Commercialization assessment: PVA Maize in Nigeria

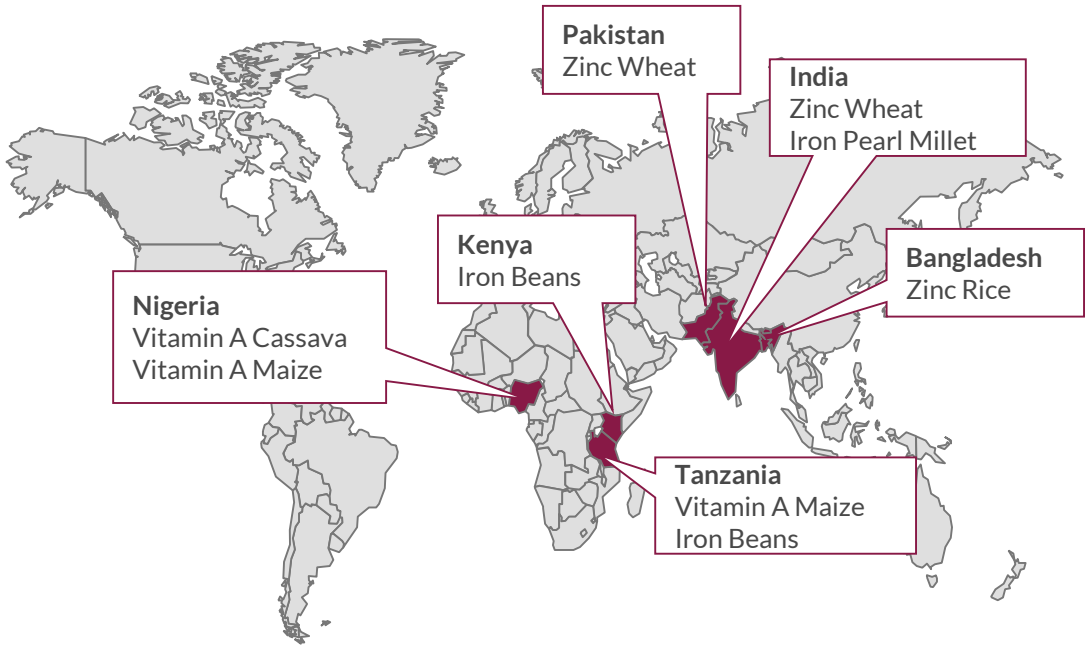
FINAL REPORT FOR GAIN AND HARVESTPLUS

DECEMBER 2019

Recap: Programme context

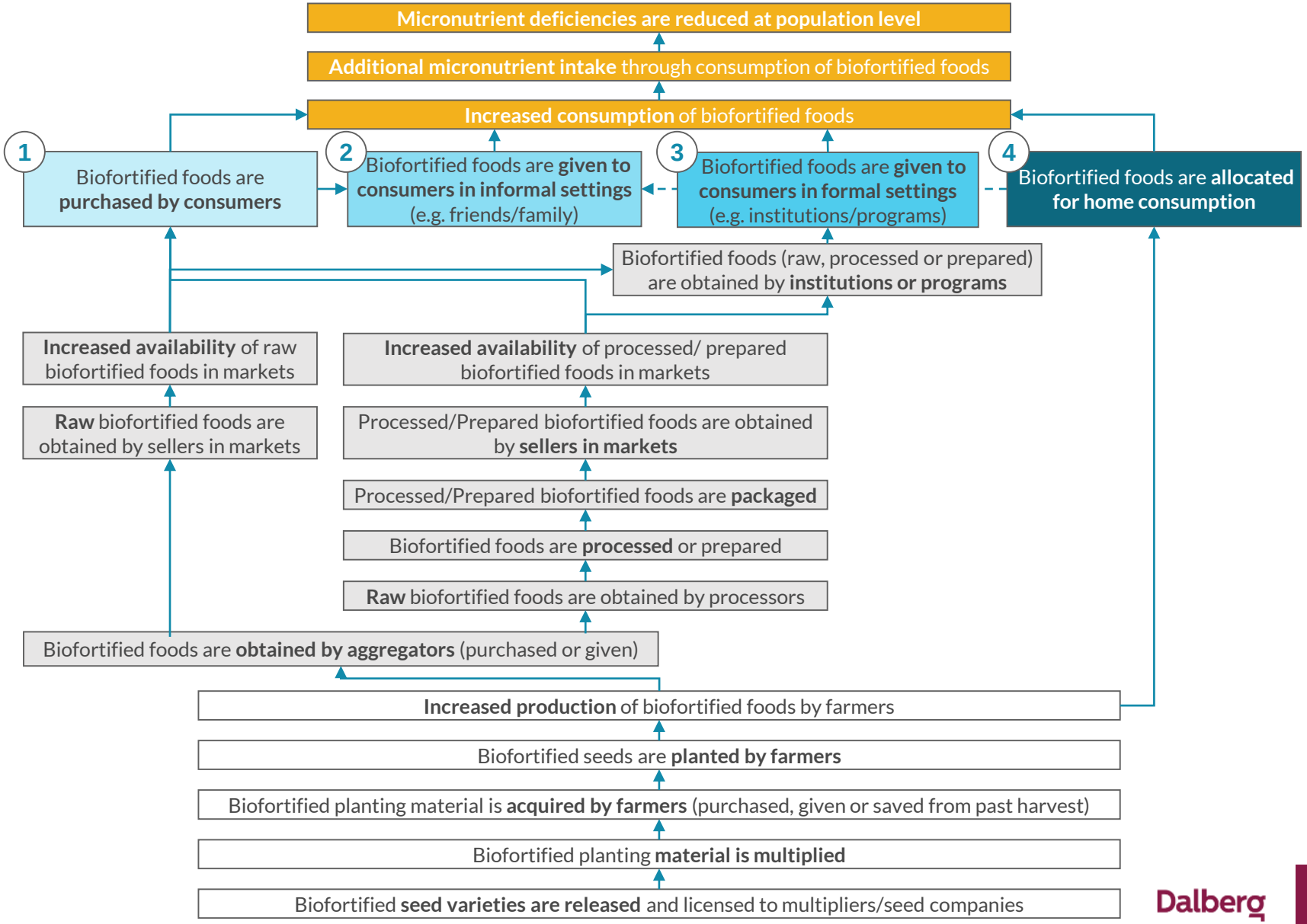
- GAIN and HarvestPlus share an ambition to expand coverage of biofortified nutrient dense foods to at least 200 million consumers. The overall vision of this program is to scale up the commercialization of biofortified foods. PVA maize in Nigeria is one of the nine selected crop/country combinations under this programme.

- In parallel to the GAIN and HarvestPlus teams jointly developing country-level strategies for commercialization, Dalberg is conducting assessments of the potential for scale/commercialization of PVA maize in Nigeria. This is the draft assessment report, based on literature review, interviews with relevant stakeholders, and a small number of focus groups.



- This draft report is designed to fit into the GAIN-HarvestPlus planning processes. As such, it is aligned with the Programme Impact Pathways in two ways
  - The potential routes to scale are codified in terms of the Programme Pathways: 1. Biofortified foods are purchased by consumers, 2. Biofortified foods are given to consumers in informal settings (e.g. friends/family), 3. Biofortified foods are given to consumers in formal settings (e.g. institutions/programs), 4. Biofortified foods are allocated for home consumption
  - The report focuses on barriers to commercialization, rather than being a systematic and comprehensive report of all aspects of the value chain.

Recap: Programme Impact Pathways



What is commercialization?

Commercialization can be thought of in three ways:

1. **An end state.** This would see the programme drive towards an end state which *is* commercial (does not require ongoing subsidy) even if the tools deployed to get there are *not* commercial themselves e.g. provision of grants for value chain actors[1]. Pathway 3, for example, might fall outside of this definition if public procurement was used to purchase and subsidize biofortified crops for the poor.

2. **A set of levers or intervention modalities.** This would include using market-based tools e.g. access to finance, strengthening value chain linkages, etc. as ways to drive scale, even if the biofortified crop itself was *not* sold [but consumed on farm]. This understanding could mean that all four Pathways are 'commercial', as long as the seed is sold to farmers in Pathway 4.

3. **A a subset of the programme Impact Pathways.** GAIN's definition, for this programme, is that "Commercialization shall be defined as the process of introducing a new product into commerce or making it available in the market, rather than producing solely for family consumption." This would mean that Pathway 4 is only relevant for its role in production of crops for sale.

The Dalberg assessments do not take a position on which of these is the most appropriate framing for the programme, rather seek to lay out "*If* GAIN and HarvestPlus want to pursue [Pathway 1-4], *then* these are the barriers, and this is what might be required".

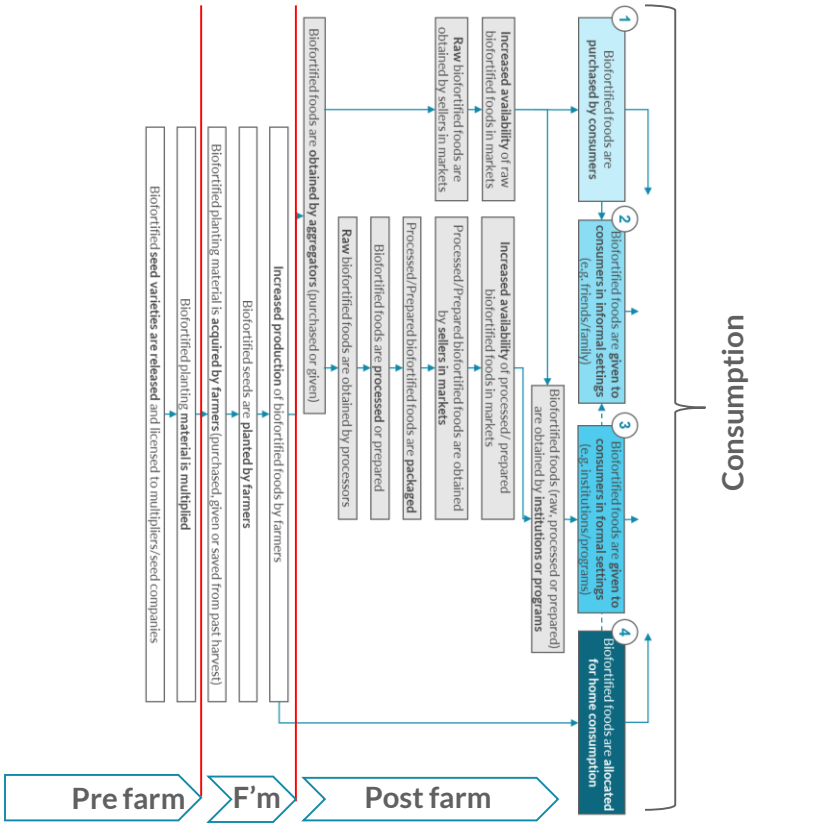
Alignment on the understanding of commercialization will potentially have significant impacts for scale that is feasible, programming, and resource allocation across the portfolio, amongst other things. On farm consumption and public procurement are significant parts of the value chains for a number of the crops under consideration.

1. With the expectation that after the grant, no further subsidy is needed because the market failure is corrected

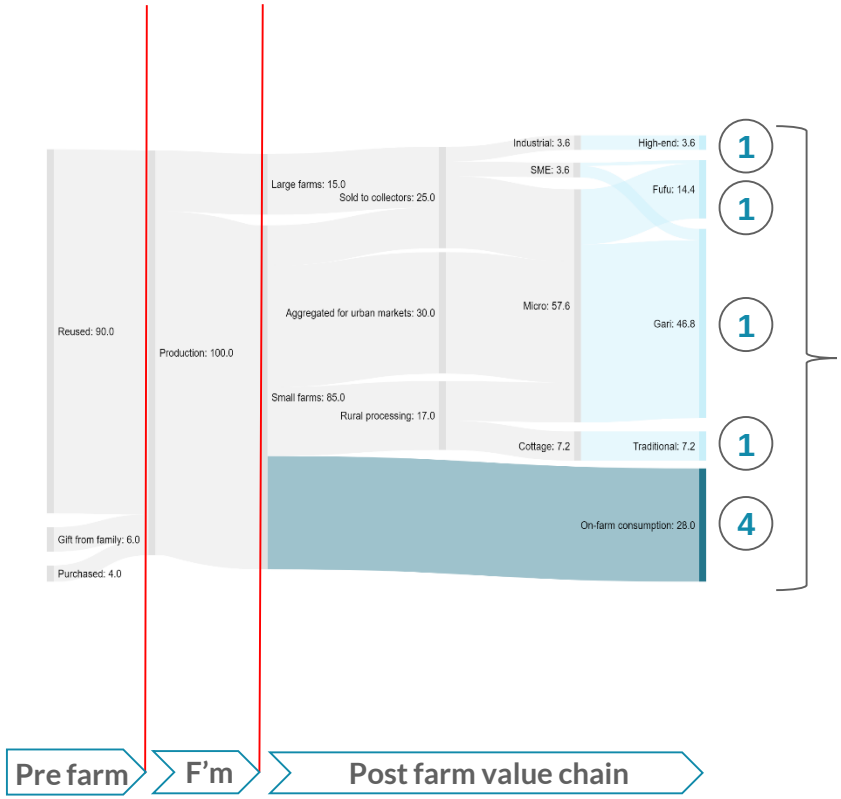
How to read this report (1/2)

This report assesses the potential for commercialization of the crops through the programme Pathways. This page highlights how the pathways correspond to a crop value chain. Note below right that there may be >1 'channel' for each Pathway e.g. biofortified foods could be purchased through a number of value chains. Note also that not every Pathway might be material for each crop e.g. Pathways 2 and 3 are not listed below right.

Conceptual outline of the value chain



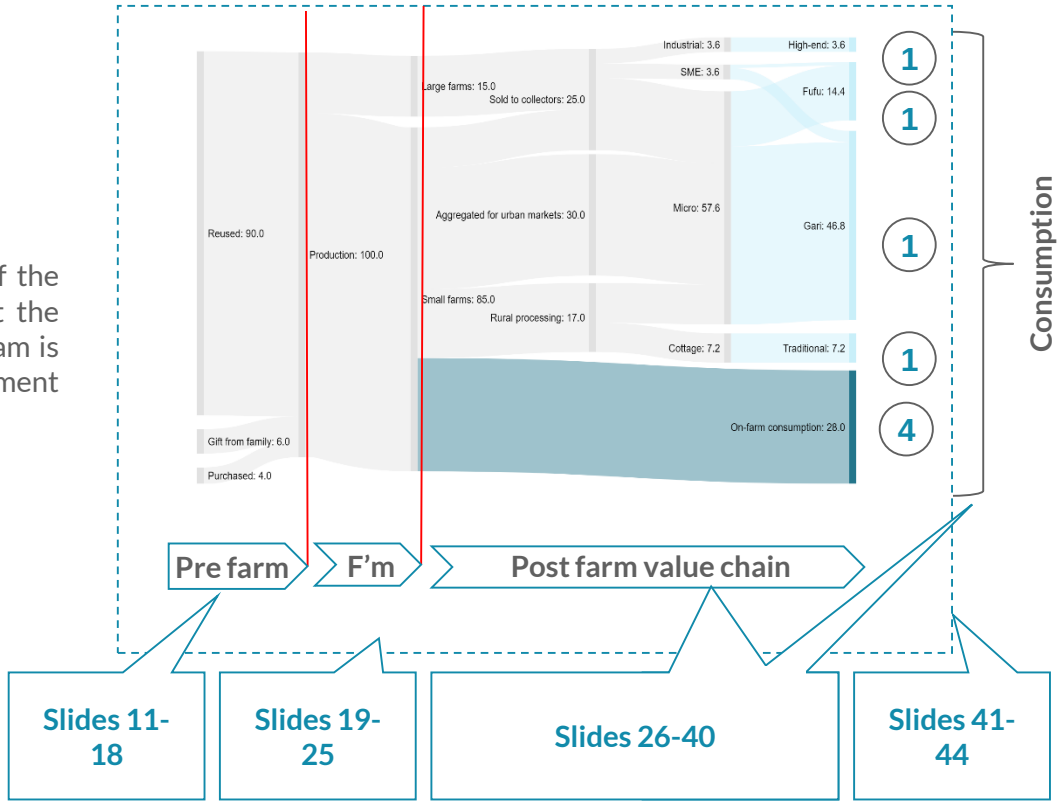
'Sankey diagram' showing relative flows through the value chain



How to read this report (2/2)

- This report is broken down into six sections:
  - Executive summary
  - Pre-farm value chain
  - On-farm
  - Post-farm and consumption
  - Policy and financing

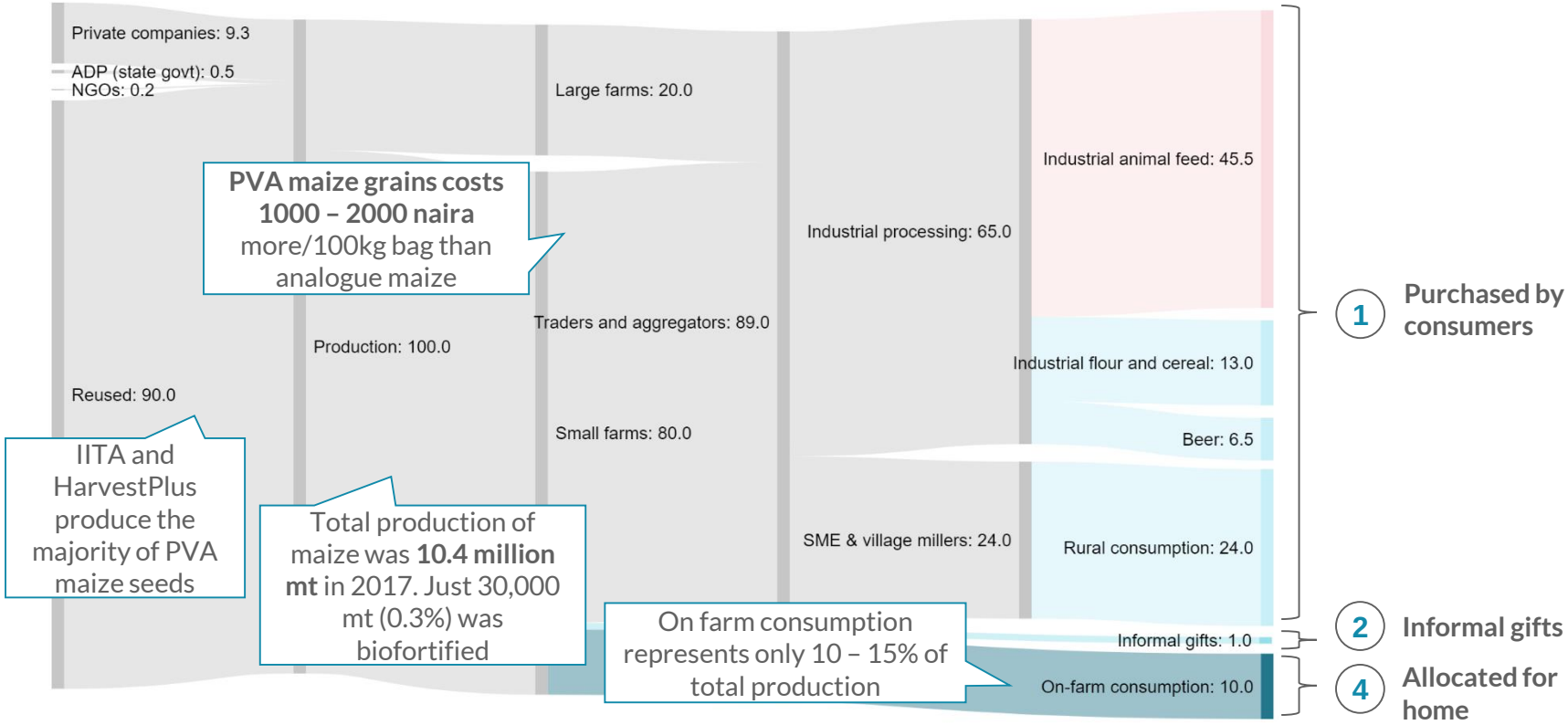
- The barriers Dalberg identifies at each stage of the value chain should align with and complement the 'Contextual analysis' and 'Barriers' that each team is feeding into the Country Strategy Development template



Executive Summary

Executive summary – Overview

Nigeria is the 12th-largest maize producer in the world, second only to South Africa in Sub-Saharan Africa. Nearly half of all marketed maize production is processed into animal feed.
Tapping in the small and rural processing of PVA maize (into flour and cereal – 13% and rurally processed goods – 24%) is the more effective pathway to commercialisation.



Source: FAOSTAT, Production quantity Nigeria, 2017; USAID, Nigeria early generation seed study, 2016; TechnoServe & Harvest Plus Nigeria, Diagnostic and Opportunity Identification, 2017; Dalberg Interviews & Analysis 2019

Executive summary – Main barriers

In Nigeria, nearly one in three children under five and one-quarter of all pregnant women are Vitamin A deficient. Maize is a major staple food in Nigeria, with maize consumption in 2017 standing at 10.9 million mt and per capita consumption at 25 kg/year in 2007. Switching to biofortified varieties of maize could provide up to 50% of the daily Vitamin A needs.

Nigeria produced 10.4 mt of maize in 2017; almost 50% is industrially processed whilst 10 - 15% is consumed on-farm. Current consumption of biofortified maize is very low: representing just 0.3% of total maize consumption.

To assess the potential for commercialisation of PVA maize in Nigeria, we have broken the market down into five main pathways (i) industrial non-human consumption which accounts for 45.5% of the market, (ii) industrially processed products for human consumption – which account for 19.5%, (iii) rural and small-scale processing, which account for 24%, (iv) informal gifts, accounting for 1% and (v) on-farm consumption which accounts for 10%.

There are three main barriers to the commercialisation of biofortified maize:

1. **Awareness – Throughout the value chain, limited coverage of The International Institute of Tropical Agriculture (IITA)/HarvestPlus and their partners across Nigeria results in low awareness of PVA maize, limiting market demand and potential for commercialisation**. An emerging body of evidence suggests that once made aware of PVA maize, both farmers and consumers are inclined to adopt it because of its nutritional benefits, sweet taste, and yellow grain colouring. There is an opportunity to stimulate supply, however, further studies are needed to test willingness to pay a premium on final price
2. **Access to biofortified seeds – In some locations, farmers lack access to new and improved PVA maize seeds due to poor linkages with seed producers;** thus 90% re-use seeds. Seed multiplication of biofortified varieties is done by a limited number of producers, and new varieties are slow to reach the market, particularly to smallholder farmers. Together, this significantly hampers the scale-up of PVA maize production
3. **Quality of biofortified seeds – Highly processed maize products tend to lose their nutritional value during milling**. Consequently, large industrial processors require a higher unit value (20ug/g for certain processors) of Vitamin A content than is currently provided by PVA varieties in order to market biofortified products as nutritious. The Wave 3 PVA varieties due for release in 2020 will not sufficiently raise standards (11-14 ug/g) as to meet these requirements. This may restrict growth for the highly processed food segments but is less of a barrier for the small-scale and rural processors since they use processing techniques that do not result in significant loss of nutrients

Source: FAOSTAT Food Balance Sheets, 2007; Girei, Saingbe, Ohen and Umar, Economics of small-scale maize production in toto local government area, Nasarawa state, Nigeria, 2018; HarvestPlus 2019; Dalberg Interviews & Analysis 2019

Recommended opportunity for GAIN/HarvestPlus

In light of this, we recommend GAIN/HarvestPlus to invest in:

- **Stimulate awareness of PVA maize amongst consumers of small-scale and rurally processed maize.** The rural and small-scale processing channels account for 24% of the market. This would take significant sensitisation, education and awareness building amongst working consumers in rural and urban areas alike, given the widespread consumption of maize. Focusing on clusters in regions with high maize production but currently lower PVA consumption (e.g. northern Nigeria) may accelerate impact
- **Coupling awareness with availability of product to ensure consistent supply**. Real demand needs to be proven and famers need to be linked to offtakers in order to increase production
- **Reinforcing seed distribution linkages**. This would require improving the connections between research institutions, seed multipliers, agro-dealers and smallholder farmers. The intended recipients being smallholder farmers, the main barrier is likely to be the fragmented and disparate nature of smallholder producers, and the challenging nature of reaching broad farmer networks. GAIN/Harvest Plus could invest in partnerships and extension services with more actors e.g. farmers associations to stimulate these connections

Given the nature of these barriers, it is important that the three interventions are implemented in parallel. Raising awareness amongst consumers is the most effective intervention as by stimulating downstream demand, the effect will spur investment and increased production of PVA maize across the value chain. However, unless linkages are reinforced, market demand for the product resulting from awareness will not be met, as it is the case today in parts of Nigeria. PVA Maize has high potential in Nigeria and is well received by downstream traders and consumers alike. Greater awareness is critical for commercialisation but reinforced linkages are a prerequisite.

Another intervention possible to boost commercialisation of PVA maize in Nigeria would be to **invest in R&D for higher concentrated PVA maize.** Increased investments in R&D could accelerate the commercialisation process by bringing to market nutritious maize which meets regulatory standards faced by more industrial processors. However, this would require significant investments to rapidly change the timelines and depend on factors outside of GAIN/HarvestPlus' control, such as licensing and regulation by government. This would not have impact to scale given that demand by large-scale industrial processors of this kind represents just 13% of the market. This is not recommended as the most efficient route to commercialisation.

Source: Dalberg Interviews & Analysis 2019

Pre-farm

More than half a million households currently consume PVA maize; with 30,000 mt produced in 2017

PVA Maize	
Delivery stage	Saturation
Number of varieties released	First wave: *Ife hybrid 3, Ife Hybrid 4, Sammaz 38, Sammaz 39.* Second wave: *Sammaz 43, Sammaz 44, and Sammaz 49, etc.*
Household reach	Est > 500,000 households (by end 2018)
Volumes	30,000 Mt (2017)
Agronomic characteristics	• Early maturity • Drought tolerance • Stable/high grain yield
Nutritional characteristics	Rich in provitamin A (5.6-11.3 ug/g)

Market composition

- PVA maize is in its second wave saturation and has been given to farmers in 13 states
  - PVA maize makes up 0.3% of the total maize market
  - Majority of PVA maize is consumed in Niger, Kaduna and Oyo due to the states' maize production and proximity to pilot states

Biofortified characteristics

- PVA maize seeds have higher beta-carotene levels* and are generally more disease-resistant than analogue
  - The nutritional content in the 2nd wave has grown by 57% but has still not reached some global processors' standards

Wave	Variety name	Carotenoid content (ug/g)*	Max yield (t/ha)	Year of release
1	Ife hybrid 3 & 4	N/A	6.65	2012
	Sammaz 38	5.7	6.4	2013
	Sammaz 39	6.4	6.8	2013
2	Sammaz 43	8.4	9.9	2015
	Sammaz 44	8.8	9.7	2015
	Sammaz 49	11.3	7.8	2016
	Sammaz 52	9.8	6.0	2017

Future releases

- Wave 3 varieties are currently undergoing testing and are scheduled to be released in June 2020 with vitamin A levels between 11 and 14ug/g

Source: SPK, Facts on Provitamin A Maize Nigeria, 2017; HarvestPlus, Vitamin A maize pamphlet, 2017; Nigeria Seed Portal Initiative, Improved Seed Varieties of Maize, 2019; Dalberg Interviews & Analysis 2019

* Vitamin A represents approximately 80% of carotenoid content

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Biofortified seeds are developed by HarvestPlus & IITA, multiplied by large farms and marketed to smallholder farmers

	Research and development	Seed/vine release	Agricultural Supply
Features	• IITA gathers groups of scientists to develop new varieties • Feedback from value chain actors is incorporated in the development of subsequent varieties • Waves 1 and 2 were released in 2013 and 2015 respectively • Wave 3 is due for release in 2020	• Seeds are distributed by HarvestPlus in Oyo, Kaduna, and Niger states, and subsequent distribution is done by several partners in expansion states • Developed seeds are given to large farms to multiply • Multipliers sell seeds to private seed companies	• Farmers locate IITA and HarvestPlus distribution points to purchase seeds • Difficulty in purchasing seeds for farmers far from private seed shops • Farmers reuse seeds due to difficulty in acquiring new seeds, and proximity to private seed shops
Actors	• IITA, Institute For Agricultural Research (IAR), and HarvestPlus act as breeders, developing new varieties • These three breeders partner with direct producers, outgrowers, and certified seed companies to understand and improve existing varieties	• Seeds are multiplied on large farms in partnership with producers and then distributed to smallholder farmers • ~8 large producers (Premier Seed, Seed Co, Maslaha Seed, Value Seed, Gold Agric, WACOT, Jirkur, Savanah seed and Youth Agripreneur)	• IITA, IAR, HarvestPlus and Oyo Agricultural Development Programs (ADPs) act as institutional distributors • ~5 key private distributors. (Niji, SeedCo, Premier Seeds, Maslaha Seeds, and GoldAgric)
Economics	• In 2018, 10.6 tons of breeder seeds were given to 8 producers to multiply	• In 2018, 8 large producers multiplied 10.6 tons of breeder seeds to 780 tons of certified seeds • HarvestPlus distributed 200,000 mt of seeds in 2018*	• PVA seeds are on average, the same price (N300 – N600/kg) as analogue seeds

Source: Technoserve, HarvestPlus Nigeria diagnostic and opportunity identification, 2017; USAID, Nigeria Early Generation Seed Study, 2016; Guardian, HarvestPlus injects over 200,000mt of PVA maize into markets, 2018; Dalberg Interviews & Analysis 2019; CGIAR, Building Nutritious Food Baskets Project: Final review and closeout meeting report, 2018
Note: (*) Unaligned with targets given 30 000 mt of PVA maize production in 2017

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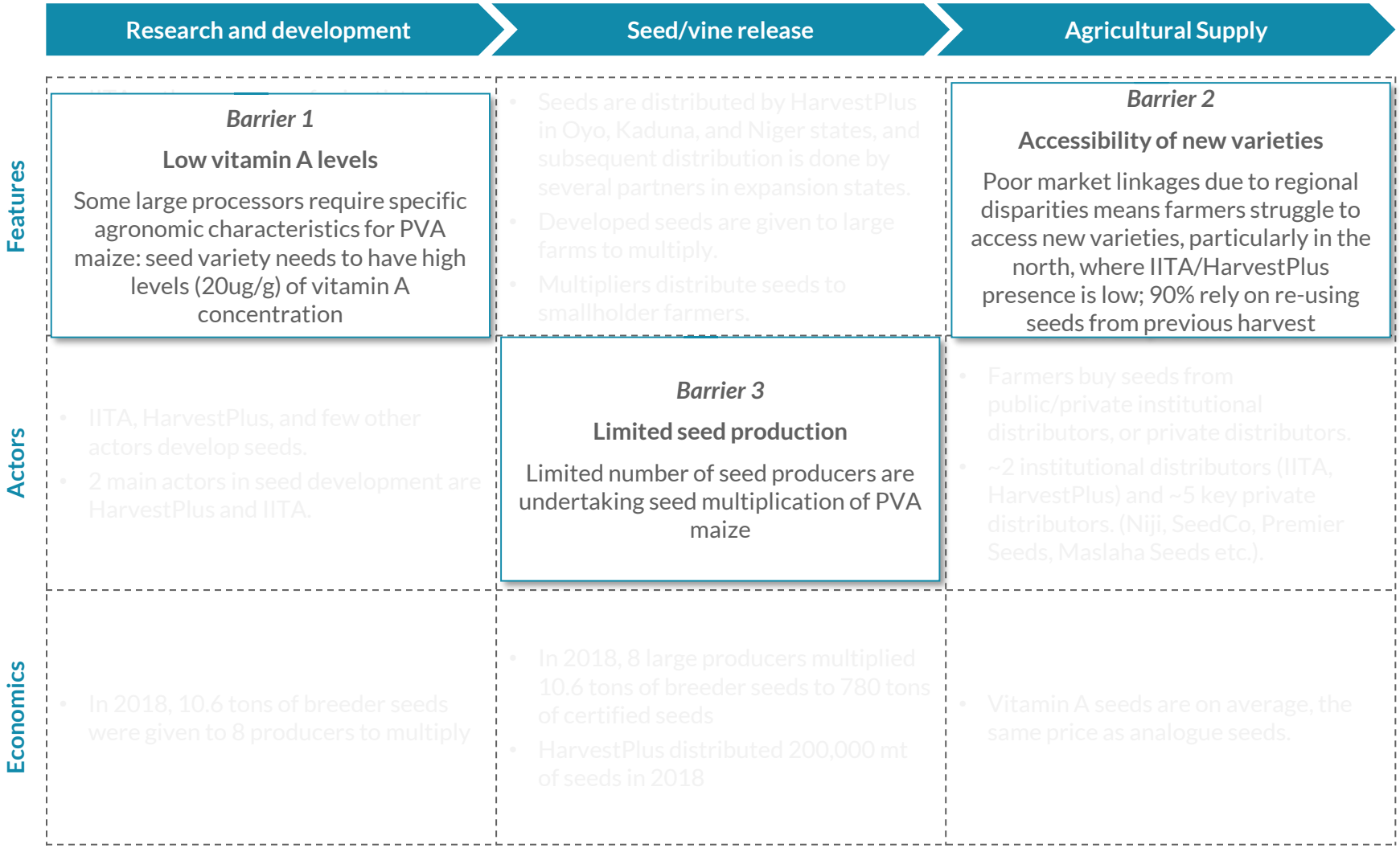
Major barriers to scaling PVA maize include low vitamin A levels, poor accessibility and limited seed production



Source: Sahel, Maize: Enhancing the livelihoods of Nigerian farmers, 2017; Dalberg Interviews & Analysis 2019

Wave 3 variety will not meet the 20ug/g concentration required to unlock part of large industrial demand for PVA maize

Root cause

- HarvestPlus and IITA have developed and are planning to release the third wave of PVA maize varieties in 2020
- However, this **new variety will only contain 11-14ug/g in terms of vitamin A concentration**, far less than the 20 ug/g required by a specific large processor
- Thus, **large farmers working with such processors might be less willing to produce PVA maize,** participating in low demand for PVA maize seeds
- Low demand of PVA maize seeds could in turn **reduce interest of large private seed processors**
- Resulting in limited development of the PVA maize seed market

Impact on potential to scale

- Inability of the wave 3 variety to respond to certain large processors requirements could have an impact on ability to scale
- More, development of new variety of seeds require a minimum of two years before release
- Given this time lag, possibility to access this market for PVA maize wont be before 3 years
- Contributing indirectly to potential to scale

"We have heard about this 20ug/g requirement, but unfortunately the wave 3 PVA maize will not meet it. We will likely be reaching that threshold for Vitamin A concentration with wave 4 PVA maize scheduled for release in 2021/22 - HarvestPlus Nigeria

Source: Lagos Focus Group, Stakeholder Interview, 2019; Abuja Focus Group, Stakeholder Interview, 2019; BGPAN Focus Group, Dalberg Interviews & Analysis 2019

Farmers without direct links or proximity to IITA and HarvestPlus distributors face difficulties in sourcing seeds

Root cause

- HarvestPlus and IITA operate from Ibadan, south-western Nigeria. This includes strategic partnerships with research institutes, seed producers and other value chain actors in the north
- However, most **smallholder maize farmers live in remote areas in the north**, far from seed markets, or are not aware of distributors close to them
- Thus, **the purchase of new seeds is difficult for these farmers** who have to travel to markets or meet distributors and pay transportation costs
- This is especially true for farmers living far away from Suleja and Kaduna
- Thus, most **smallholder farmers plant seeds from their harvests** to avoid the waiting time for new seed-acquisition

"We need to go all the way to Suleja in Niger state to get PVA maize seeds, we have only one contact person for the whole north-central region"
- Biofortified producers and processors Association

Impact on potential to scale

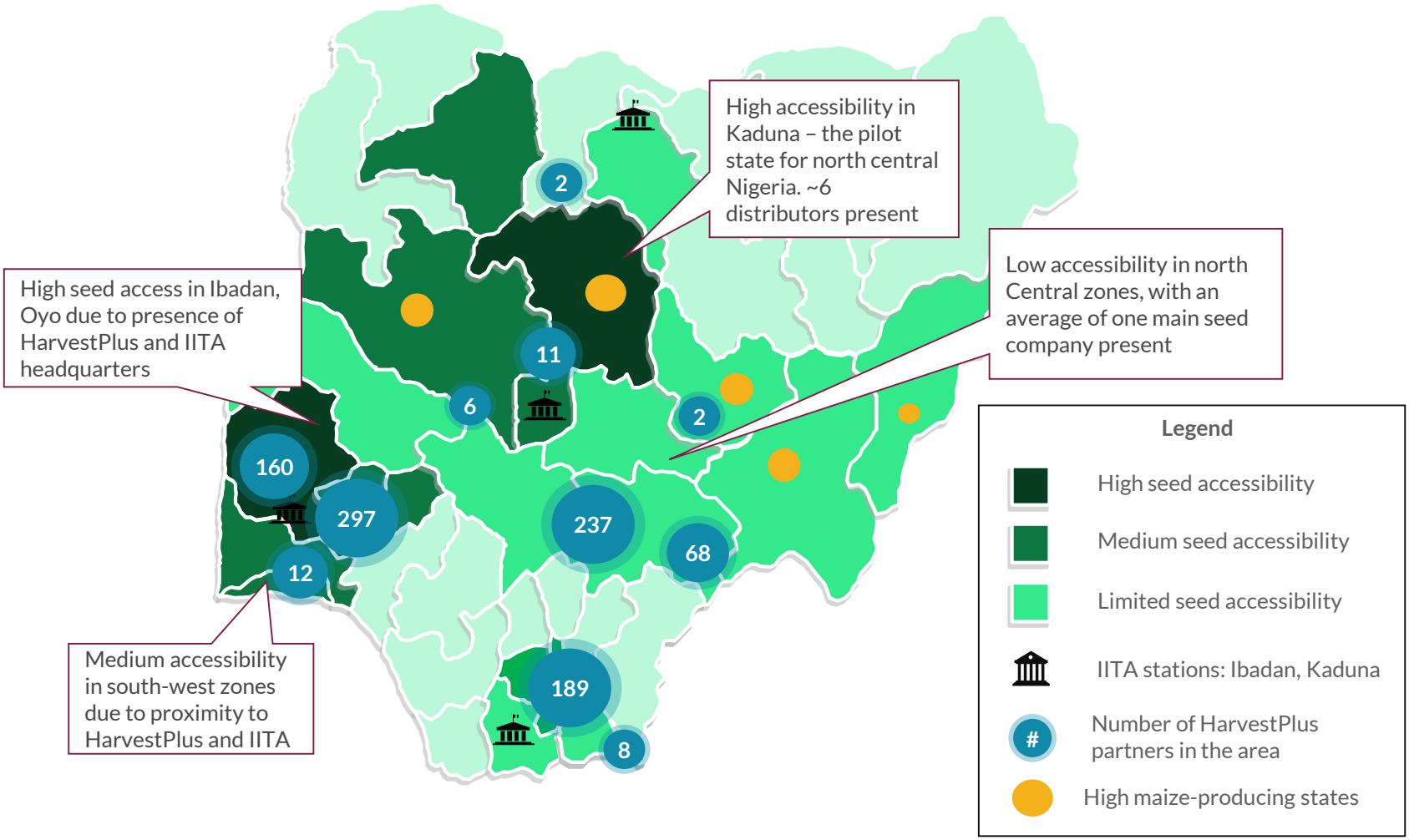
- **Regional differences in awareness and demand** affect accessibility of seeds in many parts of Nigeria, thus impacting commercialisation potential
- **Reusing seeds can lock farmers into growing old varieties** instead of PVA maize seeds
- **Reusing seeds can also reduce PVA maize yields,** affecting perceived seed quality by farmers and widespread uptake
- Absence of IITA/HarvestPlus support in certain regions can also lead to poor farming practices e.g. cross-contamination

"There is no structure to ensure availability of seeds in the north, but in the south west this is not a problem" - Biofortified producers and processors Association

- Ultimately, these accessibility issues can lead to low uptake of new varieties and slow rate of analogue substitution

Source: Lagos Focus Group, Stakeholder Interview, 2019; Abuja Focus Group, Stakeholder Interview, 2019; BGPAN Focus Group, Dalberg Interviews & Analysis 2019

Lack of seed access is more pronounced in certain parts of Nigeria due to HarvestPlus and IITA's limited presence



Source: HarvestPlus 2019, IITA Nigeria 2019; Dalberg Interviews & Analysis 2019

The limited number of actors in seed multiplication results in varying PVA maize seed availability across Nigeria

Root cause

- Limited presence **of IITA and HarvestPlus** in the north has resulted in **low PVA awareness and technical capabilities** amongst seed producers and farmers
- Consequently, **seed demand is not growing as fast** as in certain parts of Nigeria, such as the South West
- A lack of consistent seed demand **means large multipliers are hesitant to expand multiplication**
- Furthermore, potential new PVA maize seed multipliers are not incentivised to switch their production to PVA maize
- Thus, multiplication remains stagnant

Impact on potential to scale

- Low seed production means that **seeds are not readily available in the marketplace** to agro-dealers, distributors, and ultimately, farmers
- In Kaduna, demand has increased faster than production this year, as 10 – 15% of PVA maize seed demand has been unmet due low seed production
- This leads to fluctuating production of PVA maize and inconsistent supply to processors, who then are reluctant to rely on PVA maize for their processed product
- Given supply uncertainties, **processors are hesitant to increase production** of existing PVA maize products **or create new PVA maize product lines**

"I think HarvestPlus should leave where they are in IITA and set up shop in Ahmadu Bello University and influential locations such as Adamawa , this will help change the narrative for PVA maize"
- Biofortified producers and processors Association

Source: Niji Foods, Stakeholder Interview, 2019; Lagos Focus Group. Stakeholder Interview, 2019; Abuja Focus Group, Dalberg Interviews & Analysis 2019

On farm

PVA maize farmers in Nigeria can be broadly classified into three archetypes: pilot, opportunistic and strategic farmers

Pilot area farmers

Farmer characteristics
- Smallholder farmer falling in a pilot area and targeted by HarvestPlus or partners for biofortification adoption

Typically gets seeds from
- IITA, HarvestPlus, religious groups, and reuses seeds in next harvest

Decision drivers
- Nutrition, low seed costs, and good yields

Consumption choices
- Interested in selling but need more demand. Keeps some of the maize for home consumption or cottage processing

Key influencers
- Family, friends, local media, and religious groups

Opportunistic smallholders

Farmer characteristics
- Smallholder farmer looking for a 'first-mover advantage'
- Typically younger and willing to try new technologies and varieties to increase farm income

Typically gets seeds from
- Mostly reuses seeds, but is more likely to buy new seeds if convinced of the potential profit

Decision drivers
- Improved profits, downstream demand, and potential for expansion

Consumption choices
- Majority (~90%) of produce is sold

Key influencers
- Media, demo plots, and social groups.

Strategic farming enterprises

Farmer characteristics
- Larger and more established commercial farmers looking to enter new local and international markets
- Working with out-growers, able to produce at scale to meet demand from large buyers and processors but will not do so without proven market demand and long-term interest

Typically gets seeds from
- More likely to buy seeds

Decision drivers
- Cheapest price, good yields, availability at scale, and downstream demand

Consumption choices
- All produce is sold

Key influencers
- National media, peer commercial farms, international trends

Source: Dalberg interviews & analysis, 2019

Pilot farmers are driven by nutritional benefits and demand for PVA maize, but regional disparities limit nationwide cultivation

1 Pilot area farmers plant PVA maize because they like the nutritional benefits and in some locations are seeing a growing consumer acceptance

- **Pilot farmers are aware of the nutritional benefits of PVA maize.** Pilot farmers understand the nutritional advantage that PVA maize has over other varieties, and have been a part of creating awareness to drive consumer uptake and consequently market demand
- **In some locations, pilot farmers have noted a growing demand for PVA maize, which in turn incentivises their cultivation.** In parts of south western and northern Nigeria, pilot farmers are driven by a growing appreciation and demand for PVA maize which creates an incentive for continued cultivation. However, awareness remains a gap in most parts of Nigeria

2 In many non-pilot locations, limited awareness of PVA maize and insufficient supply of seeds result in low farmer appetite

- **There are striking regional differences in awareness and demand for PVA maize across Nigeria.** Awareness and demand are concentrated in Oyo state in south western Nigeria, and in Kaduna and Niger states of northern Nigeria. This is attributed to the presence of IITA and HarvestPlus in the west and their partners including research institutes in the north. In other parts of Nigeria, awareness and demand for PVA maize is almost non-existent
- **These regional differences have implications for farmer interest and strength of value chain linkages.** In tandem with awareness and demand, farmers in Oyo, Kaduna and Niger have the highest interest in cultivating PVA maize whilst other farmers focus on non-biofortified maize. The lack of market demand and farmer interest in most parts of Nigeria disincentivises investments in value chain linkages e.g. seed production and supply, further limiting farmer appetite

"We understand that there are gaps in awareness and consequently consumer demand. This is due to the fact that Nigeria is a big country and we have a limited budget for marketing. If we aimed to publicize on all national platforms, the cost of doing that will surpass our budget. Consequently, we have prioritized a few states to focus on"
- HarvestPlus

Source: Dalberg interviews & analysis, 2019

Similarly, opportunistic farmers are market sensitive, cultivating the most lucrative maize variety with accessible seeds

1 **Although opportunistic farmers are excited by the growing market for PVA maize, they will only plant more of the maize variety that has the greatest demand and most accessible seeds**

- **Similar to pilot farmers, opportunistic farmers recognise the nutritional value and growing acceptance of PVA maize in certain locations.** In Oyo state where there is a growing awareness and demand for PVA maize, farmers cultivate four times more PVA than analogue maize. A small portion of their harvest is consumed on-farm due to its nutritional properties
- **However, these farmers will only cultivate PVA maize to the extent that market conditions and seed accessibility are favorable.** In contrast to south western Nigeria, there is far less cultivation of PVA maize in north central Nigeria given low awareness, demand, and availability of seeds. Instead, farmers grow non-biofortified maize to serve a ready market
- **Opportunistic farmers see awareness as the critical link to market demand.** According to them, consumers tend to buy PVA maize after they taste it and have been educated about its nutritional properties

"Consumers really like the PVA maize because of its sweeter taste and attractive golden look. In fact, it seems like regular white maize is fading around here because PVA maize is becoming our default these days. We can use PVA maize for most of the food that we previously prepared with white maize"
- PVA maize farmer in Oyo

" If you are not in Kaduna or Niger, then it is hard to get the seeds. For most of the north central region, there is only one seed producer that sells PVA maize seeds. With such accessibility problems, it will be hard to increase farmer uptake in this region"
- Biofortified Crops Growers and Processors Association of Nigeria

Source: Dalberg interviews & analysis, 2019

Strategic enterprises are purely market-driven and only enticed by long-term demand from large buyers and processors

1 **Strategic farming enterprises are tied to existing long-term supply contracts, typically leveraging farmer out-grower networks to generate sufficient volumes**

- **Strategic farmers are tied to the choices of their downstream market.** These farmers only produce the highest demanded maize variety typically on a long-term supply agreement to large processors. Consequently, they will not increase production of any variety of maize without long-term demand as it will constitute a significant opportunity cost
- **Often times, strategic farmers engage out-growers to meet required volumes, limiting their planting choices.** Strategic farmers will usually engage hundreds to thousands of smaller out-grower farmers to produce the required volumes of maize, in turn limiting the out-growers to the variety of maize that is demanded by large processors

2 **Strategic farming enterprises see PVA maize as an opportunity to expand their business, but are reluctant to scale up production until they confirm sustainable downstream demand**

- **Similar to other farmers, strategic farmers are also aware of the nutritional benefits and potential commercial opportunity in PVA maize.** In some locations, strategic farmers are faced with more demand for PVA maize than their current production capacity can meet, signaling the growing opportunity in PVA maize production
- **Strategic farmers have appetite to invest in large scale commercial production of PVA maize, but are concerned about long-term demand.** Despite challenges with meeting current demand, these farmers are yet to be convinced about the potential for long-term demand from processors. Strategic farmers would be happy to invest in scaling up their current production levels if they had guaranteed long-term downstream demand

"It is tricky making huge investments in production and even processing of biofortified crops without proven market demand. It doesn't make sense to set up dedicated infrastructure for these crops until I am sure that there is a big market for it. For instance, if I get a letter of intent from Nestle, I will be comfortable to invest in producing more PVA maize."
- PVA maize integrated farmer in Oyo state

Source: Dalberg interviews & analysis, 2019

Key barriers for increased PVA maize cultivation therefore hinge on awareness, demand, and seed accessibility

Awareness

- Gaps in awareness of PVA maize across Nigeria constitutes the most significant barrier to commercialisation, cutting across all farmer archetypes
- Awareness is correlated with demand as farmers have noted that consumers tend to buy PVA maize once they are educated about its nutritional benefits
- With increasing awareness and demand, farmer interest and continued cultivation of PVA maize will be incentivized, and without these factors, farmers will continue producing non-biofortified maize

Downstream demand

- Similar to awareness, demand is a cross-cutting barrier for all farmer archetypes and is the singular most important factor for continued farmer cultivation of PVA maize
- Beyond demand from individual consumers, farmers (especially opportunistic and strategic farmers) will be excited by increased medium and large-scale processor interest in PVA maize as this usually translates into long-term supply agreements

Accessibility of seeds

- A third barrier to scaling PVA maize commercialisation lies in the accessibility of seeds, particularly in locations with low awareness and demand
- Farmers that experience difficulties in getting PVA maize seeds are unlikely to cultivate and sell them, limiting the potential for scaling production and consumption across Nigeria

Source: Dalberg interviews & analysis, 2019

Consequently, opportunity areas are creating awareness, increasing market demand and ensuring access to seeds

Key opportunity area	Description

Scaling production for large processors	• This is likely a long-term focus area and will likely involve:
	  • R&D for seed-improvement to meet a large processor' standards of 20 ug/g. A target which might not be achievable in the next four years
	  • Gathering information from financial-service-providers to understand the requirements needed to fund the expansion of seed multiplication – a process which is underway with this analysis

Scaling production for on-farm consumption	• This opportunity area **is a quicker win that can likely be achieved in the short to medium-term**
	• Interventions in this area will likely focus on:
	  • **Developing farmer awareness** about the importance of PVA maize to increase appetite for consumption in their own households
	  • **Improving PVA maize seed availability** to complement awareness initiatives. This will especially be important for most the north central, south east and south south geopolitical zones as these locations have low awareness and demand for PVA maize

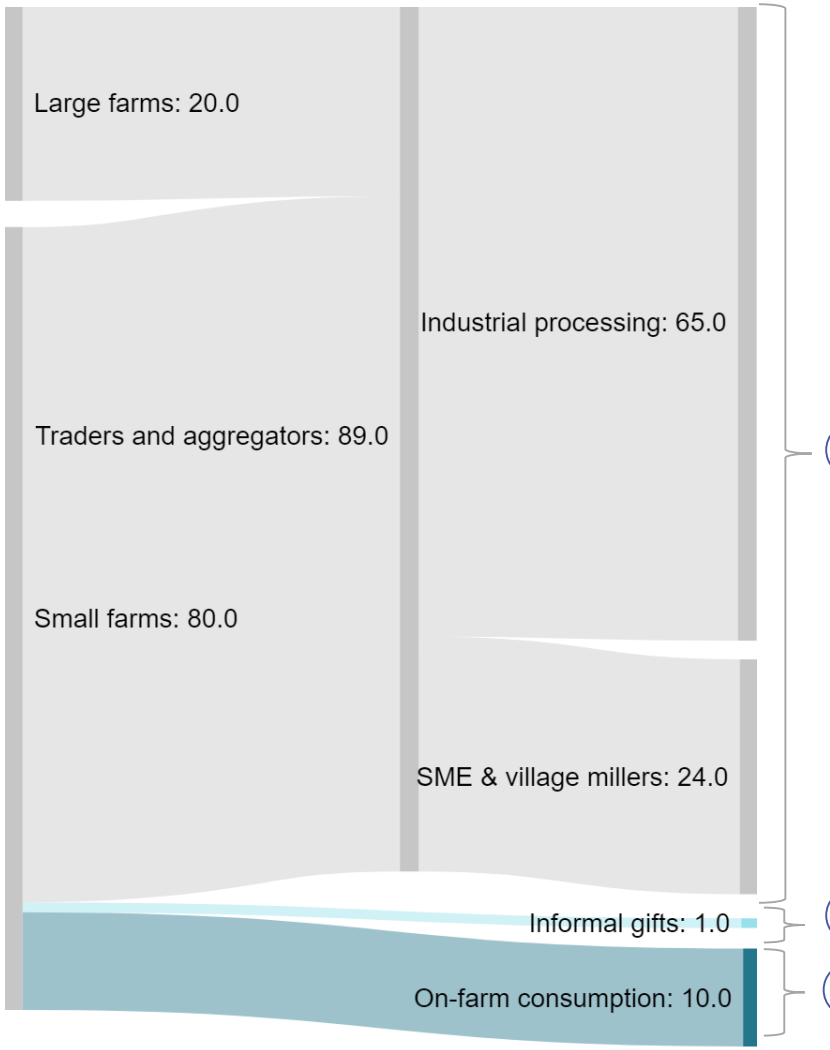
Scaling production for market sale and retail consumption	• This is likely a longer-term focus area given that the key barrier – insufficient market demand across most of Nigeria – will require targeted awareness initiatives executed over time • Awareness initiatives could be phased such that a few Nigerian states are targeted per time and initial learnings can be used to inform subsequent interventions. This would likely be more useful than a one-time nation-wide dissemination requiring significant resources and greater coordination, but leaving no opportunity to apply lessons • To engage strategic farmers, it will be necessary to ensure PVA maize uptake by large processors such as FMCG companies. These processors typically require a high level of Vitamin A concentration (around 20 ug/g) as some nutrient is lost during processing

INITIAL HYPOTHESES FOR DISCUSSION DURING DUBAI WORKSHOP

Source: Dalberg Interviews & Analysis 2019

Post-farm value chain and consumption

Post-farm, maize is mostly aggregated and sold to feed millers, large and small-scale processors in rural and urban areas



A. Industrial use, non-human consumption

- Large and medium farms sell directly to industrial processors for the production of animal feed
- ~50% of maize is used for the production of animal feed, with poultry consuming 98% of maize for feed

B. Industrial use, human consumption

- Farms, traders and aggregators sell to FMCG companies and SMEs for production of cereals and beverages
- Accounts for ~15% of maize consumption

C. Small-scale and rural

- Small farms and aggregators sell directly to small-scale and rural millers for the production of household meals (e.g. pap and tuwo massara)
- Accounts for ~25% of maize consumption

Informal gifts

- ~1% of maize is gifted to friends and family for consumption

On-farm consumption

- ~10 of maize is consumed on-farm, including for informal gifts as highlighted above

Source: Sahel Capital Partners, Maize: Enhancing the value of Nigerian farmers, 2017; Dalberg interviews & analysis, 2019

The four main channels each have different consumption drivers

1

Industrial use, non-human consumption

- 45.5% goes into the industrial animal feed production – around 50% of the total marketed maize

Industrial use, human consumption

- 6.5% goes into beer production
- 13% goes into industrial flour and branded cereals

Small-scale and rural

- 24% of maize is consumed locally, mostly cooked/roasted and sold as street food
- Some maize is rurally processed to animal feed

2

Informal gifts

- A small amount of maize is gifted to friends and family for consumption, but most gifts are for seed

3

On-farm consumption

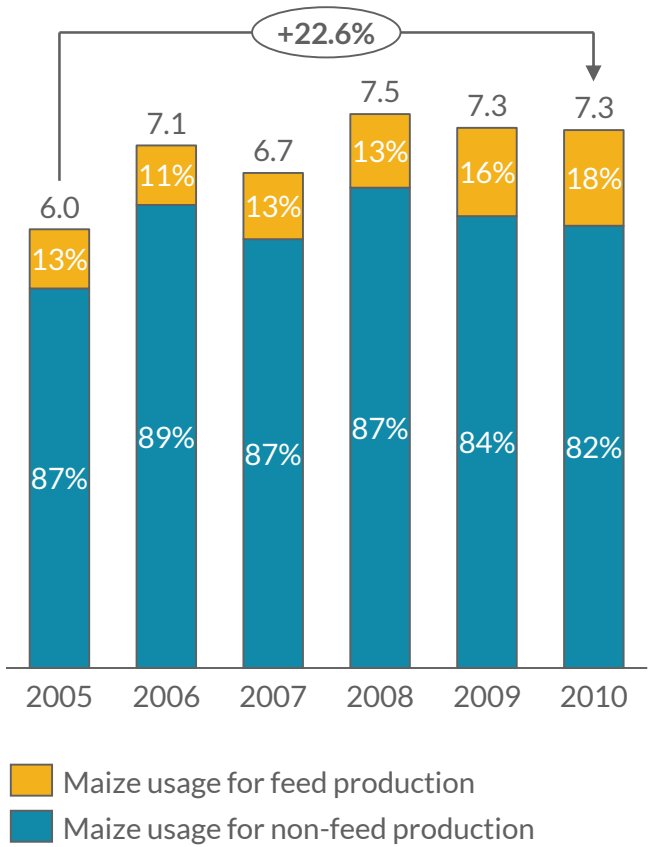
- About 10% is consumed at farmgate, mostly by subsistent households

Source: Sahel Capital Partners, Maize: Enhancing the value of Nigerian farmers, 2017; Dalberg interviews & analysis, 2019

Industrial use, non-human consumption is dominated by the animal feed sector that processes 50% of marketed maize

1 **Non-human industrial use of maize is primarily driven by the rapid growth in the livestock market, and the use of PVA maize is favored as an input to animal feed**

Maize usage for production, millions 2005-10



- In 2013, **Nigerian poultry farmers produced 650,000 mt of eggs** and near 170 000 mt of chicken meat
- About **50% of the marketed maize is consumed by the animal feed sector**, with poultry claiming as much as 98% of the total feed produced in Nigeria between 2005 and 2010
- The percentage of total maize production used for feed has grown from 13 to 18% 2005 to 2010 and is expected to continue to increase
- **Growing population and incomes are driving high consumption of animal meat**. FAO forecasts that Nigerians are expected to consume 60% more animal protein, with meat consumption rising nearly 73%. This growth in protein consumption will drive demand for maize, one of the core component of animal feed
- **Feed millers are now the main large consumers of PVA maize on the market** although many poultry famers still buy white maize because it is cheaper

"Feed millers love PVA maize. It gives a very yellow color to the egg yoke, which is why they prefer it to non bio-fortified maize"
- PVA maize seed producers in Kaduna

Source: MAFAP,Analysis of incentives and disincentives for maize in Nigeria, 2013, USDA, 2005-2010 , FAOSTAT, 2017, Sahel Capital Limited, 2015, Sahel, An Assessment of the Nigerian Poultry Sector 2015, GAIN, Grain and Feed Annual – Nigeria 2011, Dalberg Interviews & Analysis 2019

Dalberg

Although PVA maize availability is key to scaling in this channel, it is not a primary target for commercialization

1 **Processing for the industrial non-human consumption of PVA maize is not a primary target for commercialization as the nutritional effects will not be directly felt by humans**

Post-harvest supply chain

- **Post-harvest, maize is aggregated and sold** to medium and large-scale processors for production of animal feed for poultry and other livestock
- **Key distributors are feed mills and other retail outlets** spread out across Nigeria

Key products and customer segments

- **Industrial non-human maize products are mostly animal feed** which consumes ~50% of maize produced in Nigeria. In particular, poultry feed consumed the majority (~98%) of maize used for feed production in Nigeria
- **Key customer segments for these products** are livestock farmers and operators of vertically integrated restaurants and food businesses

Economics

- **Processors are driven by profit margins** for animal feed, with gross profit margins estimated at ~18-22% depending on the scale of processing

Factors for scale up

- **Availability of PVA maize is critical to scaling up processing into all forms of finished products,** including animal feed. There is growing acceptance as producers of poultry feed note that the PVA maize feed enriches the color and nutrient content of egg yolk in poultry

Poultry feed

Livestock feed

Source: Sahel Capital Partners, Maize: Enhancing the value of Nigerian farmers, 2017; Mukaila A. Ademuyiwa, Economic Analysis Of Feedmill Industries In Ogun And Oyo States, Southwest Of Nigeria, 2014; Hybrid Feed Website; Dalberg interviews & analysis, 2019

Industrial human consumption is mostly through packaged foods purchased by urban households and institutions

1 Industrial processing for human consumption currently absorbs~15% of produced maize, presenting a viable pathway to scaling up PVA maize consumption in Nigeria

Post-harvest supply chain

- **Post-harvest, maize is aggregated and sold** to small and medium scale processors and FMCG companies for production of packaged foods
- **Key distributors are restaurants and retail outlets** including open markets, stores, and supermarkets spread out across Nigeria

Key products and customer segments

- **Industrial, human maize products are mostly household foods** including cereals and beverages – these consume ~15% of maize produced in Nigeria. Some processors also produce packaged affordable maize meals such as pap
- **Customer segments for industrial, human maize products** are urban and peri-urban households, corporate centers and offices, schools, restaurants, hotels and eateries across Nigeria

Packaged cereal

Economics

- **Processors are driven by profit margins** for finished products, especially as they are mostly targeted at urban areas with both a higher appreciation for packaged goods and willingness to pay

Factors for scale up

- **Availability of PVA maize is critical to scaling up processing,** in turn ensuring availability of PVA maize end products
- **Increased awareness will likely drive market demand,** incentivising more PVA maize processing across Nigeria

Malt beverage drink

Source: Sahel Capital Partners, Maize: Enhancing the value of Nigerian farmers, 2017; Dalberg interviews & analysis, 2019

Increasing health consciousness is driving consumption of products such as PVA maize flour, cereal, etc.

1 Demand for industrial maize products, including flour, cereals and beer, is driven by growing middle-class markets, mostly in urban areas

- The potential for consumption of PVA maize processed products is high in Nigeria. Maize consumption in Nigeria is 22 kg/person/year. More than 10% of Nigeria's maize production is consumed by the industrial sector for the production of beer, malt drinks, maize flakes etc. Survey showed that about 20% of the households consume maize as flour and green
- Nigeria's MY2019/20 wheat consumption is projected at 5.26 million metric tons, a 4% increase over the previous year
- **Processed products in general have a considerable potential in Nigeria**:
    - Estimates show that between 2008 and 2020, there is a $40 billion growth opportunity in food and consumer goods in Nigeria
    - 11 to 18% of urban households have purchasing power and annual incomes over $10,000. Nigerian households with incomes of more than $5,000 a year will increase from a current 20 percent of the population to 27% by 2020, putting them within the target customer base of formal retail chain
    - Increased demand for foods offering convenience and time savings is a trend due to the growing presence of women working outside the home
- **More, evidence show that customers are increasingly health conscious**. A study in urban Nigeria showed that:
    - **80%** of customers **read nutritional information prior to purchase**, and
    - **75%** agreed that **nutritional information on labels influence their purchase decisions**

  This consciousness translates into demand for healthier foods, including PVA maize
- **Large processors recognise that brand loyalty is high among Nigerians.** 70% of consumers say they are brand loyal versus 59% in Africa, as a whole. Once a consumer is converted to the product, they become a regular buyer. Processors recognise this as a driver for PVA maize products
- **Interventions related to awareness and labelling/certification** will have the most impact on this pathway. Consumers in this channel trust that large producers will provide required nutrient levels/healthy foods products and are willing to pay a little more for improved nutrition. They will deliberately choose nutritional products such as PVA maize flour or cereals

Source: Africa's growing giant: Nigeria's new retail economy, 2013; An empirical determination of consumers' reaction to nutritional labeling of prepackaged food products in Lagos, Nigeria, 2012; International Plan Biotechnology Outreach, Maize in Africa, GAIN, Grain and Feed Annual,2019; Dalberg interviews & analysis, 2019

Insufficient Vitamin A content and low awareness are key barriers to industrial human consumption of PVA maize

1 Loss of nutritional value during large scale industrial processing is a significant barrier, meaning that nutritional benefits are lost in the process

- **PVA maize is currently more suited for small- and medium-scale processing as its Vitamin A concentration is not high enough for processing by large FMCG companies.** Some large processors require Vitamin A concentration levels as high as 20 ug/g due to the potential for loss of nutrients during processing. This requirement, which applies only to large-scale processors, is significantly higher than current concentration levels of ~10 ug/g in PVA maize
- **Consequently, large FMCG companies are reluctant to replace non-biofortified maize.** Due to current large-scale processing techniques with potential for loss of nutrients, large FMCG companies are hesitant to substitute non-biofortified maize with higher priced PVA maize
- **Wave 3 varieties of PVA maize are not on track to meet threshold levels required by large FMCG companies.** Wave 3 varieties of PVA maize are scheduled to come on stream by mid-2020, but at concentration levels of 11-14ug/g, these would not meet the threshold for large FMCG companies. However, there are early indications that wave 4 PVA maize varieties (scheduled for release in 2021/22) will meet the required concentration levels for large scale industrial processing

2 Low awareness of the nutritional benefits of PVA maize limits downstream demand, disincentivizing industrial processing into end products

- **In locations with limited or no awareness of / demand for biofortified foods, industrial processors are unwilling to pay a premium for PVA maize.** Farmers and processors have noted this unwillingness and attributed it to an overall lack of awareness of the nutritional benefits of biofortified foods

"We cannot pay a premium for PVA maize if the Vitamin A concentration does not match our minimum threshold, because some of the content will be lost during processing. It takes a lot of years to increase Vitamin A levels in maize. If suppliers meet our quality and nutrient specification, we can definitely look to replace the regular maize"
- FMCG company in Lagos

Source: Dalberg interviews & analysis, 2019

Rural maize consumption is mostly in form of low-cost end products purchased by rural households

1 Small-scale and rural processing absorb ~25% of produced maize, holding the greatest potential for scaling up PVA maize consumption in Nigeria

Post-harvest supply chain

- **Post-harvest, maize is aggregated and sold** to small and mostly rural processors for the production of affordable household foods
- **Key distributors are informal retail outlets** such as street kiosks, open markets, and stores

Key products and customer segments

- **Key products are affordable household meals** like pap, tuwo massara, and boiled or roasted maize which fit within the purchasing power of rural dwellers. These products consume ~25% of maize produced in Nigeria
- **Customer segments** are mostly rural households and a few urban dwellers

Pap / akamu

Economics

- **Processors are driven by profitability** of finished products, especially as these household meals are highly demanded in rural locations across Nigeria

Factors for scale up

- **Availability of PVA maize is critical to scaling up processing,** in turn ensuring availability of associated end products
- **Increased awareness will likely drive market demand,** incentivising more PVA maize processing across Nigeria

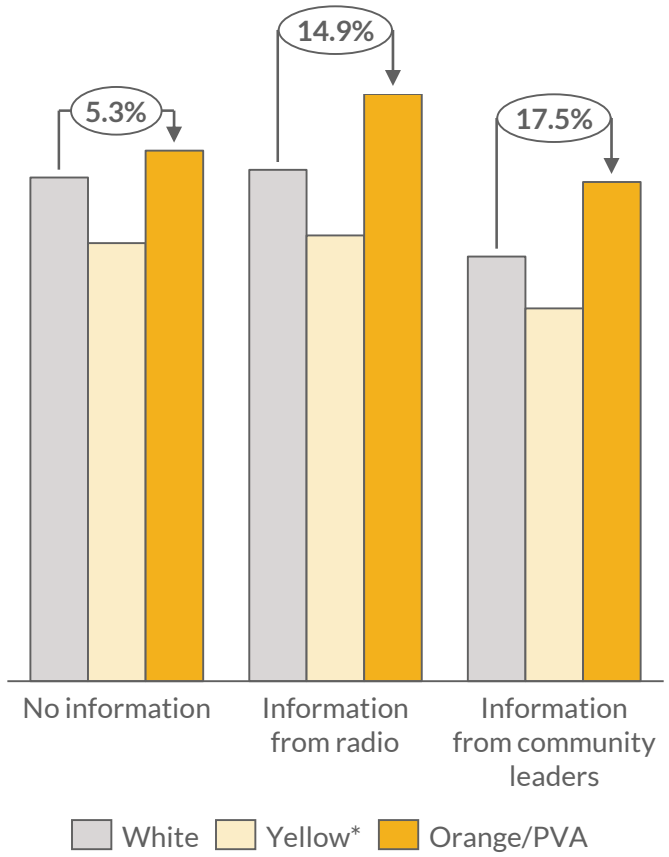
Tuwo massara

Source: Sahel Capital Partners, Maize: Enhancing the value of Nigerian farmers, 2017; CookPad Website, 2019; Dalberg interviews & analysis, 2019

In Zambia, consumers of small scale & rural processed products demonstrated higher WTP, Nigeria could aim to replicate

1 Small-scale and rural demand is driven by the taste preferences for maize as a traditional part of Nigerian cuisine

Zambia rural population WTP for white, yellow and PVA maize



- The Nigeria Food Consumption and Nutrition Survey, conducted by IITA in 2003* shows that **maize is the most frequently consumed food staple in Nigeria**
- Maize is a key part of the diet of rural households. In particular, maize is cooked/boiled, or used to prepare low-cost household meals such as pap *(ogi)*, tuwo, gwate, and donkunu
- **Demand is largely driven by taste, texture and color attributes, customers prefer PVA maize because of its yellowish look, and sweet taste.** Its gelatinous attributes makes it more appealing than non bio-fortified maize to consumers and processors
- However, **some customers note that PVA maize is not adapted for "cold-solid pap"** which is still consumed in regions such as Oyo
- **Rural consumer willingness to pay for biofortified varieties varies significantly by geography, but can be positive.** A study in Zambia showed the potential for higher WTP for PVA maize in rural communities regardless of nutritional information. Such results could translate in Nigeria as consumers in focus groups in southern Nigeria have noted a higher willingness to pay for PVA maize

"Yellow maize is good, you can make good pap with it"
- PVA maize consumer

"White maize is better for starch than yellow maize"
- PVA maize consumer

Source: Meenakshin, Banerji and al., Consumer acceptance of provitamin A orange maize in rural Zambia, 2010, Oyo Focus groups, Dalberg interviews & analysis, 2019
* based on the survey of 6 480 households across federal states

High processor fragmentation and low awareness are key barriers to rural consumption of PVA maize

1 High fragmentation of processors in the value chain poses a challenge for creating effective market linkages between PVA farmers and micro-processors

- **Given low barriers to entry and steady demand for processed maize products in rural areas, there are numerous small scale processors** located in kiosks, street stores, and open markets across rural Nigeria. These processors play a critical role in ensuring the availability of affordable maize end-products such as pap and tuwo massara
- **The high number of small-scale processors necessitates significant investments in awareness building to drive their appetite for PVA maize.** Processors can help drive awareness amongst their consumer base if they are sensitized on the benefits of biofortified foods. However, given the large number of processors, awareness building is likely to be resource intensive and difficult to simultaneously execute in multiple geographies

2 Low awareness of the nutritional benefits of PVA maize limits downstream demand, disincentivising small-scale processing into end products

- **In locations with limited or no awareness of / demand for biofortified foods, small-scale and rural processors are unwilling to pay a premium for PVA maize.** Farmers and processors have noted this unwillingness and attributed it to an overall lack of awareness of the nutritional benefits of biofortified foods

"After my contract with the current seed company I work for, I will like to set up my own business and only sell PVA maize seed because I really like the nutritional content and the latest Sammaz 52 variety is simply fantastic. The only thing that can make me change my mind is market demand, because most people here don't know anything about biofortified maize, so they tend to want to buy it at the same price as regular maize in the market. It is only the few elites and processors in this area that understand the value and are willing to pay a higher price for PVA maize"
- PVA maize seed producer in Kaduna

Source: Dalberg interviews & analysis, 2019

On-farm consumption is minimal and mostly through grains & low-cost end products given to farmer households and friends

1 **On-farm consumption and gifts have the lowest potential to reach target populations given ~10% of maize production is consumed by these channels**

Post-harvest supply chain

- **Post-harvest, maize is consumed by farming households** who use rudimentary processing techniques to prepare affordable household foods
- **Maize is also gifted to family and friends** either for consumption (~1%) or as seed for replanting (~2-3%)

Key products and customer segments

- **As with the small-scale processing pathway, key products here are affordable household meals** like pap, tuwo massara, and boiled or roasted maize. On-farm consumption, either for food or gifts, consume ~10% of maize produced in Nigeria
- **Customer segments** are mostly farming households, and their friends and families

Pap / akamu

Economics

- **Farmers are indifferent about the economics of on-farm consumption** given it comprises a small portion of their overall maize production. They happily provide gifts of maize during visitations or community events

Factors for scale up

- **Increased awareness will likely drive market demand,** incentivizing more PVA maize cultivation which in turn will increase on-farm consumption[4]
- **Availability of PVA maize seeds is critical to scaling up on-farm consumption**

Tuwo massara

Source: Sahel Capital Partners, Maize: Enhancing the value of Nigerian farmers, 2017; CookPad Website, 2019; Dalberg interviews & analysis, 2019

Consumption of PVA maize by farmers is positively correlated with awareness on its nutritional benefits

1 Informal gifting of maize is mostly for the planting of seed, and not for consumption

- PVA farmers estimate that less than 1% of their total production is gifted to family and friends
- Most of the informal gifting is for PVA maize seeds and not harvested products

"I obtained the PVA maize seed from a church member"
- PVA maize producer in Oyo

2 Farmer household consumption is higher for subsistence farmers with lower incomes, and is thus often driven by necessity than positive attributes such as nutritional value

- **10 – 15% of the maize is consumed on farm by rural households.** The maize is consumed a wide range of products including pap *(ogi)*, tuwo, gwate, and donkunu
- **Farmers are more inclined to consume PVA maize due to their awareness of the product.** They plant it for its market potential but consume it foremost because they are unable to sell it
- On farm consumption is considered a small portion of their overall production

"I will keep between 4 to 10 kg of PVA maize for my home consumption"
- PVA maize producer in Oyo

Source: Oyo Focus groups, Dalberg interviews & analysis, 2019

Seed availability and low awareness are key barriers to scaling on-farm consumption of PVA maize, although not a priority

1 **Inconsistent availability of PVA maize seeds stifles farmer uptake forcing some farmers to switch back to analogue varieties**

- **PVA maize seeds are not readily available across Nigeria, limiting farmer uptake.** Although acceptance of PVA maize is growing in parts of south western and northern Nigeria, there are still weak linkages in the value chain that sometimes result in limited availability of seeds. This has negative implications for farmer uptake, resulting in some farmers switching back to analogue maize varieties

2 **Low awareness of the nutritional benefits of PVA maize limits market demand and disincentivizes further cultivation**

- **Gaps in awareness across several locations in Nigeria do not encourage farmers to cultivate PVA maize.** Being strongly correlated with market demand, low awareness of the nutritional benefits of PVA maize translates into low demand, disincentivizing further cultivation by farmers

"Although I sometimes plant PVA maize just to feed my family with nutritious stuff, the real game changer for me will be if people start recognizing the value of this biofortified maize and begin to demand more for it. If that happens, I can switch totally to planting only PVA maize and have a steady supply from which I can also feed my family"
- PVA maize farmer in Kaduna

Source: Dalberg interviews & analysis, 2019

Given the barriers across the various pathways, opportunities lie in increasing processing and strengthening value chain linkages

	Key opportunity area	Description
SHORT-TERM OPPORTUNITIES	**Increased small scale processing**	• Given small scale processing is the biggest lever for driving human consumption of PVA maize, sensitize small-scale rural processors on the importance of PVA maize so they can serve as "change agents" further creating awareness amongst their customer base • In areas with low awareness and demand, incentivize small-scale processors to progressively replace small volumes of their analogue maize with PVA maize to begin to stimulate farmer interest and generate downstream demand
	Strengthened value chain linkages	• Invest in strengthening value chain linkages across the PVA maize value chain, but particularly upstream in connecting seed producers with farmers in underserved areas
	Large scale processing	• In the long-term, invest in increasing Vitamin A levels in PVA maize towards the required 20 ug/g concentration required for large scale processing. This will likely unlock demand from large processors, resulting in increased industrial human consumption of PVA maize

INITIAL HYPOTHESES FOR DISCUSSION DURING DUBAI WORKSHOP

Source: Dalberg interviews & analysis, 2019

Policy and financing

Gaps in policy implementation and financing further limit the potential for PVA maize commercialisation in Nigeria

- Beyond the specific value chain for PVA maize, **there are a number of factors that could support or hinder ability to commercialise**. In this analysis we focus on two: policy, and access to finance. Given the timeframe and ambition of the programme, the analysis focuses on aspects of policy and finance that GAIN and HarvestPlus could feasibly influence[1]:
  - Interpretation and delivery of existing policy, rather than creation of new policies / changes to existing policies
  - Access to finance for value chain actors (rather than consumers)
- In terms of 'policy', the analysis considers multiple types of policy: norms, standards, and regulation. The analysis also looks at difference units of scale e.g. national/federal, regional/state, city level
- **For PVA maize in Nigeria, we see three main barriers in policy and finance**:

Unclear implementation parameters

Broad policy support for biofortification is not backed up with clear implementation plans or dedicated budget lines

Lack of regulatory enforcement

Whilst regulatory pressure exists for general food fortification initiatives, this has not extended to biofortification

Limited financing

Financing is currently constrained by the absence of a compelling business case and unfavorable lending conditions for value chain actors

(1) Beyond traditional pillars of [written] policy, and finance, there are deeper, often cross cutting issues that will impact on the ability of the biofortified crop to reach commercial pathways to scale:

1. Policy coherence – Do different decisionmakers have clear and aligned visions for how a biofortified system should work?
2. Institutional incentives – Is biofortification a priority or not?
3. Effective coordination – Are the different actors talking with one another? Are there clear platforms for alignment?
4. Capacity & agency – Do the different actors in the system have awareness as well as the technical capacity or general capabilities to scale biofortification?

Often these issues are very hard to influence, and outside the remit of GAIN/HarvestPlus to intervene in. However, they are important to note and track, especially where they are crucial to a given pathway e.g. Government capability as crucial to a public procurement led pathway

Source: GROW Africa, Market Opportunities for Commercial Cassava, 2015, Dalberg interviews & analysis, 2019

Biofortification policies do not include implementation plans, regulatory enforcement initiatives or certifications

1 Nigeria's policy environment broadly supports biofortification, but lacks clear implementation plans and dedicated budget lines

- **There is broad policy and regulatory support for food fortification in Nigeria.** Six policy documents reference the role of biofortification in combatting malnutrition, with two policies – the Agriculture Sector Food Security and Nutrition Strategy, and National Guideline on Micronutrients Deficiency Control – advocating for the scaling up of PVA maize production to reduce malnutrition in Nigeria
- **However, these policies lack clear implementation plans and dedicated budget lines for biofortification.** The policies neither assign coordination responsibility nor earmark budgetary resources for implementation. Consequently, there is little information available to track the implementation of these policies and identify areas for increased intervention. However, nutrition policies are typically championed by the Federal Ministries of Agriculture and Health, both of which are well-recognized entities capable of implementing national mandates

2 Current regulatory mechanisms only support specific large scale food fortification initiatives, and are yet to include standards or certifications for biofortified foods

- **Nigeria's food and drug agency, NAFDAC, has created a directorate to enforce Vitamin A fortification of several high-demand foods including maize derivatives like flour.** NAFDAC forbids sales of any of these foods not fortified with Vitamin A, and is authorized to confiscate such food stocks
- **In contrast, regulatory pressure has not been extended to biofortified foods, limiting high-end processor appetite.** Neither NAFDAC nor other national food agencies have released standards or certifications to guide the production and processing of biofortified foods. Some processors see certifications as inevitable in promoting high quality biofortified products and would rather invest in this aspect of regulatory compliance before scaling up PVA maize processing

Source: HarvestPlus, Global review of regulations and standards for biofortified products, 2019; GAIN, Improving Food Security and Standards in Nigeria, 2015; Dalberg interviews & analysis, 2019

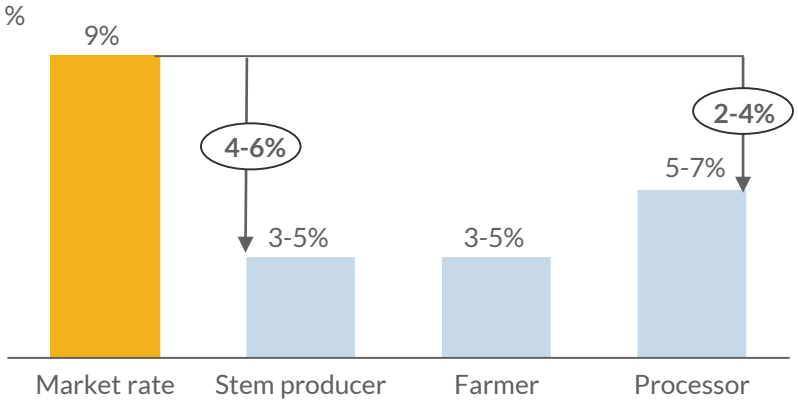
Current financing packages are not well suited for the commercialisation of PVA maize in Nigeria

1 Financing for PVA maize value chain actors is limited by the lack of steady market demand and unfavorable lending conditions

- **Several financing packages (e.g. CACS, NIRSAL)* have been dedicated to improving agricultural production in Nigeria, broadly covering the production of biofortified crops.** These initiatives focus on high-demand crops like maize, and the funding is designed to be accessible by farmers and other value chain actors including seed producers, aggregators and processors
- **However, these and other packages can only be used to finance agricultural value chains for which there is a ready market or guaranteed offtake**. Several banks and other financial institutions have emphasized that they will not disburse loans to value chain actors until there is proven market demand for PVA maize
- **Additionally, value chain actors prefer more lenient financing terms than the market currently provides.** In describing their ideal loan terms, PVA maize value chain actors mentioned interest rates that were below current market rates for agriculture lending. As illustrated in the chart below, actors in primary production (i.e. seed production and farming) and processing preferred rates that were 4-6% and 2-4% lower than the going rate respectively, suggesting that current financial support is not ideal for PVA maize commercialization

"If you can provide guaranteed offtake for biofortified produce, we will even get you the farmers to engage in production. We have access to thousands of farmers across the country, and everybody along the entire agriculture value chain is a potential customer of ours"
- Financial institution in Abuja

Interest rates on agriculture loans (market rate vs preferred rate by PVA maize value chain actors)



Note: (*) Commercial Agriculture Credit Scheme, Nigeria Incentive-Based Risk-Sharing System for Agriculture Lending; Dalberg interviews & analysis, 2019