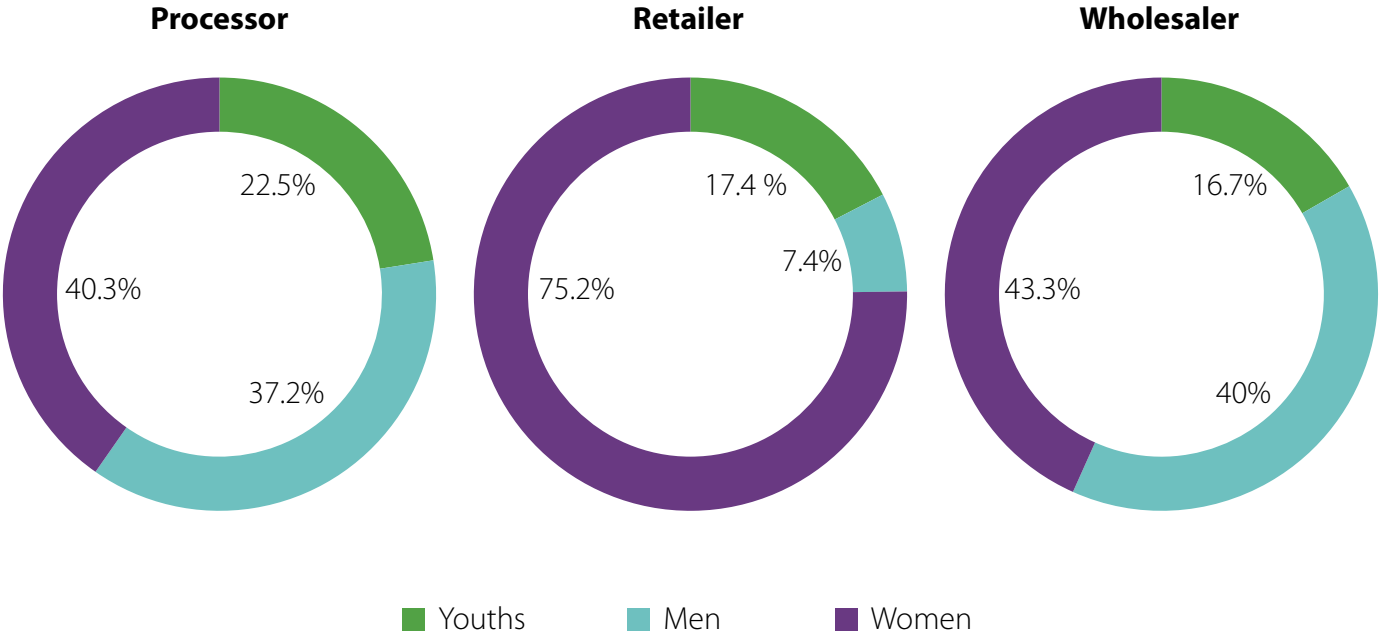

Figure 5. Labor market composition by actor.

Demand for seafood safety certification

Descriptive evidence from key informant interviews and household surveys with producers revealed a willingness to participate in aquaculture food safety certification if it is established. More than 70% of the producers interviewed indicated they would be interested to participate in a certification scheme if established. The most important perceived benefits of aquaculture certification, from a producer's perspective, include higher prices and higher demand for fish. Among the major perceived barriers to participation in certification are high expected costs, lack of trust in the certifying agents and difficulty satisfying the requirements. These descriptive insights suggest interest among producers to participate in certification. But is there a premium for seafood safety in the domestic market?

An experiment with consumers in Nigeria's fish markets showed positive and significant premiums for food safety certified catfish. Consumers were willing to pay 3.1%–18.8% more for certified fish than non-certified fish (Tran et al. 2021). Willingness to pay for certification was higher for larger-sized fish than smaller-sized fish, and higher for smoked fish than live fish. These findings are consistent with growing concerns regarding the use of certain chemicals and fertilizers by some fish farmers. Differences in the consumers' willingness to pay (WTP) for safety certification across fish types may be related to post-production processes. Higher WTP for safety certified smoked catfish relative to live fish suggests that there are concerns about not only the production processes, but also post-production smoking practices. Improperly smoked fish can contain carcinogenic chemicals and lead to health concerns. This finding suggests that food safety certification should be developed that includes not only the production stage, but also the post-production supply chain. This suggests that for any certification standards to be effective, it needs to certify the product along the entire value chain rather than at a single node.

These findings of higher WTP for safety certified fish motivate the deployment of the government-led voluntary food safety certification program to value chains serving Nigeria's domestic fish market. Higher prices for certified fish would incentivize the reduction in harmful pesticide and fertilizer use and allow post-production processes to be conducted more carefully. However, it should be noted that consumer preferences for the certification of larger, processed and more expensive fish suggest that a voluntary certification system may evolve to cater to individuals of higher socioeconomic status. Certification schemes should be careful to not exclude the certification of smaller, less expensive fish, as this could lead to inequities in access to safe food.

Photo credit: Hung Tran, WorldFish

Women selling fish in a Nigerian fish market.

Conclusions and recommendations

In this brief, we have summarized the findings of recent research aiming to close aquaculture supply chain data gaps present in Nigeria and analyze whether there is a demand for a national seafood safety certification program. Currently, this research is the only nationally representative study to evaluate post-harvest fish value chains in Nigeria, as well as the demand for seafood safety certification.

We have analyzed three key distinct post-harvest stages along the value chain: (1) processing, (2) retail and (3) wholesale. We found that high transportation costs were reported at all stages of the value chain, possibly indicating deficiencies in transportation infrastructure, such as roads. Regarding market competition, concentration statistics indicate that competition ranges from less than ideal to almost monopolistic. Additionally, we report the active engagement of women and youths in post-harvest aquaculture value chains. Women are especially represented in the retail sector, making up approximately three-quarters of the sample. This contrasts with the production stage of aquaculture, which is a heavily male dominated industry.

We find that there is significant demand for seafood safety certification within Nigeria. Consumers were found to be willing to pay price premiums of up to 18.8% for certain kinds of certified seafood, with the highest price premium reported for larger portions of smoked catfish. This demonstrates the need for any safety certification program to account for processes happening along the whole value chain. Overall, our findings indicate strong potential for a national seafood safety certification program.

Recommendation 1: Increase women's participation in aquaculture production
Although we have discussed that there is a large proportion of women working in post-production services, most notably retail, there is little participation among women in the production of aquaculture. In a recent survey conducted by WorldFish and Mississippi State University, men owned and/or managed more than 85% of aquaculture farms. This unequal gender composition calls for increased investment to encourage women to participate in aquaculture production. Religious and cultural beliefs, high degree of risk aversion, liquidity, and informational constraints limit women's role in aquaculture production.

Recommendation 2: Improve transportation and cold-storage infrastructure
Transportation costs range from 10% of total costs to 18% among post-production processes. These high transportation costs lower the gross margins of profitability for fish production. Increased investment in roads and cold-storage infrastructure would help lower transportation costs and reduce post-harvest losses. In this way, efficiency is maximized while decreasing the barriers faced by a growing aquaculture industry. Additionally cold transportation is largely absent from Nigerian fish value chains. The advent of this technology would increase the options available to all actors in the supply chain as well as help reduce post-harvest losses, bolster food safety and make fish products more accessible in inland states of Nigeria.

Recommendation 3: Incentivize quality control at post-farmgate stages of the value chains
Our findings suggest that consumers are aware of the food safety hazards introduced in the processing, storage and transportation of fish. Higher WTP for certification of processed fish may reflect that the further fish products move down the value chain the more uncertainty consumers face regarding the safety of the product. To address this, seafood safety certification must not only be present at the production level, but also include downstream processing steps. Our findings suggest that a certification program that excludes this part of the value chain may not be viable due to lower consumer WTP for fresh certified seafood in comparison to processed certified seafood.

Recommendation 4: Incentivize participation in aquaculture certification
The results of our recent studies highlight the benefits that may be accrued from participation in seafood safety certification. Certification programs in the Global North have already been deployed and have been largely successful. These programs have the power to reduce the use of harmful chemicals and antibiotics and motivate fish processors to adhere to safe food practices, improving post-harvest handling in general. In addition to food safety, these programs can also lead to the implementation of more environmentally friendly production and processing practices.

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WorldFish is a nonprofit research and innovation institution that creates, advances and translates scientific research on aquatic food systems into scalable solutions with transformational impact on human well-being and the environment. Our research data, evidence and insights shape better practices, policies and investment decisions for sustainable development in low- and middle-income countries.

We have a global presence across 20 countries in Asia, Africa and the Pacific with 460 staff of 30 nationalities deployed where the greatest sustainable development challenges can be addressed through holistic aquatic food systems solutions.

Our research and innovation work spans climate change, food security and nutrition, sustainable fisheries and aquaculture, the blue economy and ocean governance, One Health, genetics and AgriTech, and it integrates evidence and perspectives on gender, youth and social inclusion. Our approach empowers people for change over the long term: research excellence and engagement with national and international partners are at the heart of our efforts to set new agendas, build capacities and support better decision-making on the critical issues of our times.

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