Scoping study on fruits and vegetables; results from Nigeria

An assessment of investment opportunities for the Bill and Melinda Gates Foundation

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WAGENINGEN
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Scoping study on fruits and vegetables

Results from Nigeria

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Wereldwijd lijdt een op de drie mensen aan een of meer vormen van ondervoeding. De teams van de Bill & Melinda Gates Foundation die zich bezighouden met landbouw en voeding, in samenwerking met het Britse Department for International Development (FCDO), willen het potentieel van groente- en fruitketens onderzoeken om het aanbod van voedzame voedingsmiddelen te vergroten en te versterken, en om de lokale marktkansen voor meer inkomsten te vergroten, speciaal voor vrouwen. Dit rapport belicht de conclusies van een onderzoek in Nigeria en identificeert verschillende oorzaken en mogelijke interventies om de fruit- en groentesectoren te verbeteren en daarmee de consumptie te verhogen.

Currently, one in three of the world's population suffer from one or more forms of malnutrition. The Agricultural Development and Nutrition teams at the Bill & Melinda Gates Foundation, in collaboration with the UK's Department for International Development (FCDO), seek to investigate the potential of vegetable and fruit supply chains to increase the supply of and strengthen demand for nutritious foods, as well as increase local market opportunities for increased income, especially for women. This report highlights the conclusions from a study in Nigeria, and identifies several root causes, as well as opportunities for interventions to further develop the fruit and vegetable sectors, and with that enhance consumption.

Key words: fruit, vegetables, food system, nutrition, supply chains

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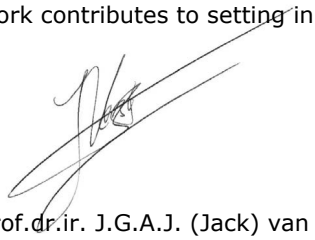
Preface

The world's population is expected to increase by 2 billion persons in the next 30 years, from 7.7 billion currently to 9.7 billion in 2050. In spite of progress made in the past decades, the number of people being undernourished is on the increase again. Globally, 462 million are underweight, while 1.9 billion adults are overweight or obese. This contrast highlights well one of the most prominent global challenges imposed on our food systems, which is: how to make available, accessible and affordable healthy food to all.

To meet the growing demand for food and improved nutrition, food production and its nutritional value need to be enhanced. Compounding this issue is the pressure that existing agricultural systems place on the environment. Although there is scope to bring new land under cultivation, for example in Africa and Latin America, this has the knock-on effect of damaging the climate, biodiversity, natural habitats and more generally the integrity of the Earth's environmental system. The challenge of achieving global food and nutrition security is underscored by Sustainable Development Goal (SDG) 2: "End hunger, achieve food security and improved nutrition, and promote sustainable agriculture."

Fruits and vegetables play a key role in achieving above mentioned goals. This was acknowledged by the Bill and Melinda Gates Foundation (BMGF) and the Foreign, Commonwealth & Development Office (FCDO) which realised that more knowledge on the current state of fruit and vegetable consumption, trade, processing and production worldwide, and notably in low- and middle-income countries, is needed. For that purpose, Wageningen University & Research was contracted to conduct a global scoping study including deep dives into selected countries. After more than a year and a half of research, we are happy to present a number of research outputs that address comprehensively the state of art and main challenges associated with fruits and vegetables. The reports take us through all aspects of food systems in which fruits and vegetables play a role, from consumption to production, but also around the world, from Nigeria to Nepal. The study provides BMGF and FCDO with a clear set of recommendations as to priorities for philanthropical investments that have the goal of enhancing consumption of and economic benefits from fruits and vegetables.

Fruits and vegetables play a key role in meeting current and future food system challenges. With this research we know better where we are and what is needed to address these challenges. I hope our work contributes to setting in motion food system changes urgently needed.



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Summary

Background

The Agricultural Development and Nutrition teams at the Bill and Melinda Gates Foundation (BMGF), in collaboration with the UK Foreign, Commonwealth & Development Office (FCDO), seek to investigate the potential of vegetable and fruit supply chains to increase the supply of and strengthen demand for nutritious foods, as well as improve market opportunities for increased income, especially for women.

A global scoping study of the horticultural sector in West Africa, East Africa and South Asia was conducted. The Phase I study was based on available literature and secondary data and resulted in the identification of so-called leverage points for interventions in the food system to promote the production, trade and consumption of fruits and vegetables. To test the validity and feasibility of the identified leverage points in specific contexts, seven deep-dive country studies have been performed in seven countries in Bangladesh, Burkina Faso, Ethiopia, India, Nepal, Nigeria and Tanzania.

This country study provides a better understanding of current trends in the horticulture sector of Nigeria. As a result of this study, BMGF and FCDO intend to identify potential investment options for enhancing the sustainable and inclusive development of the horticulture sector in Nigeria. The goal of this country study is to understand what kind of investments can be made to accelerate systemic changes in the food system for healthier diets and provide more economic opportunities for women.

Method

We investigated key questions on fruits and vegetables identified during Phase I. To add scope and focus to the study we selected three fruit (citrus, mango, papaya) and three vegetable crops (amaranth, onion, tomato). The crop selection is justified based on opportunities for 1) an uptake of consumption among poor and middle-class urban and rural consumers; 2) economic importance and income generation for farmers; 3) importance for nutrition; and, 4) empowerment opportunities for women. We used a mix of eight focus group discussions (FGDs), six key informant interviews (KIIs) and literature to provide an answer to the key questions identified, allowing for in-depth information gathering as well as cross referencing and triangulation.

Key findings

The volume of fruits and vegetables produced has increased in Nigeria due to an increasing production area, but yield improvements have been extremely limited. Traditional mixed crops and livestock farming systems, in which fruits and vegetables feature, are most common. With expected population growth and rapid urbanization, the current modes of production are insufficient to meet future demands for fruits and vegetables.

We estimate that most fruits and vegetables are traded in the informal market (est. 95-99%). Wholesale traders dealing in fruits and vegetables have a dominant position in linking producers to consumers. Only a minority of farmers take their produce to the market themselves. The Nigerian fruit and vegetable sector also faces a limited availability of relevant infrastructure and facilities for processing and storage.

The cost of fresh vegetables and fruits is relatively high; about 90% of the Nigerian population cannot afford sufficient intake of fruit and vegetables. The consumption remains below World Health Organization recommendations. Current fruit and vegetable consumption per day is estimated at

238 g per capita. Disparities are observed in consumption of fruit and vegetables across the country and between income classes.

Women are active in the different parts of the fruit and vegetable supply chain, although women's overall economic productivity and capacity remain lower than men. Women form the bulk of the labor force in fruit and vegetable processing, they dominate in the informal retail sector, and they also run informal small-scale cottage industries. Nigerian women provide labor for the fruit and vegetable supply chain, especially where there is a need for intensive processes which allows them to earn an income. Even though this employment is important for women, these employment opportunities are not always empowering and sometimes expose women to exploitative labor arrangements.

The enabling environment in Nigeria is improving, but remains very challenging. Nigeria has a weak institutional environment, particularly its legal frameworks, which leads to difficulties in enforcing contracts, and rent-seeking behavior. There is also the challenge of inadequate infrastructure, including poor feeder roads, poor or limited specialized transport for agricultural produce, and shortages or the lack of reliable electricity needed for cold storage to ensure the smooth flow of perishable items such as fruits and vegetables to markets.

1 Introduction

1.1 Background

The Agricultural Development and Nutrition teams at the Bill and Melinda Gates Foundation (BMGF), in collaboration with the Foreign, Commonwealth & Development Office (FCDO) in the UK, seek to investigate the potential of vegetable and fruit value chains to increase the supply of and strengthen demand for nutritious foods, as well as increase local and export market opportunities for increased income, especially for women.

First, a global scoping study of the horticultural sector in West Africa, East Africa and South Asia was conducted. This Phase I study was based on available literature and secondary data and resulted in the identification of so-called leverage points for interventions in the food system to promote the production, trade and consumption of fruits and vegetables. These potential leverage points were formulated in general terms only. To test the validity and feasibility of the identified leverage points in specific contexts, seven deep-dive country studies have been performed in seven countries in Bangladesh, Burkina Faso, Ethiopia, India, Nepal, Nigeria and Tanzania. This report describes the findings of the Nigeria country study.

1.2 Objective of this report

This study aims to gain a better understanding of current trends in the horticulture sector of Nigeria. As a result of this study, BMGF and FCDO intend to identify potential investment options for enhancing the sustainable and inclusive development of the horticulture sector in Nigeria. The ultimate goal of this country study is to understand whether and what kind of investments can be made to accelerate systemic changes in the food system for healthier diets and more economic opportunities for women.

1.3 Research questions

In Phase I, various leverage points, assumptions and associated research questions for the country case studies have been identified. For each question we used a mix of literature research and primary data collection using FGDs and KIIs.

Table 1.1 *Leverage points and related research questions*

Leverage point	Assumptions	Guiding research question Phase II
Production	Increase in production leads to lower fruit and vegetable consumer prices	How does seasonal variation in weather influence fruit and vegetable production, yields and market prices (disaggregated by fruit and vegetable category)?
		What are the main causes and volumes of production losses, and where do they occur?
		What are the main barriers for farmers to increase the production of fruits and vegetables?
		What keeps farmers from intensification? Do female producers face greater barriers than male producers, and are there examples that have lowered these barriers? Are quality inputs and services accessible and is the enabling environment supportive to intensification?

Leverage point	Assumptions	Guiding research question Phase II
		Does the intensification of fruit and vegetable production offer additional opportunities for women? Does it overburden women? How do women balance working on fruit and vegetable production with household tasks? Are the latter 're-negotiated' or mitigated by other strategies?
Cost price	Reduction in cost price will make production of fruits and vegetables more profitable to smallholders	How much are the production costs and can we compare them across the seven countries? What happens to the farm-gate price when costs are reduced? What happens to the income of farmers when farm-gate prices are lower?
Fruit and vegetable supply chain efficiency	More efficient supply chains can lead to lower fruit and vegetable consumer prices	Does value chain efficiency result in lower farm-gate prices and/or consumer prices? Data on prices: farm-gate and consumer prices. What are the risks, costs and types of coordination for the key fruit and vegetable categories? How can more efficiency be achieved and are there examples of such enhanced efficiencies?
	More secured fruit and vegetable markets increase value chain efficiency, farmer income and reduce wastage	Are there examples that more secure markets (formal markets) are beneficial to smallholder farmers? How should farmers benefit from such arrangements?
Communication	Intermediary actors communicate consumer needs to producers and (jointly) develop innovative food products	How do traders and processors (male and female) connect to consumers? Are they organized to support each other? Do they impose standards on producers? What examples are there of women succeeding? Are these exceptions or at scale in the different levels of the food value chain?
		Are there examples of traders and processors (male and female) who are capable of responding to consumer needs by developing innovative food products?
		What are the conducive conditions for information sharing and what is the role of trust?
Diversity	More and higher diversity in fruit and vegetable crops produced and traded leads to more and more diverse fruits and vegetables in the food environment	Has the introduction of new fruit and vegetable varieties contributed to more fruits and vegetables being consumed? What are the trends in fruit and vegetable consumption, are these dependent on season, geographical location (production/ non-production areas), and can these trends be disaggregated by different types of fruits and vegetables?
Consumer prices	Prices of fruits and vegetables are always higher compared to other food categories	Why are consumer prices of fruits and vegetables higher compared to other domestically produced food crops? Are there differences between categories of fruits and vegetables and what explains these differences?
Women participation	Women's participation in fruit and vegetable production and value chain operations leads to higher income and empowerment of women	Are there examples of the successful integration of women in profitable production and fruit and vegetable value chain operations? What explains these successes and is there evidence of them being scaled up? What business models work best for women's inclusion and leadership?
	Higher income by women leads to higher consumption of fruits and vegetables	If fruits and vegetables become more commercial (or scaled up) will the income be controlled by women?
Consumer participation	Public enforcement of standards will enhance food safety for consumers of fruits and vegetables	An inventory of relevant standards (public/private). How are these standards enforced? Do consumers trust these standards? How are they perceived and acknowledged by other stakeholders in the food system?
	Nudging and public extension will improve consumer awareness of	Are there specific policies and strategies formulated and implemented for improving diet quality among different consumer

Leverage point	Assumptions	Guiding research question Phase II
	the health benefits of fruits and vegetables and consumption preferences	categories and do they include strategies on fruit and vegetable consumption? Is there evidence of their impact? How have policies enabled women to address systemic constraints that they face, and to successfully access sufficient nutrition? An inventory of innovative policy and strategy examples implemented – who is implementing them? Are consumers' motives taken into account?
	Increased food safety, consumer awareness and responses to consumer preferences lead to higher acceptability of fruits and vegetables	What are consumer motives and barriers to (not) consume (specific) fruits and vegetables, such as indigenous vegetables, for different household members?
	Improved availability, affordability and acceptability leads to intake of fruits and vegetables that meet the recommendations	If everything is as planned (available, affordable, acceptable) will consumers increase fruit and vegetable intake in their diet, according to the recommendations?

1.4 Approach

During Phase II, we investigated key questions on fruits and vegetables, that were identified during Phase I (see Section 1.3 for an overview of the identified questions). To add scope and focus to the study we selected 3 fruit and 3 vegetable crops. We used a mix of focus group discussions (FGD), key informant interviews (KII) and literate to provide an answer to the key questions identified, allowing for in-depth information gathering as well as cross referencing and triangulation:

- Desk research: This was focused on academic publications describing the situation in the Nigerian horticultural sector, with special attention focused on the selected crops. We complemented this with additional secondary data sources like FAO Statistics on farm-gate prices and wholesale prices, however data was only available for a limited number of the selected crops.
- FGDs: To collect views on the recent developments in the fruit and vegetable sector and to harvest sector expert and actors' opinions on the horticultural sector, we organized eight FGDs, with 63 participants. Representatives came from private businesses, non-governmental organizations (NGOs), government etc. The participants were spread across several states including core production states like Kano, Kaduna and core consumption states like Lagos, Ogun and Oyo states (see Annex 3 for a list of FGD participants). Four were conducted online using a video conferencing platform and four involved physical visits to the field by local consultants, albeit with strict observance of COVID-19 measures, including two that were dedicated to female farmers only:
  1. FGD 1: A mixed group with NGO representatives and private sector actors applying a development perspective and gender focus on the fruit and vegetable sector (online)
  2. FGD 2: representatives involved in production and trade of the selected fruit and vegetables (online)
  3. FGD 3: mixed public and private sector actors (online)
  4. FGD 4: actors with a focus on consumption of fruit and vegetables including representatives from the public and private sector (online)
  5. FGD 5: male tomato, onion and amaranth farmers in Kaduna/Liman (in the field)
  6. FGD 6: female tomato, onion and amaranth farmers in Kaduna/Liman (in the field)
  7. FGD 7: female tomato, onion and amaranth farmers in Kano, and mango farmers in Samari/Kadawa (in the field)
  8. FDG 8: male only group with tomato and onion farmers in Kano/Garumalam (in the field)
- KIIs were conducted with various actors, including experts in the field of fruit production, the development sector, public sector and private sector with actors located in Oyo, Benue, Kaduna

states and the FCT. In total, we conducted seven KIIs (six online and one physical KII) (see Annex 4 for a list of the key informants interviewed).
- Both the FGDs and the KIIs provide interesting cases and novel approaches emerging from the Nigerian fruit and vegetable sector. These cases are described in boxes throughout the report.

In addition, we produced crop budget calculations for each crop. This was based on typical farm costs like seeds, fertilizers, crop protection, labor (including family labor valued at a day wage of a typical laborer), and potential revenues from the foreseen harvest. All calculations were made for 1 ha of production, excluding fixed costs like land rent. As input for these calculations, we used various sources, including relevant literature, but also expert information from the KIIs.

1.5 Reading guide

Chapter 2 gives a general overview of the fruit and vegetable system in Nigeria, including current domestic production volumes, trade, consumption, and the role of women in the fruit and vegetable system. Chapter 3 describes how the three priority fruits and vegetables were selected for the focus group discussions and interviews with the key informants. This Chapter also describes the significance of the selected crops, their recent production development and role in different farming systems. Chapter 4 and its sub-sections analyses the leverage points and associated research questions as described in Table 1.1. The final Chapter compiles the major findings of the study by reviewing the leverage points, discussing the research results.

2 State of play

2.1 Country profile: Nigeria

2.1.1 Economy

Nigeria is a multi-ethnic and culturally diverse federation of 36 autonomous states and the Federal Capital Territory (FCT). Agriculture is the main stay of the economy and employs approximately 35% of the country's total labor force and contributes 22% to Nigeria's gross domestic product (GDP), according to recent World Bank data.[1] The majority of the agricultural value is generated from arable crops.

Nigeria is highly dependent on global commodity markets and therefore is vulnerable to economic disruptions, particularly declines in oil prices. Oil accounts for over 80% of exports, a third of the credit in the banking sector, and half of government revenues. Oil prices also affect growth in non-oil industries and services (World Bank, 2010).

2.1.2 Land use

From the total land size of 910,770 km^2 (2018; most recent World Bank data available), about 75% is considered as agricultural land. Only half of this land is currently used for arable farming.[2] According to an International Food Policy Research International (IFPRI) study, there is great potential for expansion of irrigation, since only 1% of crop land is currently under irrigation with most farmers relying on rainfed production (Xie et al., 2017). In 2010, the area equipped for irrigation was 325,106 ha, of which 232,106 ha was under full control irrigation and 93,000 ha was equipped wetlands. However, only 40% to 70% of the land equipped for irrigation was actually operational due to a need to rehabilitate most schemes (FAO AQUASTAT, 2016).

2.1.3 Population trends

Nigeria has a population of 200 million people and this is growing at a rate of about 2.6% annually.[3] In addition, the share of the urban population has also increased from 35% in 2000 to 50% in 2018. According to United Nations Department of Economic and Social Affairs (DESA) forecasts, by 2050 the Nigerian population is likely to increase to more than 410 million and the urbanization rate is expected to further increase by up to 70%. Nationally, 40% of Nigerians (83 million people) live below the poverty line of ₦137,430 (or US$360 per year) (NBS, 2020).

[1] https://data.worldbank.org/indicator/NV.AGR.TOTL.ZS
[2] http://www.fao.org/faostat/en/#country/159
[3] https://data.worldbank.org/indicator/SP.POP.TOTL

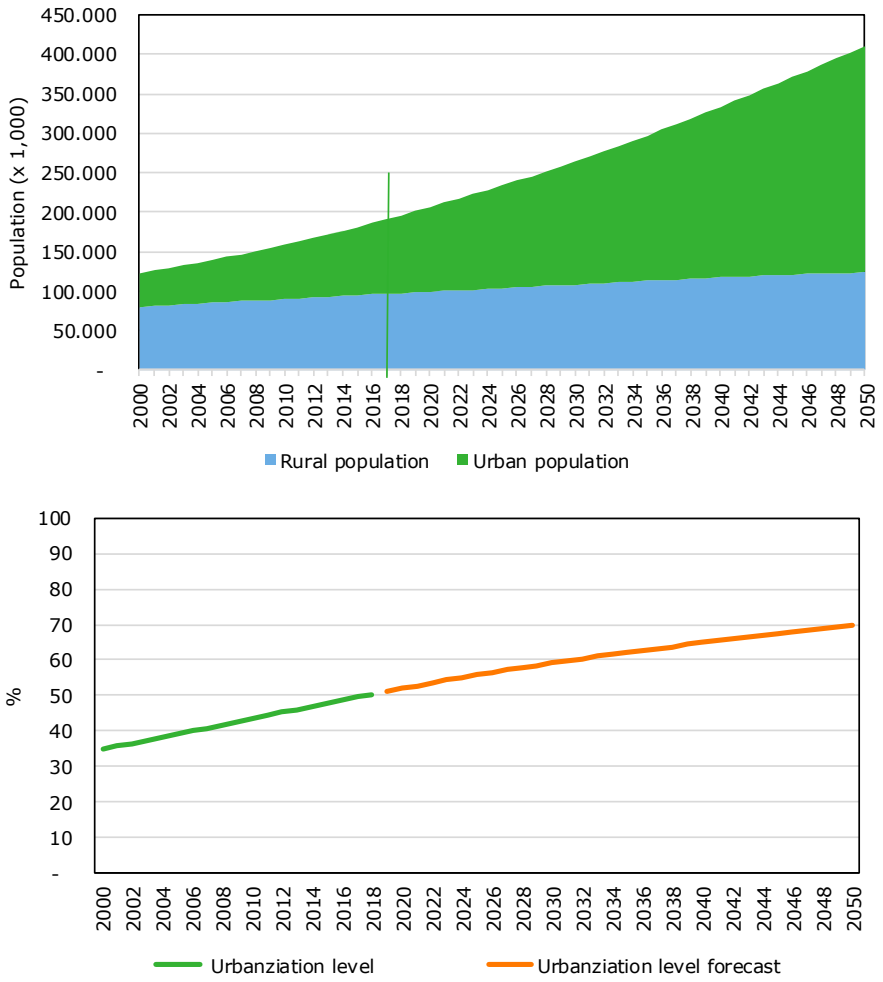

Figure 2.1 *Demographic developments Nigeria (current and forecasts)*
Source: DESA.

2.2 Overview and trends analysis for fruit and vegetable produce

2.2.1 Area and volume of fruit and vegetable production

Nigeria is an important producer of fruits and vegetables in Africa. For fruit production, there is only limited data available. Data only exist for mango, papaya, pineapple, and other fruit and other citrus fruit (see Table 2.1). Since 2016, little increase in production volume has been reported.

Table 2.1 *Area (ha) and production (t) of fruits (excluding banana and plantain) in Nigeria*

		2010	2016	2017	2018	2019	Diff. 2010-2019
Citrus fruit (NES)	Area (ha)	790,000	814,253	819,665	825,014	830,302	4.9%
	Production (t)	3,800,000	4,010,030	4,060,209	4,110,388	4,160,568	8.7%
	Yield (t per ha)	4.81	4.92	4.95	4.98	5.01	4.0%
Fresh fruit (NES)	Area (ha)	177,000	173,650	170,916	168,204	165,516	-6.9%
	Production (t)	1,200,000	1,185,384	1,171,773	1,158,162	1,144,551	-4.8%
	Yield (t per ha)	6.78	6.83	6.86	6.89	6.92	2.0%
Mangoes, mangosteens, guavas	Area (ha)	130,000	132,434	132,453	132,752	133,015	2.3%
	Production (t)	850,000	912,294	923,288	935,096	946,695	10.2%
	Yield (t per ha)	6.54	6.89	6.97	7.04	7.12	8.1%
Papayas	Area (ha)	92,865	99,856	100,373	101,059	101,634	8.6%
	Production (t)	750,000	840,228	844,654	850,117	855,581	12.3%
	Yield (t per ha)	8.08	8.41	8.42	8.41	8.42	4.1%
Pineapples	Area (ha)	180,000	189,285	194,191	197,567	200,911	10.4%
	Production (t)	1,487,350	1,552,833	1,600,564	1,636,002	1,671,440	11.0%
	Yield (t per ha)	8.26	8.20	8.24	8.28	8.32	0.7%
Total fruit excluding banana and plantain	Area (ha)	1,369,865	1,409,478	1,417,598	1,424,596	1,431,378	4.3%
	Production (t)	8,087,350	8,500,769	8,600,488	8,689,765	8,778,835	7.9%
	Yield (t per ha)	5.90	6.03	6.07	6.10	6.13	3.7%

Source: FAOSTAT.

The key vegetable crops in terms of volume are tomatoes, okra and onion. Table 2.2 provides an overview of the most important vegetable crops. Crops like okra, onions, and other vegetables have increased in production volume in the last 4 years. Most of this increase is due to expansion of land under cultivation, rather than increases in yield. The exception is tomatoes, where a small increase in yields has been reported (+10%). The group of vegetables, not elsewhere specified (NES), is the largest group in the Food and Agriculture Organization of the United Nations (FAO) dataset, but is missing a detailed breakdown. NES does include green leafy vegetables (GLV) such as amaranth.

Table 2.2 *Area (ha) and production (t) of vegetables in Nigeria*

		2010	2016	2017	2018	2019	Diff. 2010-2019
Carrots and turnips	Area (ha)	25,300	26,515	26,534	26,553	26,573	5.0%
	Production (t)	219,911	232,815	233,244	233,673	234,102	6.5%
	Yield (t per ha)	8.69	8.78	8.79	8.80	8.81	1.4%
Chilies and peppers, green	Area (ha)	94,808	98,057	98,606	99,159	99,715	5.2%
	Production (t)	733,631	747,384	749,295	751,205	753,116	2.7%
	Yield (t per ha)	7.74	7.62	7.60	7.58	7.55	-2.4%
Garlic	Area (ha)	52	176	176	138	98	88.5%
	Production (t)	679	2,300	2,300	1,800	1,283	89.0%
	Yield (t per ha)	13.06	13.07	13.07	13.04	13.09	0.3%
Maize, green	Area (ha)	183,916	199,885	201,971	203,737	205,307	11.6%
	Production (t)	676,338	762,030	772,918	783,207	793,739	17.4%
	Yield (t per ha)	3.68	3.81	3.83	3.84	3.87	5.1%
Okra	Area (ha)	397,290	1,338,600	1,301,600	1,451,376	1,802,463	353.7%
	Production (t)	1,083,620	1,461,600	1,561,900	1,695,020	1,819,018	67.9%
	Yield (t per ha)	2.73	1.09	1.20	1.17	1.01	-63.0%
Onions, dry	Area (ha)	179,984	493,570	550,399	577,757	592,678	229.3%
	Production (t)	1,346,218	1,332,300	1,432,186	1,400,000	1,374,764	2.1%
	Yield (t per ha)	7.48	2.70	2.60	2.42	2.32	-69.0%
Onions, shallots, green	Area (ha)	13,232	15,188	15,438	15,776	16,124	21.9%
	Production (t)	231,684	244,029	244,172	245,885	247,599	6.9%

		2010	2016	2017	2018	2019	Diff. 2010-2019
	Yield (t per ha)	17.51	16.07	15.82	15.59	15.36	-12.3%
Tomatoes	Area (ha)	272,950	634,660	701,300	754,896	836,320	206.4%
	Production (t)	1,799,960	2,632,500	2,809,200	3,500,000	3,816,009	112.0%
	Yield (t per ha)	6.59	4.15	4.01	4.64	4.56	-30.8%
Fresh vegetables (NES)	Area (ha)	724,335	752,663	759,078	765,510	771,612	6.5%
	Production (t)	5,998,811	7,080,987	7,263,243	7,447,732	7,631,012	27.2%
	Yield (t per ha)	8.28	9.41	9.57	9.73	9.89	19.4%
Total vegetables	Area (ha)	1,891,867	3,559,314	3,655,102	3,894,902	4,350,890	130.0%
	Production (t)	12,090,852	14,495,945	15,068,458	16,058,522	16,670,642	37.9%
	Yield (t per ha)	6.39	4.07	4.12	4.12	3.83	-40.0%

Source: FAOSTAT.

2.2.2 Production areas and main farming systems

In Nigeria, the Middle Belt, with the states of Kaduna, Kano and Jos Plateau, produce over half of all of the tomatoes, onions and potatoes. Figure 2.2 presents the share of production of some crops for each state. Data were collected by the National Agricultural Statistics Service in 2011 (NASS, 2011). The data present the share of the total volume produced of the sample size of 18 million farmers. Despite the data being 10 years old, they still give a representative overview of the relative differences between the states for today. For fruit production, there is no data available on the division per state.

In the northern production zones of Nigeria, the main farming system is the smallholder mixed crops and livestock system, with seasonal irrigation. In Kaduna State the average land size of irrigated dry season production is 0.7 ha (Van den Broek et al., 2021). Estimations for the typical farm size range between 1-3 ha (Plaisier et al., 2019; Van den Broek et al., 2021) but there are also some larger-scale farmers, however their share is limited (estimated at less than 5%). In the southern production zones farmers rely more on rainfed production.

In addition to the mixed crops and livestock system, home gardening provides an opportunity for people in different settings to provide extra food for themselves and their families. These small cropping systems often have a limited commercial outreach, but fruit and vegetable gardening has been on the rise in Nigeria, in both rural and urban communities. Home gardening is also being increasingly recognized as being a strong contributor to household food security.

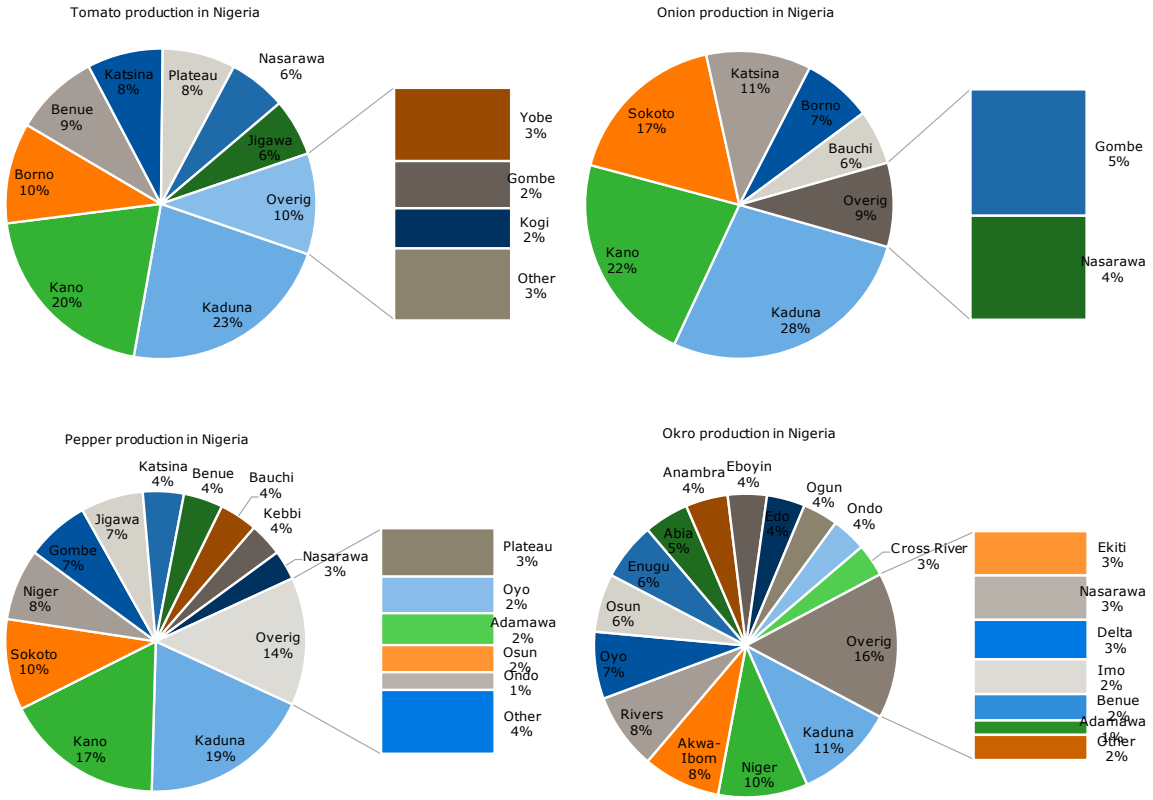

Figure 2.2 *Division of different vegetables produced per state, in % of total t*
Source: NASS (2011).

2.2.3 Trade of fruits and vegetables

2.2.3.1 Domestic trade

The Nigerian food supply system has the task of connecting food from over 70 million rural food producers to over 95 million urban consumers. Most urban consumers live in urban centers in the south of the country. This enormous size, difficult business conditions with no recourse to legal systems, a corrupt and ineffective police force, minimal banking infrastructure, poor communications and a highly degraded transport infrastructure make it a feat of ingenuity (Lyon and Porter, 2007). After arriving at the urban centers, traders and retailers meet in informal wholesale markets, also called territorial markets (CSM, 2018). At wholesale markets, the produce is sold to urban low-income retailers, usually women. Those retailers form the link to the consumers.

2.2.3.2 Import and export trade

According to the Federal Ministry of Agriculture and Rural Development (FMARD) (2016), there are serious annual demand gaps for vegetables, including tomato (1.4 million t). According to FMARD, this is a result of low yields, high post-harvest losses and increasing demand (FMARD, 2016a). In addition, vegetable production has not been able to keep pace with Nigeria's increasing population, so Nigeria imports food as a quick fix. High urban demand is met through cheap food imports. Food imports have more than quadrupled in the past decades, from a value of US$964 million in 1995 to US$4,566 million in 2016 (FAO, 2019), resulting in a substantial trade deficit for the agri-food sector.

Table 2.4 shows the top seven product groups that have the highest export value in Nigeria during 2017.[4] Also shown is the share that each export category represents in terms of overall exports from Nigeria. From this figure, it becomes clear that exports of fruits and nuts (rank #7) and vegetables (rank #51) represent only a marginal share of the total exports of Nigeria, which are dominated by oil (87%).

[4] https://www.intracen.org/country/nigeria/

Table 2.4 *Export product groups with the highest value in US$, 2019*

Rank #	HS02	Product group	In US$	Of total exports
		All commodities	53,617,812,190	
1	27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes	46,668,564,820	87.0%
2	89	Ships, boats and floating structures	3,180,792,370	5.9%
3	83	Metal; miscellaneous products of base metal	2,096,813,149	3.9%
4	18	Cocoa and cocoa preparations	311,338,508	0.6%
5	12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit, industrial or medicinal plants; straw and fodder	300,059,363	0.6%
6	31	Fertilizers	151,903,957	0.3%
7	08	Fruit and nuts, edible; peel of citrus fruit or melons	113,026,999	0.2%
51	07	Vegetables and certain roots and tubers; edible	924,364	0.0%

Source: UN Comtrade.

2.2.4 Consumption of fruit and vegetables

Nigeria scores 40.1 out of 100 (58 being the average) on the *Economist's* Global Food Security Index, placing it 100th out of 113 countries.[5] Among households in rural areas, 71% of the population remain food insecure (Matemilola and Elegbede, 2017). Meanwhile, in 2004, the Nigeria Consumption and Nutrition Survey also identified obesity among adults as a serious issue. In the early 2000s, the level of obesity nationwide was calculated at 7.8% (Maziya-Dixon et al., 2004), however a systematic literature reviews published in 2013 provide figures ranging between 8.1% and 22.2% of the population, with 22.2% reported in urban Lagos (Chukwuonye et al., 2013).

Globally, but also in Nigeria, food security has long been associated with the aim to secure access to sufficient carbohydrates such as grains, roots, and tubers – the staple crops that provide affordable sources of dietary energy. Many consumers in Nigeria are therefore focused on consuming affordable sources of energy instead of nutrient-rich food. As a result, intake of fruits and vegetables remains under the daily recommendation of 400 g. Various estimates are provided in the literature about the current daily intake of fruits and vegetables. One study mentioned that 27% of respondents reported adequate daily intake of fruits and vegetables as recommended (Olatona et al., 2018). Other studies in Nigeria reported much lower percentages such as 5.5% among Junior Secondary School students in Surulere, Lagos, 12% among adolescents in Ibadan, Nigeria (Ilesanmi et al., 2014). However, reliable data on food intake in developing countries (including Nigeria) are scarce and limited, meaning that the estimated figures may deviate from actual consumption levels.

The available information on expenditure reveals that the consumption of fruit and vegetables remains insufficient to meet daily recommendations. The Global Burden of Disease (GBD, 2019) provides estimates of a daily per capita consumption for fruit vegetable is 238 and for fruit 84 gr per day per person.[6] Disparities are observed in consumption of fruit and vegetables across the country and between income classes. As a result, this study specifically differentiates between different consumer groups: urban high-income classes, the middle classes, and low-income classes.

2.2.5 Gender and women's roles

In Nigeria, women account for 75% of Nigeria's farming population, yet, women's overall productivity and capacity in the different parts of the value chain remain lower than their male counterparts, thus,

[5] https://foodsecurityindex.eiu.com/Country/Details#Nigeria
[6] https://foodsystemsdashboard.org/countrydashboard

impact overall productivity adversely (Olakojo, 2017). Women farmers and entrepreneurs continue to face a number of disadvantages, including lower mobility, less access to training, less access to market and information, and less access to productive resources such as credit, land and labor-saving processing technologies. Increasing access and agency increases food production and provides opportunities for them to earn extra income that would enable women to spend more money on health care, nutrition, and education for their children – investments that could produce long-term, positive results for families that are dependent on the fruit and vegetable value chain (Gustavsson et al., 2011).

Despite women's significant presence in the sector, most agricultural data collection systems fail to capture the actual contributions and gender specific challenges that women in Nigeria navigate. There is much diversity in women's roles, and continued generalization undermines policy relevance and planning. In terms of farm labor, generally, women have heavier workloads than men, including farm work, marketing, household chores and casual laboring. Women have more prominent roles in post-harvest activities and their ability to access to land for production is dependent on their husbands or fathers.

Vegetable production continues to be a profitable enterprise for women despite challenges that affect constrain their production and profits. Fruit and vegetable value chains provide women with economic opportunities as producers, and value-addition activities from production to marketing. The sale of garden surplus is often a major source of income for rural women who may not be producing exclusively for sale. Intensification of fruit and vegetable production can therefore offer additional opportunities for women, from the farm, to processing and retail.

In Nigeria, the processing landscape in fruit and vegetable value chains is largely informal and at a small-scale level; as such, women handle the bulk of the processing (Ajibade, 2021). Similarly, in formalized fruit and vegetable processing plants (often established by men), women form the bulk of the labor carrying out the actual processing.

Traditional GLVs are important crops in Nigeria and are a major source of income for women entrepreneurs (Kelechi and Dorothy, 2015). The nutrient rich and inexpensive amaranth vegetable value chain is largely dominated by women, especially at the retail end of the value chain. Amaranth possess tremendous potential for income generation among women because it is popular with consumers, easy to grow, highly affordable for the consumer, easily available, and requires minimum production inputs. Unlike staple crops like cassava and yams – which need large parcels of land, take a long time to mature and whose value chains are traditionally managed by men – amaranth can be produced on small parcels of land, and is culturally acceptable for women to produce. Since women are likely to have access to less land than men, GLVs such as amaranth are an easier crop for women agripreneurs to produce (Umar et al., 2019).

In the tomato sector, small-scale processing and packaging is often dominated by women. In tomato greenhouses female labor is also often used to collect the tomatoes during harvesting. While the involvement of women in the onion value chain is much lower than men, most retailers are women. The fresh onion retail trade is dominated by women due to gender barriers at production level that make it difficult for women to access land and other production resources (Kaka et al., 2021). The minimal capital requirements needed to start off as a tomato trader makes it easier for women, who often have limited business capital to start off as small scale traders. In addition, more women trade in food items that they can incorporate in their household nutrition, this strategy helps reduce losses in case they have leftover stock. In both tomato and onion markets, and more generally in most fruit and vegetable markets, retailers are mostly women who source their produce from rural marketers directly or through middlemen and sell directly to customers.

In the fruit value chain, women are key actors in retail (Ocholi et al., 2020) and in processing activities. For example, mango processing and consumer targeted trading is largely dominated by women. Similarly for pawpaw, the downstream supply system is largely dominated by women. However, in the citrus value chain, both men and women are involved in retail activities.

Data and survey results therefore reveal that women involved in fruit and vegetable production in Nigeria can benefit from increased access and agency over agribusiness capital across the value chain. Increased income can be used for long-term positive nutrition growth in the households, and economic participation benefits that include having an income that they can access and make decisions over (as opposed to providing labor for the household farm and all the income going to the men in the household with women having limited input on how the income will be allocated). Yet in order to achieve this, agricultural development research needs to highlight the roles, contributions and gender-specific challenges that women in Nigeria navigate in different fruit and vegetable value chains. Addressing sociocultural factors such as cultural norms, that inhibit women's agribusiness initiatives can also enhance their profits.

3 Selection of fruits and vegetables

3.1 Introduction

During Phase II we investigated key questions on fruits and vegetables emerging from Phase I, as well as system innovations. To add scope and focus to the study we selected key categories of fruits and vegetables. To achieve this, we identified the following:

- The most important current and potential categories of fruits and vegetables for poor and middle-class urban and rural consumers, in terms of income generation, and their importance for nutrition (trying to represent a mix of the various sentinel foods that are essential for a healthy diet), and empowerment opportunities for women. We took the lists of fruits and vegetables, presented in Table 2.1 and Table 2.2, as a starting point for our selection.
- The most important production areas serving these linkages (as identified in section 2.2.2). Also, important consumer categories and the most prominent food chains, food environments and consumer linkages in the food system were considered.

Table 3.1 provides an overview of the different groups of fruits and vegetables, including the sentinel foods that are typical consumed by a large share of the population in Nigeria. The last column provides the typical health benefits. Some crops like tomatoes and onions are often consumed as ingredients for stews and soups and therefore lose most of their nutritional value, therefore they are not linked to any health association.

Table 3.1 *Overview of the different sub-groups for fruits and vegetables in Nigeria*

Sub-group	Sentinel foods	Health benefits
(Dark) GLVs	Jute leaves, pumpkin leaves, afang/okazi, water leaves, bitter leaves, green, kuka, Lagos spinach, sorrel leaves, garden egg leaves, sweet potato leaves, cowpea leaves, or karkashi	Contributes to iron, vitamin C, vitamin A and folate intake. Reduces dietary risk for coronary heart disease (CHD), stroke, all-cause mortality, but negative with cardiovascular disease (CVD).
Red, orange and yellow vegetables	Carrots, tatase, pumpkin, squash that is orange inside, or sweet potatoes that are orange inside	Contribute to vitamin A and folate intake. Reduces dietary risk for CHD, and total cancer[1].
Cruciferous vegetables	Cabbage	Reduces dietary risk for total cancer and all-cause mortality but increases dietary risk for CVD.
Other vegetables	Tomatoes, garden eggs, okra, cucumber, green pepper, or green beans	No specific richness in relevant nutrients; no or unknown dietary risk for non-communicable diseases.
Red, orange or yellow fruits	Mango, bush mango fruit, papaya, yellow melon, monkey cola fruit, or locust bean fruit	Contribute to vitamin C, vitamin A and folate intake. Reduces dietary risk for CHD.
Citrus fruits	Orange, tangerine, or grape	Contribute to vitamin C (and help to improve iron/zinc bioavailability) and folate intake. Reduces dietary risk for CHD, stroke, CVD, and all-cause mortality.
Apples, pears	Apple	Reduces dietary risk for CHD, stroke, CVD and all-cause mortality.
Other fruits	Banana, African cherry, guava, soursop, watermelon, cashew fruit, pineapple, avocado pear, coconut flesh, dates, African bush pear, or African elemi	No specific richness in relevant nutrients; no or unknown dietary risk for non-communicable diseases.

1 Total cancer refers to cancer not specified by type of cancer

Source: Summarized based on studies from e.g. Afshin et al. (2019); Alemu et al. (2019), Yip et al. (2019); Aune et al. (2017).

3.2 Most important production areas

Nigeria has a range of climates: the Sahelian climate in the northern part of the country, a tropical savannah/steppe climate in the center and a tropical wet climate in the south (Figure 3.1). The mountainous areas of Jos and Adamawa, close to the Cameroon border, have a more temperate climate. The various climates have the following key characteristics:

- Kano, in northern Nigeria, has a dry semi-arid climate suitable for agriculture. The regional landscape is defined by semi-arid plains. The region is crossed by several rivers, the most important being the Kaduna River flowing from the Jos plateau to Lake Chad. Kano State is located between the central area and the northern area and has a Sahelian climate. In Kano, there is also a major irrigation scheme, the Kano River Irrigation Scheme, which will consist of 22,000 ha of irrigated land. The main source of water for the irrigation scheme is provided by the Tiga Dam, which blocks the Kano River from flowing further into the Hadejia River which in turn drains to Lake Chad. Another major dam is the Challawa Gorge Dam in the north-west of Kano state (close to Makoda), which irrigates an estimated 10,000 ha (Van den Broek et al., 2021).
- Kaduna, in central Nigeria, is characterized by a tropical steppe climate. The central area of the country is an interface between the dry and arid north and the tropical rainforest of the south. The climate is considered tropical wet and dry because a dry (in winter) and a wet season are distinguishable. Vegetation is divided between a variety of forests, steppes and savannahs: a tropical savannah or steppe, the Guinean savannah (large expanse of land between Guinea on the west coast of West Africa and Nigeria) and the Sudan savannah. Kaduna is located within this climatic area.
- A temperate climate is observed in the Jos plateau at an altitude of 1,520 m above sea level and in the Adamawa plateau. The Jos plateau is defined by highlands at an average altitude of 1,200 m above sea level.
- The south is characterized by a tropical wet climate with relatively high temperatures. Vegetation is abundant as the region is divided between a tropical rainforest and a mangrove swamp. The southern part of the country is a delta region crossed by two important rivers: the Benue River flowing from east to west to meet the Niger River which, eventually, flows into the Atlantic Ocean in the Gulf of Guinea. The heavy rainfall, a typical rainfall pattern of tropical forests, comes from the evaporation of the Atlantic Ocean in the Gulf of Guinea. This then moves north where it meets dry and hot air coming from the north of the country. The meeting of the two air masses, one dry and hot and the other wet, results in important rainfall.

All zones supply urban areas with food and each zone has a typical peak season of supply. The areas of Kaduna and Jos plateau in particular have a significant impact on the availability of fruit and vegetables, which will be discussed in more detail in Chapter 4.

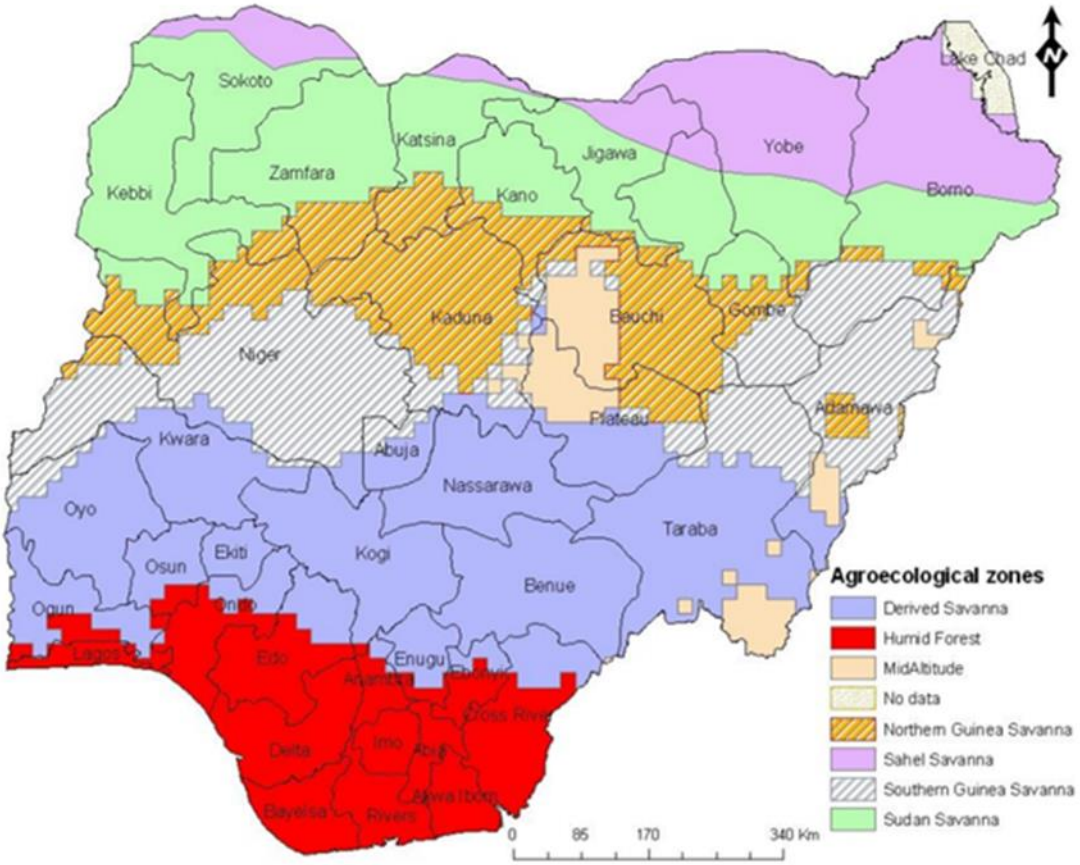

Figure 3.1 *Map of Nigeria with different states and agroecological zones*
Source: Alamu et al. (2013).

3.3 Selected fruits and vegetables

The Middle Belt is the main production area for onion and tomato. Fruits are also widely grown in these northern production areas, although they are grown in more significant quantities elsewhere. Therefore as all of the selected fruits and vegetables (Table 3.1) are grown in the northern production areas, the study focused on these areas which also serve Lagos, which is an important urban consumption area.

This section presents an overview of the selected fruits and vegetables. We justify the crop selected based on opportunities for 1) an uptake of consumption among poor and middle-class urban and rural consumers, 2) economic importance and income generation for farmers, 3) importance for nutrition, and 4) empowerment opportunities for women.

3.3.1 Tomato

Tomato production in Nigeria is significant, accounting for 3,816,000 t/year and is a major food that is consumed in every household. It is an important part of the Nigerian daily diet (Plaisier et al., 2019). However, tomatoes are most often consumed as part of stews or soups and therefore lose much nutritional value. Small-scale processing and packaging also often employs a lot of women and the retail end of the fresh and processed tomato value chain is also dominated by women.

3.3.2 Onion

Like tomato, onion is one of the most consumed vegetable crops in Nigeria, but is often an ingredient in stews or soup and therefore lose nutritional value. Retailers are also often women. As the vegetable

is available throughout the year, as farmers and upstream actors often use storage, there is also a strong regional and global export market.

3.3.3 Amaranth

Amaranth is a common GLV and is widely produced and consumed in Nigeria. It goes with all Nigerian carbohydrate dishes such as pounded yam, amala and fufu (Akin Idowu et al., 2013). Amaranth is an adaptable crop and it resists various weather conditions and the short production cycle present amaranth as a high potential vegetable of importance (Hoidal et al., 2020). The amaranth value chain is largely dominated by women especially the retail end. Health is a key driver for consumption of vegetables and Amaranth in particular is seem by consumers to be a major contributor to a healthy diet. Amaranth is a source of iron, vitamin C, vitamin A and folate.

3.3.4 Mango

Mango production accounts for 946,695 t per year. In the mango value chain, retail, processing and packaging is largely dominated by women. Mango is high in fiber and an important source of vitamin A, vitamin C and folate intake. Consumption of mango also decreases the risk of coronary heart disease.

3.3.5 Pawpaw

Pawpaw production accounts for 855,581 t per year. Women largely carry out aggregation of pawpaw from rural communities and sell it onto consumers. From a consumption perspective, mango is high in fiber and an important source of vitamin A, vitamin C and folate intake. Consumption of papaya also decreases the risk of coronary heart disease.

3.3.6 Citrus

Various citrus fruits are produced in Nigeria, including oranges, lemons and grapefruits. Orange is a significant crop produced in Nigeria with a volume of 4.2m t per year. The citrus value chain is equally dominated by both men and women. Nigerian oranges, however, do not meet export standards because of their green color and small size.

Table 3.1 *Selected fruit and vegetable supply chains and the different sentinel sub-groups*

Selected fruit and vegetable supply chain	Focus production area	Possible economic opportunities	Possible specific opportunities for women	Sentinel sub-group
Amaranth	Nationwide	Easy to cultivate	Women dominate amaranth supply chain	(Dark) GLVs
Tomato	North (Kano, Kaduna and Jos Plateu states)	One of the most consumed vegetable crops in Nigeria	Women dominate retail	Other vegetables
Onion	North (Kano, Kaduna, Sokoto and Kebbi states)	One of the most consumed vegetable crops in Nigeria	Women dominate retail	
Mango	North/South (Benue and Oyo states)	Improving varieties, agricultural practices and processing can make it more profitable	Women dominate retail	Red, orange or yellow fruits
Pawpaw (papaya)	Nationwide	Improving varieties and agricultural practices can make it more profitable	Women dominate trade and retail	Red, orange or yellow fruits
Citrus	North/South (mostly Benue State)	Improving varieties and agricultural practices can make it more profitable	Women dominate trade and retail	Citrus fruits

4 Research results

4.1 Selected regions and their fruit and vegetable supply chains

4.1.1 Description of actors

The Nigerian food system is divided into two main market channels: the formal and informal market. We focus on the tomatoes, onions, amaranth, mango, citrus and pawpaw, and while specific information on these crops is provided where possible, in some cases the information provided is generic for all crops. Annex 2 provides a more detailed overview of the six fruit and vegetable supply chains.

At present, most fruit and vegetable production occurs in the northern and Middle Belt regions of Nigeria, while the bulk of consumption occurs in the southern markets in the south-south and south-west. These two zones are separated by long distances.

Figure 4.1 provides a simplified overview of the actors involved in both the formal and informal fruit and vegetable supply chain. In the following sections the various actors will be discussed in more detail.

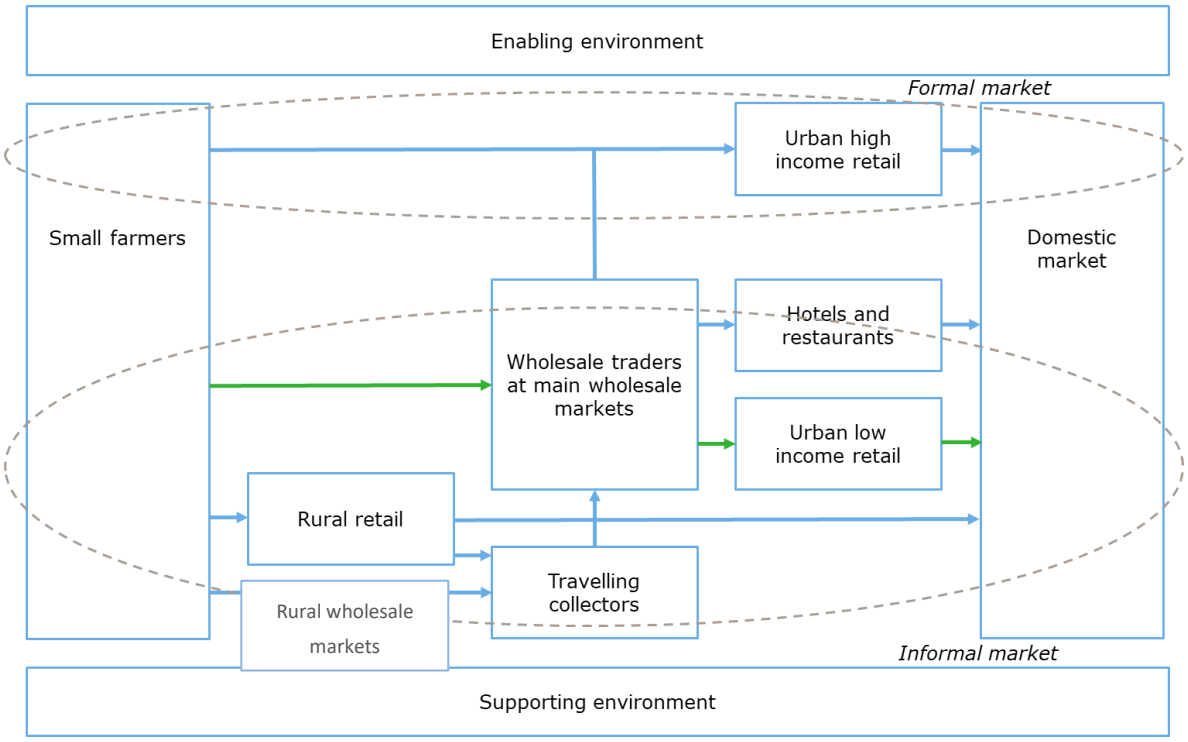

Figure 4.1 *Vegetable and fruit supply chain, distinguishing the formal and informal chain*
Source: Adapted from Plaisier et al. (2019).

4.1.1.1 Farmers for all fruit and vegetable supply chains are predominantly smallholders

Traditional mixed vegetable cropping systems are the most common production systems. The Nigerian farming population is predominantly older in age than the general population. Onions, tomatoes and amaranth are often produced in mixed crop and livestock farming systems. Tomatoes and onions are

grown to a large extent in *fadama* lands (seasonally irrigated flood plains) in the Northern savannah. Amaranth is produced across Nigeria and throughout the year. In general, it is produced close to and within cities due to the crops high perishability.

Our research did not identify a significant number of specialized fruit farmers. Instead, fruit trees are scattered around mixed farming systems, from which farmers harvest to be taken to the markets.

A recent report by Van den Broek et al. (2021) mentions that in Kaduna around 10% of farmers are members of a farmer cooperative of association. These farmer organizations mainly focus on joint purchase of inputs for field crops (fertilizer, seeds) and are less involved in joint marketing of horticulture crops. For Kano state around 30% of the farmers are a member of a cooperative, most of the 30% are tomato farmers. Cooperatives assist farmers with training, and access to credit and inputs.

4.1.1.2 Traders connect farmers to consumers

In both the formal and informal value chains, wholesale traders have a dominant position in connecting farmers to consumers. The majority of farmers sell to travelling collectors, with only a small minority taking their produce directly to the market. Traders provide an important intermediary service for both farmers and consumers since they transport fruit and vegetables over large distances from the main production areas in the northern states to the consumption regions in the south.

During the FGDs there reference was often made to exploitative behavior, including the formation of cartels governing the fruit and vegetable trade. This exploitative behavior, and high levels of informality, are significant challenges for the fruits and vegetables supply chains in Nigeria. Literature also indicates that most traders have no basic formal education. This hinders marketing efficiency because they do not keep records of day-to-day financial activities, and prevents traders from obtaining loans from formal financial institutions (Ajani, 2007; Reardon, 2015). As a result, most traders acquired their initial start-up capital from informal sources, which further stresses the importance of trade networks.

4.1.1.3 Reliable transportation is lacking

The lack of good and cheap transportation poses a serious threat to traders. Frequent fuel scarcity, long distances from the point of production to the point of sale, and the dilapidated condition of existing roads (Ajani, 2007) are all significant challenges. In addition, trucks do not have cooling facilities. Various stakeholders participating in the FGDs confirmed that this is affecting trade efficiency and also the quality of the produce. Unofficial taxes that have to be paid along the road is also adding costs.

4.1.1.4 Formal retail shops can be found in larger Nigerian cities

The Nigerian food retail sector is divided into two main market channels: the formal and informal market each which their sub-divisions and adaptations. Two different types of urban market segments can be distinguished: urban high income and urban low income. Based on interviews with industry experts we estimate that the informal market comprises most of food sales (est. 95-99%). Figure 4.1 provides an overview of fruit and vegetable supply chains. Lagos, and to a far lesser degree Ibadan, have supermarket chains that serve the higher-income classes and the top tiers of the middle class. The lower-income classes are served through informal wholesale and retail markets (e.g. corner shops).

Most markets in Nigeria serve as wholesale and retail markets at the same time. Most resellers are reported to be women (93%) and are aged between 31 and 40 (58%). According to Adeoye et al. (2009), retailers in Lagos have often completed primary education (79%) and 50% of them have 6 to 10 years of retail experience. Many retailers buy only small quantities from wholesalers since they lack the required capital to buy larger volumes. These retailers often buy at informal (wholesale) markets.

In Lagos alone, there are more than 30 informal (wholesale) markets. Every neighborhood has its own fresh produce market. The markets are often private but are supported by the (local) government. The markets are operated by internally-elected markets officials with connections to the (local)

government. However, the main wholesale market in Lagos is Mile 12. This is by far the biggest in Nigeria and has been in business for over 40 years. The market is located along the Ikorodu Road and serves as the main distribution center for vegetables and fruit arriving in Lagos. Given the importance of the market, Mile 12 is operated by market officials with close connections to the national government. Smaller markets are often controlled by local governments.

Mile 12 has a specific area dedicated to selling each crop. From the market, produce is then distributed to other informal markets which are often more retail orientated. At Mile 12, all traders are united in an official association for each crop. Each association is highly organized and controls trade of each crop by governing the north-south trade in terms of supplied volume and access to the market.

Sourcing of fruits and vegetables often occurs at rural informal wholesale markets. Key markets for the different crops are:

- For tomato and onion these are Kwanar Gafan tomato markets and Karfi yan Albasa respectively in Kano while notable markets in the south-west are Total market in Akure, Ondo State, Sasa/Akinyele and Bodija markets in Ibadan, Oyo State, Sabo market in Abeokuta in Ogun State, and Ilepo and Mile 12 in Lagos State
- Amaranth is picked up everywhere since it is an easy to produce crop and produced virtually in every region in substantial quantity.
- Citrus and mango are produced and traded in Benue State. For these crops the main markets are Makurdi market and Railway market both in Makurdi LGA, Wurukum market and Agidi market both in Konshisha LGA, and Austoma market in Gwer LGA in Benue.
- Pawpaw markets in south-west can be found in all major fruit and vegetable markets. The notable urban markets are Oje market in Ibadan, Oyo State, and Ketu market in Lagos.

The informal retail market also includes roadside retailers and those who operate from stalls in the open markets. A consultancy report provides estimates that transactions worth more than ₦1 billion (US$2.4 million) are carried out by these retailers daily in Lagos. They are not well regulated so most traditional open market retailers[7] do not pay taxes, and may also affect the environment where city plans do not support their existence of the particular areas where they conduct their businesses (BusinessDay, 2015).

Supermarket chains are increasing in urban Nigeria. They serve the higher-income classes and the top tiers of the middle class. The leading supermarket is ShopRite from South Africa with over 20 stores in Nigeria; other chains are Spar International with 10 stores and Massmart with 5 stores. Direct delivery is emerging in Nigeria as an innovative segment. For example, Fresh Direct is an upcoming door-to-door delivery start-up. They only serve consumers in Abuja and are focusing on introducing new technologies to improve current farming methods (e.g. drip irrigation, cooling). They also work with outgrowers and supply consumers directly.

4.1.2 Number of actors at each stage in the fruit and vegetable supply chains

Data on the specific number of actors in each step of the fruit and vegetable supply system is not available. However, based on our data and expert knowledge we were able to make some accurate estimations (see Table 4.1). A distinction between the different types of famers (smallholder versus commercial) however was not possible. Tomato farmers are spread across most parts of the northern states with high concentrations found in states like Kano, Kaduna and Kastina. For every 20 farmers in these areas, it is likely that at least one of them is a farmer growing tomatoes. Retailers of tomatoes can be found across every neighborhood ranging from major markets to isolated retailers. The ratio of farmers to retailers can be put at 1:5 while farmers to traders can be put at 5:1.

Farmers growing onions as part of their cropping system are mainly found in northern states, with high concentrations found in Kano, Kebbi and Sokoto states. The sales and marketing of onions go hand-in-hand with other produce like tomato and different types of pepper. Most farmers that plant

[7] However they do pay markets levies that are paid to market officials for the space used at the trading locations.

tomatoes also plant onions, especially in Kano and Kaduna. Retailers of onion can be found across every neighborhood ranging from major markets to isolated retailers. Similar to the tomato supply chain, the ratio of farmers to retailers can be put at 1:5, while farmers to traders can be put at 5:1.

Farmers growing amaranth are found everywhere in Nigeria. With Lagos being the core consumption area, there can be between 70,000 to 100,000 regular farmers growing amaranth in the suburbs of the state. Retailers of amaranth are found across every neighborhood ranging from major markets to isolated retailers, who in most cases also sell other soup ingredients. The ratio of farmers to retailers can be put at 1:5 while farmers to traders can be put at 5:1.

Fruit farmers are scattered across the country but in most cases they are not exclusively fruit farmers since they combine the cultivation of other crops. In Benue State, however, there are high concentrations of exclusive orchard farmers. For every 50 farmers, there is one trader while for every farmer, there are between 3-10 retailers on average.

Table 4.1 *Number of actors at each stage of the fruit and vegetable supply chains*

Sector	Location	Farmers involved in production	Dominant type	Traders	Retail	Share of informal market*
Tomato	Kano State	24,000	Smallholder, mixed vegetable	4,800	120,000	95-99%
Onion	Kano State	24,000	Smallholder, mixed vegetable	4,800	120,000	95-99%
Amaranth	Lagos suburbs	200,000	Smallholder, mixed vegetable	40,000	1,000,000	99.9%
Mango	Benue State	588,000	Smallholder, mixed crop	11,760	1,764,000	90%
Pawpaw	Oyo State	49,000	Smallholder, mixed crop	980	2,940	90%
Citrus	Benue State	588,000	Smallholder, mixed crop	11,760	1,764,000	90%

Source: Authors' estimations.

4.1.3 The enabling and supporting environment is improving

4.1.3.1 Policies

The enabling environment for agriculture development in Nigeria is improving, but is still very challenging. The Agriculture Transformation Agenda in Nigeria is, and has been, key to agricultural development. Food security, import substitution, job creation and economic diversification are priorities of the new agricultural promotion policy.

The Federal Government concentrates on supporting the development of a conducive enabling environment. Policy emphasis is on providing a conducive legislative and agricultural knowledge framework, macro policies, security, enhancing physical infrastructure and institutional mechanisms for coordination and enhancing access to adequate inputs, finance, information on innovation, agricultural services and markets. However, in general, policies are considered to be infective and lacking enforcement, as indicated by some participants in our FGDs. The fact that Nigeria ranks 146th out of 190 in the World Bank's Doing Business measure and 144th out of 180 in Transparency International's Corruption Perceptions Index is illustrative for the challenging enabling environment. The legal frameworks in Nigeria lead to difficulties in enforcing informal contracts, and rent-seeking behavior in the sector. All these factors consume resources and inhibit economic and technological development, which inhibits market development.

There is a directive in place to stop the importation of various inputs for processed products (fruit concentrates, fresh tomato and tomato concentrates), and pre-prepared processed products (packed

juices, tomato paste). These products are all on the Central Bank of Nigeria's (CBN) list of banned food items.[8] This means that CBN will not give forex to any company wanting to import this item. However, people still import the products through the back door, especially tomato concentrate which is meant to be repacked.

The public sector remains fragile and this has implications. Public policies governing the seed sector are key for a well performing seed sector, but the informal seed system remains important. The formal seed sector is run by FMARD, and the National Agricultural Seeds Council (NASC), which works under FMARD, and is a member of the Crop Varieties Registration and Release Committee (CVRRC). The CVRRC is responsible for varietal evaluation, release and registration in the national catalogue of registered and released varieties. NASC is a statutory government agency with the responsibility of coordinating and regulating the seed industry. It advises the government on seed related programs and is responsible for quality control through certification procedures and enforcement of quality standards. Before varieties are officially released, NASC forms part of the committee that evaluates the technical procedures and parameters.

Another challenge is inadequate infrastructure, including poor quality feeder roads, poor or limited specialized transport for agricultural produce, and shortages or no electricity needed to ensure the smooth transportation of perishable items such as fruits and vegetables to markets.

National agricultural research institutes (NARIs) play a significant role in the agriculture sector. NARIs, among others, produce foundation seed. Nigeria has a large national agricultural research and extension service, however, their research has traditionally not been focused on fruits and vegetables, but mainly on other crops like cereals. Public agricultural research institutes are critical for varietal development, however public investment in the development of vegetable and fruit varieties is absent. NARIs are made up of 17 commodity-based research institutes, a specialized national agricultural extension institute, 18 faculties of agriculture in regular federal universities, and three specialized agriculture universities. Moreover, the Consultative Group on International Agricultural Research (CGIAR) is an important player in Nigeria, with ongoing activities particularly through the International Institute of Tropical Agriculture (IITA) in Ibadan.

4.1.3.2 Civil society

Successive governments have made efforts aimed at the development of rural areas. Unfortunately, these efforts have not achieved the desired goal (Ngeh, 2013). More recently, NGOs have participated in rural development programs to complement government efforts. Some of their contributions include human capital development, technical assistance and assistance to smallholder farmers. In contrast, very few NGOs have been active in supporting healthier diets of the Nigerian urban population. The Global Alliance for Improved Nutrition (GAIN) is an exception, and have diversified their activities to include targeted dietary improvement programs such as better diets for children, post-harvest loss reduction, and support to businesses through the Scaling-Up Nutrition Business Network. Also the Nigerian Heart Foundation is actively promoting a healthy lifestyle, including the consumption of at least 5 portions of fruit and vegetable per day. See Annex 1 for a list of the different activities of the various NGOs and several public research institutes identified that have or planning to have activities in Nigeria.

Table 4.2. *NGOs and other organizations active in the fruit and vegetable sector in Nigeria*

	Name
1	World Vegetable Center (WVC)
2	Netherlands-African Business Council (NABC)
3	Netherlands Development Organisation (SNV)
4	MERCY CORPS
5	PALLADIUM
6	Global Alliance for Improved Nutrition (GAIN)
7	Sustainable Trade Initiative (IDH)

[8] https://www.bbc.com/pidgin/tori-54114861

	Name
8	SOLIDARIDAD
9	International Fertilizer Development Center (IFDC)
10	TECHNOSERVE
11	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
12	PYXERA GLOBAL
13	Alliance for a Green Revolution in Africa (AGRA)
14	50 Million African Women Speak
15	Nourishing Africa
16	Inventive Minds
17	KickStart International
18	Royal Netherlands Embassy
19	Nigerian Heart Foundation (NHF)

4.1.3.3 Seed systems

For vegetables and most fruits, farmers use local varieties and informal seed sources. As a result, a large diversity of varieties are currently being used, often adapted to specific locations, and various farmer and customer demands. The formal commercial seed sector serves only a small portion of vegetable producers, more often supplying commercial markets with quality seed and improved varieties, such as for tomato, onion, and peppers. The informal sector remains particularly important for other vegetables (including especially African leafy vegetables) and fruits.

Private sector participation in breeding and variety release has led to an increase in its share of variety release in the country, which the public sector dominated until 2000. The private sector now constitutes 13% of variety releases in the seed market, with the public seed sector constituting the remaining 87%.

There is a wide diversity of national and global seed companies in Nigeria. According to the NASC, there are 157 registered seed companies in Nigeria. Seed sector reform in Nigeria has led to the development of seed companies, but at a much slower pace than in Asia, and Eastern and Southern Africa.

For global seed companies, the enabling environment especially with respect to variety release and registration remains an obstacle to promoting new varieties in Nigeria. Variety release and registration is costly and takes much effort, time and is not transparent. The country is a signatory to various treaties of FAO and the Agreement on Trade-Related Aspects of Intellectual Property Rights. A Plant Variety Protection bill has been drawn up and was moved to the National Assembly in September 2019, but has not yet been signed. Work is also ongoing to develop a model plant variety law that will be in line with the International Union for the Protection of New Varieties of Plants' 1991 convention. As a result of the limited progress with the policy environment, only a few global vegetable seed companies sell seeds to customers in Nigeria. East West Seed is investing in variety promotion and the professionalization of the vegetable sector. Some other global companies only operate through third parties or national or international development projects.

Most Nigerian seed companies have built their business around trading and distributing vegetable seed but, unlike Asia, they have not invested in research and development to develop their own locally-adapted varieties (Thijssen and de Boef, 2020). There is very little national breeding of maize, rice or vegetable crops for domestic markets in sub-Saharan Africa despite the entry of several multinational seed companies. For grain crops most seed companies depend primarily on international public research and development organizations, such as IITA, and the International Crops Research Institute for the Semi-Arid Tropics.

Much of the vegetable seed used in Nigeria is still imported from outside the continent. Companies demonstrate tailored approaches to smallholder customers by offering a few hybrid and primarily open-pollinated varieties (OPVs) for vegetables. Adoption of hybrid seed still has a long way to go, with promotion efforts aiming to illustrate the potential of hybrid varieties among farmers. Smallholders currently prefer OPVs as they lend themselves to on-farm seed saving. Given the

frequent presence of substandard or fake seed, especially for food crops, the trust of farmers in seed companies also remains an issue. With the presence of digital tools ensuring the quality and source of the seed, such practices are foreseen to disappear, but still require a major behavior change among both companies and farmers, the government, donors and development programs engaged in institutional seed markets.

Farmers growing fruits and vegetables use multiple seed sources. They use farmer saved seed or planting material (fruit trees) from neighbors or informal markets or nurseries. For some vegetables, they may purchase small packs from regional or national companies, opting for quality seed that may be an OPV.

With such a wide array of seed systems (from farmer saved to national and initial global commercial seed systems), Nigeria's seed sector, particularly for vegetables, is in an initial development phase (Figure 4.2). The public sector is fragile, and the role of the informal seed system is important, but imported varieties are becoming increasingly important, particularly for the more commercially attractive vegetables.

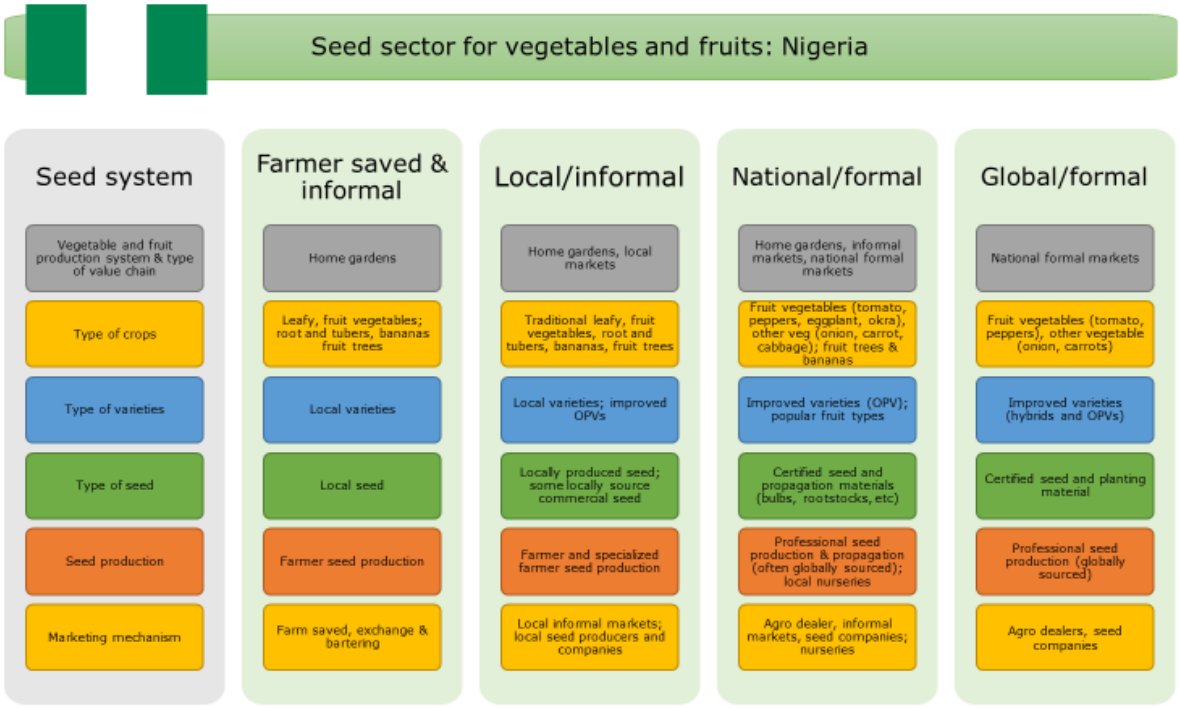

Figure 4.2 *Nigerian seed sector according to the seed system dimensions*
Source: based on Louwaars et al. (2013).

4.2 Production

4.2.1 Seasonal variation has a strong influence on the price

Our study indicates that in Nigeria, seasonality has a strong influence on the availability of fruits and vegetables in urban markets. Most vegetable farmers depend massively on irrigation (in the north), or rain-fed farming (in the south). Tomato production in the north is mainly done during the dry season, depending on farmers' access to irrigation. During the wet season, the disease pressure is too high and the land is often used for grain production, which is necessary to supply staple crops for household consumption. To ensure a higher yield, farmers use irrigation in the dry season.

The major supplies are from the suburbs of Lagos such as Ojo, Ikorodu, Epe, Badagry etc. while additional supply comes from neighboring rural towns mostly in Abeokuta in Ogun State. Amaranth is

limited in supply from December to April in Lagos, due to lack of rainfall as that period is the peak of dry season in Nigeria. Therefore only few farmers who can cultivate amaranth using irrigation.

Citrus is available all year round. The major growing season is during the rainy season, from March to June/July. Citruses are grown during the dry season, but the moisture levels are lower so the fruit if often smaller and less sweet. Pawpaw is available throughout the year but is most abundant during from November to March/April. The availability of water during the rainy season aids this. For a well irrigated pawpaw farm, fruit can be available throughout the year. Mango has two harvest seasons, with the first from February until April/May and the second harvest towards September and October. This second harvest is only small in quantity. But even between the two harvests it is possible to find mango.

Table 4.3 *Seasonal variations of different fruits and vegetables supplied in Lagos*

	Region	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Tomato	North	X	X	X	X	X	-	-	-	-	X	X	X
Tomato	South	-	-	-	-	X	X	X	X	X	X	X	-
Onion	North	X	X	X	X	X	X	X	X	X	X	X	X
Amaranth	South	X	X	X	X	X	X	X	X	X	X	X	X
Pawpaw	South	X	X	X	X	X	X	X	X	X	X	X	X
Citrus	Benue	X	X	X	X	X	X	X	X	X	X	X	X
Mango	Benue	-	X	X	X	X	X	-	-	X	X	-	-

Note: The red represents the scarcity period with high prices, though the produce is still supplied to the market.

Source: Authors' compilation.

Seasonality affects prices at fruit and vegetable markets. For tomato and onion farmers in the north, the window of opportunity for large-scale production (i.e. nursery, transplanting and tendering) is short – mostly from September to late February – before the on-set of rising temperatures (up to 45°C) accompanied by a sharp increase in disease and pest infection. Due to this reason, farmers harvest at the same time which results in peak supplies. Markets often cannot absorb such quantities of produce, which leads to wastage and prices crashing. In the south, farmers depend on rainfall, so again everyone tends to plant around the same time during the wet season, which also results in peak supply during the harvest period. During the wet season, vegetables are often supplied from the south where the production is mainly rainfed.

Prices of fruits and vegetables are governed by supply and demand. For tomato, seasonal price variations can range from ₦500 (US$1.21) per traditional raffia basket in the dry season to ₦1,200 (US$2.90) per basket in the wet season. A basket can contain 55 kg, but in reality, farmers are often requested to 'top-up' their baskets with an additional 5 to 10 kg. The farm-gate price for citrus is around ₦80-100 (US$0.21-0.24) per kg. For mango, the prices are much higher and there are paid per piece. During the peak season, prices are as little as ₦300 (US$0.73) per piece but in the low season, prices can reach ₦3,500 (US$8.48) a piece.

Table 4.4 *Range of selected farm-gate prices in Naira (₦100 = US$0.26) (February 2021)*

	High season	Low season	Location	Comments
Tomato	500 per 55 kg basket	1,200 per 55 kg basket	North, Kaduna State	
Onion	12,000 per 100 kg	>30,000 per 100 kg	North, Kebbi, Kano, Sokoto	
Amaranth	1,200 per 15 kg	2,500 per 1 5kg	Rural/semi urban in south-west	
Pawpaw	1,500 per dozen	3,000 per dozen	Rural areas	Big sized fruit
	500 per dozen	1,000 per dozen		Smaller sized fruit
Citrus	80 per kg	100 per kg	Rural areas	
Mango	300 per unit	3,500 per unit	Rural areas	Depends much on varieties

Source: Collected by authors.

When supply of any vegetable or fruit exceeds the demand for that product, prices tend to be lower than average. Similarly, when the demand exceeds the supply, prices tend to rise. These interactions are so significant that even a small change in the quantities of fruits and vegetables available have an effect on prices. So we conclude that volatility of consumer prices of fruit and vegetables are highly influenced by seasonality in supply.

4.2.2 Barriers for farmers to increase production per unit of inputs

The growing population of Nigeria and increased incomes, especially in urban areas, are creating a rise in market demand for fruits and vegetables. Increasing fruit and vegetable production to respond to this demand creates important economic opportunities, especially for smallholder farmers and midstream operators. However, some factors create disincentives for expansion among fruit and vegetable farmers in Nigeria. During the FGDs, the following key barriers were identified: 1) access to finance, 2) poor markets, 3) weak extension services, 4) access to quality inputs and technology, 5) climate change, and 6) access to land titles. In addition, a number of factors were mentioned only once, or have been mentioned in KIIs (Table 4.5).

Table 4.5 *Barriers identified*

#	Barriers	Importance as mentioned in the 8 FGDs (n=8)
1	Limited access to finance	63%
2	Poor market structure/demand	50%
3	Weak extension services	50%
4	Lack of quality inputs	38%
5	Climate change	25%
6	Lack of land titles is an important barrier to investment by farmers	25%
7	Social and political pressures	13%
8	Weak fruit and vegetable farmer associations	13%
9	Pests and diseases (mentioned in KII)	
10	Poor infrastructural and logistics framework (mentioned in KII)	

4.2.2.1 Limited access to finance

Most fruit and vegetable production is carried out by traditional smallholder farmers who access finance for their production through informal networks. As such investment is often low. Increased investment into fruit and vegetable production will require a combination of innovative and formalized sources of low interest finances. Participants in the FGDs on gender and the FGDs with producers of onions and tomatoes, mentioned that finance is a key barrier that prevents farmers from to increase production.

There are many reasons why farmers struggle to access finance. Farmers often do not have the technical expertise required to put together the documents, or the collateral needed to secure the loan. Requirements of credit/financial institutions are also sometimes too rigid, while corruption and lack of transparency in the allocation of government loans is also a challenge. For example, CBN works with the Nigeria Incentive-Based Risk Sharing System for Agricultural Lending (NIRSAL) micro-finance bank to make it possible for farmers to access loans. However, farmers are still struggling to access these loans. Therefore, it is important to build capacity of farmers in the areas of bookkeeping to enable them to more easily access loans.

4.2.2.2 Unsecured market

Vegetable production is risky for smallholders because the produce is perishable, so the marketing chain must be reasonably secure before farmers make investments to increase production. However, FGD participants argued that the market structure in Nigeria for fruit and vegetables farmers is very unfavorable in reality. Farmers are largely dependent on traders and middlemen and prices can substantially fluctuate, making the market for both fruits and vegetables in Nigeria far from secure.

4.2.2.3 Ineffective extension services

Public extension services are ineffective and non-functional in most parts of Nigeria (Plaisier et al., 2019). This weakness deprives farmers of access to real-time information on innovations and practices in the fruit and vegetable industry.

This is one of the issues affecting productivity in the country. In Nigeria, the Agricultural Development Program delivers extension services for the agricultural sector. It works with the Research Institute for Improved Technology, in order to effectively deliver services to the farmers. Problems identified at the grass root levels are transferred to the researchers by the extension personnel, and solutions in form of improved technology are disseminated back to the farmers for implementation. In spite of such a structure in place, there still remain challenges of knowledge transfer at the grass root level.

The biggest challenges for Nigeria's agricultural extension services have been identified in the literature (Ibrahim et al., 2014) and include: a lack of legislated agricultural extension policy, inadequate and untimely funding, poor leadership and coordination, low private participation, and a very weak research-extension-farmer inputs linkage system driven by ineffective top-down, supply-driven extension approaches.

Increasing and intensifying production requires substantial knowledge of good agricultural practices (GAPs), without which intensification is impossible. Nigeria's farming population is predominantly from an older generation and have out-of-date farming knowledge and practices. Where the younger generation is involved, however, they often lack the adequate skill and experience to make a substantial impact. Extension, therefore, is vital in order to support every farmer.

4.2.2.4 Lack of high-quality inputs and inefficient supply systems

There is a general lack of availability of good inputs, technology and services and where these are available the distribution system is sub-optimal (Plaisier et al., 2019). The seed sector does not function well, there is no quality control, and quality seed are hard to access. As a result, tomato and onion farmers mostly use outdated varieties and farm saved seed.

In the FGD on production and trade, it was also mentioned that a lack of monitoring of the quality of inputs by the government is a serious issue. Farmers therefore are often faced with counterfeit inputs like fake crop protection agents or counterfeit seeds.

The cost of input is continuously increasing. Participants in the production and trade FGD stated that the cost of fertilizer per 50 kg bag has tripled in the last 2 years and it is also often not readily available. The cost of pesticide has also increased by at least 50%. Various reasons explain this: there has been serious inflation and this increased the costs of food and non-food items in the country. Besides that, many of the inputs which are not produced within the country are imported and their costs are highly dependent on the exchange rate which has not favored local currency in the last few years.

The cost of setting up a modern irrigation system, such as drip tape, can be in the range of ₦1,250,000 per hectare (US$3,030), including workmanship (excluding the cost of sourcing water if natural sources such as a dam, lake etc. are not readily available). This is beyond the reach of smallholder farmers.

4.2.2.5 Climate change

The increasing occurrence of stresses due to weather conditions, associated with climate change, is a barrier to intensification. Drought and the receding Lake Chad threaten tomato and onion farming in the north-central and north-west regions of Nigeria. Other extreme events such as flooding in the southern regions of the country also create barriers to intensification.

4.2.2.6 Lack of land titles is an important barrier to investment by farmers

Access to land is an important factor in agricultural production. Ironically, while Nigeria has plenty of arable land, it is often unavailable for farmers. Land allocation and management is not formally arranged and therefore most farmers do not possess a land title. Therefore, Nigerian farmers cannot

use their land as collateral to buy inputs, which also limits access to technologies (Posthumus et al., 2019). For female farmers, it was argued in the FGDs that it is even more difficult to access land due to limited financial capital. Culture and norms around men being the only ones to benefit from inheritance are additional challenges for women. Even where land is owned and available for women, female farmers sometimes require male laborers to conduct particularly physical farm operations that requires physical strength, and use of male owned or male operated machinery; which adds costs to production which male farmers often do not have to incur. This implies additional costs and lower returns on investments for women.

The land tenure system and land fragmentation in Nigeria are serious issues hampering processes of increasing fruit and vegetable production. Most farmers are limited in expanding production because of their farm size. The cost of renting a hectare of land for a season is as much as ₦150,000 (US$364) in some parts of Kano and ₦75,000 (US$182) in the south-west.

4.2.2.7 Insecurity

In the main areas where tomato and onions are produced, there are various examples of social and political unrest such as rising insecurity, farmer-herdsmen clashes and terrorism (Ajibefun, 2018). In recent years, communities have been destroyed, and thousands of farmers and pastoralists have lost their lives. The social and political unrest is not only destroying livelihoods, but is also worsening hunger by posing challenges to (small) farmers and agribusinesses, who are the drivers of the agricultural value chain. In the face of uncertainty and danger (e.g. due to farmer-herdsmen clashes), farmers are migrating to urban centers, and those who are still farming are reluctant to invest to scale up their farms. Investors are also becoming increasingly averse to investment. This insecurity also hinders the government's ability to provide training and inputs needed to improve crop yield. Peace and stability is required before farmers will go back to their farmland (Ezinwa and Oguamanam, 2018), and investors will have the confidence to invest in the sector in these areas.

4.2.2.8 Lack of fruit and vegetable farmer associations

Apart from tomatoes, there are no other associations for fruit or vegetable farmers. The formation of farmer associations could provide a strong platform on which farmers can access funding, demand better regulation for seeds and inputs, and bargain for better market prices. Tomato associations have been observed in a pocket of states such as Kano, Kaduna, and Jigawa, where production is high, but they are only involved in representation activities directly with the government.

4.2.2.9 Pests and diseases

Pest and disease outbreaks are frequent because farmers use local unimproved varieties of fruits and vegetables and have only limited knowledge of how to apply pesticides appropriately and implement other practices for controlling pests and diseases. The correct use of pesticides is also important to prevent misuse and overuse.

4.2.2.10 Poor infrastructural and logistics

The main production and consumption zones are separated by large distances, generally linked by poor road networks. Ownership of vehicles (trucks and lorries) is private, and the vehicles are often in poor conditions and not equipped to keep the fruit and vegetables cold. However, the poor state of the roads and the unreliability due to the poor conditions of the vehicles increases the time of travel, and makes it difficult to predict arrival dates of the produce.

Good road accessibility is a serious issue. Feeder roads (leading from farms to towns) are generally in bad shape. Since many farmers practice rain-fed farming the road situation is also often worse during harvest. Price fluctuations for fuel and diesel affect transportation costs. The often high transportation costs discourage some farmers from even trying to transport their produce to markets. Rail transport would be a more suitable form of transport for agricultural produce because of its ability to handle bulky freight, like agricultural produce, and the relative predictability compared to road transport, but the rain network is not currently operational.

Poor and unstable electricity supplies deter the adoption and development of cold storage facilities and fruit vegetable processing, which result in huge losses for the fruit and vegetable industry and further

disincentivizes investment in the sector. A lack of power to run irrigation facilities also forces many to farm only in the wet season farming.

4.2.3 Opportunities to increase fruit and vegetable production

Farmers have four options to increase fruit and vegetable production:
1. Expand the cropping area;
2. Increase production frequency;
3. Increase crop productivity; and
4. Reduce on-farm losses.

4.2.3.1 Expansion of the cropping area

Access to land is an important factor in agricultural production. Ironically, while Nigeria has plenty of arable land, it is often unavailable or its ownership is disputed. Land allocation and management is not formally arranged and therefore most farmers do not have a land title. This is particularly relevant for the production of perennial fruits that have a long-term return on investment. And access to land is a greater obstacle for women compared to men. Short-cycle vegetables that are produced intensively, such as amaranth, are less constrained by access to land.

4.2.3.2 Increasing production frequency

Increasing cropping frequency is only possible if farmers have access to irrigation. Some production regions do have access to irrigation, but others have almost no access. Out of the total area that could be irrigated, only 40% to 70% is operational because some schemes need to be rehabilitated. So important efforts need to be made to increase irrigation by rehabilitating the existing schemes and creating new schemes.

4.2.3.3 Increasing crop productivity

Increasing productivity (yields) implies producing more fruits and vegetables on the same plot of land within the same period. To assess the potential for increasing yields in Nigeria we looked at the yield gap of crops; the difference between the yield potential (Yp) without limitations, due to water or other abiotic and biotic stresses (the most relevant benchmark for irrigated systems), and actual crop yields (Ya). Because such models are lacking for fruits and vegetables, or are not parametrized for the prevailing conditions in Nigeria, we used global average yields based on FAOSTAT data. We also used yields obtained under experimental research conditions as benchmarks for Yp. We show the actual yields and yields obtained under experimental research conditions in Nigeria for tomato, and for Uganda (as a proxy for onion). The relative yield gap for fruits is 50% (i.e. (Yp – Ya) / Yp * 100%). For vegetables the gap is as much as 85%.

Increasing crop yields depends on the availability and quality of inputs and the skills of farmers to apply these inputs efficiently and effectively. Average yields of both fruits and vegetables have decreased in the last decade, suggesting that the inputs, knowledge and skills of farmers currently are not sufficient to result in productivity increases. For intensification to work, agricultural practices land fertility need to improve, and access to finance needs to increase to enable fruit and vegetable smallholder farmers to purchase high quality inputs.

Table 4.6 *Yield gap for selected crops (2019)*

		Current yield Ya (t per ha)	Obtainable yield Yp (t per ha)	Gap	Average fruit/ vegetable yield gap
Fruit	Mangoes, mangosteens, guavas	7.11	10*	29%	
	Papayas	8.42	29*	71%	
	Citrus fruit (NES)	5.01	10*	50%	50%
Vegetable	Tomatoes	4.56	30**	85%	
	Onions (dry; mature)	2.32	15***	85%	85%

*FAOSTAT Global average **Plaisier et al. (2019) ***Dijkxhoorn et al. (2019) using the obtainable yield in Uganda as proxy

4.2.3.4 Reduce on-farm losses

The fruit and vegetable harvest season results in a peak period of supply, and low market prices. This means that farmers are often unwilling to harvest and transport their produce to market. As a result, vegetable farmers in some part of Kano regularly lose up to 40% of their harvest. FGD participants stated that for onions, the greatest losses occurred during transport and storage, rather than during production. Poor storage infrastructure and practices, and lack of technical know-how by farmers were given as key reasons for losses.

KIIs and the literature agree that losses in the fruit value chain, especially for orange, mostly occur as a result of poor harvesting methods, and poor storage and other handling facilities along the supply chain (see Section 4.4.4.2 for more information). In addition, the cultivation of local cultivars of fruit crops contributes to the amounts of post-harvest losses recorded. In mango cultivation in Benue, some common local cultivars such as Jumbu, Indiana, Paparanda and Kerosine have a reduced shelf-life compared to other improved cultivars such as Peter, Broken, Julie and Dasha.

4.2.4 Socio-cultural norms limiting female farmers to increase production

Women face greater, and additional, barriers to agricultural intensification of fruits and vegetables than men. Three distinct mechanisms account for this: the burden of reproduction; obligations of women are more time consuming than that of men hence women farmers have less time for activities, that could increase income; and women's farmers' limited access to resources and information (Adenugba, 2013).

Intrahousehold allocation of labor relegates women and girls to performing domestic tasks. Tradition defines the tasks, accessible resources and taboos that determine the acceptable economic and social spheres that women can operate in. Increasingly faced with economic pressures, gender roles are becoming more flexible enabling women to engage in the economic domain. While this opportunity to engage in economic activities is a positive step for women, it adds to their reproductive and care related household tasks. The continued expectation for women to take on these roles in the household, puts a limit on how much time they can allocate to their agribusiness initiatives. This time limit affects their ability to increase their production and grow their agribusiness initiatives. In addition, although women play an important role in production and processing processes, their role in decision-making processes (regarding buying inputs, planting crops, schooling their children, or planning the household budget) is relatively small due to gender norms that restrict their participation in household economic management. Their quest to increase production and profits is held back by cultural and structural factors such as their household tasks and limited access to production resources. Despite this, From the focus group discussions, women expressed a desire to increase their produce as this has potential to provide additional income for women in the fruit and vegetable agribusiness.

In Nigeria, cultural norms and lack of collateral often prevent women from borrowing money. Without adequate funds for capital investments, female farmers are less likely than men to buy and use fertilizer and drought-resistant seeds, implement sustainable agricultural practices, and use advanced farming tools and techniques that increase crop yields. They have less access to information, technology, inputs, land and credit than men. Women farmers with less income, limited access to credit, and their limited role in income management, are particularly unlikely to be the beneficiaries of investment opportunities. In addition, women farmers have not only been excluded from many benefits of technology and have also been negatively affected by its application for example, they still bear the workload of increased use of new technology. Improved fields are generally the men's, rarely the women's, hence the women rarely benefit from their increased workload. Women are at the core of value chain processes but their work patterns are marked by change, continuity, flexibility and rigidity. Change and flexibility are characterized by women taking on new roles in farm production, off-farm production, increased market trading and community production to ensure their family's access to food and household resources. Continuity and rigidity relate to social norms that define gender roles and dictate that women and girls should assume home production responsibilities in their households.

4.2.5 Cost of production

Figure 4.3 gives an overview of a typical crop budget for onion, tomato and amaranth produced in the selected zones for a production cycle. The typical gross margin ranges between 41% and 45% for the vegetable crops studied. However, all margins are dependent on the market prices obtained, which are heavily influenced by supply and demand dynamics, and crop losses as a result of pests and diseases. In addition, our calculations did not include fixed costs like land rental since farmers mainly obtain access to land through family inheritance, or associate or government lease. The data was also used to calculate a unit cost price (see Appendix 1 for a detailed overview of the inputs for the calculations).

For irrigated tomatoes the cost of production is calculated at ₦24,000/t (US$60). Tomatoes are sold at wholesale markets for ₦42,000/t (US$101). The total estimated yield for 1 ha of tomato is 5.5 t. This suggests that 1 ha will generate a sales value of ₦250,000 (US$606) and costs totaling ₦150,000 (US$363), which results in a gross margin of 41%. For tomato, we considered the common inputs, including costs of standard OPV seeds. One of the most expensive inputs are the seeds, but irrigation costs are also significant. Family labor is widely used to carry out necessary manual activities, and is accounted for in our calculations. Input for our cost price calculation was a recent study that looked at 60 tomato farmers in Kano (Dahiru, 2019). The study came to the same conclusion that tomato production is highly profitable.

For onion, the costs of production is ₦38,500/t (US$93). Onions have a sales price of ₦65,000/t (US$157) at wholesale markets. The forecasted yield of 4 t/ha will generate a total revenue of ₦255,000 (US$618), which is a gross margin of 42%. For onion, various inputs (like seeds, fertilizers, fuel for irrigation) make up almost half of the total costs, with labor accounting for the rest.

Amaranth is a leafy vegetable that requires very little practical skill and it can grow almost anywhere. The crop has a short production cycle and due to its perishability markets are not usually far from the hub of production. Yield on 1 ha is estimated at 2.25 t and is sold for ₦166,000/t (US$402), so total revenue for 1 ha producing 2.25 t is estimated at ₦375,000 (US$909), with costs amounting to ₦205,000 (US$497). This results in a gross margin of 45%. As amaranth is produced across the country, and transport costs are high, it is not cost effective to transport amaranth from the north down to the south, unlike for tomato or onion.

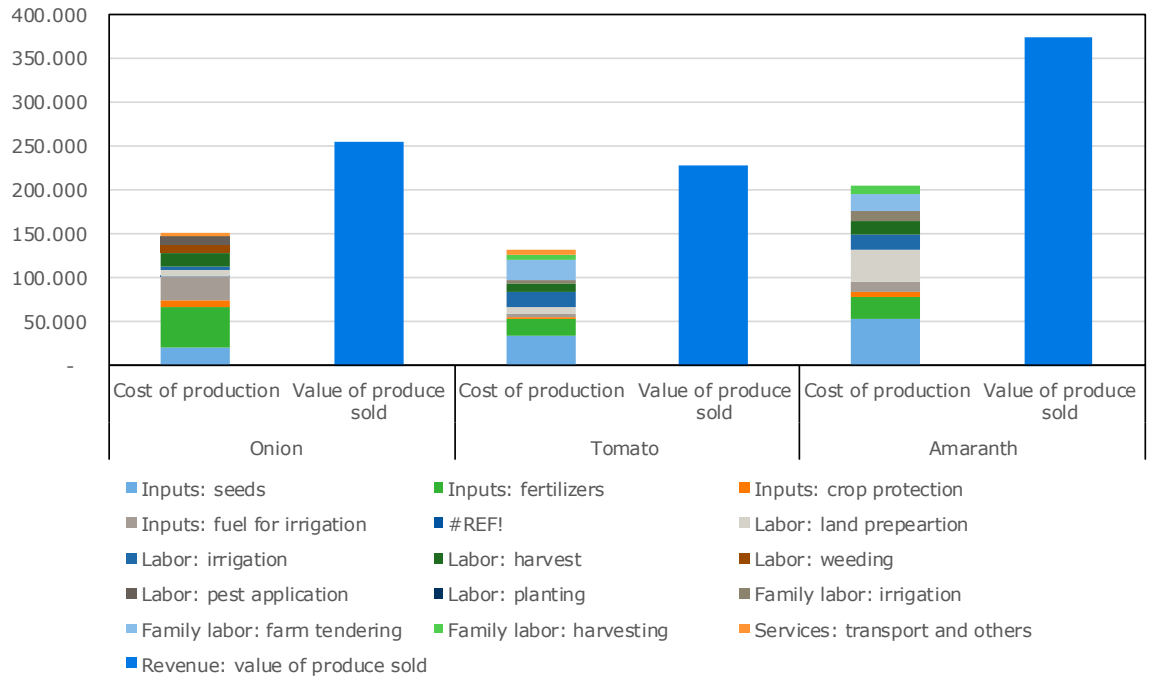

Figure 4.3 *Cost benefit analysis of selected vegetables per hectare in the dry season 2021*
Source: Authors' compilation, expert interviews and Dahiru (2019) for tomato.

For fruit, the gross margin is higher and it ranges from 78% to 81% for pawpaw, mango and oranges (see Figure 4.4). For all fruit crops, the key cost is the labor needed for harvesting. The demand for farm workers can be very high in the south without availability of labor. For mango, the cost of production is ₦24 (US$0.06) per kg, for pawpaw it is ₦74.5 (US$0.26) and for oranges it is ₦189.2 (US$0.49) (see Appendix 1 for a detailed overview of the inputs used for the calculations).

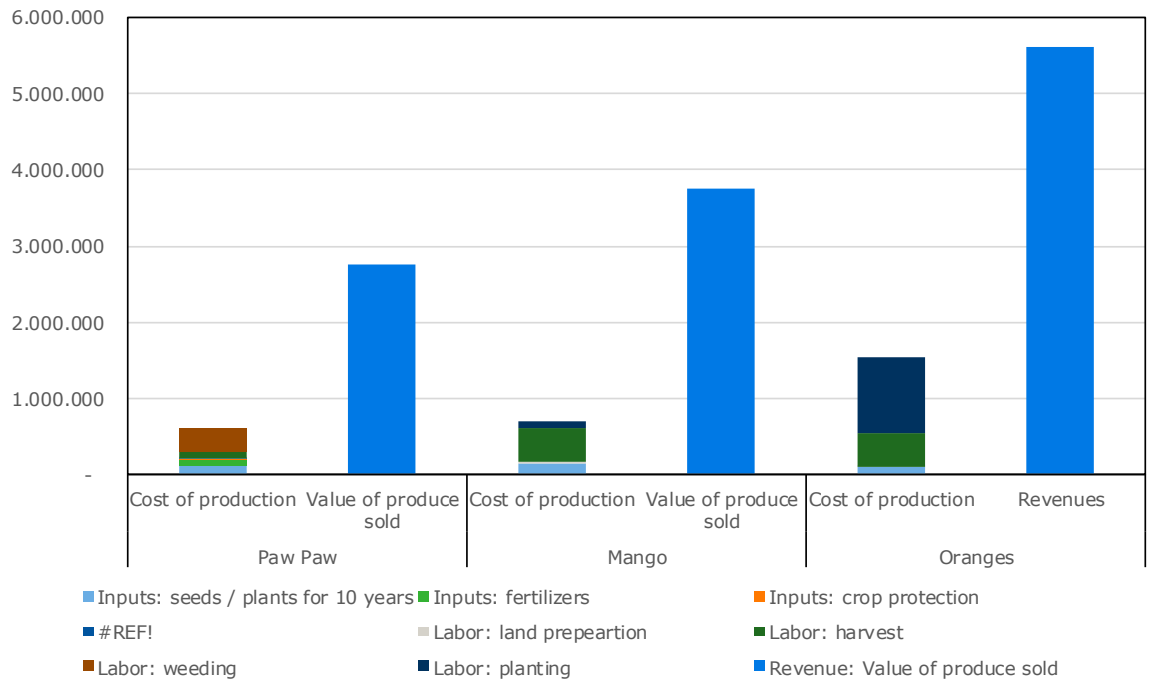

Figure 4.4 *Cost-benefit analysis of selected fruits per hectare in the dry season 2021*
Source: Authors' compilation and expert interviews.

The cost of production for fruits and vegetables is high compared to other crops, like staples like sorghum, maize, cowpea and groundnut. These crops have an annual costs ranging from ₦32,000 (US$77) to ₦84,000 (US$204) per ha because the only cost item for these crops is usually labor (Garkuwa and Eze, 2018; Jenkins et al., 2018). Where the costs per hectare for vegetables range between ₦133,000 (US$322) and ₦205,000 (US$496) per ha, for fruit this ranges between ₦650,000 (US$1,575) and ₦1,540,000 (US$3,379).

4.2.6 Effects of cost reduction strategies

Reducing the costs of production present a viable method towards realizing better and more competitive prices that maximize profit, but this is a huge challenge, particularly for smallholder farmers who produce most of the fruits and vegetables in Nigeria. Smallholder farmers usually lack access to finance and credit that is necessary to reduce farm costs through investing in land expansion, inputs, adoption of farm mechanization and basic processing. The lack of farmer associations mean that fruit and vegetable farmers also lack the agency to influence prices. Fruit and vegetable farmers often reduce this risk by avoiding to rely on one (high income) cash crop and diversify the range of crops, including subsistence crops. This means that they will only be able to offer small amounts on the market and are not able to specialize and to reduce costs. These factors impede cost reduction and make it difficult for farmers to achieve competitive prices.

4.3 Fruit and vegetable supply chain efficiency

4.3.1 Fruit and vegetable supply chains in Nigeria are inefficient

Interviewed stakeholders highlighted various inefficiencies that lead to higher costs but also increase the lead time of the fresh produce coming from the field to urban centers. A well-organized fruit and vegetable supply chain could contribute to a better allocation of resources, with the (economic) benefits passed onto all stakeholders along the value chains. Efficiencies can relate to 1) smooth running operating chains resulting in low post-harvest losses with actors being well-aligned, but 2) are also related to low transactions risks and associated costs.

4.3.2 Post-harvest losses vary between crops

High post-harvest losses are observed in all fruit and vegetable supply chains in Nigeria. It is estimated that about 40-60% of agricultural produce is lost annually because of inadequate farm and village-level storage in Nigeria (FMARD, 2016a; Gustavsson et al., 2011). Almost all studies identified, however, only provide estimates; there is hardly any primary data available giving clear insights into the issues of post-harvest losses.

For specific crops, various data is provided:

- Tomato: Ugonna et al. (2015) estimated the annual post-harvest losses of tomatoes produced in Nigeria to be 50%. This assessment of post-harvest losses of tomatoes was based on a survey of 450 farmers in eight different areas. Tomato wastage occurs mainly at the processing, packaging and distribution stages. This is due to poor processing technology, lack of good storage systems and poor transport systems used for the distribution of fresh tomatoes. A more recent study (Kok et al., 2019) measured the losses of eight tomato-producing value chains in the south-west (five value chains) and south-west (three value chains) that supply the main markets in the south. By load tracking, it was found that post-harvest losses were limited, at between 7% and 12% from farmer to retail. However, the economic losses were much more significant since product quality also decreased quickly and created serious value loss for all actors involved. A simple scenario leading to a change in grade of produce leaving the farms to the markets can be put in this form: Off all products that leaves 70% is grade 'A', but when it arrives in Lagos only 35% remains grade 'A', which is a serious economic loss. The study also concludes that the introduction of plastic crates led to a reduction of losses by 50%.
- Onion: According to the World Vegetable Centre, post-harvest losses in onions account for as much as 50% (WVC, 2018). Poor post-harvest practices occur throughout the onion value chain, especially during transit. Gaps in knowledge on how to properly grade bulbs for marketing and how to manage stored produce drive losses, the World Vegetable Centre states. With few good storage facilities available at farm level, farmers are often forced to sell onions at lower prices during peak periods.
- Mango: There is little data on losses in the mango value chain. A report covering Benue State, by the State Ministry of Agriculture in 2010, revealed 20-80% post-harvest losses of mango. These losses are mainly caused during harvesting, packaging, storage, transportation, retailing and consumption.
- Pawpaw: Most pawpaw losses occur during the post-harvest phase, during storage, transportation and in informal markets due to very poor handling. Transportation and storage activities contributed to 84% of the post-harvest loss of pawpaw fruits in Ekiti State, followed by marketing with 10% (Agbowuro, 2012). This is similar to what happens in other states according to the KIIs.
- Citrus: Almost half (45%) of the citrus currently produced in the country is consumed fresh and 50% is wasted due to post-harvest losses, while 5% are processed (Olife et al., 2015).

Reasons for the high losses of vegetables include poor materials used for packing and overstocking of vehicles used for transportation. Trucks are loaded with raffia baskets (for tomato) and bags (for onions and oranges) and are often overloaded so goods are squeezed. Most transporters are contracted and are paid per unit which is an incentive for overloading. Delays (caused by roads being in a poor condition, roadblocks and long distances between production hubs and the markets), and poor handling on farms and in the fruit and vegetable supply chain also contribute to the losses.

For fruit additional factors contribute to losses. For example, Sambe (2020) revealed that major causes of post-harvest losses of mango fruits in Benu State were weather (heat or rain), livestock, bats and rodents, disease, poor handling techniques, and insects such as wasp and ants.

4.3.3 Transaction risks and costs in fruit and vegetable value chains are high

There are various factors influencing transaction risks and the size of transaction costs. In this section, we discuss four kinds transaction attributes, as outlined by Eaton et al. (2008):

- asset specificity;
- uncertainty;
- the difficulty of measuring performance in fulfilling the terms of an agreed transaction; and
- the level of coordination.

4.3.3.1 Asset specificity

Specificity is key for the studied fruit and vegetable supply systems, and refers to transactions for which the location of production is important. Tomato and onion only grow well in certain locations at certain times, often far away from consumer locations. This means that there is an important role for traders such as collectors as well as transporters. Information and coordination costs increase with distance. Buyers, therefore, choose to establish personal relationships with sellers and producers in these areas so that they are ensured of produce after they have incurred (transport) costs, which can be seen as a fixed investment. If the seller has already sold to someone else, the buyer cannot recuperate this investment. This problem increases when there are many buyers and few sellers during the low season. However, the reverse may also be true. A producer located in a remote location may only be able to sell produce for a relatively low price during peak season.

4.3.3.2 Uncertainty is high

Uncertainty is a key feature of horticulture production. The amount and quality of output that will result from a given amount of inputs are typically not known with certainty, due to uncontrollable elements, such as the weather. The effects of these uncontrollable factors are accentuated by the fact that time itself plays a particularly important role in agricultural production because long production lags are dictated by the biological processes that underlie the production of crops. Thus, markets for agricultural products are often characterized by volatility and cyclically fluctuating prices. In the face of such uncertainty, concluding agreements or contracts is difficult; in other words, transaction costs are high, because renegotiation and adaptation might be required when unforeseen events emerge. This is especially in the case of Nigeria where the institutional environment is also weak. This is highlighted by the low scores Nigeria receives on various World Bank Doing Business indicators such as 'Resolving Insolvency' and 'Enforcing Contracts.[9]

Participants of FGDs also confirmed that the production of fruits and vegetables is a very risky commercial activity which can result in an appreciable percentage loss for farmers, due to pests and diseases, and during transportation due to many factors associated with poor roads and notorious price fluctuations.

4.3.3.3 Performance measurement is poor

Transaction costs are affected by the extent to which a contracting party measures the performance of the other party in fulfilling the terms of the contract. When measuring performance is difficult, people commonly arrange their affairs to make measurement easier or to reduce the importance of accurate measurements. In most situations, performance measurement is a problem with fruits and vegetables, as quantity is determined by the number of basket or bags and quantity is not weighed per kg. In addition quality is not graded (Kok et al., 2019; Plaisier et al., 2019).

4.3.3.4 Coordination is lacking

Coordination of fruit and vegetable supply systems is challenging for the following reasons:

- **Complex fruit and vegetable supply systems**. In Nigeria it is common practice to source from fruits and vegetables from different, remote locations. Traders operating in the main markets

[9] https://www.doingbusiness.org/en/data/exploreeconomies/nigeria

usually employ or contract other actors to contact farmers, gather information on supply, quality and prices, and purchase, inspect, pack and transport goods. This can result in a long supply chain involving many middlemen and other actors such as transporters, farmers collectors, packers etc. This type of fruits and vegetable supply chain configuration requires complex coordination.

- **Lack of fair sorting, grading and weighing**. Within fruits and vegetables supply systems, fair trading standards for all actors are lacking. The following concerns were raised by FGD participants:
  - A lack of accurate weighing of fresh produce creates a lack of transparency in the fruits and vegetables supply chain system. The products are traded in a basket that can vary in weight. In a study by Kok et al. (2019) the differences in weight in the basket was measured. For example, producers in the north filled their basket with an average weight of 63 kg and had a variation of between 60 and 66.8 kg. During the FGDs stakeholders often refer to these northern baskets as 55 kg baskets. This means that farmers are paid 10-20% less per kg compared to what is expected. The absence of an accepted set of weights is likely to influence transaction costs.
  - Sorting and grading is hardly done in the fruits and vegetables supply system. This means that farmers are not rewarded for producing good quality produce. Grading only occurs at the retail stage. Tomatoes are graded on color, firmness and damage. Grade A tomatoes are red, firm and undamaged, and can be sold for a premium price to consumers, however in transactions between farmers and traders this grading is not considered (Kok et al., 2019).
- **Weak institutional environment**. Nigeria has a weak institutional environment, particularly its legal frameworks, which lead to difficulties in enforcing impersonal contracts, and rent-seeking behavior in the sector. All these factors consume resources and inhibit economic and technological development, which hinders access to markets and market development. This leads to high transaction costs and risks, and high unit costs for infrastructural development.
- **Low degree of association and organization within and among farmers**. Value chains of agricultural products are increasingly being concentrated, however, farmers – the mainstay of agrifood production in Nigeria – still often operate at small-scale levels. As mentioned in Section 4.1.1, only 10-30% of farmers are organized in a cooperatives (and these only focus on joint input sourcing). As result they remain isolated and thus unable to exercise any bargaining power against better consolidated buyers and some large processors. This situation raises serious concerns about the state of integration of such farmers into value chains.

4.3.4 Secured markets are not common

4.3.4.1 Farmers are dependent on informal markets

There is a fruit and vegetable supply chain serving urban high-income consumers through supermarkets, and a supply chain serving the urban poor through corners shops. As a result, horticultural markets serving the poor in Nigeria are scattered and fragmented. The largest demand is still for cheap, highly-caloric food on local markets, but the higher-end niche markets in grocery stores and supermarkets are growing in urban centers. Farmers supplying these high-end markets sell their produce at premium prices. For example, in the case of citrus, a farmer can sell 1 kg directly to a retail chain giant for ₦600 (US$1.45), while the same quantity would be sold in the informal market for ₦400-450 (US$1.05), and the latter is not always guaranteed, as explained by sector experts in the Benue KII.

4.3.4.2 Fruit and vegetable processing is challenging

Stakeholders in the FGDs indicated that the fruit and vegetable processing industry is still in its infancy and is uncoordinated. A key processing challenge is the lack of tomato varieties suitable for processing. The import of raw material from abroad (despite introduced import bans) also jeopardizes the competitiveness of the domestic processing sector. Another issue mentioned was the volatile supply and the high cost of raw materials. For example, processors need a constant supply of raw material at an affordable price to be able to offer a competitive product to consumers. Some studies (e.g. Plaisier et al., 2019; Ugonna et al., 2015) also confirmed some of these challenges faced by the Nigerian processing industry. To overcome these barriers, a large processing company has set up dedicated outgrower schemes and provides farmers with technical support and inputs (e.g. quality seed and varieties needed for processing).

Table 4.7 lists the key processing companies active in the fruit and vegetables supply chains. In recent years there has been a small increase observed in companies processing fruit juices on a small scale, possibly thanks to a directive to ban imported fruit juices and juice concentrates (see Section 4.1.3).

Table 4.7 *Processing companies of fruit and vegetable in Nigeria*

Processor	Location	Classification
Tomato Jos	Kaduna, Nigeria	Large scale. Focused on tomato
Dangote	Kano, Nigeria	Large scale. Focused on tomato
Dangi Foods	Abuja, Nigeria	Large scale. Focused on tomato
Nature's Bounty Healthcare products	Lagos, Nigeria	Medium scale. Focused on dried fruit mix
Dansa holdings limited	Lagos, Nigeria	Large scale. Focused on fruit juice and beverages
Gunni Royal Tomato paste and Allied company	Oyo, Nigeria	Medium scale. Focused on tomato
Frutta Juice and services limited	Lagos, Nigeria	Large scale. Focused on fruit juice
Mystrose Limited	Abuja, Nigeria	Small scale. Focused on vegetable mix
AACE Foods and Processing	Ogun, Nigeria	Medium scale. Focused on dried spices

During the research, we obtained several successful stories of commercial fruit and vegetable processing activities, involving both men and women who have the capabilities to develop innovative fruit and vegetable processing. Some processors, mostly at the downstream, are focused on value addition using innovative approaches. One company is producing a pasteurized tomato, pepper and onion mix which is used as a ready-to-cook product for stew making (Cases of Easy Sauce, Kaptain). A big player like Dangote Tomato Processing also makes tomato concentrate and puree. For mango, there is a small and medium-sized enterprise (SME) making mango chips. Some SMEs also specialize in dry food mix packaging destined for retailed markets in urban areas (e.g., ReelFruit in Lagos). Box 1 and 2 detail two companies.

Box 1: AACE Foods and Processing

AACE Foods and Processing was founded by the female entrepreneur Ndidi O. Nwuneli. AACE Foods is an indigenous Nigerian company established in November 2009. AACE processes, packages and distributes nutritious and tasty food made from the best of West Africa's fruits, herbs, vegetables and cereals. The product line consists of an innovative range of spices, spreads, sauces and complementary food that excite and satisfy institutional, commercial and retail customers.

More information: https://aacefoods.com/

Box 2: Tomato Jos

Tomato Jos was founded by Mira Mehta (female) and Shane Kiernan (male) in 2008. Tomato Jos helps smallholder farmers to grow excellent tomatoes and uses the tomatoes to make tomato paste. Tomato Jos created and runs an out-grower scheme on the company's 500 ha irrigated land. It provides inputs including seeds with a buy back promise of final produce. Tomato Jos also prefers to work with female farmers, according to the representative of the company at the FGD, and lease out land at the rate of ₦1,000 (US$2.4) per 0.5 ha

More information: http://www.tomatojos.net/

4.3.4.3 Contract farming is limited

Contract farming is an agreement between farmers and processing and/or marketing firms for the production and supply of agricultural products under agreements, frequently at predetermined prices (Holtland, 2017). The agreement often includes the provision of production support by the buyer to the producer, for instance the supply of production inputs or technical assistance. The basis of a contract farming arrangement is a commitment on the part of the farmer to provide a specific quantity of a commodity and at certain quality standards determined by the buyer, and a commitment on the part of the buyer to support the farmer's production and to purchase the commodity. Producing on a contractual basis is not new to Nigeria, but is increasingly gaining attention. It is mainly applied in tomato production by the main tomato processors such as Dangote Tomato Processing Ltd. (see Box 3).

Box 3: Enhanced efficiencies: reducing the risk for farmers and buyers

The coordination in the value chain often occurs in an informal but well-structured manner. For small-scale farmers, the merchants either come to buy the produce directly from their farms or they take the harvested produce to informal small markets where merchants gather to then take it to larger markets. The largest of these informal markets in Kano is Kwanar Gafan Tomato market where farmers sell to dealers who then transport the produce to the south.

In contrast the to the current practices, companies like Dangote Tomato Processing factory have organized transport systems to take the tomato directly from farmers' cluster centers using solid plastic crates. Payment is always made per kilogram of supplied tomato, rather than the usual visual measurement of informal markets. They also provide backward support in the form of the CBN Anchor Borrower Programme, which includes quality seedlings, fertilizers and sometimes pesticides, and extension services. This backward support is provided through the grant (between Dangote Tomato Processing, smallholders tomato farmers and CBN) which contains the following benefits for farmers:

- Access to quality seedlings (only hybrids varieties) that are tested and have very high yields in the growing locations. The grant covers all most the inputs. The cost is deducted from their final sales.
- Access to quality inputs in the form of a grant which ease the financial burden of production during the on-set of the season.
- Private extension services to provide technical support not readily available elsewhere.
- A ready market for harvested produce which will be transported using plastic crates. This arrangement includes a transport service.
- Cluster farming is encouraged as farmers are put in clusters and the company only deals with clusters rather than individual farmers.
- A price peg which will be above average open market prices, therefore they are protected from price shock (high fluctuating prices during that time of the year).
- Guaranteed markets, therefore are sure that their produce will be sold.
- Encouragement to improve on their good agronomic practices, since there is an emphasis on produce quality. Farmers are forced to do this since their produce can be rejected if it does not meet the requirements. Over time this contributes to the improvement of farming practices which have been known to be poor.

This kind of model of contract farming is not without challenges, such as side-selling and diverting of support materials by farmers. However, it does supply farmers with a guaranteed income and a guaranteed market.

4.4 Communication and information sharing

4.4.1 Linkages between actors in the chain are weak

Our KIIs and FGDs confirm that linkages between traders and consumers are not common. Only a few examples were reported that lead to value addition activities. However, they are mostly practiced specifically for tomatoes and onions, and involve basic slicing and sun drying, which are then bagged, stored to be resold during the lean season, and used for domestic consumption.

Some NGO initiatives (e.g. TechnoServe, APPEAL, 2SCALE etc.) have been supporting farmers through technical information sharing and creating linkages with buyers. Some of them have been focused on improving agronomic practices and encouraging the use of quality inputs, especially seeds. In other cases, demonstration farms have been set up to encourage the use of improved seeds and other complementary inputs. Farmers are often brought together to observe land and nursery preparations, transplanting, tendering and harvesting phases. Farmers are able to compare outcomes in terms of yield, market appeal, unit price and shelf life with local varieties and traditional practices.

4.4.2 Information sharing is limited

FGD participants stated that information is generally not shared across the fruit and vegetable supply chain. For example, information about consumer preferences, or prices on the main markets are not readily available for (rural) farmers, and obtaining this information is costly. Thus, traders who have access to this information can decide not to share it with farmers, or provide farmers with

misinformation (e.g. state that prices in main markets are lower than they are in reality, or not provide information on consumer preferences with respect to grades or product characteristics). The introduction of mobile phones has lowered this asymmetric access to information and other activities, such as providing bus drivers with relevant market information, are also being tried out in various developing countries (Eaton et al., 2008).

4.5 Diversity of supply

4.5.1 New varieties contribute to increased consumption

The existing literature is yet to mention a link between new varieties of fruits and vegetables and the increasing consumption of fruits and vegetables in Nigeria. However, most FGD participants supported the idea that new varieties have contributed to an increase in consumption. The introduction of new varieties of tomato (plum), adapted to the soil in southern Nigeria, which has led to an appreciable increase in tomato cultivation, is an example. These varieties are easier to grow and have better yields, so farmers and choosing them and therefore they are being consumed more.

4.5.2 Consumption depends mainly on seasonal availability

The participants of the different FGDs, confirmed that the consumption of all the fruits and vegetable depends on the seasons. During the peak season, consumers tend to consume more because the low price of unit quantity. However, the same unit quantity' price surges up during the scarce (lean) season resulting into consumers looking for alternatives due to economic reasons. This is applicable to both fruits and vegetables.

Also existing literature confirms this but has identified also other determinates underlines that daily fruit and vegetable consumption in Nigeria is socially acceptable, as indicated in recent studies (e.g. Brouwer et al., 2019a). The study shows that various encouraging cultural factors are present, such as local traditions of eating green leafy vegetables with starchy meals. Family members support each other in eating fruit and vegetables, typically by procuring preparing, or eating them together. Men were more often supported by someone preparing them fruit and vegetables. Most consumers eat fruit and vegetables because of their dietary habits. Health benefits are recognized, but low awareness of the importance of daily fruit and vegetable was also observed. Access was considered an important barrier for fruit and vegetable consumption (e.g. the market being far away). So, we conclude from the above that consumption of fruits and vegetables depends on the seasonality but also relates to various other factors. Fruit and vegetable category disaggregation is unavailable.

4.6 Consumer prices

4.6.1 Consumer prices of fruits and vegetables are higher compared to other food categories

Since 2019, Nigeria has seen an increase in food prices due to internal conflicts (due to Boko Haram and farmer-herdsmen clashes) and an oil price induced recession, which has resulted in food crises in many communities (Nwoko et al., 2016). In fact, the Nigerian National Bureau of Statistics reported a year-on-year increase in the price of tomato and onion by 22% and 57%, respectively.

In Nigeria the cost of production of fresh vegetables and fruits is relatively high (see section 4.2 and 4.3). The cost of production, in combination with supply and demand dynamics heavily influences the affordability of a healthy diet for consumers. For example, the estimated cost of a healthy diet (e.g. EAT–Lancet reference diet) exceeds the mean daily per capita household income in Nigeria (Hirvonen et al., 2020). Average household expenditure on food has increased over the past decades. On

average, the share of total income spent on food is 41% of annual income.[10] Table 2.3 shows an overview of the average costs (US$) per person per day of a healthy diet, based on food-based dietary guidelines (Herfort et al., 2020). The average cost of a healthy diet in Nigeria is higher than for example in developed countries. In Nigeria, the average cost of a healthy diet has been calculated at US$3.57 per person per day, while in North America and Europe it is only US$3.21 per person per day. Various studies indicate that the costs for fruit and vegetables is an important barrier (Brouwer et al., 2019a)

Table 2.3 *Cost of fruits and vegetables, and the proportion of the cost of a healthy diet accounted for by fruits and vegetables, in several countries, 2017*

	Cost of a healthy diet (mean across 10 guidelines)	Cost of least costly fruits and vegetables (mean across 10 guidelines)	Share of the cost of a healthy diet accounted for by fruits and vegetables
Bangladesh	3.41	1.17	34%
Burkina Faso	3.66	1.08	30%
Ethiopia	3.73	1.46	39%
India	3.27	1.26	39%
Nepal	4.13	1.72	42%
Nigeria	3.57	1.21	34%
Tanzania	2.62	0.86	33%
Global	**3.77**	**1.46**	**39%**

Note: These results are based on an analysis of the 2017 International Comparison Program (ICP) dataset to find the lowest-cost foods in each country. National datasets may have additional foods that may be more or less expensive at different times and places in the country. The proportion of the cost of a healthy diet is based on the mean cost of ten different national food-based dietary guidelines. The mean cost may differ from the median cost, which was reported in FAO's *State of Food Security and Nutrition in the World* 2020.

Source: Anna Herforth and Aishwarya Venkat, personal communication. Based on the analysis in Herforth et al. (2020).

Tomatoes and onions are consumed in all seasons, but costs is always higher during the low season as supply is reduced (Adeoye et al., 2009). Consumption is higher during festivals and ceremonies (e.g. Christmas and Easter in the more Protestant-oriented states), and therefore prices also increase. Figure 4.5 provides an overview of the average prices of tomatoes and onions in Lagos, but also the variation with the national price. Lagos is the main market for fresh produce, and prices are therefore higher compared to the national average (Figure 4.5). Figure 4.5 shows the fluctuations for a 3 years average for tomato in Lagos (₦300-595; US$0.73-1.44) and onion (₦95-135; US$0.23-0.33). For the other crops no data on consumer prices is available.

[10] http://nigeria.opendataforafrica.org/ytwryqe/household-food-expenditure

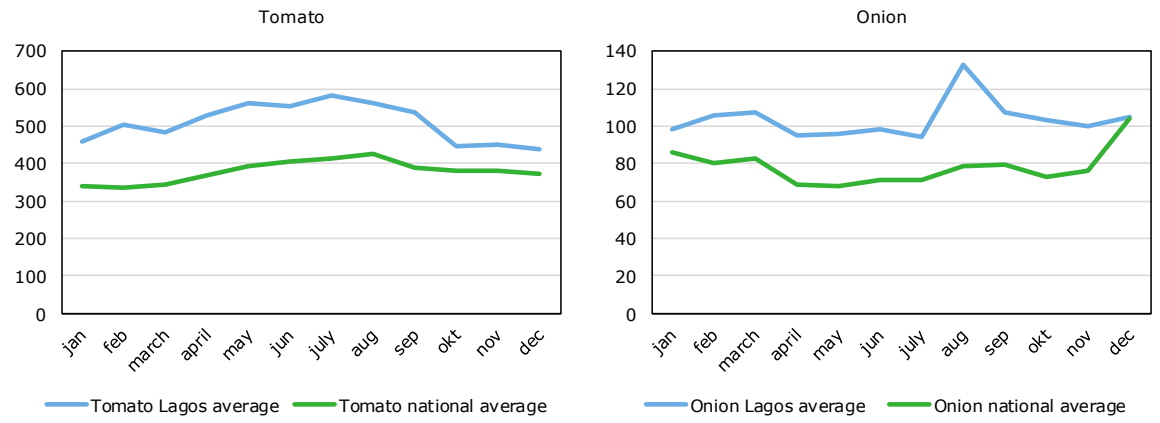

Figure 4.5 *Average consumer prices of tomato and onion in Nigeria in Naira per kg, based on a 3-year average 2017-2020*
Source: National Bureau of Statistics Nigeria.

4.6.2 Transaction risks also contribute to higher prices

Fruits and vegetables fetch higher prices than some categories of crops, like staple crops, due to their high costs of production. High value crops require relatively higher investments and therefore demand higher end prices, but the transactions risks for all actors are also high. Their high perishability makes trading these high value crops a risky business. For actors in the food system, the sales price of the produce needs to reflect this risk in order to make a meaningful profit. This is one reason why the margin added by traders and middlemen is high and is also an important contributor to high end prices for consumers. Also, the losses that occur during transport are a significant risk and contribute to the high prices.

4.7 Income and empowerment opportunities for women

In Nigeria, certain parts of the value chain prefer women's labor, for example, where there is a need for intensive processes such as care for seedlings and food processing (Olakojo, 2017). Women who work in the vegetable value chain earn a basic income, but often cannot be classified as economically successful. While these jobs provide much needed employment for women, it is important to ensure that these opportunities are empowering and not exploitative labor arrangements. Working conditions are better for women working as urban laborers in the fruit and vegetable value chains than for their rural counterparts (Ajibade, 2021). Cottage industries, which allow women to innovate and process on a small scale, are also becoming increasingly popular. In this section we explore examples of women earning income and explore empowerment models in the different levels of the fruit and vegetable value chain.

4.7.1 Examples of women in production and processing

In Nigeria, there are examples of women working in the fruit and vegetable value chain. Despite socio-cultural barriers that restrict the participation of women in production in Kano, there are women working in the tomato value chain from production to the market. The majority of the women are engaged in marketing of tomatoes. However, women also work in greenhouses where women's labor is preferred to produce tomato seedlings for farmers, and as a result 80% of the workforce is female. Women are perceived to be gentler than men when handling the delicate vegetables therefore the agro-processing industry prefers them. In addition to the tomato value chain, women also make up the majority of the workforce in processing other fruit and vegetables, such as mango and citrus fruit juice processing.

Cottage industry processing is a successful agribusiness venture for women in northern Nigeria, who take advantage of aggregation and innovation such as using social media marketing, and establishing a network of consumer clients who they supply their products to, as a unique way of organizing supply and processing, but these women can also sometimes be limited by knowledge gaps or lack of access to affordable processing equipment to carry out processing activities. The lack of a consistent supply of raw materials also means that some processing units do not function year-round. Despite these challenges, at Sowemimo Ope Farm, women who produce and trade tomatoes also dry them as a way of preserving excess produce which they sell when supply is low. At Ene Inogu Farm, in Kaduna, Ogun State, women tomato farmers have also invested in transport logistics infrastructure to be able to directly access far away markets in order to achieve higher prices and reduce post-harvest losses. AACE Foods, which was founded by a woman, started off as a small outfit that dries and packages vegetables and other food products and has grown to supply these to customers in different parts of Nigeria. In Benue State, and other parts of Nigeria, female hawkers extract citrus juice, bottle and chill it, after which they sell it on the street and at markets places for consumers.

Women traders are also active in green leafy vegetable production and sales, including of ogu, pumpkin leaves and amaranth. To increase production, and reduce post-harvest losses, women often develop a network of retail level customers, such as families and hotels to whom they supply directly. This also gives them higher profits than selling to middlemen. It is important to note that some of the urban women who are engaged in the processing sector are all well trained business people with more advanced processing skills and access to more advanced small scale processing technologies. Hence for there to be more examples of success, there needs to be a greater focus on rural women processors, to equip them with the necessary logistical, processing, business and smart technology skills and access. Currently, much produce goes to waste at the farm-level where there is minimal processing and preservation of produce, and an over-reliance on farmgate and local market sales; these contributes to reduced women's profit margins.

4.7.2 Commercial pathways to improve income and empower women

Fruit and vegetable agribusinesses present opportunities for women to earn an income across different operations in the supply chain. While there are examples of successful women entrepreneurs, women agripreneurs largely run small-scale informal agribusiness initiatives, engaging in low-level value-added activities that reap marginal returns (Agbor and Eteng, 2018; Umar et al., 2019). Women are also often engaged in minimal wage labor opportunities, largely in production and processing, which are often taken out of necessity and survival rather than as an empowerment opportunity. Women are often driven into small-scale income generating opportunities by the lack of other self-reliant paying alternatives that allow them to earn an income while fulfilling their household tasks such as caring for young children (Agbor and Eteng, 2018; Igwe et al., 2019).

Production intensification, aggregation opportunities, value addition, scaling up and skill development all provide avenues for women involved in fruit and vegetable value chains to earn more income, but if the increased income and opportunities in agribusiness are not managed well, women could end up earning additional income and still not having control over it due to household gender roles. Therefore, income generation by women is not a sufficiently adequate indicator for measuring women's empowerment. In addition, as new opportunities emerge, men often position themselves to serve these new markets, and the income opportunities that were traditionally managed by women start to be dominated by men.

Women's control over income is important because controlling one's income is a source of empowerment and agency, the income often benefits the household, and it increases women's stake in the value chain. Ultimately, it means that women have some say in how household income is used. A central component of empowerment through agribusiness income is agency, and inclusion of women in decision-making throughout the agriculture sector. Women's access and agency over resources is a precursor to agricultural intensification and has the potential to increase food production by women and opening up of opportunities to earn extra income and invest in their agribusiness ventures (Njuki et al., 2019). Empowerment involves creating access to funds, technology and innovation which women farmers can use to make daily life more efficient and productive, such as using electric

blenders instead of hand mills or gas cookers instead of wood fires for cooking (Arch, 2012; Jena et al., 2018). Access to funds enables women farmers to purchase farm equipment or pay for hired laborers during growing and harvesting seasons.

Contributions made by women within the household are increasingly affected by changes external to the household. For instance, rural poverty has acted as a push factor, whereas new economic opportunities outside of the household have emerged as pull factors encouraging rural women to cross customary gender role boundaries and to participate in the economy outside the household, often in farm production and off-farm production. Yet although recent trends in agricultural diversification accompanied by commercialization and marketisation have generated opportunities for off-farm paid work, rural women's poor educational attainment, inadequate training and social immobility often prevent them from responding to these opportunities. Due to women's labor-intensive work as caregivers and food consumption managers, empowering women to undertake intensification of fruits and vegetables has the potential to overburden women and therefore needs to be complemented with labor-saving strategies. Labor-saving technologies are also are instrumental in achieving gender equality and women's empowerment. The saved time gives women more opportunities to participate in development and decision-making, with the possibility of undertaking more productive work (such as intensification of fruits and vegetables) with greater income potential.

4.8 Consumer behavior towards fruits and vegetables

4.8.1 Relevant standards and consumer trust in standards

Standards and regulations in the fruit and vegetable sector in Nigeria are absent. Standards are mostly considered to be 'foreign' and were unknown to all of the farmers interviewed. Some understood the importance of the quality of farm produce, but often only knew about outward appearance, rather than other aspects of quality including food safety. More advanced actors in the fruit and vegetable supply chain understand what standards are, but most think they are largely ineffective, particularly local standards issued by government bodies like the Standard Organization of Nigeria (SON) and the National Agency for Food and Drug Administration. Nevertheless, there is a rise in the adoption of global standards such as GlobalG.A.P, and HACCP (Hazard Analysis and Critical Control Point), but farms (or companies) who use these standards are mostly targeting markets outside of the country.

Some consumers do consider quality (appearance) of the produce but they also have little or no understanding about the subject of food safety. Value for money, with respect to gaining the highest levels of quantity, is the primary motivation of most consumers. However, among consumers in the upper economic classes there is an increasing awareness of food safety. Young consumers across the country are also driving initiatives like home gardening with slogans such as 'be in control of your food', and 'know the source of your food'.

Since there are no standards for the fruit and vegetable supply system, there is also no evidence that public enforcement of standards enhances food safety or would contribute to increased fruit and vegetable intake in Nigeria.

4.8.2 Affordability and health are the most important motives

4.8.2.1 Consumer motives

Regarding the drivers of vegetable and fruit consumption, recent studies found that consumption is much associated with seasonality and related availability (Brouwer et al., 2019b). During the FGD on consumption price was considered a major motive for the consumption of fruit and vegetables. Consumers tend to be more encouraged if the price is low (often in times of high availability).

However, a study indicated that health is considered to be one of the main motives for vegetable consumption (Raaijmakers et al., 2018). Additional motives, identified in the same study, are mood,

natural, price, convenience and familiarity. Ethical concern (e.g. origin of the produce) was considered least important. The same study indicated that the total urban consumption of vegetables was 2.5 portions per day whereas it is recommended to eat at least 4 portions (200 g). Vegetables were considered a standard element of meals, but a limited variety of vegetables was commonly consumed, both in terms of types of vegetables eaten and the degree of processing (i.e., mostly fresh), and outlets (i.e., mostly traditional informal markets). Other studies gave a range of 1-2 portions a day, for example the study by Olatona et al. (2018).

Geographical disparities are also observed in consumption trends of fruit and vegetables across the country. Households in the south, south-east, north-east, and north-west regions of the country have a higher probability of consuming and the demand for vegetable, while households in the north central region have lower probability of consuming and the demand for vegetable, compared to households in the south-west region (Ogundari and Arifalo, 2013).

For fruit consumption a study has been done by Olatano et al. (2018). It showed that the majority (89.09%) of the respondents in Lagos took 1-2 servings of fruit daily. The most preferred fruits were apples (18.8%) and oranges (18.8%) but the most consumed fruits were oranges (24.5%) and watermelon (24.2%). The commonest motives for the choice of fruits were taste (27.4%) and availability (13.7%) (Olatona et al., 2018).

For high class consumers, consideration is also given to food safety, nutritional value etc. This cut across all the focus crops. Also, the study by Raaijmakers et al. (2018) shows that 1) higher consumption of vegetables relates to higher knowledge of vegetables and belief in ones' own ability to prepare the vegetables. Health was considered the most important driver by the respondents. And 2) consumers in higher economic classes consume a greater variety of vegetables, especially the ones that are considered exotic (e.g., broccoli, cauliflower) and they also consume more raw vegetables. Consumers from lower economic classes, tend to place caloric value over nutritional value for economic reasons, as indicated in our FGD focusing on consumption.

A number of small scale private initiatives to stimulate fruit and vegetable consumption do exist. Some private primary schools initiated what is termed 'fruit days' (2 days out of 5 school days of the week). Pupils are mandated to bring fresh fruits salad, fruits mix to school to be used as lunch instead of the regular snacks, processed fruit juices/drinks. This will not only benefit the children nutrition-wise but also develop their appetites for fresh fruits and vegetables which will develop with them into adulthood. As such, the ripple effect in decades to come will be that, the society will move from heavy caloric food to more healthy meals.

4.8.2.2 Consumer barriers

Several potential barriers for healthy food choices (including fruit and vegetables) of urban Nigerians are identified in literature, including limited availability, high price, limited convenience and possible food safety issues (Brouwer et al., 2019b; Raaijmakers et al., 2018). For example convenience, the time to prepare the meal, and the availability of vegetables is limiting the consumption of fruit and vegetables but this is increasing the popularity of out of home consumption among all economic classes. For example street foods are popular and their popularity is increasing as they are considered to be convenient, quick, reasonably priced, tasty and a good alternative for home cooked meals. There are various successful out of home related interventions implemented in (urban) Nigeria aiming to increase vegetable intake: Veg on Wheels showed the potential for increasing vegetable intake among consumers, see box 4. But also another project implemented in Lagos aiming to increase green leafy vegetable intake at clients of street food vendors, see box 5. For fruit we could not find any specific examples.

Box 4: Veg-on-wheels intervention

The veg-on-wheels intervention offers fresh and ready-to-cook vegetables to urban Nigerian consumers. This joint research project of Wageningen Economic Research and the Federal University of Technology Akure, sold ready-to-cook green leafy vegetables in cool boxes on bikes and push carts. This kept the vegetables fresh and enabled the retailers to sell them at convenient locations close to work places. Vegetables are usually bought fresh on open markets but availability and freshness diminish by the end of the day. Veg-on-wheels reduced barriers to purchasing vegetables in several ways:

1. Preparation time is reduced by offering vegetables already washed and cut.
2. Travel time and costs to purchase vegetables are reduced by selling close to work places.
3. By keeping vegetables cool, they can be sold throughout the day.

Through the project consumers were interviewed prior to the intervention. After the 5-week intervention in which ready-to-cook, washed and pre-cut green leafy vegetables were kept cool and sold for at different convenient locations near workplaces and on market. The results show that a market exists for convenience vegetables and this approach has the potential to increase vegetable intake among urban consumers.

Source: https://www.wur.nl/en/newsarticle/Veg-on-wheels-ready-to-cook-vegetables-for-Nigerian-consumers.htm

Box 5: Street food vending

Urban Nigerians perceive vegetables as healthy health is considered as one of the main motives for consumption. However, vegetable consumption remains low in urban Nigeria. Previous interventions were successful in increasing urban Nigerians' vegetable intake, but focused on the home environment. Out-of-home consumption is also a common practice. Street foods (SF) are popular in Nigeria and their popularity is increasing, so their consumption contributes to a significant proportion of daily nutrient intake. A study by researchers from Wageningen University and Research (Raaijmakers et al., forthcoming) explored the potential to increase SF customers' vegetable intake by adding additional vegetables to SF meals by working jointly with 12 SF vendors (SFV). During the intervention the trained SFVs actively promoted the healthiness of vegetables and the option to buy an additional vegetable portion as a side dish to their meals. The study showed that almost half of the customers of the 12 SFVs in Lagos bought additional vegetables with their meal when this was offered to them, in combination with information about the potential health benefits of vegetable consumption. The customers also paid a viable price for these additional vegetables. Six weeks after the pilot, nine SFVs still offered and sold additional vegetables. This intervention clearly shows the potential of increasing vegetable intake through SF by nudging the food environment and accessibility of vegetables.

4.8.2.3 Role of women in consumption

A large percentage of households in Nigeria are still food and nutrition insecure. Food insecurity could be attributed to some of the challenges women face when engaging in subsistence vegetable production (including small land holdings, lack of farm inputs, and the fact that women handle subsistence food production labor). The consequence of the non-participation of men in food production means that women's decision-making and workload around household nutrition increases. The role of women in household roles also contributes to the prevalence of malnutrition among mothers, due to the limited time they have to focus on their own nutrition. Women are responsible for feeding the family and an increase in women's overall empowerment has been shown to be positively associated with food availability and dietary diversity at the household level (HLPE, 2017; Obong-Ene et al., 2017). Women have a special role to play in ensuring diversity in foods consumed by their households. Their role in food utilization for food security is critical determinant of household food security (Quisumbing et al., 2014). The contribution of women to food and nutrition security is therefore significant and a gender focus should be used as a framework for designing gender-sensitive and specific nutrition interventions.

From FGDs, one example of innovation among female traders and processors in Nigeria demonstrates the potential that exists for responding to consumer needs by developing innovative food products through value addition. Out of a passion for cooking and sharing good food, which traditionally takes a long time to prepare, Ogola Lois Kange started her business to reduce time spent on food preparation for women and reduce post-harvest losses. Smiley'z started with Smiley'z Fresh tomato paste and has

since created Smiley'z Mobile Kitchen which delivers healthy home cooked meals to the doorstep of clients. The target market is busy clients. Other examples of women setting up successful value addition agribusinesses include Limlim Foods in Ikigosi, which provides dried fruit snacks and reduces post-harvest losses among agribusiness actors in the value chain, and in the process they get increased profits from the increased prices of the dried fruit snacks.

4.8.3 Consumer nudging and public policies are lacking

4.8.3.1 Policies and strategies

Nutrition is featured in health, and agriculture policies, including some specific policies on increasing nutrition awareness among consumers in Nigeria. These policies contain nutrition-specific (e.g., improving the nutritional status of the population) and, to a lesser degree, nutrition sensitive content (e.g., improving food and nutrition security). Research by IFPRI identified various gaps in Nigeria's current nutrition policies, including the lack of coherence, the lack of prioritization and coordination, poor mainstreaming of nutrition, and the lack of recognition of nutrition as a cross-cutting theme (Vanderkooy *et al*. 2019). While there have been some improvements in Nigeria's nutrition statistics since the implementation of the National Strategic Plan of Action for Nutrition (NSPAN), malnutrition remains a direct or underlying cause of 45% of all deaths of children under-five, and Nigeria's progress on malnutrition remains slow.

Nigeria's most important nutrition-focused policies are mentioned below (Table 4.8). As part of efforts to improve Nigeria's nutrition status, NSPAN was devised for implementation between 2014 and 2019. It was designed to follow-on to other strategic documents including Vision 2020 and the National Strategic Health Development Plan for 2009 to 2015, and to build upon a framework outlined in the National Policy on Food and Nutrition (NPFN). NSPAN provides guidance and motivation to different levels of government to develop more in-depth implementation plans for nutrition interventions in Nigeria.

The goal is to improve the nutritional status of the entire population. NSPAN covers six areas including (FMoH, 2014):

- Maternal nutrition;
- Infant and young child feeding;
- Severe acute malnutrition in children under five years of age;
- Micronutrient deficiency control – 'hidden hunger' is common in Nigeria meaning children are not receiving the proper nutrients to improve immunity and growth;
- Diet-related noncommunicable diseases – poor nutrition and dietary practices will be addressed;
- Nutrition information systems – proper monitoring and evaluation controls will be developed to support early detection of nutrition emergencies.

Although NSPAN was multisectoral, going beyond the health sector to include agriculture, relevant budgetary departments and national planning sectors taking lead roles, coordination was a challenge. Yet, the plan was well-received and Nigeria was one of the first countries among the Scaling Up Nutrition[11] (SUN) movement to develop such a nutrition plan. Several improvements could be made to NSPAN and, therefore, the National Multi-Sectoral Plan of Action for Food and Nutrition (NPAN) was developed. It remains necessary for policies in each sector to be better aligned with nutrition targets. NPAN aims to reduce the proportion of people who suffer from malnutrition by 50%, and reduce stunting among the under-five-year-olds by scaling up impact nutrition-specific and nutrition-sensitive interventions.

A food and nutrition response plan for COVID-19 was developed to ensure the integration of nutrition into the national COVID-19 response plan and emphasize the importance of good nutrition in supporting the immune system. The plan aimed to prevent a worsening of the nutrition situation of the vulnerable people in Nigeria. The plan prioritized various strategies to ensure the continuity of critical nutrition interventions, including mitigating the impact of the COVID-19 pandemic on the food system, developing guidance for actions for ensuring safe, resilient markets and fruits and vegetables

[11] https://scalingupnutrition.org/about-sun/the-sun-movement-strategy/

supply chains, and developing a Food and Nutrition Communication plan to ensure awareness of and access to safe nutritious foods (FMoH, 2020).

In 2007 a National Council on Nutrition (NCN) was established. Membership includes ministers from relevant ministries, one representative each from Nigeria's governors and organized private-sector and nutrition-related agencies. The Vice President of the Federal Republic of Nigeria, being the Chairman of the Ministry of Budget and National Planning chairs the NCN. The NCN is the highest decision-making body on food and nutrition in Nigeria, and serves as the policy body for all efforts geared towards ensuring food and nutrition security for all Nigerians.

Table 4.8 *Different nutrition-related policies*

Name	Acronym	Starting	Ending
National Strategic Health Development Plan	NSHDP	2009	2015
National Strategic Plan of Action for Nutrition	NSPAN	2014	2019
National Policy on Food and Nutrition	NPFN	2016	2025
National Multi-Sectoral Plan of Action for Food and Nutrition	NPAN	2021	2025
Nigeria Food and Nutrition Response Plan for COVID-19 Pandemic		2020	

Source Vanderkooy et al. (2019)

4.8.3.2 Systemic responses to constraints for women

The goal of Nigeria's National Gender Policy in Agriculture is to promote and ensure the adoption of gender sensitive and responsive approaches, so that men and women have access to, and control over, productive resources, while also reducing the vulnerability of women to biases in agriculture (FMARD, 2016b). In addition, each state Ministry of Agriculture and Rural Development has a gender mainstreaming office to address the knowledge and skills limitations among women in agribusiness. In practice however, the implementation of this interventions is lagging behind women behind, remains a mirage as women remain vulnerable to gender constraints in the fruits and vegetable supply chain affecting overall nutrition.

One example of a policy response designed to enable women to address the challenge of limited land that they face, and to promote sufficient nutrition, is the promotion of the use of improved seeds and chemical fertilizers by women, under the Crop Intensification and fertilizer subsidy Program, to increase productivity despite the small land sizes that women operate. However, beyond pilot projects, a lack of capital and a limited gender focused intervention has limited the adoption of improved technologies.

4.8.4 Improved availability, affordability and acceptability will increase intake of fruits and vegetables

Most people do consume fruits and vegetables, however there are differences between consumer classes and geographical locations. During FGDs, stakeholders confirmed that creating more awareness about the benefits of fruits and vegetables is important to increase consumption. With a rise in different health issues across Nigeria, it is important to keep advising consumers to consume fruits and vegetables, even in rural areas. The limited availability of fruits and vegetables in some months of the year, and therefore higher prices, are also barriers to increasing overall consumption. Increasing the availability and affordability are therefore important elements to increasing the intake of fruits and vegetables.

5 Conclusion

5.1 General findings

In recent years, the volume of fruits and vegetables produced has increased in Nigeria due to an increasing production area, but yield improvements have been limited. Traditional mixed crops and livestock farming systems, in which fruits and vegetables feature, are most common. Specialized vegetable farmers do exist, but not specialized fruit farmers. With expected population growth and rapid urbanization, the current modes of production, through mixed farming systems, are insufficient to meet future demands for fruits and vegetables.

Informal wholesale traders dealing in fruits and vegetables have a dominant position in linking producers to consumers. We estimate that most fruits and vegetables are successfully traded in the informal market (est. 95-99%). Considering the difficult business conditions with no recourse to legal systems, a corrupt and ineffective police force, minimal banking infrastructure, poor communications and a highly degraded transport infrastructure, the movement of fruit and vegetables to supply millions of urban consumers is a feat of ingenuity (Lyon and Porter, 2007). Only a minority of farmers take their produce to the market themselves.

Women are active in the different parts of the fruit and vegetable supply chain,. Women form the bulk of the labor force in the processing of fruits and vegetables, they dominate in the informal retail sector, and they also run informal small-scale cottage industries. Nigerian women provide labor for the fruit and vegetable value chain, especially where there is need for intensive processes which allows them to earn an income. Even though this employment is important for women, these employment opportunities are not always empowering and sometimes expose women to exploitative labor arrangements. Women in fruit and vegetable supply chains often engage in income generation out of survival rather than with clear economic empowerment goals. To overcome the barriers they face, women can take advantage of production intensification opportunities, aggregation opportunities, labor saving technologies, scaling up and skill development provide avenues in fruit and vegetable supply chains for women to earn more income. However increased income and opportunities in agribusiness need to be managed well so that the opportunities are not taken over by other established actors. In addition, economic empowerment of women, needs to provide realistic options for supporting the care roles that women play in the home for them to have time to work and grow their agribusiness ventures.

The enabling environment for agriculture development in Nigeria is improving, but remains challenging. Nigeria has a weak institutional environment, particularly its legal frameworks which lead to difficulties in enforcing contracts, and rent-seeking behavior. There is also the challenge of inadequate infrastructure, including poor feeder roads, poor or limited specialized transport for agricultural produce, and shortages or the lack of reliable electricity needed for cold storage to ensure the smooth flow of perishable items such as fruits and vegetables to markets. The Nigerian fruit and vegetable sector faces a limited availability of relevant infrastructure and facilities for processing and storage.

The formal vegetable seed sector is not well developed and is difficult to access for vegetable farmers. Improving access to good quality seeds requires improved import process facilitation, but also attention from domestic research and development initiatives. Nigeria is in the process of establishing a plant variety protection law, but quite a lot of progress is required to achieve an enabling environment that encourages private sector investment.

5.2 Leverage points

This section highlight results from Chapter 4. Ultimately, improved availability, affordability and acceptability will increase intake of fruits and vegetables.

5.2.1 Production

The growing population of Nigeria and increased incomes, especially in urban areas, are creating a rise in market demand for fruits and vegetable as consumers seek to diversify their diets. Increasing vegetable production to respond to this demand creates important economic opportunities, especially for smallholder farmers.

Increasing production is a necessary first step, however, the Nigerian fruit and vegetable farmers faces many challenges which create disincentives for farmers to increase production: 1) access to finance, 2) poor markets, 3) weak extension, 4) access to quality inputs and technology, 5) unpredictable weather due to climate change, and 6) access to land titles. In Nigeria, seasonality has a strong influence on the availability of fruits and vegetables in urban markets.

On-farm production losses are limited compared to losses further upstream. However, outbreaks of pests or diseases often causes lower yields than are feasible, especially in the wet season when the pressure of pests and diseases is high. Therefore, in the key production states the majority of the tomatoes and onions are produced in the dry season making use of irrigation.

5.2.2 Prices

Producing fruits and vegetables in Nigeria is estimated to be profitable, with profit margins ranging between 40-45% for vegetables and 78-81% for fruit crops. However, all margins are dependent on the market prices obtained, which are heavily influenced by supply and demand dynamics. For other stakeholders such as traders and retailers we could not retrieve any information about income.

The costs for the production of fruits and vegetables is higher compared to staple crops, but reducing farm costs continues to be a huge challenge. Fruit and vegetable farmers in Nigeria are mainly smallholders and are often not organized into farmer associations. Smallholder farmers usually lack access to finance and credit necessary for farm cost reduction strategies such as land expansion, improved inputs, adoption of farm mechanization, and investments in basic processing. The lack of cooperation between fruit and vegetable farmers means that they do not have sufficient bargaining power and do not have the ability to influence prices.

5.2.3 Fruit and vegetable supply chain efficiency

Post-harvest losses show variations between crops, chains, regions, and seasons. It is, however, clear that post-harvest loss levels are high and need to be reduced. Various sources indicate losses in the range of 7-80% for fruits and vegetables. Poor handling, overstocking and long transportation distances are the main causes identified. The high perishability of vegetables means that the economic losses are very high. The deterioration of premium quality (sometimes up to 50% for example in the case of tomato) significantly reduces the total value generated.

For the different fruits and vegetables studied, we observed a high presence transaction risks and high levels of inefficiency. It is likely that these increase final consumer prices. Our study, however, has identified some local initiatives to develop new market channels, partly to avoid trading on informal markets. We found anecdotal examples of short supply chains where producers market their produce to end consumers themselves. However, many of these examples are limited in terms of scalability, as they depend on individual entrepreneurship and business skills developed in other sectors.

5.2.4 Communication and access to information

Communication between actors is lacking, and mistrust between actors is often observed. Better price information is key for farmers to understand market dynamics, and to plan and spread production/harvest. However, Nigerian informal retailers often have direct contact with consumers, but there is little backward linkage of consumer information, which is why most fruit and vegetable chains are supply driven, and do not respond to changing consumer needs and preferences. The work of the extension departments of both federal and state governments is also generally non-existent which is robbing farmers of important information about how they could improve crop production and reduce losses.

5.2.5 Introduction of new varieties

We did not find any existing literature that studied a link between new varieties of fruits and vegetables, and an increase in consumption of fruits and vegetables in Nigeria. However, most FGD participants supported the idea that new fruit and vegetable varieties had contributed to an increase in consumption.

5.2.6 Consumer prices

Since 2019, Nigeria has faced an increase in food prices due to internal conflicts, and the Nigerian National Bureau of Statistics has reported a year-on-year increase for tomato and onion of 22% and 57%, respectively. In Nigeria, the cost of production of fresh fruit and vegetables is relatively high, but the transaction risks (perishability, specificity, lack of standards for grading and weighing etc.) are also high. These are important reasons why margins added by traders and middlemen are high and which also contribute to high consumer prices. Therefore, fruits and vegetables command higher prices than some categories of crops, like staple crops that have less risks.

5.2.7 Income and empowerment opportunities for women

Despite the widespread engagement of women agribusiness actors across the fruit and vegetable value chains, they need capacity building in the form of training, smart technologies, gender inclusion and aggregation solutions as they set up and run cottage industries, often that process fruits and vegetables. These interventions will strengthen their capacity for increased production, value addition, decision-making and preservation of produce to avoid post-harvest losses. Female fruit and vegetable farmers can take advantage of aggregation strategies such as by the formation and organization of group market access logistics and processing infrastructure such as drying equipment and transportation, to pool their resources together, increase capital and overcome liquidity constraints that can limit their accessibility to resources in fruit and vegetable agribusiness. Intensification of production is only possible with improved household gender role allocation that allows women to provide the necessary time investment.

5.2.8 Consumer behavior

Many crops show a rotating patterns of availability. During the peak season, consumers tend to consume more because the price per unit is lower. The price of the same unit surges during the scarce (lean) season, resulting in consumers looking for alternatives. For example, consumers can reduce the intake of a specific fruit or vegetable or choose other crops that are available.

Standards for fruit and vegetable production are absent. There is no evidence that public enforcement of standards enhances food safety and contributes to increased fruit and vegetable intake in Nigeria. Nudging and public extension is also lacking. This study did not identify any examples of nudging or public extension improving consumer awareness and consumption of fruits and vegetables. The study did identify, however, that affordability and health are the most important motives for consumers to consume fruits and vegetables.

References

Adenugba, A.. 2013, 2013. The Role of Women in Promoting Agricultural Productivity And Developing Skills For Improved Quality of Life In Rural Areas. IOSR J. Eng. 03, 51–58. https://doi.org/10.9790/3021-03855158

Adeoye, I.B., Odeleye, O.M.O., Babalola, S.O., Afolayan, S.O., 2009. Economic Analysis of Tomato Losses in Ibadan Metropolis, Oyo State, Nigeria. African J. Basic Appl. Sci. 1, 87–92.

Agbor, U.I., Eteng, F.O., 2018. Challenges Of Rural Women In Agricultural Production And Food Sufficiency In Cross River State, Nigeria. Adv. Soc. Sci. Res. J. 5. https://doi.org/10.14738/assrj.512.5803

Agbowuro, G., 2012. POST HARVEST HANDLING AND TRANSPORTATION OF PAWPAW (Carica papaya) IN EKITI STATE, SOUTHWESTERN NIGERIA. Adv. Agric. Sci. Eng. Res. 2, 385–387.

Ajani, O.I., 2007. Economic Analysis of the Marketing of Fruit in Lagos State of Nigeria (A case study of Oyingbo, Oshodi and Ikotun Markets). Niger. J. Hortic. Sci. 10, 16–19. https://doi.org/10.4314/njhs.v10i1.3407

Ajibade, Y., 2021. Analysis of gender roles in tomato production in Municipal Area Council, Abuja, Nigeria 0–12. https://doi.org/10.31248/JASP2020.237

Ajibefun, M.B., 2018. Social and economic effects of the menace of fulani herdsmen crises in Nigeria. J. Educ. Soc. Res. 8, 133–139. https://doi.org/10.2478/jesr-2018-0024

Akin Idowu, P.E., Odunola, O.A., Gbadegesin, M.A., Oke, A., Orkpeh, U., 2013. Assessment of the protein quality of twenty nine grain amaranth (Amaranthus spp. L.) accessions using amino acid analysis and one-dimensional electrophoresis. African J. Biotechnol. 12, 1802–1810. https://doi.org/10.5897/ajb12.2971

Arch, R., 2012. Women ' s Empowerment in Agriculture Index. Agriculture 12. https://doi.org/10.1177/1757975913486730

Brouwer, I., Kennedy, G., Samuel, F., 2019a. Determinants of fruit and vegetable consumption in low income neighbourhoods in Ibadan, Nigeria. Fruits Veg. intake Vietnam Niger.

Brouwer, I., Kennedy, G., Samuel, F., 2019b. Seasonal availability, sources, preferences and use of fruits and vegetables in Ibadan, Nigeria. Bioversiyt Int. Unversity Ibadan.

BusinessDay, 2015. The Nigerian Retail Report 2014/2015. BusinessDay Res. Intell. 1–60.

Chukwuonye, I.I., Chuku, A., John, C., Ohagwu, K.A., Imoh, M.E., Isa, S.E., Ogah, O.S., Oviasu, E., 2013. Prevalence of overweight and obesity in adult Nigerians - A systematic review. Diabetes, Metab. Syndr. Obes. Targets Ther. https://doi.org/10.2147/dmso.s38626

CSM, 2018. Connecting Smallholders to Markets: An Analytical Guide. Civ. Soc. Indig. Peoples' Mech. relations with United Nations Comm. World Food Secur. 1–6.

Dahiru, B., 2019. Cost-Benefit Analysis of Tomato Production Among Small-Scale Farmers in Kano River Irrigation Project Area of Kano State,.

Dijkxhoorn, Y., Galen, M. Van, Barungi, J., Okiira, J., Gema, J., Janssen, V., 2019. The Uganda vegetables and fruit sector. https://doi.org/https://doi.org/10.18174/505785

Eaton, D., Bijman, J., Meijerink, G., 2008. Understanding institutional arrangements: Fresh Fruit and Vegetable value chains in East Africa. ISNIE Conf. Toronto.

Ezinwa, V.C., Oguamanam, C.C., 2018. Insecurity in Agrarian Communities: Threats to Food Security in Nigeria in the 21st Century. J. Tour. Herit. Stud. 101–109. https://doi.org/10.33281/jths20129.2017.2.9

FAO AQUASTAT, 2016. Country profile - Nigeria. FAO.

FMARD, 2016a. The agriculture promotion policy. Fed. Minist. Agric. Niger. 59.

FMARD, 2016b. REVISED DRAFT NATIONAL POLICY ON GENDER IN AGRICULTURE.

FMoH, 2020. NIGERIA FOOD AND NUTRITION RESPONSE PLAN FOR COVID-19 PANDEMIC. Fed. Minist. Heal.

FMoH, 2014. Health Sector Component of National Food and Nutrition Policy: National Strategic Plan of Action for Nutrition (2014-2019). Fed. Minist. Heal. Niger. 1–39.

Garkuwa, R.R., Eze, P.C., 2018. COST-BENEFIT ANALYSIS OF CROP RESIDUE MANAGEMENT PRACTICES ON YELD OF MAIZE IN MINNA, SOUTHERN GUINEA SAVANNA, NIGERIA. Int. J. Agric. Dev. 3444–3448.

Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., Meybeck, A., 2011. Global food losses and food waste. FAO.

Herfort, A., Bai, Y., Venkat, A., Mahrt, K., Ebel, A., Masters, W.A., 2020. Cost and affordability of healthy diets across and within countries, Cost and affordability of healthy diets across and within countries. https://doi.org/10.4060/cb2431en

Hirvonen, K., Bai, Y., Headey, D., Masters, W.A., 2020. Affordability of the EAT–Lancet reference diet: a global analysis. Lancet Glob. Heal. 8, e59–e66. https://doi.org/10.1016/S2214-109X(19)30447-4

HLPE, 2017. High Level Panel of Experts. 2017. Nutrition and food systems. Comm. o World Food Secur. 44, 150.

Hoidal, N., Jacobsen, S., Odone, A., Alandia, G., 2020. Defoliation timing for optimal leaf nutrition in dual-use amaranth production systems. J. Sci. Food Agric. 100, 4745–4755. https://doi.org/10.1002/jsfa.10533

Holtland, G., 2017. Contract Farming in Ethiopia: Concept and Practice. SNV SNV.

Ibrahim, H., Zhou, J., Li, M., Chen, Q., 2014. Perception of Farmers on Extension Services in North Western Part of Nigeria: The Case of Farming Households in Kano State. J. Serv. Sci. Manag. 07, 57–62. https://doi.org/10.4236/jssm.2014.72006

Igwe, P.A., Madichie, N.O., Newbery, R., 2019. Determinants of livelihood choices and artisanal entrepreneurship in Nigeria. Int. J. Entrep. Behav. Res. 25, 674–697. https://doi.org/10.1108/IJEBR-02-2018-0102

Ilesanmi, O., Ilesanmi, F., Ijarotimi, I., 2014. Determinants of Fruit Consumption among In-school Adolescents in Ibadan, South West Nigeria. Eur. J. Nutr. Food Saf. 4, 100–109. https://doi.org/10.9734/ejnfs/2014/5087

Jena, A., Mishra, P.K.K., Ojha, S., Joshi, P., 2018. Women Empowerment Through Agripreneurship. Int. J. Sci. Environ. Technol. 7, 1329–1333.

Jenkins, G.P., Miklyaev, M., Basikiti, P. V, Preotle, E., 2018. Cost Benefit Analysis of Agricultural Interventions to Enhance the Production of Cowpea, Groundnuts, Maize and Soybeans Value Chains in Nigeria.

Kaka, Y., Gindi, A.A., Magaji, U., 2021. Evaluation of Onion Value Chain Actors in Kebbi State, Nigeria: A Case Study of Producers and Retailers. Asian J. Agric. Extension, Econ. Sociol. 39, 12–22. https://doi.org/10.9734/ajaees/2021/v39i230526

Kelechi, A.I., Dorothy, T., 2015. ECONOMIC STUDY OF TROPICAL LEAFY VEGETABLES IN SOUTH-EAST OF NIGERIA : THE CASE OF RURAL WOMEN FARMERS Economic Study of Tropical Leafy Vegetables in South-East of Nigeria : The Case of Rural Women Farmers. Am. J. Agric. Sci. 2, 34–41.

Kok, M.G., Groot, J.J., Dastoum, S., Plaisier, C., Dijkxhoorn, Y., Wagenberg, C.P.A. Van, 2019. A Measurement tool on Food losses and Waste. Wageningen Food Biobased Res. 34.

Louwaars, N.P., de Boef, W.S., Edeme, J., 2013. Integrated Seed Sector Development in Africa: A Basis for Seed Policy and Law. J. Crop Improv. 27, 186–214. https://doi.org/10.1080/15427528.2012.751472

Lyon, F., Porter, G., 2007. Market institutions, trust and norms: Exploring moral economies in Nigerian food systems, in: Cambridge Journal of Economics. pp. 903–920. https://doi.org/10.1093/cje/bem008

Matemilola, S., Elegbede, I., 2017. The Challenges of Food Security in Nigeria. OALib 04, 1–22. https://doi.org/10.4236/oalib.1104185

Maziya-Dixon, B., Akinyele, I.., Oguntona, E.B., Nokoe, S., Sanusi, R. a., Harris, E., 2004. Nigeria Food Consumption and Nutrition Survey. Niger. Food Consum. Nutr. Surv. 2001–2003 © Int. Inst. Trop. Agric. (IITA 1–67.

NASS, 2011. COLLABORATIVE SURVEY ON NATIONAL AGRICULTURE SAMPLE SURVEY. Natl. Bur. Stat. Fed. Minist. Agric. Rural Dev.

NBS, 2020. 2019 Poverty and Inequality in Nigeria: Executive Summary. Natl. Bur. Stat. 1–27.

Ngeh, D.B., 2013. Non-governmental organizations (NGOS) and rural development in Nigeria. Mediterr. J. Soc. Sci. 4, 107–112. https://doi.org/10.5901/mjss.2013.v4n5p107

Njuki, J., Doss, C., Boote, S., 2019. Women's Control over Income: Implications for Women's Empowerment and the Agricultural Sector. Gend. Equal. Rural Africa From Commitments to Outcomes 149–175.
Nwoko, I.C., Aye, G.C., Asogwa, B.C., 2016. Effect of oil price on Nigerias food price volatility. Cogent Food Agric. 2, 1146057. https://doi.org/10.1080/23311932.2016.1146057
Obong-Ene, N.H., Onuoha, N.O., Eme, P.E., 2017. Gender roles, family relationships, and household food and nutrition security in Ohafia matrilineal society in Nigeria. Matern Child Nutr 13. https://doi.org/10.1111/mcn.12506
Ocholi, A., Nyiatagher, Z.T., Ayila, V., 2020. Effect of marketing intermediaries on pricing of agricultural perishable products: A case study of onions and tomatoes in Benue State, Nigeria 1 / 8 100%. J. Agric. Crop Res. Volume 8, 132-139. https://doi.org/https://doi.org/10.33495/jacr_v8i7.20.138
Ogundari, K., Arifalo, S.F., 2013. Determinants of household demand for fresh fruit and vegetable in nigeria: A double hurdle approach. Q. J. Int. Agric. 52, 199–216. https://doi.org/10.22004/ag.econ.173646
Olakojo, A., 2017. Gender gap in agricultural productivity in Nigeria: A commodity level analysis. Ekon. Poljopr. 64, 415–435. https://doi.org/10.5937/ekopolj1702415o
Olatona, F.A., Sosanya, A., Sholeye, O.O., Obrutu, O.E., Nnoaham, K.E., 2018. Knowledge of fruits and vegetables, consumption pattern and associated factors among adults in Lagos State, Nigeria. Res. J. Heal. Sci. 6, 50. https://doi.org/10.4314/rejhs.v6i2.2
Olife, I.C., Ibeagha, O.A., Onwualu, A.P., 2015. Citrus fruits value chain development in Nigeria. J. Biol. Agric. Healthc. 5, 36–48.
Plaisier, C., Dijkxhoorn, Y., Bonnand, J., Talabi, O., 2019. The Vegetable and Potato sector Nigeria. Wageningen Econ. Res.
Posthumus, H., Dengerink, J., Dhamankar, M., Plaisier, C., Baltissen, G., 2019. Enhancing Food Systems in Nigeria. KIT WUR 1–97.
Quisumbing, A.R., Meinzen-Dick, R., Raney, T.L., Croppenstedt, A., Behrman, J.A., Peterman, A., 2014. Gender in agriculture: Closing the knowledge gap, Gender in Agriculture: Closing the Knowledge Gap. https://doi.org/10.1007/978-94-017-8616-4
Raaijmakers, I., Dijkxhoorn, Y., Okoruwa, A., Plaisier, C., Snoek, H., Talabi, J., Toye, O., n.d. Increasing green leafy vegetable consumption through street food meals in Lagos, Nigeria.
Raaijmakers, I., Snoek, H., Maziya-Dixon, B., Achterbosch, T., 2018. Drivers of vegetable consumption in urban Nigeria: Food choice motives, knowledge, and self-efficacy. Sustain. 10. https://doi.org/10.3390/su10124771
Reardon, T., 2015. The hidden middle: the quiet revolution in the midstream of agrifood value chains in developing countries. Oxford Rev. Econ. Policy 31, 45–63. https://doi.org/10.1093/oxrep/grv011
Sambe, N., 2020. Mango Varieties and Causes of Post-Harvest Losses in Kwande Local Government Area, of Benue State, Nigeria. Prod. Agric. Technol. 16, 104–112.
Thijssen, M.H., de Boef, W., 2020. Seed Sector Review in Nigeria : End of project report.
Ugonna, C., Jolaoso, M., Onwualu, A., 2015. Tomato Value Chain in Nigeria: Issues, Challenges and Strategies. J. Sci. Res. Reports 7, 501–515. https://doi.org/10.9734/jsrr/2015/16921
Umar, S.M., Sadiq, S.M., Suhasini, K., 2019. Nexus between gender components and aggregate food production in Nigeria: a path way to agricultural development, in: Invited Paper Presented at the 6th African Conference of Agricultural Economists. pp. 1–23.
Van den Broek, J., Steemers, S., BAGU, B., 2021. SCOPING STUDY HORTICULTURE NIGERIA. Resil. bv Agri-logic.
Vanderkooy, A., Verstraeten, R., Adeyemi, O., Covic, N., Becquey, E., Dogui Diatta, A., Diop, L., Touré, M., 2019. Nutrition Policy in Nigeria, Evidence Note #2.
World Bank, 2010. Nigeria Overview, in: The World Bank Group. https://doi.org/10.2752/bewdf/edch1043
WVC, 2018. Increasing production and reducing postharvest losses of onion in Nigeria – World Vegetable Center [WWW Document]. World Veg. Cent. URL https://avrdc.org/increasing-production-and-reducing-postharvest-losses-of-onion-in-nigeria/ (accessed 5.4.21).
Xie, H., You, L., Takeshima, H., 2017. Invest in small-scale irrigated agriculture: A national assessment on potential to expand small-scale irrigation in Nigeria. Agric. Water Manag. 193, 251–264. https://doi.org/10.1016/j.agwat.2017.08.020

Appendix 1 List of NGOs working on horticulture in Nigeria

NGO	Function and scope
World Vegetable Center (WorldVeg)	The World Vegetable Center (WVC) conducts research, builds networks, and carries out training and promotion activities to raise awareness of the role of vegetables for improved health and global poverty alleviation. The Center's research and development work focuses on breeding improved vegetable lines, developing and promoting safe production practices, reducing post-harvest losses, and improving the nutritional value of vegetables. The Center works on projects in northern and south-western Nigeria with both government and NGOs. Some examples projects in Nigeria include: 1. The Dutch government's 2SCALE project: From 2018-2020. See above. 2. FCDO funded project that has been working to identify commercially-available, high-performing tomato, chili, and amaranth varieties adapted to the diverse agro-ecologies of Nigeria (and Ghana). WVC combines variety trials with the testing of other safe pest management methods. 3. The African Vegetable Breeding Consortium (AVBC): Through AVBC, which was set-up in 2018, WVC assists local, regional and international seed companies to develop improved vegetable varieties that benefit African farmers. 4. Strengthening tomato processing: WVC is collaborating with Tomato Jos and other Nigerian processors to boost local production of high-quality tomato paste through the identification of suitable varieties. Funding has been provided by the UK Government's Global Challenges Research Fund. 5. Need Assessment for Seed Companies: WVC conducted an assessment survey on local seed companies in Nigeria, which was part of as assessment survey conducted with seed companies in Africa. https://avrdc.org/about-avrdc/about-us/
Netherlands-African Business Council (NABC) through Seeds 4 Change (S4C)	Partly funded by the Dutch government, S4C is a 3-year project coordinated and implemented by NABC and six Dutch companies, seed breeders and experts in biological crop protection. S4C aims to develop the vegetable sector in Kano through the provision of high-quality vegetable seeds and biological crop protection, combined with training of farmers on how to cultivate vegetables with improved inputs. Access to improved inputs and knowledge transfer will be facilitated through trials, and demonstrations, and capacity building activities (on-farm trainings and open field days) focused on crop management, basic and improved cultivation techniques and good agricultural practices. https://www.dutchvegseedsnigeria.com/
SNV	SNV Netherlands Development Organisation is a non-profit international development organization. It is implementing the Increasing Performance of the Cassava Industry project, but is also planning to start a large program in the horticultural sector. https://snv.org/project/increasing-performance-cassava-industry
Mercy Corps	Mercy Corps is a global team of humanitarians working together on the front lines of today's biggest crises to create a future of possibility, where everyone can prosper. Since 2012, Mercy Corps has been working in the most marginalized regions of Nigeria to deliver urgent, lifesaving assistance and build the resilience of communities. In 2019, Mercy Corps' works impacted the lives of more than 984,000 people across the country. Building Resilience in Complex Crisis (BRICC) is a European Union (EU)-funded program implemented jointly by Mercy Corps, the Danish Refugee Council and Cooperazione Internazionale (COOPI). The program aims to build the adaptive resilience capacities of 26,875 households (6,719 men, 6,719 women, 6,719 male youth, and 6,718 female youth) identified as vulnerable members of 30 target communities in six LGAs (Damaturu, Potiskum, Geidam, Yunusari, Gujuba and Gulani) of Yobe State, by increasing their ability to cope with the shocks and the stresses of conflict, climate change and complex crisis, and their ability to transform underlying causal dynamics to reduce the risk of future conflict for a period of three years (April 2019 – April 2022). In addition, six vocational skills centers, financial institutions, government actors, 30 community resilience groups, 600

NGO	Function and scope
	community leaders, 248 savings and loan groups, 248 farmer's associations, and two local civil society organizations will benefit. Livelihood activities implemented by COOPI in Geidam LGA under Mercy Corps Nigeria-led EU BRICC Program have recorded numerous successes in the lives of the people in Geidam with 1,920 farmers benefiting from the program. https://nigeria.mercycorps.org/blog/reviving-community-livelihood
Palladium	Palladium works with governments, businesses, and investors to solve the world's most pressing challenges. Palladium works on the United States Agency for International Development's (USAID) Nigeria Agribusiness project. The goal of the project is to create a catalytic investment mechanism which links smallholder farmers to the private sector and to create a positive business enabling environment for the thriving agribusiness sector. https://www.advance-africa.com/palladium-group-policy-advisor-agriculture-competitiveness-investment-jobs-in-nigeria.html
Global Alliance for Improved Nutrition (GAIN)	GAIN is a Swiss-based foundation launched at the UN in 2002 to tackle the human suffering caused by malnutrition. Working with governments, businesses and civil society, GAIN aims to transform food systems so that they deliver more nutritious foods for all people, especially the most vulnerable. GAIN has been working in Nigeria since 2012. At the beginning, their work focused on large-scale food fortification. In recent years, it has diversified its activities to include targeted dietary improvement programs such as better diets for children; post-harvest loss reduction; and support to businesses through the Scaling-Up Nutrition Business Network. Over the next five years GAIN will target Nigerians who are affected by malnutrition, especially women of reproductive age, pregnant women and nursing mothers, adolescent boys and girls, as well as infants and young children below the age of five. GAIN will make targeted investments in the areas of the large-scale food fortification of staple foods for the delivery of essential nutrients and vitamins to large populations. GAIN also plans to work on reducing post-harvest loss to minimize food waste and to encourage dietary diversity and ensure the availability of nutrient-dense fresh foods all year round. https://www.gainhealth.org/impact/countries/nigeria
The Sustainable Trade Initiative (IDH)	IDH is a social enterprise that works with businesses, financiers, governments and civil society to realize sustainable trade in global value chains. IDH believes that action-driven coalitions will drive impact on the Sustainable Development Goals (SDGs) and create value for all. The Food Crops & Ingredients (F&I) program aims to mobilize demand from retailers and manufacturers to accelerate responsible production practices at a large scale. F&I combines a number of agro-commodities, and provides cross-sector solutions on critical issues. The program builds on existing sector platforms that have been established by IDH over the last five years around these agro-commodities, including fresh fruits and vegetables. For Nigeria, IDH carry out major intervention in the cassava value chain. https://www.idhsustainabletrade.com/teams/nigeria/ https://www.idhsustainabletrade.com/ni-scops/
Solidaridad	Solidaridad is an international civil society organization with over 50 years of experience in developing solutions to make communities more resilient — from their early roots supporting repressed communities in Latin America to their current work fostering more sustainable supply chains. Solidaridad currently works in over 40 countries, on five continents, through eight independently supervised regional offices. Solidaridad is currently intervening in the horticultural sector in Nigeria under the Dutch SDG Partnership Facility 'Transforming the Nigeria's Vegetable Market' project, implemented by Solidaridad, East West Seed and partners. The project is supported by the Dutch Government through the Netherlands Enterprise Agency. It is being implemented in Kano and Kaduna states, with intervention on tomato, cabbage, pepper, onion, cucumber, okra, pawpaw, amaranth and citrus. The project is targeting 136,000 smallholder horticulture farmers by 2024. https://www.solidaridadnetwork.org/ https://guardian.ng/news/solidaridad-west-africa-to-support-nigeria-ghana-in-oil-palm-production-stakeholders/ https://www.idhsustainabletrade.com/ni-scops/

NGO	Function and scope
International Fertilizer Development Centre (IFDC)	IFDC is an independent non-profit organization that combines innovative research, market systems development, and strategic partnerships to spread sustainable agricultural solutions for improved soil health, food security, and livelihoods around the world. IFDC initiated an intervention called 2SCALE which is an incubator program that manages a portfolio of public-private partnerships for inclusive business in agri-food sectors and industries. 2SCALE offers a range of support services to its business champions (SMEs and farmer groups) and partners, enabling them to produce, transform and supply quality food products. These products go to local and regional markets, including to base of the pyramid consumers. 2SCALE focuses on establishing agribusiness clusters built around business champions. Champions are either entrepreneurial producer organizations or local SMEs that trade or process the produce of farmers. By providing support to these clusters, 2SCALE is developing products and markets for local consumer markets, preferably at the base of the pyramid. 2SCALE partnerships in Nigeria cover interventions in horticulture, root crop (cassava) and the dairy industry. On the vegetables and fruits intervention, 2SCALE introduced GAPs through several field demonstrations across Nigeria, to emphasize the importance of adoption of improved seeds etc. 2SCALE is funded by the department of Inclusive Green Growth of the Directorate General of International Cooperation of the Dutch Ministry of Foreign Affairs. https://ifdc.org/by-country/nigeria/
TechnoServe	TechnoServe helps people lift themselves out of poverty by harnessing the power of the private sector. A leading non-profit organization operating in almost 30 countries, TechnoServe works with hardworking women and men in the developing world to build competitive farms, businesses, and industries. By linking people to information, capital, and markets, it has helped millions to create lasting prosperity for their families and communities. TechnoServe works in most of Nigeria's 36 states, TechnoServe is partnering with a variety of public and private funders in agriculture and enterprise development. TechnoServe interventions have targeted the maize, rice, cashew, tomato, cassava, soy, and poultry value chains, increasing smallholder productivity and income, improving access to input and finance, and strengthening market linkages. In addition, TechnoServe is working with entrepreneurs to help small retail shops become more profitable and to increase access to clean water through sustainable business models. TechnoServe is also working with food processors to improve compliance with national fortification mandates and increase the availability of nutrients in local markets. https://www.technoserve.org/search-results/?search=Nigeria
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	GIZ has worked in Nigeria since 1974. Since 2004, GIZ has maintained a country office in the capital city, Abuja. In the focal area of economic development and employment, GIZ aims to increase employment and income generation, as well as access to finances for micro, small and medium-sized enterprises (MSMEs). Through demand-oriented vocational training measures, GIZ assists partners to adapt vocational training programs to market needs. GIZ supports Germany's Federal Ministry for Economic Cooperation and Development's Digital Africa Initiative, to create an enabling environment for young tech entrepreneurs. Along various agricultural value chains, GIZ further strengthens the income, employment and food security of smallholder farmers, and promotes sustainable agriculture and innovations in processing and storage of agricultural products in Nigeria. The current program is referred to the West African Competitiveness Program. This regional program included regional and national components. The Nigerian component, also known as NICOP (Nigeria Competitiveness Program), is implemented by the Pro-Poor Growth and Promotion of Employment in Nigeria Program (SEDIN) program with the main partner being the federal Ministry of Industry, Trade, and Investment (FMITI). The overall objective is to strengthen the competitiveness of Nigeria and enhance the countries' integration into the regional and international trading system. This is achieved through interventions at the micro and meso level that are geared towards improving the performance, growth and contribution to the regional trade and export of selected value chains. In addition, the action focuses on policy initiatives to improve the business climate for businesses at federal, state, and local levels. Support for an enabling environment also includes activities to improve access to finance and increase inclusion in the financial system for entrepreneurs in selected value chains. The focus value chains are tomato (and chili/pepper), ginger, leather, and garments. The focus states are Kano, Kaduna, Plateau, Ogun, Oyo, Lagos and

NGO	Function and scope
	Abia. The NICOP program has three major pillars or areas of support: technical, access to finance/investment facilitation, and policy. Saving and loans groups are one of the sources of internal sources of finance for MSMEs, cooperatives, clusters, and farmers' associations. Based on the benefits of savings and loans groups, NICOP conducted a study to pilot this methodology in Kano in the agricultural value chain (tomato/chili farmers' association), and light manufacturing (finished leather products cluster) in February 2020 which was well received and recorded huge successes. Following the successes recorded in the pilot phase, the program is now aiming to scale-up its set-up to other focal states and value chains. The scaling-up phase will leverage on the successes recorded and the resources available within the program to strengthen the existing savings groups in Kano and scale-up implementation of activities that include 'training of trainers' and set-up of additional groups in pre-selected locations/states and value chains with particular focus on gender inclusiveness as well as strengthening the existing established savings groups. The new phase will also implement the Saving for Change (SfC) saving and loan groups methodology by setting-up at least 25 additional savings groups in various industries, including tomato/chili in Kano and Kaduna states. The new phase will consider gender inclusiveness in all activities of the assignment with a focus of at least 95% of women participating in the savings and loans groups. https://www.sedin-nigeria.net/nicop
Pyxera Global	Pyxeral Global leverages the unique strengths of corporations, governments, social sector organizations, educational institutions, and individuals to enhance the abilities of people and communities to solve complex problems and attain mutually beneficial goals. With a quarter of a century of experience in more than 90 countries, its team is passionate and dedicated to navigating challenges and pinpointing purposeful global engagement opportunities for clients and partners. In a timely and strategic effort towards addressing youth employability challenges in the agricultural sector, the Mastercard Foundation and Michigan State University launched the Agrifood Youth Opportunity Lab (Ag Youth Lab) in May 2017 (this project is managed by Pyxeral Global). The five-year, US$13 million collaboration intends to provide 15,000 young people between the ages of 18-24 with access to employment and entrepreneurship opportunities in the fast-growing horticulture, aquaculture, poultry, cassava, and oilseed sectors in Nigeria. https://www.pyxeraglobal.org/launching-agrifood-youth-opportunity-lab-nigeria/
Alliance for a Green Revolution in Africa (AGRA)	AGRA is an alliance led by Africans with roots in farming communities across the continent. AGRA understands that African farmers need uniquely African solutions designed to meet their specific environmental and agricultural needs so they can sustainably boost production and gain access to rapidly growing agriculture markets. They are catalyzing an inclusive agricultural transformation in Africa by increasing incomes and improving food security for 30 million farming households in 11 focus countries by 2021. The work of AGRA in Nigeria is aligned with the Federal Government's Agriculture Promotion Policy or 'Green Alternative' policy, and the Government's Economic Recovery and Growth Plan. AGRA supports the Nigerian Government's agricultural priorities of building an agribusiness economy for sustainable prosperity through domestic food security, export generation, import substitution and job creation. AGRA also supports female-led SMEs in agriculture in Nigeria. https://agra.org/focus-countries-old/nigeria/
50 Million African Women Speak (50MAWS)	50MAWS is a digital platform which is available via the web and on mobile devices as an app. The platform is intended to empower millions of women in Africa to start, grow, and scale-up businesses by providing a one-stop shop for their specific information needs. The 50MAWS platform aims to facilitate a dynamic and engaging exchange of ideas among women entrepreneurs, using in-built social media functionality to connect them with one another in ways that will foster peer-to-peer learning, mentoring and the sharing of information and knowledge within communities, and access to financial services and market opportunities between urban and rural areas, and across borders and between countries. Featuring information on doing business in 38 countries across the African continent, 50MAWS' unique proposition is building a community of women entrepreneurs who will act as peers, mentors, advisors and financiers to each other. This social network is designed to help women learn from each other, inspire each other and draw from the most comprehensive resource bank for information on various aspects of doing business. It is also designed to facilitate access to training, business management tools and financing options specifically targeted to women. https://www.womenconnect.org/platform

NGO	Function and scope
Nourishing Africa Hub	The Nourishing Africa Hub serves as a platform for entrepreneurs to accelerate their work, connect with funders, markets, talent, and celebrate their successes on the African Continent. The portal includes information about data, funding, knowledge, e-learning, African food and chefs, career opportunities, and other resources to enable entrepreneurs to scale their impact. Its vision is a flourishing, sustainable, and just food ecosystem, which leverages agtech and digital innovations, driven by Africa's vibrant entrepreneurs to ensure that the Continent nourishes itself and becomes a net exporter of food by 2050. https://nourishingafrica.com/about
THE INVENTIVE MINDS (TIM)	TIM is a youth development and agricultural commodity value chain development organization that seeks to lead the youth towards self-actualization and national development. Its core areas are leadership, agriculture, education, community and enterprise development. Over the years, TIM has offered business development services to SMEs, cooperatives, farmers' organizations, youth and women groups through a clustering approach. TIM works in Benue, Kogi, Nasarawaand, and Taraba states, with its head office in Benue. Area of focus: • value chain development • business development services • cooperative building • extension services • community development services • EXCEL (Excellence in Entrepreneurship and Leadership) youth development center Past TIM work includes: providing training in access to input in Guma, Benue State; capacity building in best production practices to meet global standards and achieve higher yields; and providing training on access to finance and financial literacy for Luga farmers in Zongo area.
KickStart International	KickStart International is a non-profit social enterprise with a mission to get millions of people out of poverty quickly, cost-effectively, and sustainably. KickStart International has been working in Nigeria as part of their mission in Africa. Recently, KickStart International worked with the International Committee of Red Cross through their Community Service Agriculture (CSA)/dry season horticulture project among 600 internally displaced person households. Each household was trained and equipped with KickStart International's MoneyMaker branded manual pumps. This was followed by training on irrigation, and the equipping of networks of smallholder farmer-focused NGOs and their lead farmers on CSA and low cost, high impact irrigation technology. Kickstart International is also partnering with the Catholic Relief Service to implement the USAID Water for Agriculture project, and the International Fund for Agricultural Development in the implementation of several projects. https://kickstart.org/why-irrigation/#africa-challenges
Royal Netherlands Embassy	The Embassy has a keen interest in developing the horticulture sector in Nigeria and is developing a project to be implemented between 2021 and 2025. It wishes to focus the intervention around the following objectives/components: • Increasing the productivity and income of a large number of smallholder farmers in northern Nigeria (Kaduna and Kano); • Piloting production systems innovation and regional diversification in south-west Nigeria (Ogun and Oyo); • Increasing access to finance for SME companies that invest in solving value chain bottlenecks at the regional and national level; • Enhancing sector coordination and business-to-business linkages. https://eu.eu-supply.com/ctm/Supplier/PublicPurchase/301679/0/0?returnUrl=transactions.asp&b=CTMSOLUTION
Nigeran heart Foundation	Nigerian Heart Foundation is a non-profit and non-governmental organization founded in 1992; promotes heart health, scientific research in cardiovascular health and advocacy on heart issues. The aims and objectives of Nigerian Heart Foundation are: • To promote the health and social wellbeing of Nigerians especially in the areas of prevention and treatment of heart and allied diseases. This includes the promotion of a healthy diet. • To organize International, National and Local Conferences, Seminars, Workshops and participate in topics related to heart diseases. • To disseminate up-to-date information on heart and other related diseases. • To establish contacts and affiliate with other groups, persons, organizations and associations with similar interests either within or outside the country. • To establish and administer research fund. • To create awareness, educate and enlighten the public on a behavioral modification for the prevention of heart diseases and other cardiovascular diseases. https://www.nigerianheart.org/

Appendix 2 Costs of different products

Cost estimates of different products

	Cost price 1 ha	Farm output 1 ha in kg	Cost per kg ₦	US$ per kg		Total sales	Sales price per kg		Cost per kg ₦	US$ per kg	Margin US$
Tomato	133,039	5,500	24.2	0.06	per harvest	228,800	41.60	0.11	17.41	0.11	58%
Onion	151,205	3,929	38.5	0.10	per harvest	255,385	65.00	0.17	26.52	0.17	59%
Amaranth	205,680	2,250	91.4	0.24	per harvest	375,000	166.67	0.43	75.25	0.43	55%
Mango	704,000	87,000	8.1	0.02	per year	3,750,000	43.10	0.11	35.01	0.11	19%
Pawpaw	605,000	22,000	27.5	0.07	per year	2,750,000	125.00	0.33	97.50	0.32	22%
Citrus	1,541,500	12,500	123.3	0.32	per year	5,625,000	450.00	1.17	326.68	1.17	27%

Appendix 3 List of FGD participants

Division	Category	Name	Organization
Online FGDs	Development perspective	Dahiru Mukhtar	TechnoServe
		Augustine Okorowa	GAIN
		Aisha Raheem	Farm2U
		Sowemimo Olusola	Ope Farms
		Rahila Musa	Dangote
		Ronke Aderinoye	AgriHub
	Actors involved in production and trade	Yakubu Bubayaro	Mile 12 Dealers Association
		Naomi Barack	Palm Valley Ltd
		Dayo Mosobolaje	KickStart International
		Ariyo Ifeoluwa	Forthworths Farms
		Seun Saka	FarmAxis
		Femi Adekoya	AgriDec
		Precious Ojewusi	MICL Farms
	Mixed public and private, civil society	Egong Owai	Solidaridad
		Ernest Ita	Solidaridad
		Esson Akolo Elijah	TomatoJos
		Yakubu Abdullai	Gamji Dankwarai MPCS
		Barack Zebede	BarakphilsAgro-Allied Venture
		Stella Okotete	NEXIM
		Caleb Olanipekun	World Vegetable Centre
	Actors with a focus on consumption of fruit and vegetables	Agnes Fasheun	SwanCape Farms
		Aderemi Banjo	Village Market International
		Ogo Ibok	Sence Agric
		Dorcas Adejare	Ladecrityfarms
		Solomon Adeniran	Osas food
		Enid Adigwu	NIFST member
		Omolola Ajakaiye	Consumer Protection Council
		Mrs Onwuka	Consumer Protection Council
In-person FGDs	Kano State (local farmers – male)	Rabiu Sule Abdullai	Yadakwari Kofar Gabas Fadama III AF Tomatoes Farmers Association, Dan Maura A. Fadama III AF Tomatoes Association, Dakasoye Rahama Fadama III AF Tomatoes Cooperative Society
		Nafiu Abubakar	
		Nura Garba	
		Audu Umar	
		Garba Lili	
		Ado Miko	
		Garba Zango	
		Samaila Ibrahim	
		Adana Sulaimon	
		Shitu Labiru	
		Falalu Abdullahir	
		Lawan Musa	
		Sada Dalladi	
		Mallama A	
		Abdullah Adamu	
	Kano State (local farmers – female)	Lydia Nkom	Alheri Women Tomato Farmers Association
		Rahila Musa	
	Kaduna State (local farmers – male)	Yusufu Musa	Ung. Kanawa Farmers Association
		Abdurrahamman Musa	
		Lawal Aliyu	
		Ibrahim Musa	Kauran Dan Gambu Farmers Association
		Sani Muhammed	
		Nasiru Usman	
		Adamu Musa	
		Habibu Usman	

Division	Category	Name	Organization
	Kaduna State (local farmers – female)	Hauwa Bellow	Ung. Sarki Women Multi-purpose Association
		Asamau Idris	
		Saradata Hamza	
		Ramatu Abdullahi	
		Halimatu Shehu	Ung. Sarki Pana Women Association
		Haunau Muazu	
		Badiyya Murtala	
		Raliya Yusuf	
		Zakiyya Adamu	
		Halimatu Usman	

Appendix 4 List of KII participants

Division	Category	Name	Organization
In-person KII	Private sector	Samuel Adetoye	Samuel Farms
	Public policy	Dr. Ekum Ojogu	National Agricultural Seeds Council
		Dr. Manzo Maigari	Nigeria Agribusiness Group (Formal Commissioner of Agriculture in Kaduna State)
	Government institute	Huud Abubakar	National Horticultural Research Institute
		Idris Bala	National Horticultural Research Institute
	Academic	Dr. Ikechi K. Agbugba	Rivers State University, Port Harcourt
Online KII	Fruit sector expert	Ekele James	Inventive Minds

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The mission of Wageningen University & Research is "To explore the potential of nature to improve the quality of life". Under the banner Wageningen University & Research, Wageningen University and the specialised research institutes of the Wageningen Research Foundation have joined forces in contributing to finding solutions to important questions in the domain of healthy food and living environment. With its roughly 30 branches, 6,800 employees (6,000 fte) and 12,900 students, Wageningen University & Research is one of the leading organisations in its domain. The unique Wageningen approach lies in its integrated approach to issues and the collaboration between different disciplines.