Commercialization assessment: Vitamin A cassava in Nigeria

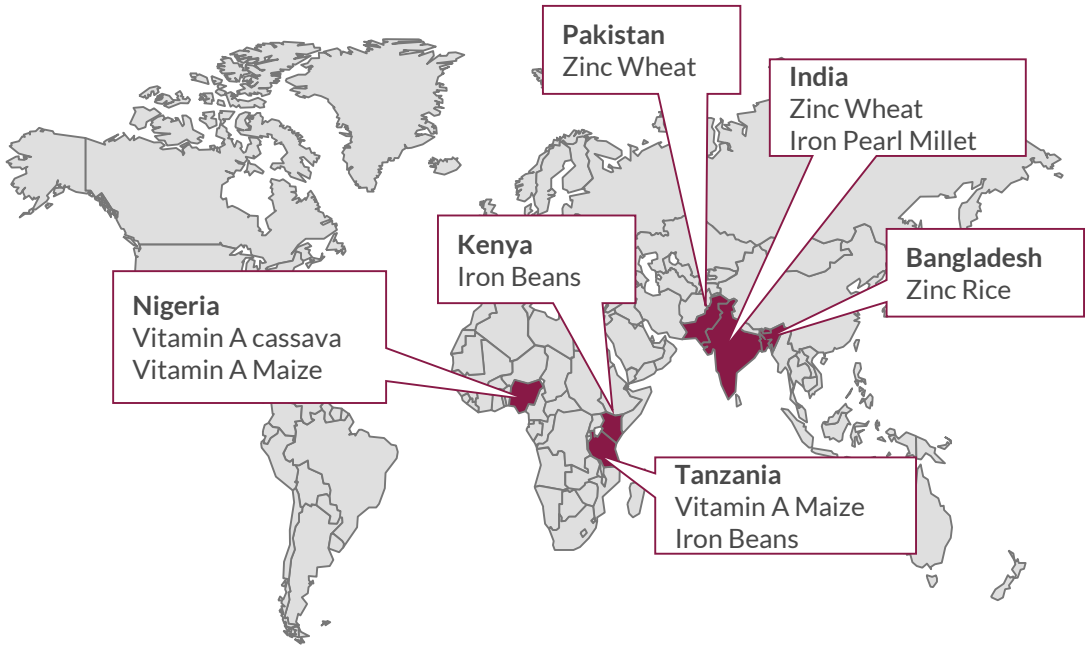
FINAL REPORT FOR GAIN AND HARVESTPLUS

DECEMBER 2019

Recap: Programme context

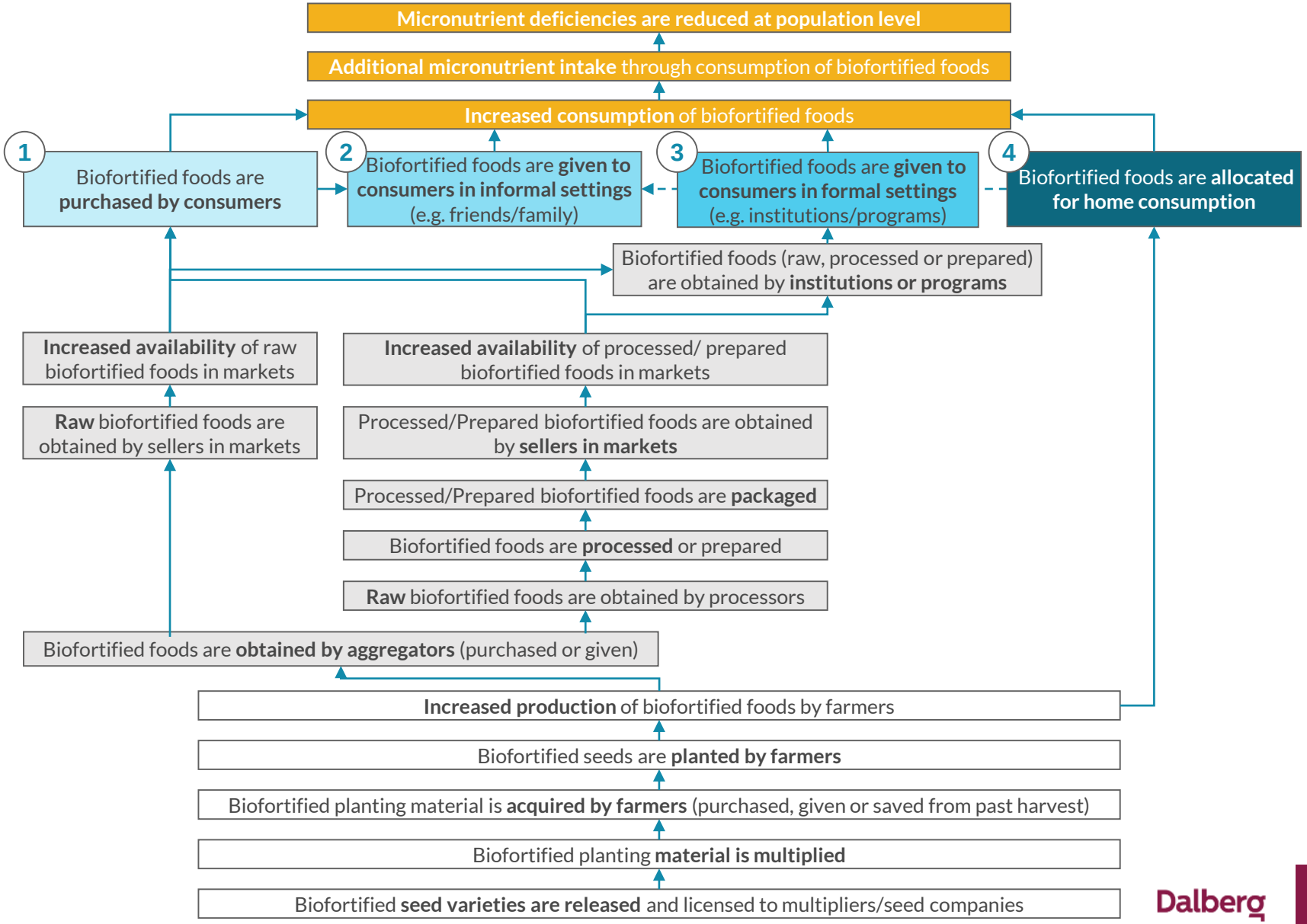
- GAIN and HarvestPlus share an ambition to expand coverage of biofortified nutrient dense foods to at least 200 million consumers. The overall vision of this program is to scale up the commercialization of biofortified foods. Vitaamin A cassava in Nigeria is one of the nine selected crop/country combinations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

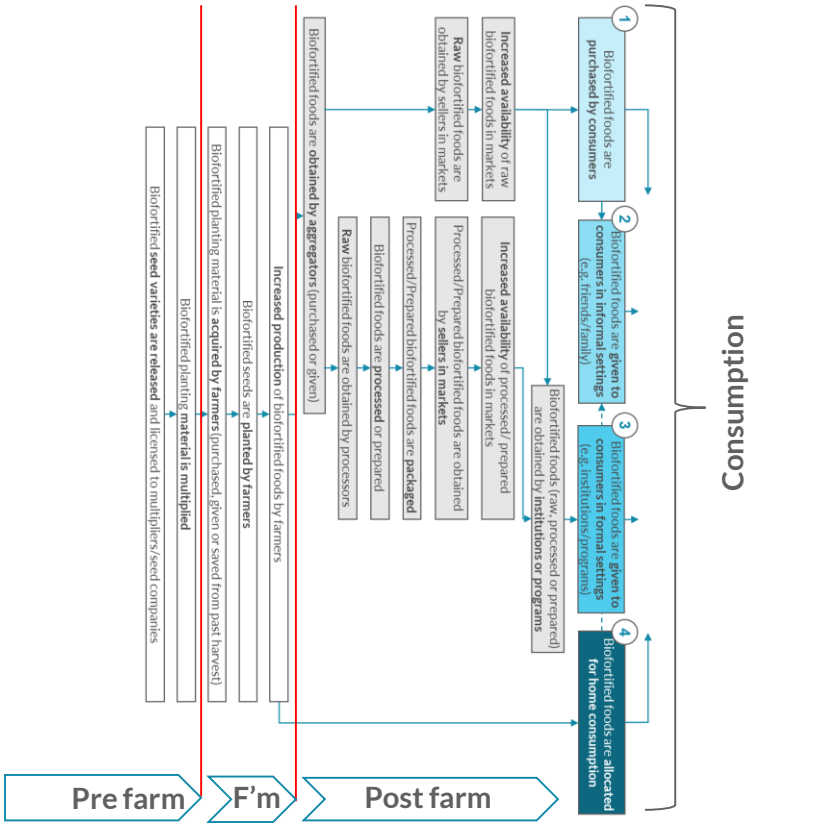
Alignment on the understanding of commercialization will potentially have significant impacts for scale that is feasible, programming, and resource allocation across the portfolio, amongst other things. On farm consumption and public procurement are significant parts of the value chains for a number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

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

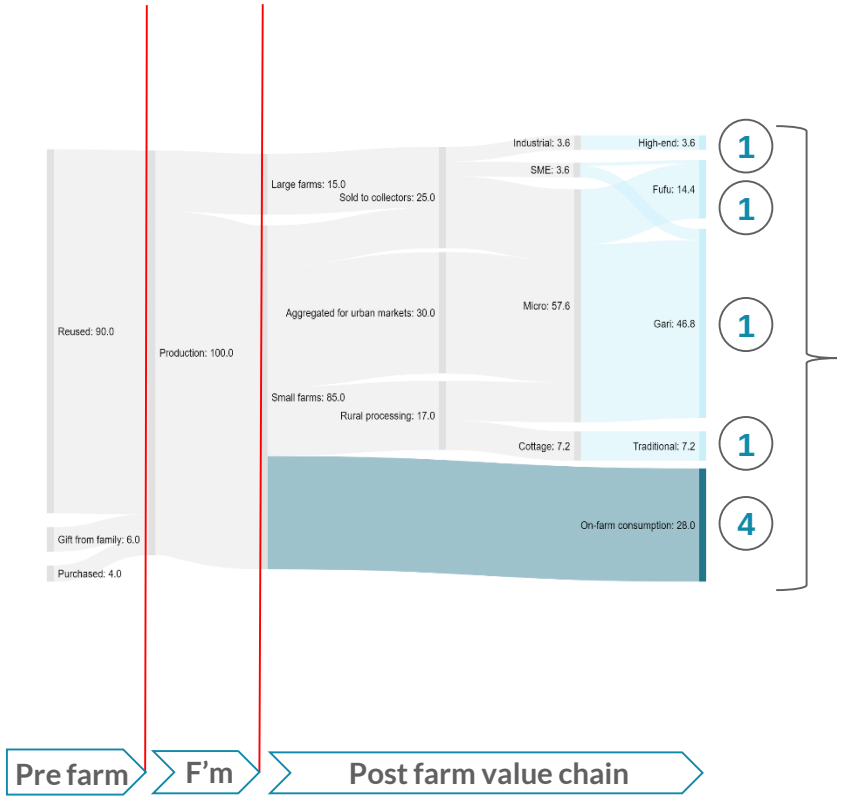
How to read this report (1/2)

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



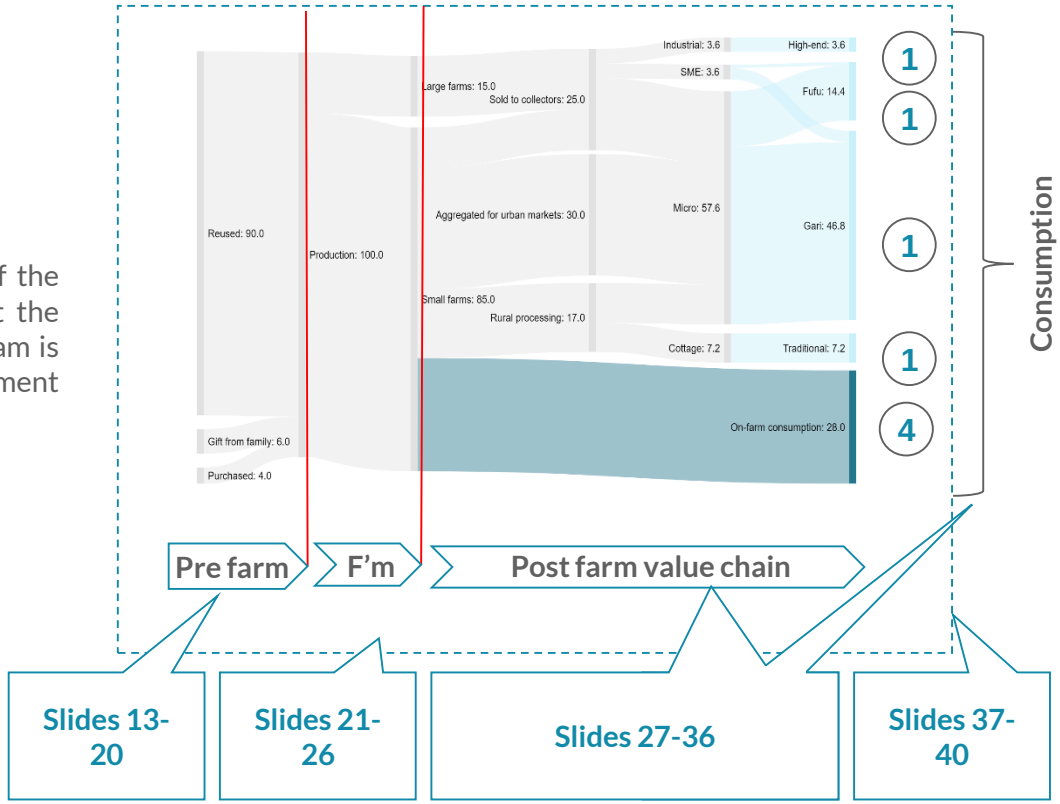
'Sankey diagram' showing relative flows through the value chain



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

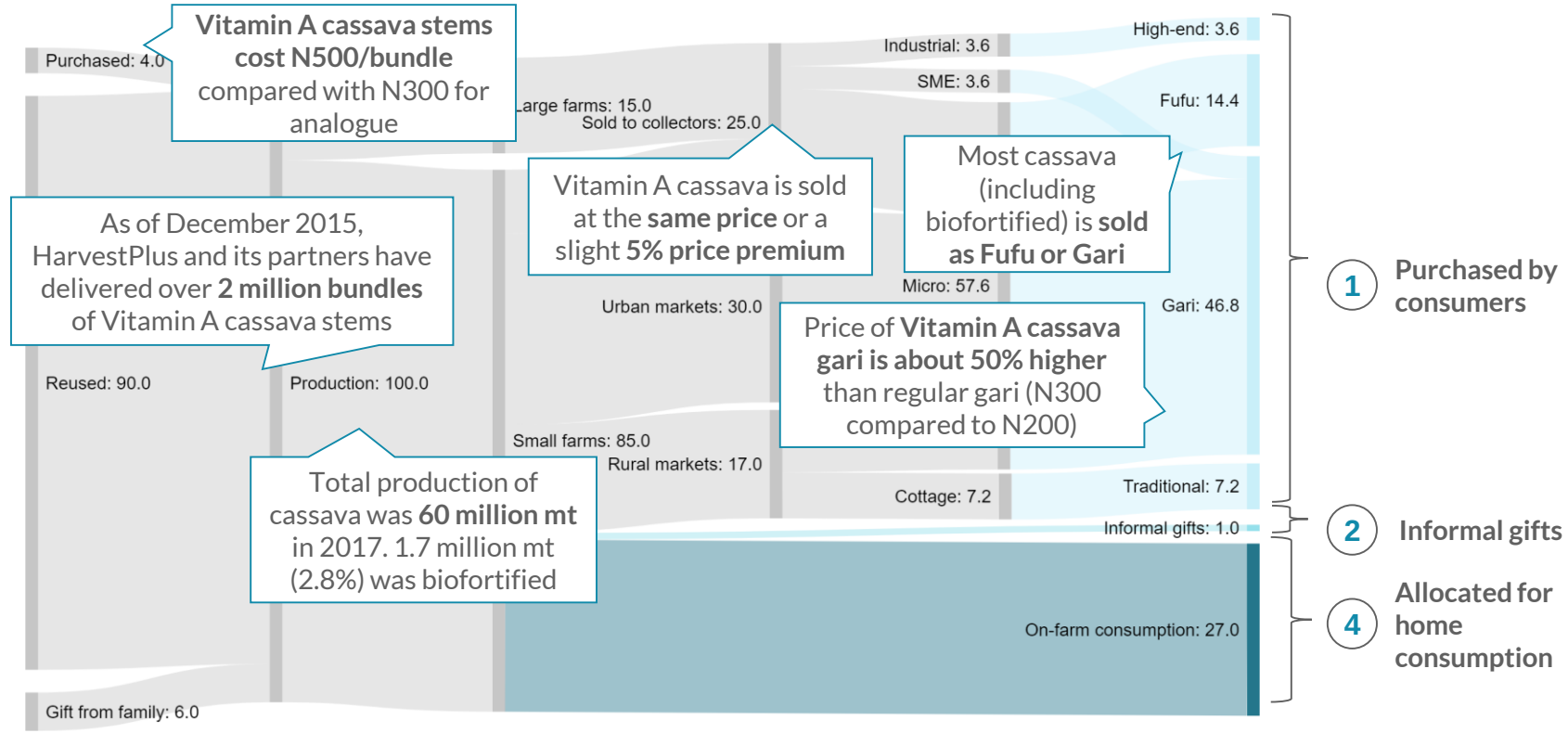
- The barriers Dalberg identifies at each stage of the value chain should align with and complement the 'Contextual analysis' and 'Barriers' that each team is feeding into the Country Strategy Development template



Executive Summary

Executive summary – Overview

Cassava is a major staple food in Nigeria, consumed daily by more than 100 million people and with an average daily consumption of 230 g per person in 2004.
Nearly 70% of the cassava is processed into fufu and gari, tapping in the micro-industry and rural processing of Vitamin A cassava is the more effective pathway to commercialisation.



Source: FAOSTAT, Production quantity Nigeria, 2017; TechnoServe & Harvest Plus Nigeria, Diagnostic and Opportunity Identification, 2017; AJIFAND, Vitamin A cassava in Nigeria: crop development and delivery, 2017; Dalberg Interviews & Analysis 2019

Executive summary – Main barriers

Whilst **Nigeria is the biggest global producer of cassava, at 60 mt in 2017, just 2.8% is biofortified**. Switching to newly released biofortified varieties of cassava could provide up to 40% of the Vitamin A recommended daily allowance for children under five, in a country where nearly one in three children under five and one-quarter of all pregnant women are Vitamin A deficient.

To assess the potential for commercialisation of Vitamin A cassava in Nigeria, we have broken the market down into four main pathways (i) high-end (highly processed) products which accounts for 3.6% of the market, (ii) micro-industry and rural processing – which accounts for the majority of the market, 68.4%, (iv) informal gifts, accounting for 1% and (v) on-farm consumption which accounts for 27%.

Commercialisation is limited by three main barriers:

1. For micro-industry and rural processing' customers, **texture attributes related to starchiness, gelatinousness, and elasticity problems** and **lack of awareness of nutritional benefits limits demand for Vitamin A cassava products such as gari and fufu**, which represent 60% of all cassava consumption
2. For medium and large-scale companies
   - **inconsistent supply of Vitamin A cassava** limits investment in production of industrial products
   - **uncertainty about meeting minimum nutritional standards** particularly for institutional orders such as the government feeding programme **could limit upscaling**

The texture challenges are likely to be resolved by Wave 3 varieties, due for release in 2020. When this happens, three possible paths, in order of importance, emerge to facilitate greater commercialization of Vitamin A cassava:

1. **Stimulate downstream demand** consumers of basic cassava products (fufu and gari), and hence proving the business case to micro-processors and SMEs, which account for nearly 70% of the market, allowing upscale by strategic enterprises and opportunistic smallholders
2. **Reinforce linkages between stem producers and farmers** to ensure a sustained demand in terms of quantity and quality for all processors
3. **Introduce certification for Vitamin A cassava** to unlock part of the 3.6% market share taken by industrial consumers that require formal Vitamin A standards

Source: IFAD, A cassava Industrial Revolutionin Nigeria, 2004, HarvestPlus, New, More Nutritious Vitamin A cassava Released in Nigeria, 2004, Dalberg Interviews & Analysis 2019

Recommended opportunity 1 for GAIN/HarvestPlus

1. Stimulate downstream demand

Urban and rural consumer groups have all demonstrated in-principle willingness to pay for Vitamin A cassava, as high as a 31% price premium in Oyo for Vitamin A gari when aware of benefits. These groups represent more than 60% of the market (46.8% consuming gari and 14.4% fufu), but the majority are not yet aware of Vitamin A cassava's nutritional benefits. Stimulating market demand through awareness campaigns will encourage upscale by strategic enterprises and opportunistic smallholders, as uncertainty about market demand will be removed for micro-processors and SMEs.

We believe GAIN/HarvestPlus should invest in marketing and education to increase awareness of Vitamin A cassava, as the retail channel has higher scale potential. However, the high fragmentation of micro-processors remains a serious challenge to uptake at scale.

Source: Dalberg Interviews & Analysis 2019

Recommended opportunity 2 for GAIN/HarvestPlus

2. Reinforce linkages between stem producers and small farmers

Once demand is proven, sustained production of Vitamin A cassava could be addressed through improved linkages between stem producers and farmers as this affects the whole value chain. The demand of basic gari and fufu is mainly serviced by smallholder farmers, who get their seeds from large farms undertaking multiplication from HarvestPlus. As such, the weak linkages between the International Institute of Tropical Agriculture (IITA), Harvest Plus and partners, and smallholders and the large farms who supply their seeds will need to be strengthened. There are a number of ways GAIN/HarvestPlus can support these value chain linkages, including:

- **Outreach.** Supporting farmer outreach to broaden connections between smallholder farmers, agrodealers and stem producers through marketing and information campaigns. This would require a short-term investment and would need to be backed by seed availability

- **Extension services**. Reinforcing government networks of extension services and demonstration plots is another avenue to connect farmers to services. However, the limited use and effectiveness of these services in Nigeria may restrict the efficacy of this approach

- **Clustering**. Facilitating clustering of smallholder farmers in associations or cooperatives in order to create direct links between cooperatives and processors. The high fragmentation of both smallholder farmers and micro-processors makes this both a potentially high impact and challenging approach

We believe that the most effective intervention would be outreach to farmers in order to establish seed links, and clustering of farmers to facilitate downstream linkages to processors. Much of this has already been conducted by HarvestPlus programmes, hence we would recommend the scale-up of these activities into areas beyond south west of Nigeria.

Source: Dalberg Interviews & Analysis 2019

Recommended opportunity 3 for GAIN/HarvestPlus

3. Introduce certification for Vitamin A cassava

The Vitamin A concentration levels desired by high-end processors and government feeding programs are unlikely to be met by Wave 3 (11 – 14 ug/g). Processors show great interest in the new wave of Vitamin A cassava and have already started testing production of products such as Vitamin A cassava chips.

The prospect of marketing their products as high vitamin A products could accelerate the commercialisation process. Industrial buyers and SMEs with significant purchasing power are interested in biofortified products and see a real market potential if they can certify the Vitamin A concentration, as this would differentiate Vitamin A cassava products on the market and demonstrate additional value-add.

As these buyers account for approximately 7.2% of the market, this segment of the market could be penetrated but would require policy changes which would make this a long-term solution.

Source: Dalberg Interviews & Analysis 2019

Pre-farm

Over 1.5 million households are consuming biofortified cassava, with two varieties released in the market

Vitamin A cassava	
Delivery stage	Saturation
Number of varieties released	First wave: *TMS 01/1371*, *TMS 01/1412*, *TMS 01/1368* Second wave: *TMS 07/593*, *TMS 07/539*, *NR 07/0220*
Household reach	1.5M households expected by end of 2018
Volumes	1.7 million mt (2017)
Agronomic characteristics	• Peak planting periods of March – June • Mostly grown in the south east due to easier accessibility to stems (pilots for Vitamin A cassava) • Low (30-35%) dry matter (starch)
Nutritional characteristics	• Higher vitamin A levels

Biofortified market composition

- Vitamin A cassava is in its second wave saturation and has been distributed to farmers in 25 states
- Vitamin A cassava makes up 2.8% of the total cassava market
  - Majority of Vitamin A cassava is consumed in Oyo, Akwa-Ibom, Benue, and Imo due to presence of IITA and Harvest plus in these pilot regions

Biofortified characteristics

- Vitamin A cassava stems have higher beta-carotene levels* and are generally more disease-resistant than analogue
  - Evidence from the field suggest that Vitamin A cassava is not as pest-resistant as analogue crops, Rodents are attracted to it because of its higher Vitamin A content
  - The 2nd wave had 57% more nutritional content but has still not reached international standards of biofortification

Wave	Variety name	Carotenoid content (FW - ppm)*	Fresh root yield (%)	Dry matter (%)
1	TMS 01/1371	8	20.1	30.7
	TMS 01/1412	7	29.8	30.1
	TMS 01/1368	7	26.7	33.4
2	TMS 07/0593	11	21.5	34.6
	TMS 07/0539	11	20.3	31.9
	TMS 07/0220	11	23.1	32.7

Future releases

- Wave 3 of Vitamin A cassava is expected in 2020. The new wave will have higher starch and vitamin A content, and will be less-exposed to aflatoxin contamination

Souce: HarvestPlus Nigeria Outcome Monitoring Listing Survey Report, 2018. TechnoServe & Harvest Plus Nigeria, Diagnostic and Opportunity Identification, 2017; Vitamin A cassava in Nigeria: crop development and delivery, Agrifad 2017, Dalberg Interviews & Analysis 2019

*Note: (*) Vitamin A represents approximately 80% of carotenoid content

Biofortified stems are produced by Harvest Plus and 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 released in 2011 and 2013 respectively • Wave 3 is due to be released in 2020	• Stems are distributed by Harvest Plus in Oyo, Akwa Ibom, Kaduna, and Benue states, and subsequent distribution is done by several partners in expansion states • Developed bundles are given to large farms to multiply • Multipliers distribute bundles to smallholder farmers at a cost of approximately N500 – N2000/bundle	• Just 4% of farmers buy stems; farmers tend to re-use stems from previous years (90%) or collect from friends and family (6%) • 51% of farmers shared Vitamin A cassava stems with fellow farmers • Direct link to IITA or Harvest Plus is the easiest way to obtain stems
Actors	• IITA, Harvest Plus, CIAT, and few other actors such as the Institute For Agricultural Research (IAR) in Kaduna develop stems • Two main actors in stem/tuber development are Harvest Plus and IITA	• Stems are multiplied on large farms in partnership with large producers such as Niji, and then distributed to smallholder farmers. • 1 main actor (Harvest Plus). ~6 large producers (Greenspore Seeds, Seedco, GoldAgric, Techniseeds, Maina Seeds, Premier Seeds)	• Farmers and agro-dealers buy stems from public/private institutional distributors, or private distributors however stems are scarce in many parts of Nigeria • ~7 institutional distributors (IITA, Harvest Plus, OSADEP, etc.) and ~3 key private distributors. (Niji, etc.)
Economics	• N/A	• N/A	• 40-60% more expensive than analogue stems per bundle

Source: Sahel, Maize: Enhancing the livelihoods of Nigerian farmers, 2017; TechnoServe & Harvest Plus Nigeria, Diagnostic and Opportunity Identification, 2017; Dalberg analysis; HarvestPlus, Nigeria Nutritious Food Fair Celebrates Vitamin A cassava and Maize, 2018, Dalberg Interviews & Analysis 2019

Dalberg

Barriers to scaling biofortified stems include high stem reuse, low levels of production, and the higher price of stems

	Research and development	Seed/vine release	Agricultural Supply
Features	• Wave 1 released in 2011 • Wave 2 released in 2013 • Wave 3 to be released soon	• Stems are released by Harvest Plus in 4 pilot states, and subsequent releases done by several partners in expansion states.	***Barrier 1*** **Low accessibility of new varieties** Only 4% of farmers buy stems due to accessibility issues and high prices; others are forced to source through gifted stems.
Actors	• IITA, Harvest Plus, and few other actors develop seeds. • 2 main actors in stem/tuber development are Harvest Plus and IITA.	***Barrier 2*** **Limited stem production** A limited number of private stem producers have invested in multiplication of Vitamin A cassava given low demand and access to finance.	• Farmers buy stems from public/private institutional distributors, or private distributors. • ~7 institutional distributors (IITA, Harvest Plus, OSADEP, etc.) and ~3 key private distributors. (Niji, SeedCo, etc.).
Economics	• Volumes and prices	• N/A	***Barrier 3*** **High stem prices** Vitamin A cassava stems are on average 40-60% higher (N500 – N2000/bundle) than analogue varieties depending on location and scarcities.

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

Only 4% of farmers buy stems due to accessibility issues and high prices; others source through gifted stems

Root cause

- **Most smallholder farmers live in remote areas**, far from stem markets
- Stems are supplied either through gifts from friends and family or bought at high prices
- **The purchase of new stems is burdensome for these farmers** who have to travel to markets and pay transportation costs
- For farmers far from IITA and HarvestPlus distribution areas, the process is long and the cost even higher
- Furthermore, **high perishability of cassava** creates a sense of urgency in sourcing stems from nearest locations
- Thus, **most smallholder farmers prefer to reuse stems from their harvests** and avoid the waiting time for new stem-acquisition, regardless of cassava variety

"IITA needs to set up a presence in the north, probably in influential institutions like ABU, Zaria, or strategic locations like Adamawa. Right now, they have limited influence in the North because they're based in Western Nigeria"
- Biofortified producers and processors Association

Impact on potential to scale

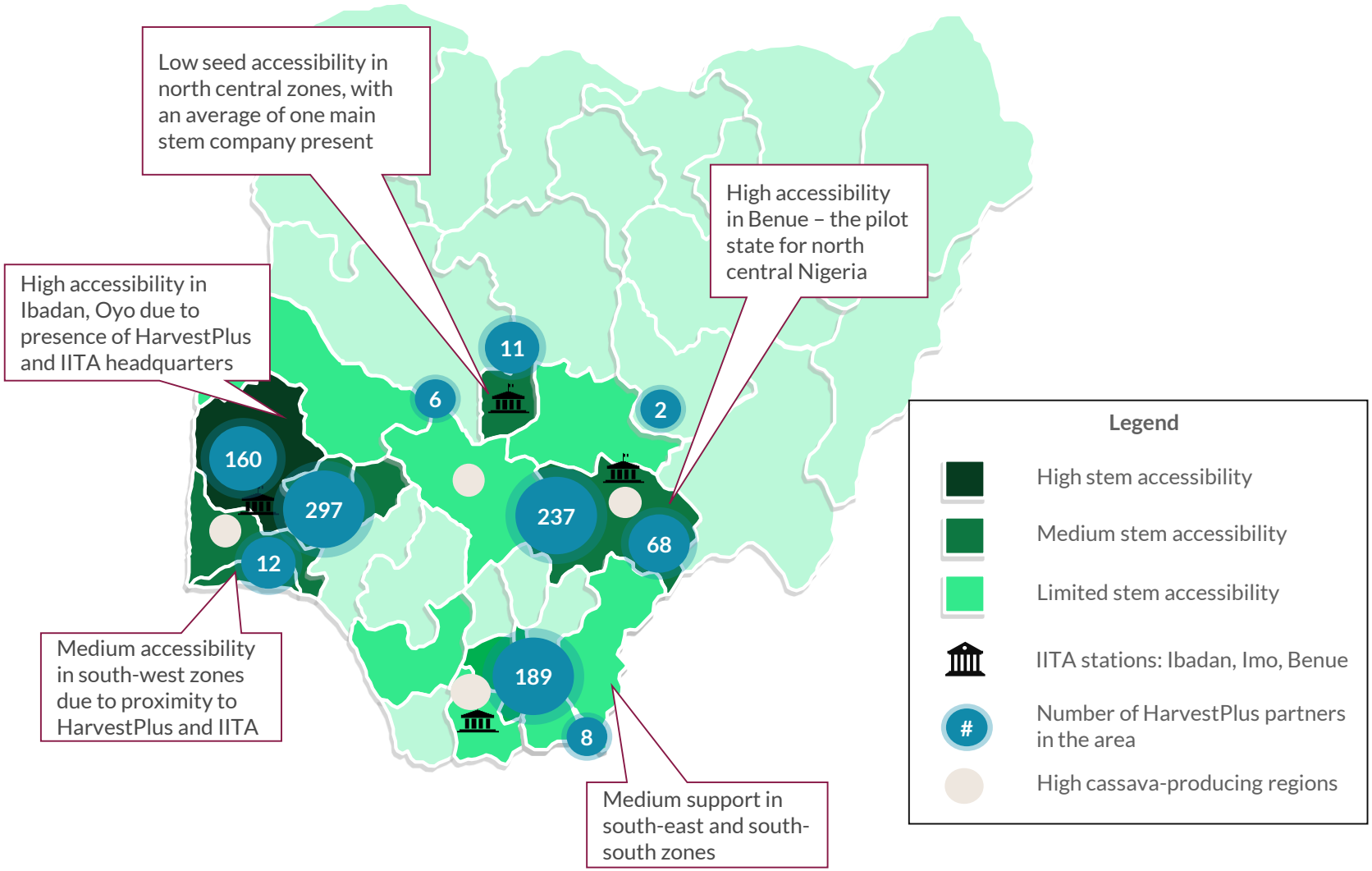
- Depending on the region, **acquiring vitamin A stems is difficult and costlier,** impacting potential to scale in parts of Nigeria
- Reusing stems can lock farmers into growing old varieties instead of Vitamin A cassava
- Evidence also suggests **that reusing of stems depletes yields by each year**
- Thus **reusing stems can affect Vitamin A cassava reputation in terms of quality** with farmers and widespread uptake

"when you reuse stems more than three times, the yields start to drop"
- Vitamin A cassava farmer in Lagos

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

Source: HarvestPlus Nigeria Outcome Monitoring Listing Survey Report, 2018, Lagos Focus Group, Stakeholder Interview, 2019, Ibadan Focus Group, Stakeholder Interview, 2019, Dalberg Interviews & Analysis 2019

Low stem accessibility 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

A limited number of private stem producers have invested in multiplication given low demand and access to finance

Root cause

- **Farmers in the north generally have lower Vitamin A cassava awareness** and lower agronomic expertise due to limited IITA technical support in those regions
- Thus, demand for Vitamin A cassava stems is lower than the market potential
- Large stem producers are reluctant to expand Vitamin A cassava stem production without **awareness support and market demand**
- Stem producers have received limited financial support for Vitamin A cassava stem expansion. Banks are willing to invest but require clear market demand first
- Thus stem producers cannot commit to expanding Vitamin A cassava stem multiplication

"We scale up according to the support from HarvestPlus. If I have industrial demand, I can plant more"
- Integrated Vitamin A cassava stem producer in Oyo

Impact on potential to scale

- Low stem production means that **stems are not readily available in the marketplace** to agrodealers, distributors, and ultimately, to farmers
- Thus farmers cannot produce Vitamin A cassava stems at sufficient volumes to meet demand
- This leads to fluctuating production of Vitamin A cassava and **inconsistent supply** for processors, who then cannot rely on Vitamin A cassava to produce a consistent product
- Given supply uncertainties, **processors are hesitant to increase production** of existing Vitamin A cassava products **or create new Vitamin A cassava product lines**

Source: HarvestPlus Nigeria Outcome Monitoring Listing Survey Report, 2018; Niji Foods, Stakeholder Interview, 2019; Lagos Focus Group; Dalberg Interviews & Analysis 2019

Stem prices are on average 30-50 % higher than analogue varieties

Root cause

- There is enough stem development from IITA and HarvestPlus; however, stem supply is not the same across all regions in Nigeria
- Thus, farmers in some areas have difficulty accessing stems, leading to higher prices.
- The presence of few, **verified Vitamin A cassava stem producers can allow for monopolistic price control**
- Thus **prices can be unstable** and very expensive with peak scarcity
- **Vitamin A cassava stems are ~30-50% more expensive than analogue stems**
- Average price of Vitamin A cassava stem is N500 per bundle; compared to N300-N400 per bundle for analogue stems

Impact on potential to scale

- **Vitamin A cassava does not have other significant advantages** such as higher yields or earlier maturity
- Thus, price premiums can put analogue cassava as top choice for farmers, reducing demand
- **Farmers want affordably-priced stems** that allow them to maximize the profit potential of the produce after harvest
- Given uncertainties with demand and consumer preferences, some farmers are skeptical about continued production
- This ultimately affects supply and limits the scale of Vitamin A cassava

Source: HarvestPlus Nigeria Outcome Monitoring Listing Survey Report, 2018; Lagos Focus Group, 2019; Dalberg Interviews & Analysis 2019

On farm

Three main archetypes produce Vitamin A cassava stems in Nigeria: pilot farmer, opportunistic and strategic enterprise

Pilot area farmers

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

Typically gets seeds from
- Mostly gets stems from IITA, Harvest Plus, religious groups, and reuses stems in next harvest.

Decision drivers
- Nutrition, cheap stem prices and good yields

Consumption choices
- Interested in selling but need more customer demand. Keeps some of the cassava 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 stems, but is more likely to buy new stems if convinced of the potential profit

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

Consumption choices
- Majority (~60-85%) 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
- Able to produce at scale to meet demand from formal collectors and processors but will not do so without proved market demand

Typically gets seeds from
- More likely to buy stems

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: HarvestPlus, Nigeria Outcome Monitoring, 2019; Dalberg Interviews & Analysis 2019

Pilot area farmers switch back to analogue cassava due to limited access to stems

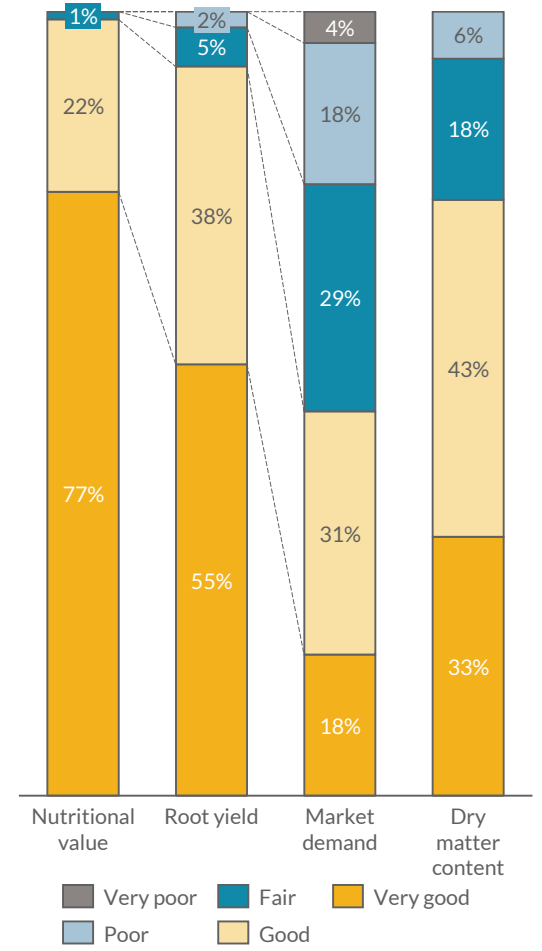
1 Pilot area farmers' planting rational is driven by Vitamin A cassava nutrition benefits but believe it has unfavorable characteristics

- **99% of pilot area farmers chose to plant Vitamin A cassava for its nutritional benefits** and other factors like root yield
- About **24% of farmers believe Vitamin A cassava has unfavorable dry matter content** (an issue to be addressed by wave 3 varieties) **which could affect demand by small scale and rural processors.** Processed Vitamin A cassava fufu is less gelatinous and so less favored by customers
- There is **high Vitamin A cassava awareness among pilot area farmers** with 77% having prior knowledge of its nutritional value

2 Insufficient supply of Vitamin A cassava stems could force pilot area farmers to switch back to old varieties

- About **41% of pilot area farmers mentioned that Vitamin A cassava has an unfavorable market demand,** which forced them to switch back to analogue cassava
- Some farmers reported **poor availability of stems** during new planting seasons, forcing some of them to reuse stems or switch to analogue crops
- In 2017, **11% of pilot area farmers acquired free stems from NGOs, HarvestPlus or government institutions** compared to 46% in 2013 as part of free stems supplied every year – signaling either financial sustainability with farmers buying new stems, or a strong stem reuse culture

Farmers' perception of Vitamin A cassava



Source: HarvestPlus, Nigeria Outcome Monitoring, 2019, Stakeholder consultations; HarvestPlus, A Baseline Cassava Varietal Adoption Study to inform Development, Delivery and Marketing of Pro-Vitamin A cassava (Oyo, Akwa-Ibom, Benue), 2013, Dalberg Interviews & Analysis 2019

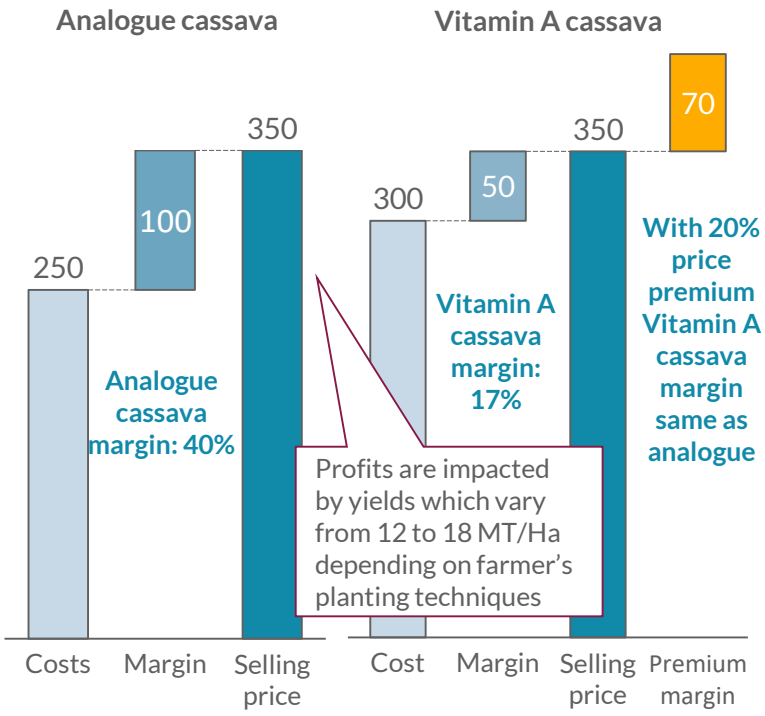
Opportunistic smallholders are reluctant to adopt Vitamin A cassava due to the lack of proven business case

1 **A limited number of opportunistic smallholders are planting Vitamin A cassava due to poor economics and low consumer awareness**

- Opportunistic smallholders are **willing to buy new Vitamin A stems**
- However, **they are driven by demand and higher profit potential** in Vitamin A cassava, and not its nutritional benefits
- Thus, **the 20% premium and 40% potential margin from Vitamin A cassava is highly attractive** to these farmers.
- However, **with profit at 17% vs 40% for analogue cassava, these farmers are not incentivized** to plant Vitamin A cassava
- Thus, **they switch back** given they are not making a profit

" When Vitamin A cassava gets to the markets, some people think it is normal white gari that had palm oil added to is. Because they don't see it as having a higher nutritional content, they don't pay more for it"
- Vitamin A cassava farmer in Oyo

Smallholder farmer economics('000 NGN/Ha)*



Economics estimate based on best agricultural practices
(Improved seeds, 6 bags of fertilizer, appropriate investment on farm maintenance)

Source: HarvestPlus, A Baseline Cassava Varietal Adoption Study to inform Development, Delivery and Marketing of Pro-Vitamin A cassava (Oyo, Akwa-Ibom, Benue), 2013; Dalberg Interviews & Analysis 2019
Note: (*) Numbers based on anecdotal evidence from two farmers

Strategic farming enterprises need large industrial demand to commit to Vitamin A cassava production

1 Strategic farming enterprises are larger farms with more commercial interests that could be interested in Vitamin A cassava as an opportunity to expand their business

- Strategic farmers are interested in Vitamin A cassava to expand their business by entering new markets. They are **largely driven by good yields, lot prices, and downstream demand**
- Strategic farmers who plant Vitamin A cassava are happy with their experience. While most of these farmers sell directly to processors, others sell at open markets due to lack of industrial demand
- Evidence from focus groups suggest that **strategic enterprises recognize that when educated on Vitamin A cassava' nutritional benefits, their buyers are more likely to pay premiums** and increase demand.

"It's a good product, I have enjoyed farming it"
- Integrated Vitamin A cassava producer in Oyo

2 However, inconsistent stem supply and lack of large scale demand are hindering the majority of strategic farming enterprises from currently growing Vitamin A cassava

- Some strategic **enterprises are reluctant to expand their Vitamin A cassava production** until there is sustainable downstream demand
- They have raised concerns on their **inability to maintain production capacity due to irregular new stem supply**
- More, other strategic enterprises have raised **concerns about limited starch in Vitamin A cassava** which affects consumer demand – an issue which should be addressed by wave 3 varieties as it contains higher starch content.

"We need to be sure the Vitamin A cassava market is going somewhere before increasing our own production. We already have a lot of unsold stems sitting in our facility"
- Vit A cassava farmer in Oyo

Source: Dalberg Interviews & Analysis 2019

Unreliable stem supply, low awareness, limited downstream demand and low profits are key barriers to upscaling production

Access

- Due to the fragmented stem market, supply has failed to meet smallholder farmers' increasing demand. An increase in stem production will result in a steady supply and in turn, increased uptake. Without improved access, farmers might be forced to switch back to analogue crops; thus, affecting potential to scale.

Awareness

- Consumers have limited knowledge about Vitamin A cassava or its nutritional benefits, resulting in low demand for Vitamin A cassava and unwillingness to pay for a premium. Given high stem prices, pilot farmers expect to sell Vitamin A cassava at a premium to cover costs. This inability to cover costs has been a barrier to scaling.

Downstream demand

- Opportunistic smallholders and strategic enterprises are hesitant to plant Vitamin A cassava due to uncertain large-scale demand. The majority of the market demand from processors is for high starch content cassava to produce products such as fufu in line with consumer preference. The low starch content of Vitamin A cassava makes it unsuitable. More, lack of consumer awareness on the nutritional benefit of Vitamin A cassava affects downstream demand. Without significant downstream demand, uptake by strategic enterprises and interest of smallholders will be limited.

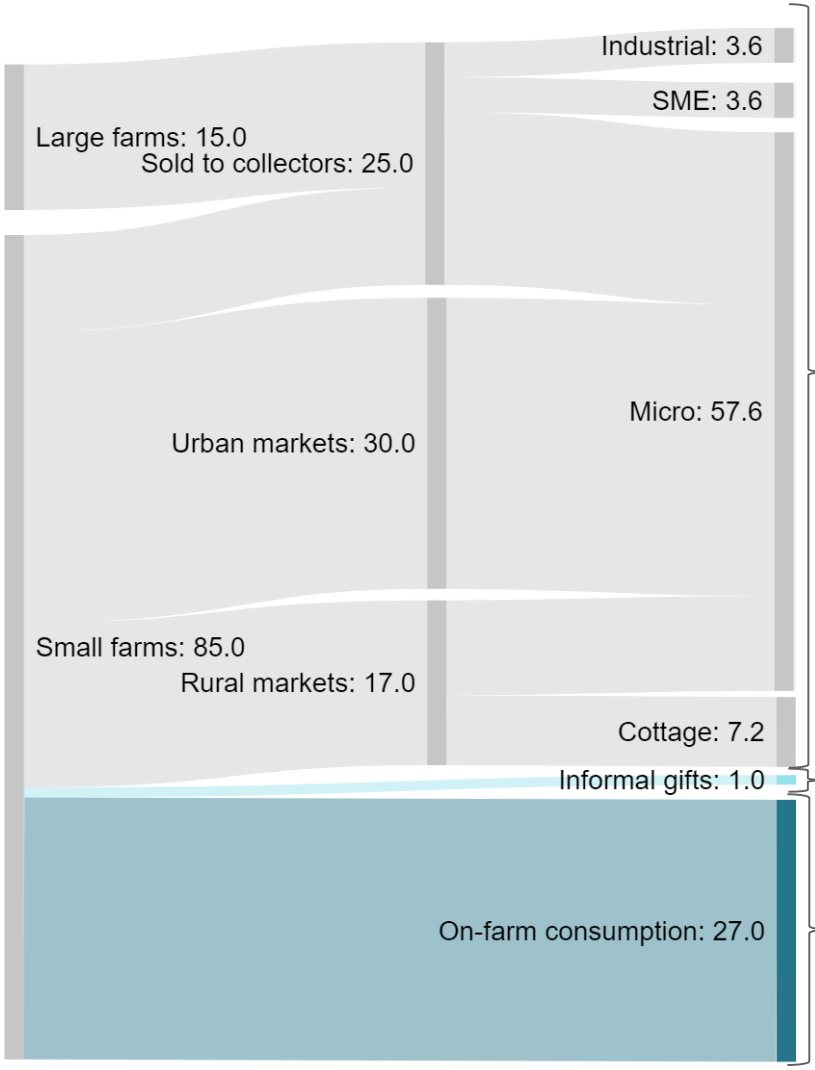
Profit

- Vitamin A cassava stems cost about 40 – 60 % more than analogue crops and sometimes, farmers are forced to sell Vitamin A cassava and analogue cassava at the same price because consumers cannot differentiate them and are unwilling to pay a premium. This barrier can affect commercialisation as the pilot farmer's economic drive is negatively impacted.

Source: Dalberg Interviews & Analysis 2019

Post-farm and consumption

Post-farm, cassava is mostly aggregated and sold to micro-industry for basic processing into gari, fufu and other products



1

A

High-end processed products

- Strategic farms sell their cassava to collectors, who aggregate 25% of cassava produce
- 3.6% goes to industrial processors (up to 55mt/day) and 3.6% to SMEs (c. 1 mt/day)

B

Micro-industry and basic products

- Micro-industry processes 80% of all marketed cassava (57.6% of the total)
- Rural mills use basic equipment such as diesel-powered pulverizers, with output around 200kg/day
- Traditional rural processing methods (such as pestle and mortar) account for 7.2% of processed cassava, with output around 30kg per day

2

Informal gifts

- Farmers gift a very small portion of their production (1%) to friends and family

3

On-farm consumption

- Farmers with the lowest rates of market access and those who are highly reliant on subsistence agriculture form the majority of on-farm consumption

Source: FAOSTAT, Production quantity Nigeria, 2017; TechnoServe & Harvest Plus Nigeria, Diagnostic and Opportunity Identification, 2017; Dalberg Interviews & Analysis 2019

The three main channels each have different consumption drivers

1

A

High-end processed products

- 3.6% of cassava goes through industrial processing into high-end products
- Products include cassava derived foods such as flour, bread, snacks and starch, in addition to non-foods such as ethanol and adhesives
- Biscuit and snack demand is growing rapidly in urban areas with higher incomes

B

Micro-industry and rural processing

- Micro-processors and the small number of SMEs output basic cassava products:
  - Gari – cassava root is pulverized, grated and roasted into a powder
  - Fufu – cassava forms a wet paste with a limited shelf life
  - Traditional methods output include tapioca and abacha
  - Dry, odourless fufu is newly developed by HarvestPlus; growing in urban popularity because it can be can be stored for longer periods of time

2

3

On-farm consumption

- Initial reports suggest farmers keep 80% of Vitamin A cassava production for home use as opposed to 28% of analogue cassava
- Evidence from the field suggest that farmers do not want to keep more than 10% of their production. Their main objective is to sell their production

Source: FAOSTAT, Production quantity Nigeria, 2017; TechnoServe & Harvest Plus Nigeria, Diagnostic and Opportunity Identification, 2017; Dalberg Interviews & Analysis 2019

Industrial processors are seeing potential for packaged Vitamin A cassava products targeted at urban markets

1 Vitamin A cassava has made a small indent to this channel, with industrial processors seeing the potential for higher profit margins in urban markets

Post-harvest supply chain

- **Post-harvest, cassava is aggregated and sold** to large-scale processors for production of industrial and household products[1]
- **Key distributors are restaurants and retail outlets** including open markets, stores, and supermarkets. Some large processors sell directly to food producers like wheat mills and biscuit companies[2]

Key products and customer segments

- **High-end cassava products include** industrial products like High Quality Cassava Flour (HQCF), sweeteners, ethanol and starch; and domestic products like cassava chips, gari and fufu
- **Customer segments for high-end products** are industrial food producers, urban households and some schools. Packaged varieties of gari and fufu appeal especially to urban consumers[3]

Economics

- **Processors are driven by higher profit margins** for finished products, especially as processing is the most profitable segment of the value chain

Factors for scale up

- **Availability of Vitamin A cassava is critical to scaling up processing,** in turn ensuring availability of Vitamin A cassava end products
- **Increased awareness will likely drive market demand,** incentivizing more Vitamin A cassava processing across Nigeria

Packaged cassava chips

Packaged fufu

Source : GROW Africa, Market Opportunities for Commercial Cassava, 2015; IITA, Potential for Commercial Production and Marketing of Cassava, 2013; HarvestPlus, How profitable is it for the private sector to invest in biofortification, 2016; Cassanovas website, 2019; Niji Foods website, 2019; Dalberg interviews & analysis, 2019

Increasing health consciousness drives consumption of Vitamin A cassava products

2 Vitamin A cassava consumers are driven by a growing health consciousness, fueled in part by numerous publicity campaigns, rural events, and films coordinated by Harvest Plus and key partners

- The potential for consumption of Vitamin A cassava high-end processed products is high in Nigeria.
- **Highly 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 percent 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 Vitamin A cassava
- **Large processors recognize 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 recognize this driver for Vitamin A cassava products.
- **Interventions related to awareness and labelling/certification** will have the most impact on this pathway. As customers are aware of the nutritional benefits, more will deliberately choose nutritional products such as Vitamin A cassava high-end processed products.

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; Dalberg Interviews & Analysis 2019

Dalberg

Inconsistent supply of Vitamin A cassava remains the main barrier to industrial processing of Vitamin A cassava

3 **However, inconsistency in the supply of Vitamin A cassava poses a major challenge to increasing industrial and SME processing**

- **Inconsistent supply of Vitamin A cassava is the biggest barrier to scaling high-end processing.** Processors express a willingness to process more Vitamin A cassava if they get steady supply from farms and aggregators
- **Fluctuations in supply of Vitamin A cassava for high-end processing are driven by the limited number of strategic enterprises involved in Vitamin A cassava cultivation.** Processors have a high dependency on a limited number of high volume and quality suppliers who are unable to meet current demand for Vitamin A cassava. Often times, this results in operational disruptions for the processors
- **Consequently, some processors are unable to launch or sustain product lines for Vitamin A cassava.** This often results in some processors wanting to have a guaranteed supply of Vitamin A cassava before developing new biofortified product lines or publicizing existing ones. Some processors also mix both Vitamin A cassava and non-biofortified cassava to keep their product lines operational

"With respect to our biofortified products, our biggest operational headache is the constancy of supply of biofortified crops. We are happy to increase processing and completely switch to biofortified crops if they were available. This is because we are big on nutrition"
- Vit A Cassava processor in Lagos

Source : GROW Africa, Market Opportunities for Commercial Cassava, 2015, IITA, Potential for Commercial Production and Marketing of Cassava, 2013; HarvestPlus, How profitable is it for the private sector to invest in biofortification, 2016; Dalberg interviews & analysis, 2019

Micro-industry and rural processors use cassava for production of household foods such as gari and fufu

1 Vitamin A cassava has entered micro-industry in clusters, sourcing mainly from the smallholder farms in the pilot areas

Post-harvest supply chain

- **Post-harvest, cassava is aggregated by traders and sold** to traditional and micro-processors mostly for the production of gari, fufu, and other derivatives like tapioca and abacha (African salad)
- **Key distributors are** merchants operating in open markets, street stores and kiosks, and local restaurants

Key products and customer segments

- **Key cassava products from micro-industry are household foods** like gari (65%), fufu (20%) and other products
- **Cassava consumption is highest in rural areas** given its use in preparing affordable meals like fufu, which fit within the purchasing power of rural dwellers

White gari from open market

Economics

- **Most agri-businesses are involved in processing given the higher profit potential compared to farming;** these are typically rural micro-businesses with varying capacity of 30-200kg/day
- **In pilot states, Vitamin A cassava micro-processing businesses are estimated to be more profitable** than their "non-biofortified" counterparts by about 9% given the price premium on end products

Ready-to-eat fufu prepared for a household

Factors for scale up

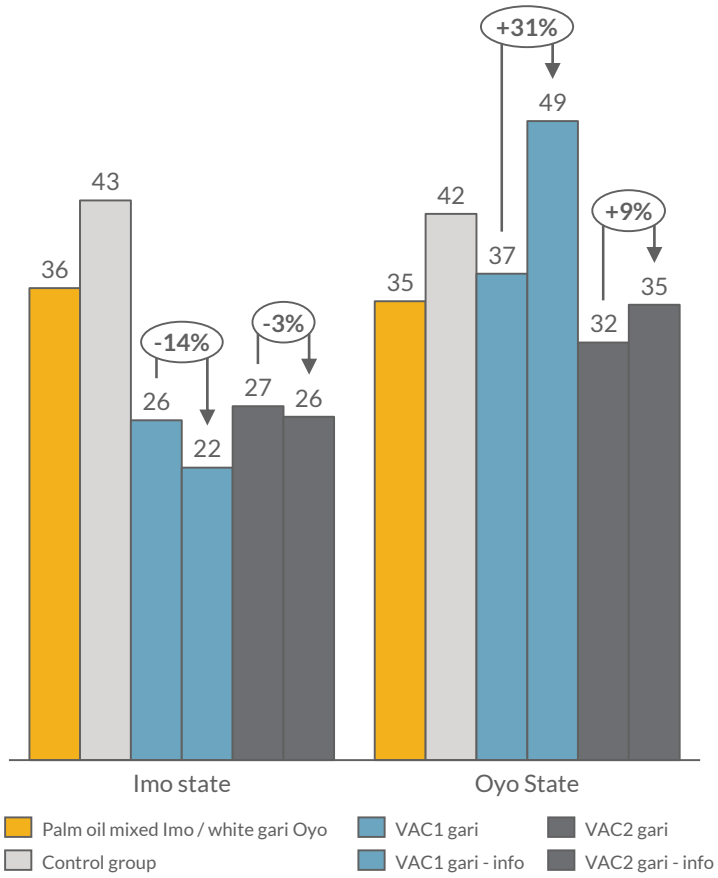
- **As with the high-end products, increased availability and awareness of Vitamin A cassava** will also be critical to scaling up micro-processing[17]
- **Improved culinary properties** (i.e. more gelatinous texture) would align with existing consumer preferences, increasing customer acceptance and consequently micro-processor appetite for Vitamin A cassava

Source: Technoserve, HarvestPlus Nigeria diagnostic and opportunity identification, 2017; HarvestPlus, How profitable is it for the private sector to invest in biofortification, 2016; Mile 12 market website, 2019; Kimi eats gluten free blog, 2019; Dalberg interviews & analysis, 2019

In Oyo state, rural consumers have demonstrated higher WTP for Vitamin A cassava gari when aware of its nutritional benefits

2 **Demand is driven by traditional tastes and cultural importance of cassava in the Nigerian diet, price and necessity of consuming low-budget items close to home areas**

Willingness to pay for Vitamin A cassava in Imo and Oyo



- **Cassava is a key part of the diet of rural households**. Most consumption is in form of processed cassava products including gari, starch and other products from cassava derivatives like flour
- **Demand is largely driven by starchiness and textural properties** of cooked food
- Peri-urban consumers in Ibadan found **biofortified processed products (i.e., gari, fufu, eba) to be generally acceptable**; although they were less gelatinous, customers were willing to consume because of the nutritional attribute
- **Rural consumer willingness to pay for biofortified varieties varies significantly by geography, but can be positive.** In the southeast, consumers have a negative WTP for biofortified varieties; in the southwest, consumer WTP is positive
- After **providing nutrition information, consumers in Oyo state were willing to pay a 31% price premium for biofortified cassava gari**
- Evidence from focus groups indicate that **despite its different texture attributes, customers were willing to purchase Vitamin A cassava** processed products because of its nutritional attributes

"We like Vitamin A cassava products because of the health benefit especially for our eyes. If we find it everywhere at a good price, we will totally switch to only Vitamin A cassava"
- Vitamin A cassava consumer in Oyo

Source: Information and Consumer Willingness to Pay for Biofortified Yellow Cassava: Evidence from Experimental Auctions in Nigeria, Harvest Plus, 2014; Dalberg Interviews & Analysis 2019

Downstream demand will incentivise increased micro-processing of Vitamin A cassava products

1 High fragmentation of micro-industry poses a barrier to scale, requiring major sensitisation and awareness building amongst a large number of stakeholders

- **Micro-processors account for more than 95% of all cassava processors in Nigeria.** As of 2016, there were more than 130 cassava micro-processors in three southern Nigeria states alone, suggesting up to 1,000* micro-processors if the entire country were considered
- **The high number of micro-processors necessitates significant investments in awareness building to drive their appetite for Vitamin A cassava**. Micro-processors are influential community actors and can therefore help to further drive awareness amongst their consumer base if they are sensitized on the benefits of biofortified foods
- **The high fragmentation of micro-industry also has implications for later segments of the supply chain.** Coupled with challenging road linkages across the production and consumption zones in Nigeria, distribution of basic products (i.e. gari and fufu) can also affected by processor fragmentation, often times impacting prices and product availability

2 Micro-processors are highly price sensitive, and show unwillingness to pay a premium for nutritious produce without proven interest from their customers

- **In locations with limited or no demand for biofortified foods, micro-processors are unwilling to pay a premium for Vitamin A cassava.** Farmers have noted this unwillingness and attributed it to an overall lack of awareness of the nutritional benefits of biofortified foods
- **In other locations, Vitamin A cassava does not fully align with consumer preferences.** Consumers have noted the less gelatinous texture and lower starch content of Vitamin A cassava products as a disincentive for use in preparing bolus meals. This limits customer acceptance and consequently micro-processor appetite for Vitamin A cassava

"The processors around here will not buy Vitamin A cassava tuber at a price premium from us farmers because they are not sure of the market and if they will be able to sell the products at a higher price than the regular products in the market. If people knew about Vit A products and demand for it, that will push the processors to buy more Vit A cassava from us"
- Vit A Cassava farmer in Lalupon L.G.A, Oyo State

Source: HarvestPlus, How profitable is it for the private sector to invest in biofortification, 2016; Dalberg interviews & analysis, 2019
Note: (*) Based on estimates from HarvestPlus 2016 survey sampling 130 microbusinesses in three states

Consumption of Vitamin A cassava by farmers is positively correlated with awareness on its nutritional benefits

1 **On farm consumption is estimated around 27% of total cassava consumption**

- **Largest cassava consumption is from rural households** consuming a wide range of cassava products including gari , fufu, tapioca, abacha and other derivatives
- In **rural areas average daily consumption is about 240g/person**, 12% higher than in urban areas. Cassava is used for the preparation of affordable meals which fit within the purchasing power of rural communities
- **Farmers are more inclined to consume Vitamin A cassava due to their awareness of the product**. They plant it for its market potential but consume it foremost for its nutritional benefit
- However, many farmers insist that the end goal is not on-farm consumption but market sale. On farm consumption is considered a small portion (around 10%) of their overall production.

"Vitamin A cassava is good for the eyes. Sometimes even if I don't have it in my farm, I will go and buy it. It also tastes good, you can boil it and eat it like yam.."
- Vitamin A cassava farmer in Oyo

Source: Oyo Focus groups, Dalberg Interviews & Analysis 2019

Policy and financing

Gaps in policy implementation and financing further limit the potential for Vitamin A cassava commercialisation in Nigeria

- Beyond the specific value chain for Vitamin A cassava, **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:
    - 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 Vitamin A cassava 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 Vitamin A cassava 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-recognised 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 Cassava derivatives like flour.** NAFDAC forbids sales of any of these foods not fortified with Vitamin A, and is authorised 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 Vitamin A cassava 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

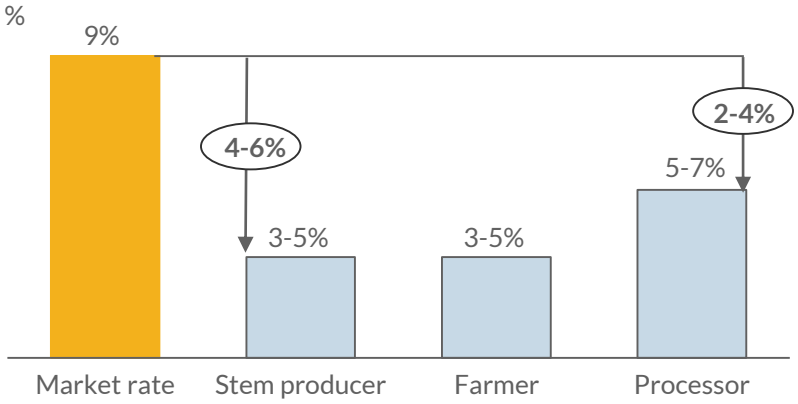
Current financing packages are not well suited for the commercialisation of Vitamin A cassava in Nigeria

1 Financing for Vitamin A cassava 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 Cassava, 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 Vitamin A cassava
- **Additionally, value chain actors prefer more lenient financing terms than the market currently provides.** In describing their ideal loan terms, Vitamin A cassava 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. stem 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 Vitamin A cassava commercialisation

"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 Vitamin A cassava value chain actors)



Note: (*) Commercial Agriculture Credit Scheme, Nigeria Incentive-Based Risk-Sharing System for Agriculture Lending