Commercialization assessment: PVA Maize in Tanzania

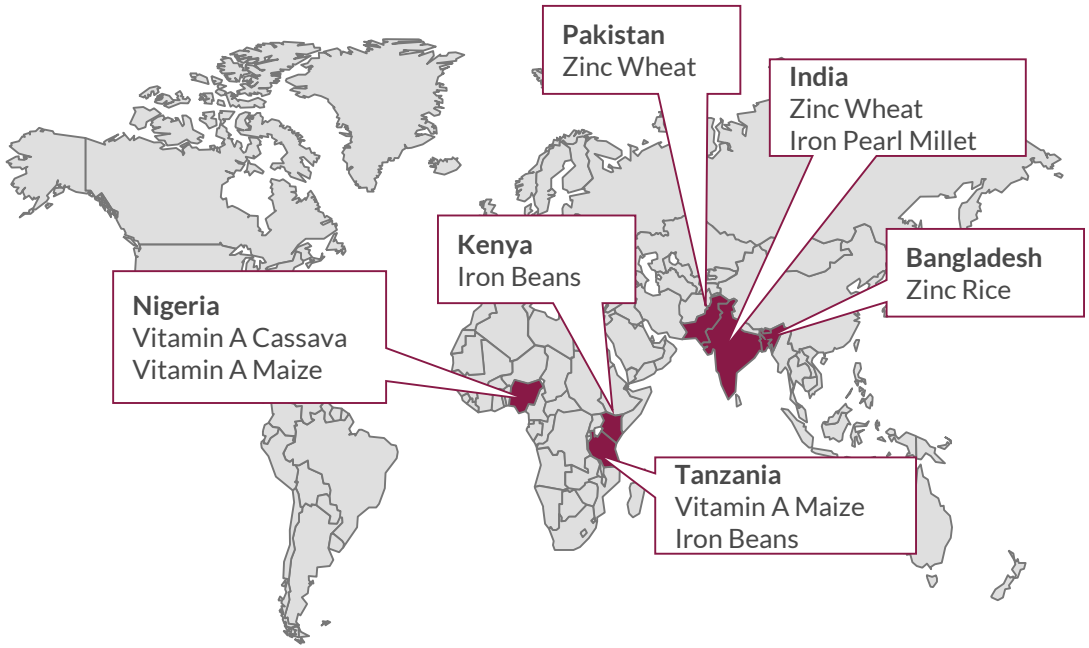
FINAL REPORT FOR GAIN AND HARVESTPLUS

DECEMBER 2019

Recap: Program context

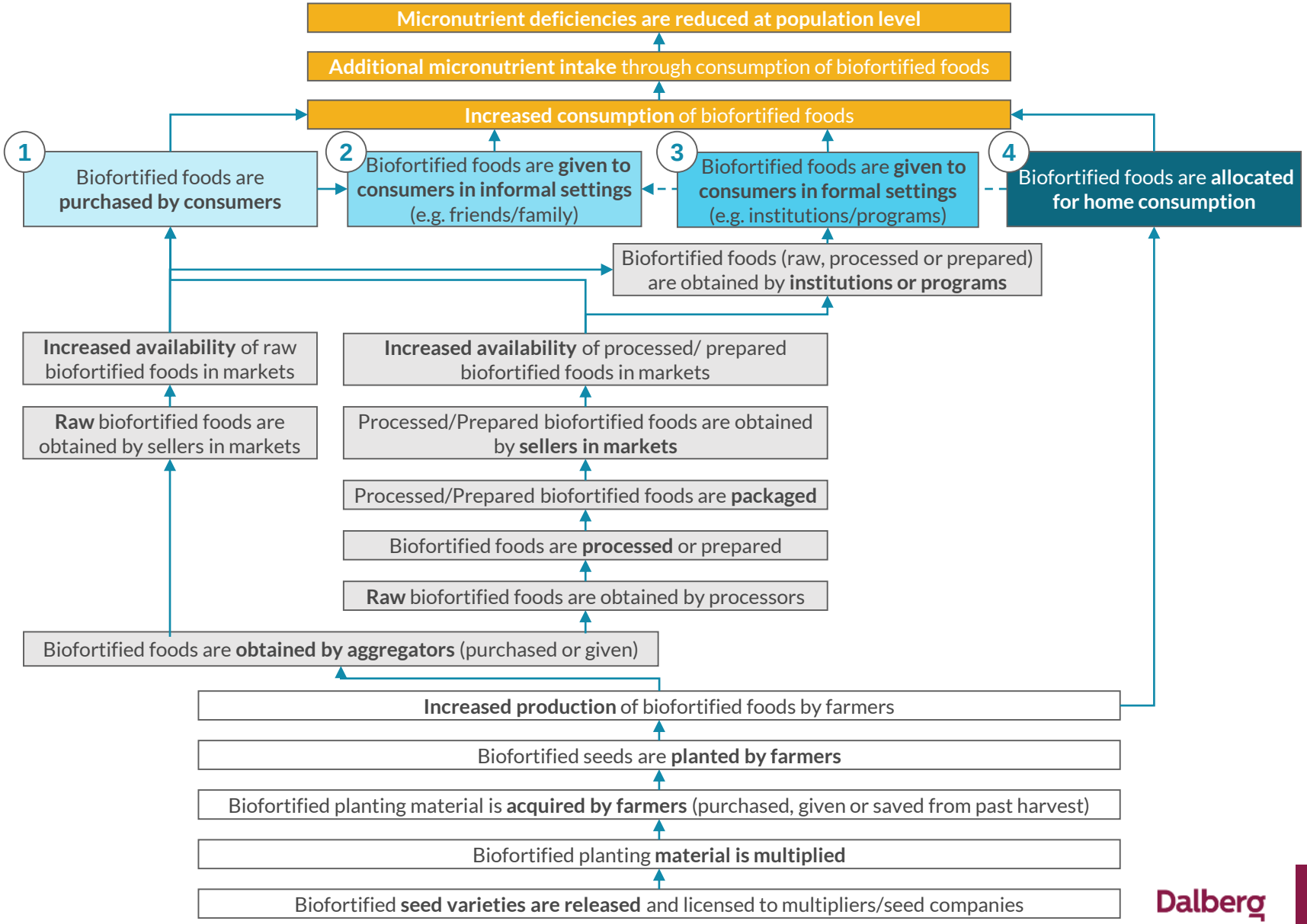
- GAIN and HarvestPlus share an ambition to expand coverage of biofortified nutrient dense foods to at least 200 million consumers. The overall vision of this program is to scale up the commercialization of biofortified foods. PVA maize in Tanzania is one of the nine selected crop/country combinations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

- 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 Tanzania. This is the draft assessment report, based on literature review, and interviews with relevant stakeholders



- This draft report is designed to fit into the GAIN-HarvestPlus planning processes. As such, it is aligned with the Program Impact Pathways in two ways
  - The potential routes to scale are codified in terms of the Program 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: Program Impact Pathways



What is commercialization?

Commercialization can be thought of in three ways:

1. **An end state.** This would see the program 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 Program Impact Pathways.** GAIN's definition, for this program, 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 program, 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".

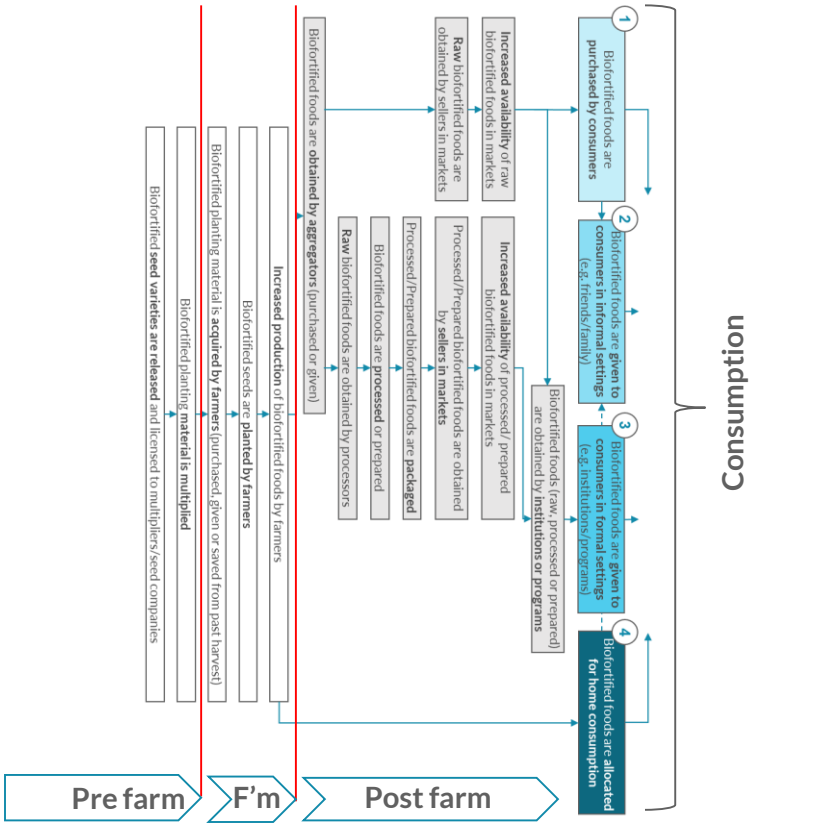
Alignment on the understanding of commercialization will potentially have significant impacts for scale that is feasible, programming, and resource allocation across the portfolio, amongst other things. On farm consumption and public procurement are significant parts of the value chains for a number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

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

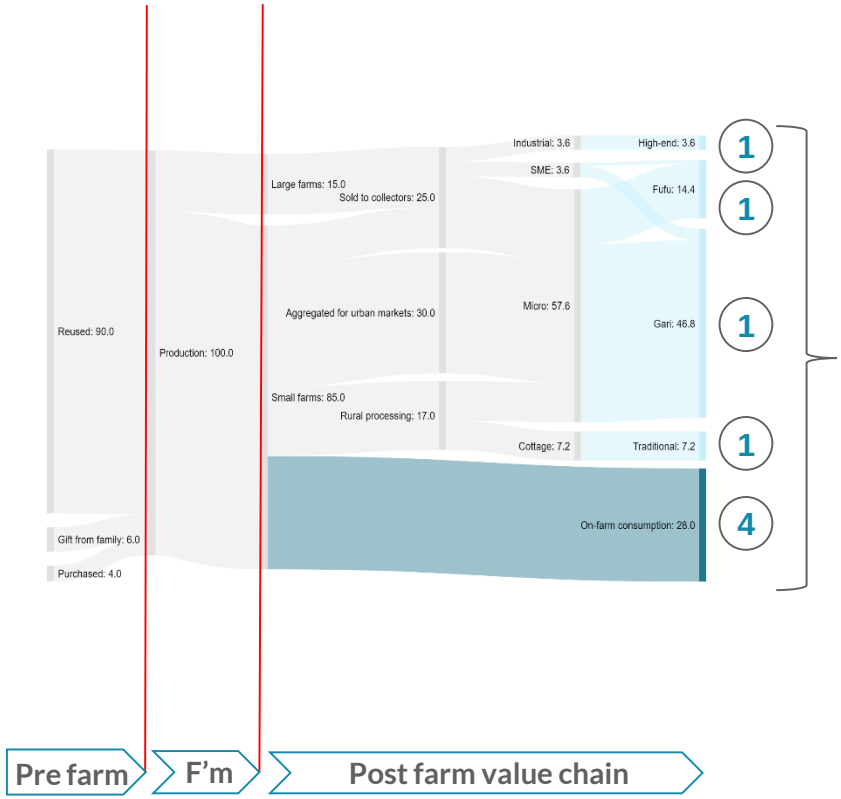
How to read this report (1/2)

This report assesses the potential for commercialization of the crops through the Program 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



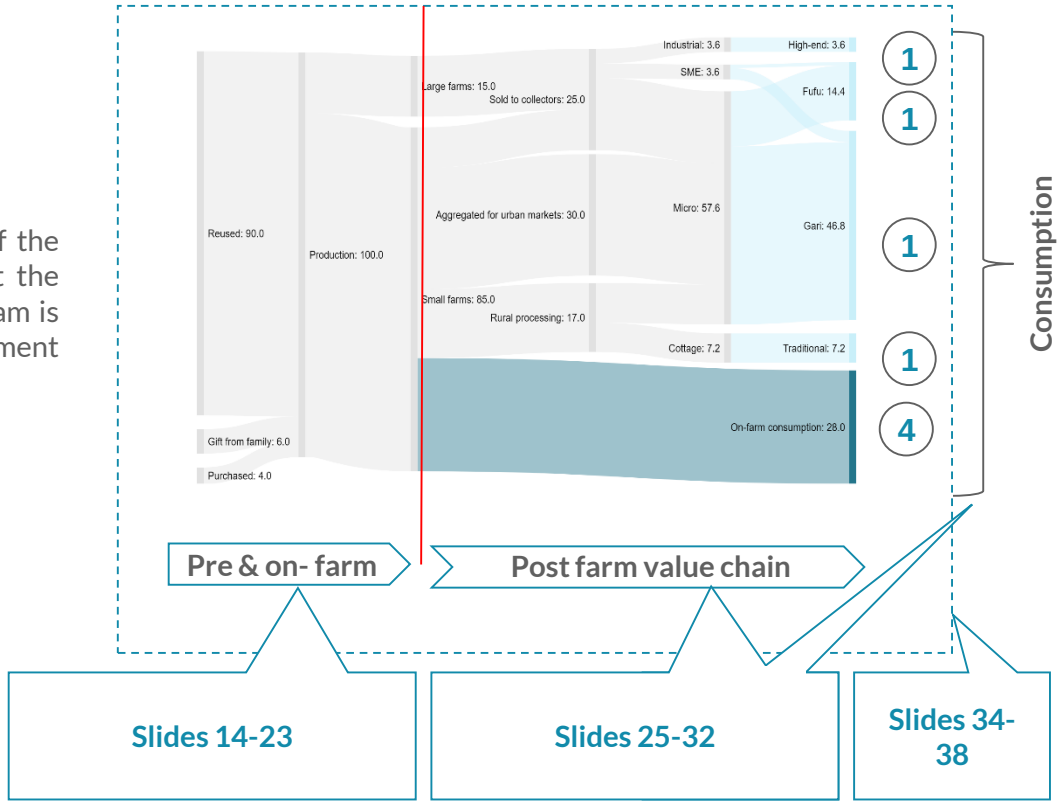
'Sankey diagram' showing relative flows through the value chain



How to read this report (2/2)

- This report is broken down into six sections:
  - Executive summary
  - Pre-farm & on-farm
  - Post-farm & consumption
  - Policy & 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

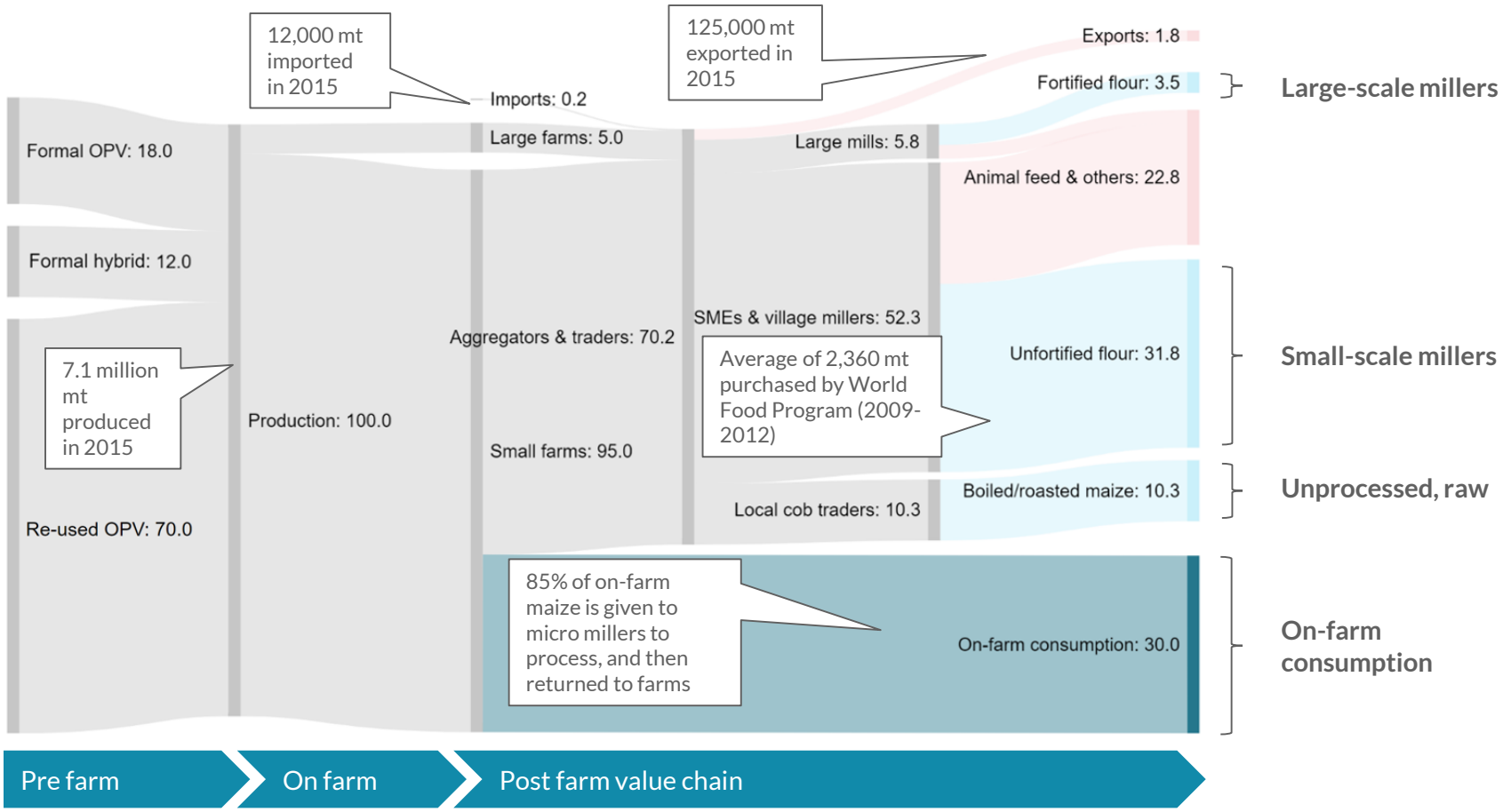
Introduction

- **Vitamin A deficiency is a key challenge for 36% of women between the ages of 15-49.**[1] Maize is the most widely consumed staple in Tanzania, with ~90% of the population as consumers.[2] Thus, PVA (Pro-Vitamin A) maize represents an opportunity to address nutritional deficiencies in the Tanzanian population
- **Biofortified maize is at an early stage of development in Tanzania.** Two varieties of biofortified maize were released in 2016, with production of seed only reaching commercial sales volumes of 18 mt in 2018. Farmers are receptive to planting the biofortified Meru VAH 517* and Meru VAH 519 varieties, which (under controlled conditions) have a higher yield of 7.5 mt/ha and 5.9 mt/ha respectively compared to common maize yields of 1.62 mt/ha,[3] and have drought resistant properties
- **Biofortified maize holds solid government support and strong potential for commercialization.** To assess the path to commercialization, we looked at pathways across:
  i. Large-scale milling & processing
  ii. Small scaling milling
  iii. Unprocessed, raw
  iv. On-farm consumption

(1) Prime Minister's Office, National Multisectoral Nutrition Action Plan, 2016 – 2021; (2) GAIN, Tanzania Corn, Wheat and Rice Report, 2017; (3) BFNB, Tanzania SITAN report; Dalberg interviews and analysis
* VAH designated by Meru Agro to stand for Vitamin A Hybrid (VAH)

Less than 5% of Tanzania's maize is highly processed, and 70% of seeds are sourced informally

Tanzania is East Africa's largest maize producer; however, its value chain is dominated by informal seed-sourcing, and micro-processed goods, with only 3.5% of maize flour going through large-scale millers.



FAO, FAO Statistics, 2019; FAO, The Maize Value Chain in Tanzania, 2015; Dalberg Literature Review, 2019; Index Mundi, Tanzania Maize Statistics; 2019; National Bureau of Statistics, 2015 Tanzania in Figures, 2016; CIMMYT, Building Nutritious Food Baskets Project Final Report: Provitamin A Maize within the Maize Seed Systems and Grain Value Chain; FAO, Institutional Procurement of Staples from Smallholders, 2014

Dalberg

PVA maize faces a binding constraint in the price premium compared to analogue maize

At this early stage of biofortification release, PVA maize attracts **a price premium at three stages of the value chain: seed purchase, at the point of sale by the farmer, and at the processing level**. Together, this contributes to **PVA grain and flour selling at up to a 60% premium more than other maize grain varieties**.

Seed purchase

- VAH 517 seed has a 20% price premium due to poorer seed performance
- VAH 519 is charged at the same rate
- With higher yields, this could still offer a profitability to farmers compared to OPVs, but not against other hybrids
- See slide 21

Farmer sale

- Farmers growing PVA maize currently control the market and charge a premium for grain
- This is likely to fall over time as new farmers enter the market
- See slide 21

Processing

- Without significant downstream demand, processors cannot invest in high-volume processing equipment
- This pushes up the price per kg of milled PVA maize
- See slide 29

With greater downstream demand, and as more farmers enter production, the processing and point-of-sale premiums may fall. However, **the seed price premium is likely to continue to affect the value proposition of PVA maize.**

Dalberg interviews and analysis, 2019; Icons by The Noun Project

The price premium is compounded by other barriers across the value chain, with additional challenges in policy and finance

Pre & on-farm		Single-use hybrid	**PVA maize varieties are a three-way hybrid, meaning that the seeds cannot be re-used.** 70% of maize seed in Tanzania is re-used, so for the majority of farmers seed purchase represents a new financial outlay.
		Lack of price competitiveness	**The high price of PVA maize means it cannot compete with analogue varieties.** A premium at the seed and farmer level means that prices for PVA grain are higher than other maize grain varieties.
		Color attributes	**PVA maize ranges from deep yellow to deep orange, but there are other yellow varieties that do not have nutritional content.** However, the distinction is unclear amongst actors, and PVA maize is still commonly referred to as yellow maize.
Post-farm & consumption		Consumer preferences	**The majority of maize consumed in Tanzania is white, whilst PVA varieties are yellow in color and carry associations with relief food.**
		Insufficient nutritional content	Despite a high Vitamin A content, **PVA maize doesn't provide the same multi-vitamin nutritional content as fortification supplements.**
Policy & Financing		Lack of incentives for biofortification	The government's nutrition policy focuses on fortification, and disincentivizes buying biofortified crops, particularly for milled maize.
		Limited School Feeding Funds	Funding required for school meals is often late or entirely lacking. Funding is limited and ownership is split across a number of stakeholders.
		Financing Gap	Actors across the maize value chain have unmet financing needs which prevent greater market formalization.

Dalberg interviews and analysis,2019; Icons by The Noun Project

Dalberg

Viable opportunities lie in retail partnerships and potentially in school meals; seed production could help unlock commercialization

OPPORTUNITIES		PATHWAYS IMPACTED
Seed production	**Supporting seed producers to access financial and technical support could help them expand seed production.** Seed producers are currently limited in their ability to invest in large maize seed production by a lack of downstream demand. If downstream demand materializes, then seed producers will need to access finance for investments such as in irrigation systems and inputs. However, this is an enabler for commercialization, not a commercial opportunity in itself.	**Large-scale millers**
School feeding program	**Purchases by school feeding programs could generate the downstream demand required to spur investment and scale throughout the value chain**. This approach could look to work across three groups of stakeholders: 1. *School Boards* 2. *School Suppliers* 3. *Policy-makers* **With children as the target end-consumers, apprehensions regarding the yellow coloring become less significant.** Furthermore, children act as agents of change by influencing buying decisions in the home, catalyzing a market effect beyond school purchases and into the mainstream. **However, this intervention can only be effective as a catalyst for commercialization if greater scale actually drives costs down due to economies of scale in processing.** Given the disparate nature of purchasing through individual suppliers, rather than a bulk institutional purchase, this may be a difficult case to make for millers.	**Large-scale millers; small-scale millers; unprocessed, raw**
Retail partnerships	**Working with downstream retailers could help to increase awareness and adoption of PVA maize as a high-end product**. Although a narrow market segment, the potential is growing, and the high-end market tends to show early increased willingness to pay for nutrition. However, the government's fortification requirements may limit adoption and commercial potential.	**Large-scale millers**

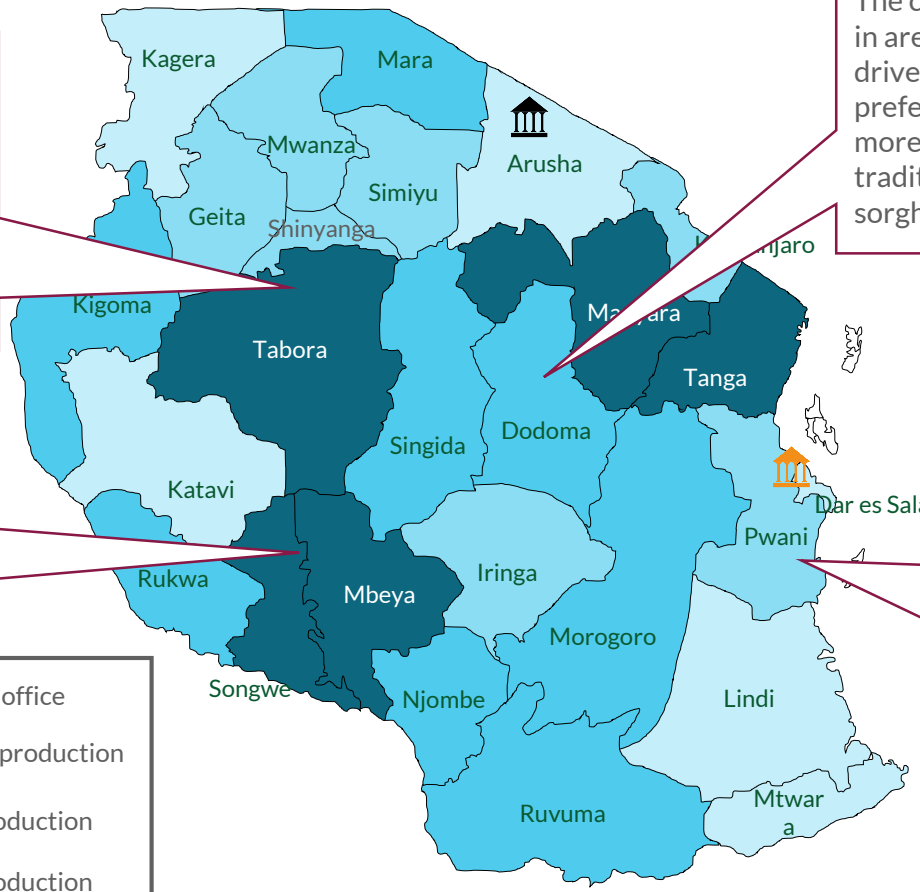
Dalberg interviews and analysis, 2019; Icons by The Noun Project

Pre-farm & on-farm

Maize production is concentrated in the southern highlands due to ample land and favorable conditions

The southern highlands account for almost 50% of maize.[1] Although principally grown for consumption, maize also serves as cash crop due trade routes to Dar and neighboring countries.

Yields vary between regions based on adoption of input use. Ranging from 0.8 in Dar to 3.7 mt/ha in Mbeya.[2]



The choice to grow maize, even in areas of insufficient rainfall, is driven by a strong dietary preference for maize over the more drought-adapted traditional cereals such as sorghum and millet.

The coast and the northern highlands produce less maize and are reliant on other regions. Transport can be costly, with prices per mt-km in Tanzania at 0.12 USD.[3]

CIAT office
GAIN office
Greater than 400,000 mt production
200,000 – 400,000 mt production
100,000 – 200,000 mt production
Less than 100,000 mt production
Insufficient data available

Quick facts (2015)

- 7.1 million mt produced
- 12,000 mt imported
- 125,000 mt exported

(1) African Crop Science Journal, Impacts Of Climate And Farming Management On Maize Yield In Southern Tanzania, 2015; (2) NBS, Annual Agriculture Survey, 2016/17; CIAT website; GAIN website; (3) The world Bank, High Marketing Costs and Inefficient Policies in Tanzania's Maize Market, 2009; FAO, The Maize Value Chain in Tanzania, 2015; Dalberg interviews and analysis, 2019

Dalberg

Maize is grown by farmers simply for home consumption, those who aspire to make sales, or purely for commercial purposes

Focus on the home

Farmer characteristics
- Smallholder farmer (SHF) focused on producing for home consumption with surplus sold to a local trader/aggregator
- Has no connections to downstream buyers

Typically gets seeds from
- Re-uses open pollinated variety (OPV) seeds from previous harvest

Decision drivers
- Cheapest price, good yields

Consumption choices
- More likely to keep for home consumption
- A large share of the maize consumed at home is first processed by a small mill into flour, and returned to the farmer

Key influencers
- Neighbors, extension officers, church

Aspiring sales-farmers

Farmer characteristics
- SHF practicing more advanced farming techniques such as use of fertilizer and pesticide
- Dedicate a minimum tradeable quantity to sell to traders or aggregators

Typically gets seeds from
- Mostly OPV reuses seeds but due to changes in rainfall patterns moving more towards buying hybrid seeds from agro-dealers
- Willingness to invest in new varieties if assured of downstream buyers

Decision drivers
- Good yields and potential to increase income or profits

Consumption choices
- Produces enough to sustain family needs and sell remainder for profit

Key influencers
- Demo plots, extension workers, media

Regular contract enterprises

Farmer characteristics
- Larger and more established farmers
- Regularly contract with processors or involved in out-grower schemes

Typically gets seeds from
- Buy hybrid seeds on a regular basis
- Receive seeds on credit from the end buyer

Decision drivers
- Availability to scale, good yields, overall profitability

Consumption choices
- All produce is sold

Key influencers
- Buyer needs, peer commercial farms, consumption trends

Dalberg interviews and analysis, 2019; Icons by The Noun Project

PVA maize was introduced in 2016, and is currently in a pilot introduction phase with 153 mt of seed produced in 2019

PVA maize	
Delivery stage	Introduction phase
Number of varieties released	Meru VAH 517 Meru VAH 519
Market reach	2,600 farmers in pilot phase
Volumes	18 mt harvested by Meru Agro (2018), 153 mt in 2019
Agronomic characteristics	• Intermediate maturing (100-110 days) • Good resistance to pests and diseases
Other characteristics	• Rich in vitamin A (8 -14 ppm) • Orange colored grains

PVA maize pilot

- PVA (pro-vitamin A) maize was introduced in 2016 by Meru Agro in partnership with the Building Nutritious Food Baskets (BNFB) project. Its pilot test showed that:
  - PVA varieties have good pest and disease resistance
  - However, consumers and farmers confuse PVA maize varieties with yellow analogue varieties such as CP 201 and CP 808

Biofortified characteristics

- Agronomic practices for PVA maize are the same for analogue varieties
- PVA maize varieties require careful post-harvest handling to avoid losing beta-carotene levels during storage and processing
- PVA potential maize yields between 5.9-7.5 mt/ha compared to the average analogue yield of 1.4 mt/ha.[1] However, the average potential yield for other hybrids is 8.6mt/ha [2]

Consumption characteristics

- Vitamin A content in maize is reduced when exposed to air, light, and heat
- Thus, cooking methods with long soaking hours and high heat levels will reduce vitamin A contents

Variety name	Vitamin A content (ppm)	Max yield (t/ha)	Maturity period (days)	Ear rot (%)	Year of release
Meru VAH 517	8 ppm	7.5	100-125	3.5	2016
Meru VAH 519	14 ppm	5.9	100-125	0.7	2016

Future releases

- Four hybrids are being tested for release by Tanseed International

(1) FAO, The Maize Value Chain in Tanzania, 2015; Dalberg, Literature Review, 2019; BNFB, Situational Analysis Report for Biofortification and Biofortified Crops in Tanzania, 2017; Dalberg Fieldwork with CIMMYT, 2019; (2) African Journal of Agricultural research, The use of improved maize varieties in Tanzania, 2014

Biofortified seeds are produced by Meru Agro and supplied to farmers with connections to an end buyer

	Research and development	Seed production and supply	Production
Features	• PVA maize is a three-way hybrid with two varieties released so far; Meru VAH 517 and Meru VAH 519 • Has a distinct orange color due to high Beta-carotenes (PVA) levels • Four more hybrids are being tested for release by Tanseed International	• Building Nutritious Food Baskets (BNFB) project initially distributed seeds to District Agricultural Extension Officers • Seeds are now being purchased by processors and co-operatives for supply to their partner farmers	• PVA maize does not require different agricultural practices and can be grown similarly to analogue maize • Seeds cannot be reused multiple times due their hybrid nature • Trials conducted suggest 4 to 5 times higher yield in pilot conditions
Actors	• The International Maize and Wheat Improvement Center (CIMMYT) along with HarvestPlus developed the variety • Tanzania Official Seed Certification Institute (TOSCI) and Meru Agro-Tours & Consultants Co. Ltd (MATC) offered support for testing and release	• MATC and Tanseed International ltd conduct early stage seed multiplication • Large buyers such as Sokoine University Graduate Entrepreneurs Cooperative (SUGECO) and Afco Investments source seeds on behalf of their farmers	• Smallholder farmers account for 95% of maize production • Many of the farmers involved in production are either attached to an end buyer or part of an out-grower scheme • BFNB supports initiatives to increase production, processing and consumption
Economics	• In 2018, MATC harvested 18 mt of certified seed[1]	• MATC supplied 89% of the seeds they produced to 2,600 farmers by November 2018[1] • In 2019, they harvested 153 mt • SUGECO also received 200 kgs of seed from MATC[2] • Seeds are sold at 6,000 TSH per kg, compared to analogue varieties at 5,000 TSH	• SUGECO distributed seeds to 10 contracted farmers • Afco Investments received 1 mt of PVA maize grain from CIMMYT[2] • The price of PVA maize grain is 800-1,000 TSH per kg[3]

BFNB, Facts on Provitamin A (PVA) Maize Tanzania, 2017; (1) BFNB, End of Project Report, 2019; (2) BFNB, Provitamin A Maize within the Maize Seed Systems and Grain Value Chain,2018;; (3) Fortunatha Mmari, Co-founder Afco Investments interview, October 19; Dalberg interviews and analysis, 2019

Potential barriers are the single-use hybrid variety nature of seeds, the lack of price competitiveness, and color attributes

Key barriers	Description
Single-use hybrid	**PVA maize varieties are a three-way hybrid, meaning that the seeds cannot be re-used.** 70% of maize seed in Tanzania is re-used (see slide 9), so for the majority of farmers seed purchase represents a new financial outlay. As just 12% of the market uses hybrids, the market for PVA seeds is limited to the larger-scale commercial and contract farms.
Lack of price competitiveness	**The high price of PVA maize means it cannot compete with analogue varieties.** Seed is 20% more expensive due to lower yielding seed multiplication (see slide 20), whilst low volumes at the processing level requires the use of more labour-intensive milling machines, thereby adding to the cost. Prices for PVA grain are almost 60% higher than other maize grain varieties.
Color attributes	**PVA maize is orange in color, and visually different from the yellow non-PVA varieties.** However, confusion over the color attributes of PVA maize means that the varieties are not clearly distinguished on the market; it is still commonly referred to as yellow maize.

Dalberg interviews and analysis, 2019

Single-use hybrid | PVA maize grains cannot be re-used as seed, which limits the potential scale through informal markets

Root cause

- PVA maize varieties were developed as a **three-way hybrid seed,** with Meru VAH 517 and Meru VAH 519 currently available on the market
- 30% of all maize planted in Tanzania is purchased formally. **18% are open-pollinated (OPV) varieties, whilst hybrid seeds make up just 12% of seed**
- Hybrid varieties tend to have higher yielding and desirable properties, but **the grain cannot be re-used in subsequent seasons**
- Plants grown from second generation seeds **may not share the desired traits selected** when creating the first-generation hybrid seed
- The seed collected from a hybrid plant will either **resemble one of the first-generation parents or be sterile.** Thus, hybrid re-use results in drastically reduced yield

Impact on potential to scale

- **Seed production companies are more willing to invest in hybrid seed production**, as they are guaranteed repeat customers every season
- However, the majority of maize **farmers are small scale and driven by cheaper cost options,** hence 70% of all maize seeds planted are re-used OPV grains
- Without the potential for re-use, **seeds will only be purchased and grown by the larger-scale farmers**
- Hence, PVA maize seeds are not competing against average maize performance at 1.4 mt/ha, but **against the yields of other hybrid varieties, where potential yields average 8.6 mt/ha compared to 5.9-7.5 mt/ha for PVA maize**[1]
- Furthermore, the potential for **wide-scale dissemination through the value chain is limited as seeds cannot be re-used in the informal market**

"Majority are small scale farmers. They prefer to reuse their seeds… Very few buy seeds from research institutions."

Jonathan, Department of Nutrition and Food security, Ministry of Agriculture

(1) African Journal of Agricultural research, The use of improved maize varieties in Tanzania, 2014; FAO, SSA training, seed and variety definitions (n.d.); Jonathan, Department of Nutrition and Food security, Ministry of Agriculture, Interview October 2019; Dalberg interviews and analysis, 2019

Lack of price competitiveness | The high price of PVA maize disincentivizes both farmers, processors and end buyers

Root cause

- **PVA maize seed is 20% more expensive than other hybrids.**[1] VAH 517 has a lower yield in seed multiplication due to the single-cross nature of the breeder seed. This makes it more expensive to produce and is sold at a higher price (519 is charged the same)
- PVA maize has smaller grain sizes; it takes 6 kg of PVA seed versus 8-10 kg of seed analogue to plant one acre. Hence **per acre cost of inputs is similar to other hybrids**
- However, PVA maize yield compares poorly with other hybrid varieties, and **farmers willing to invest in seeds are likely to choose other higher-yielding hybrid varieties**
- The newness of the crop and lack of early market entrants means that **farmers currently control the market, and charge a premium for PVA grain**

"Farmers are aware that they are few who grow PVA maize and can sell at a higher price particularly during dry season. Prices can range from 800 to 1000 compared to normal maize which is 500 to 600"

Fortunatha, Co-founder, Afco Investments

Impact on potential to scale

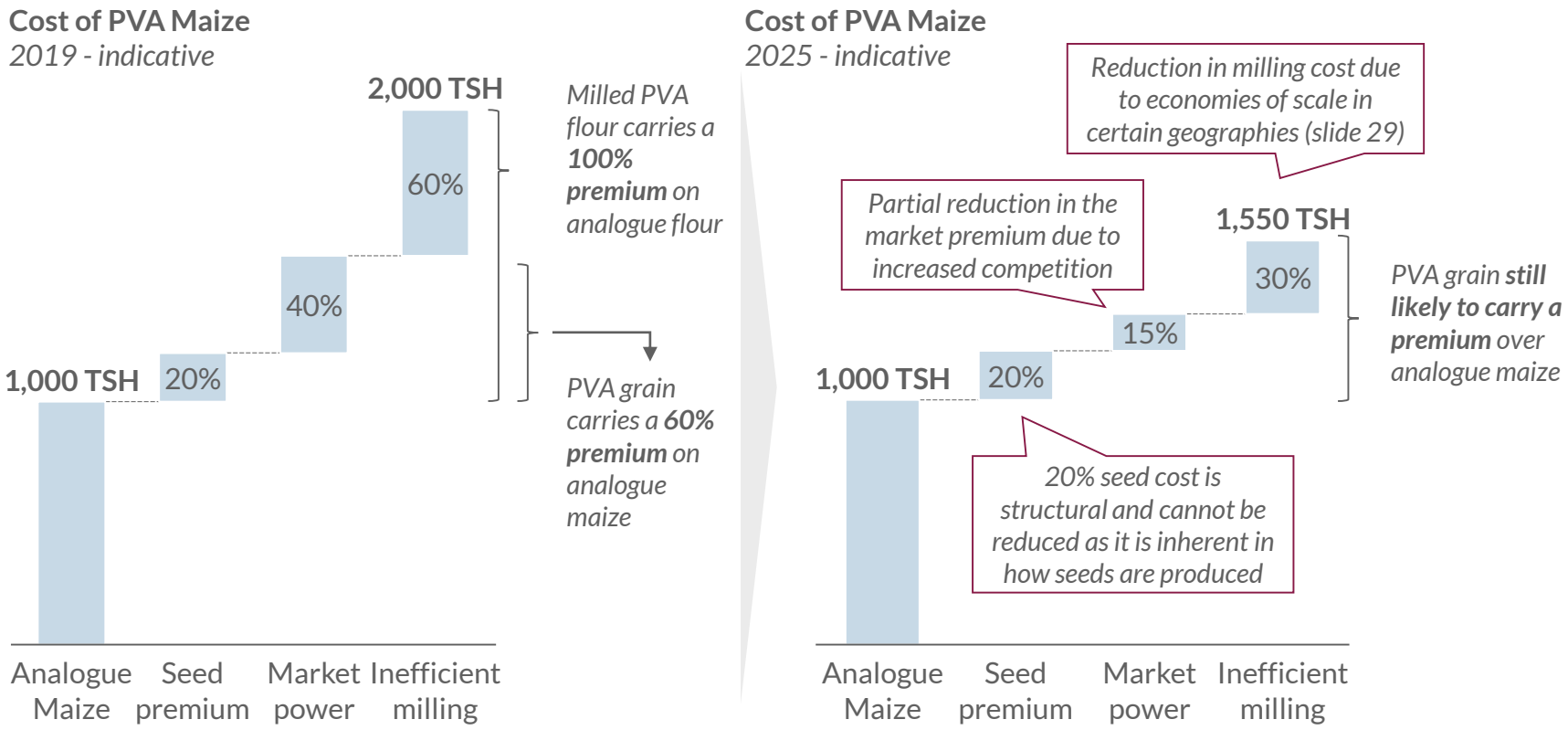
- **High prices and availability of cheaper varieties disincentivizes buyers** from choosing PVA maize even with added nutritional benefits (see slide 29)
- Consumers have shown **a willingness to pay up to 25% more** for other higher nutrient products but this does not always materialize in reality[2]
- A persistent price premium will **limit the potential commercialization of PVA maize to the higher-end market segments**

"People are capitalizing on the newness of the variety. The best way in the long run, is to see how all the varieties in Tanzania can be high iron…but it takes time"

Jean Claude Rubyogo, Coordinator, CIAT Tanzania

(1) Chacha, Meru Agro, Interview October 2019 (2) International Center for Tropical Agriculture, Consumer acceptance of and willingness to pay for high-iron beans in northern Tanzania, 2019; Fortunatha, Co-founder, Afco Investments, Interview October 2019; Jean Claude Rubyogo, Coordinator, CIAT Tanzania, Interview October 2019; Dalberg Interviews and analysis, 2019

Lack of price competitiveness | Whilst the farmer's premium and cost of milling may reduce over time, seed cost is structural



- Strong **downstream demand and a profitable value proposition** could cause the price premium to fall:
  - Potential profit margins could persuade farmers to switch to PVA varieties. As more farmers enter production, **prices are likely to fall as their bargaining power reduces**
  - Higher volumes of demand could lower the cost of processing (slide 29)
- However, **the seed margin and poorer performance compared to other hybrids will persist**, and the **profit potential for farmers is not guaranteed** given lower yields. Thus **PVA will continue to carry a premium over other maize hybrids**. It is unclear how much the price is likely to fall over the GAIN/HarvestPlus project timeframe

Dalberg interviews and analysis, 2019

Color attributes | Confusion among farmers regarding the orange color of PVA maize makes it difficult to distinguish

Root cause

- **PVA maize color ranges from deep yellow to deep orange** while most of the maize produced in the country is white
- There are **other yellow maize varieties distributed in the market that are not PVA maize**
- Confusion exists throughout the value chain as a result of **poorly practiced segregation for each color variety**

Impact on potential to scale

- **Farmers willing to switch varieties may believe they are planting PVA maize**, but may substitute for other yellow maize varieties
- This leads to a **loss of confidence in PVA maize**, and unwillingness for farmers to adopt it as they think they might not be able to sell

" The yellow color is not a barrier. Its just difficult to differentiate – this is the issue. You cannot tell if it's PVA"

Jeremiah Mwambange, Department of Nutrition, PO-RALG

(1) CGAP, National Survey and Segmentation of Smallholder Households in Tanzania, 2016; BFNB, Facts on Provitamin A (PVA) Maize Tanzania, 2017; Revocatus Kimario, Director, SUGECO, Interview October 2019; James Gichuru, Senior Scientist-Seed Systems Specialist, CIMMYT, Interview October 2019; Dalberg interviews and analysis, 2019

Supporting seed producers could help to unlock commercialization, but is secondary to downstream demand

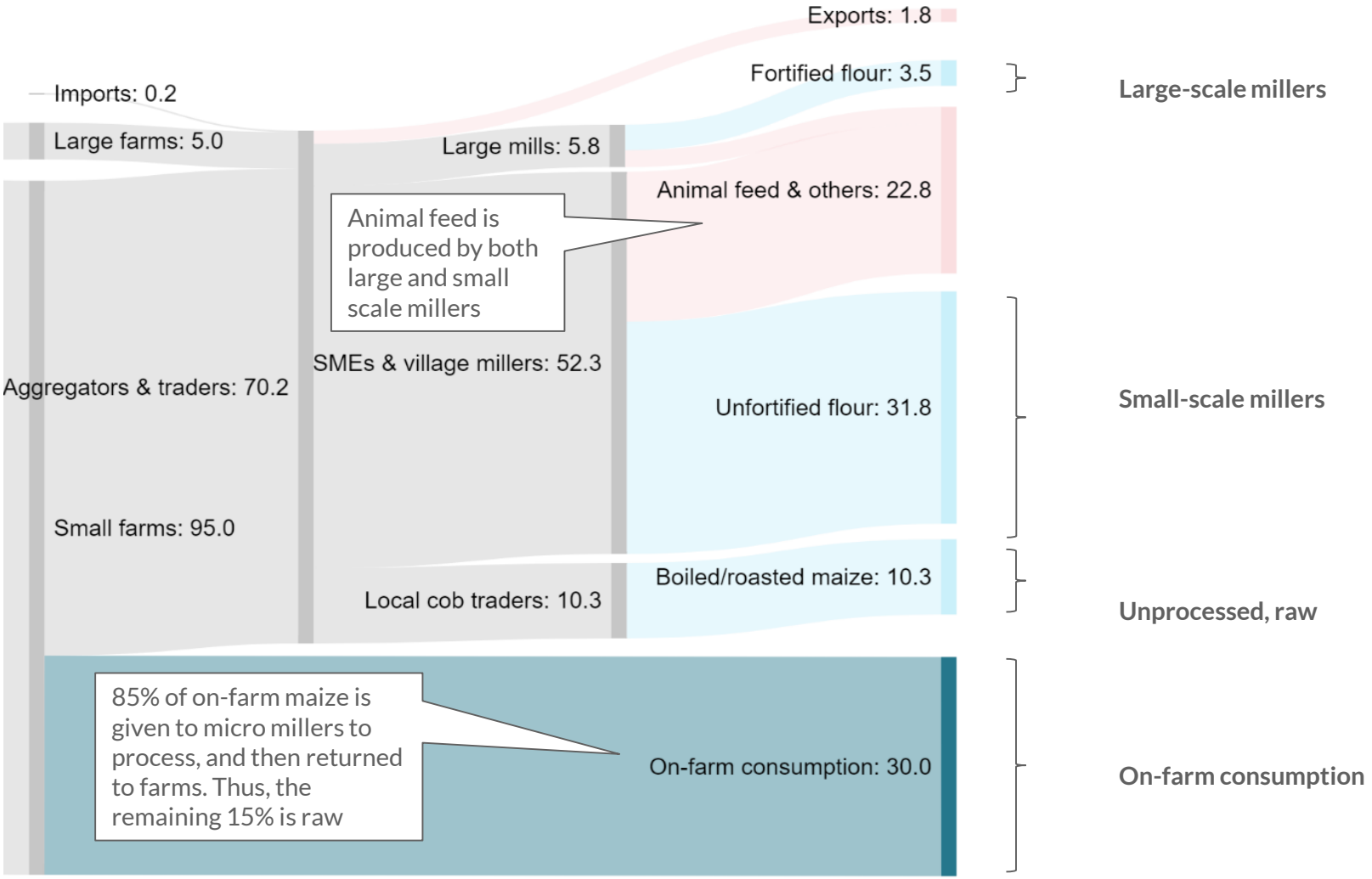
Key Opportunities	Description
Seed production	**Supporting seed producers to access financial and technical support could help them expand seed production.** Seed producers are currently limited in their ability to invest in large maize seed production by a lack of downstream demand. If downstream demand materializes, then seed producers will need to access finance for investments such as in irrigation systems and inputs. Additional support such as in managing farmer out-grower networks and marketing to agro-dealers and other customers may also enable them to quickly ramp-up and scale. However, this is an enabler for commercialization, not a commercial opportunity in itself.

*Whilst the hybrid nature of the seeds does present barriers for commercialization downstream, the **potential profitability from a well-performing hybrid can be appealing for seed producers and attract investment**. Thus, supporting seed producers in PVA maize may not be a primary opportunity to pursue.*

Dalberg interviews and analysis, 2019

Post-farm & consumption

Post-farm, maize stocks are aggregated and traded to large and small processors, or sold without processing



FAO, FAO Statistics, 2019; FAO, The Maize Value Chain in Tanzania, 2015; Dalberg Literature Review, 2019; Index Mundi, Tanzania Maize Statistics; 2019; National Bureau of Statistics, 2015 Tanzania in Figures, 2016; CIMMYT, Building Nutritious Food Baskets Project Final Report: Provitamin A Maize within the Maize Seed Systems and Grain Value Chain; FAO, Institutional Procurement of Staples from Smallholders, 2014

There are four main channels to market, with small-scale mills holding the large-scale potential

	Features	Primary consumers	Drivers
Large scale mills	• A limited number producing higher quality product • Capacity ranges from 20-50 mt per day[1] • Process less 5.8% of the maize in the market	• Major consumers are middle and upper income urban households • Other products coming from this channel include flour exports, beer and animal feed • Flour is used to cook ugali	• High quality product • Availability at scale • Palatability
Small scale mill	• Hammer mills with capacity <20 mt, but often operate below capacity[1] • Mills frequently not government registered • Small mills process 52% of maize on the market, plus an estimated 85% of maize consumed on-farm	• The primary consumers are low income households, the majority of which are in rural areas • This includes farming households who process a portion of their maize grain into flour for home consumption	• Affordability of maize flour • Proximity and convenience • Palatability
Unprocessed, raw	• Unprocessed maize includes maize grain and cobs • Maize cobs can be boiled or roasted • Boiled/roasted cobs are consumed as a snack	• Large consumption channel encompassing consumers across low income households • Roasted maize is consumed among different groups of people	• Affordability of grain • Shorter cooking times for cost saving on fuel • Availability of roasted maize
On farm consumption	• On farm consumption accounts for 30% of small-scale production. 85% of this first processed into flour • Maize can be consumed as a grain or as flour. Flour is processed by small mills and returned to the farmer, making up 85% of on-farm consumption	• Smallholder farmers consume what they produce on the farm • Grains are used in food such as makande and flour in Ugali	• Sustenance and food security • Shorter cooking times for cost saving on fuel

(1) FAO, The Maize Value Chain in Tanzania, 2015; Royal Tropical Institute, Lessons on small and medium-scale maize flour fortification in Tanzania, 2017; Dalberg interviews and analysis, 2019

Barriers include the color preferences for white maize and insufficient nutritional content

Key barriers	Description
Consumer preferences	**The majority of maize consumed in Tanzania is white, whilst PVA varieties are yellow in color and carry old associations with relief food.** Consumer preferences are slow to shift, and awareness raising has not resulted in increased demand at scale. Awareness of nutritional benefits alone is unlikely to shift consumers away from long-standing preferences for white maize. Without demand at scale, processors cannot invest in processing equipment that could lower the cost of PVA maize.
Insufficient nutritional content	**Despite a high vitamin A content, PVA maize does not provide the same multi-nutrient content as fortification supplements.** Whilst the government states that biofortified crops do not need to be subsequently fortified at the milling stage, this may not play out in practice, as biofortification simply does not meet the same standards.

Dalberg interviews and analysis, 2019

Consumer preferences | The majority of consumers in Tanzania prefer white maize, whilst PVA varieties are yellow in color

1 **Traditionally, consumption in Tanzania is for white varieties of maize, translating to a strong preference for white maize products**

- Most maize that is available on the market is white. **White is the preference for most maize consumers**
- White maize has resulted in a preference for white maize products and meals such as cobs, flour, ugali and makande
- **Older generation consumers associate PVA maize color to famine relief food.** The yellow/orange color is often regarded as food for the poor, particularly for elders in the community
- **Changing the preference of white maize to yellow will require consumers to shift their inclination** towards a different color products, and habits that have existed for generations

"The yellow coloring is a problem, especially for elders. They associate it with the hunger in the 1980s... for younger people, they don't mind."

Revocatus Kimario, Director, SUGECO

2 **Consumer preferences are slow to shift, and awareness raising has not resulted in increased demand at scale**

- PVA Maize is a new product on the market; many consumers are unaware of the availability of PVA maize in Tanzania, and the potential nutrition benefits
- PVA maize products often **lack proper branding and promotion to consumers,** especially at the high-end of the market
- Processors, government and NGOs are advocating for increased awareness creation to stimulate demand, but this is **yet to translate into large-scale demand**

"We are at the juvenile stage…Promotion is required to make people aware of their nutritional importance."

Margareth Natai, Nutritionist, Ministry of Agriculture

Mr. Nalaila, Second headmaster, St. Mathew secondary school, October 2019; Dalberg interviews and analysis , 2019; Icons by The Noun Project

Consumer preferences | Low demand limits investment in high-volume processing equipment

3 Awareness of nutritional benefits alone is unlikely to shift consumers away from long-standing preferences for white maize

- There is anecdotal evidence that consumers prefer the taste of PVA maize. With a growing generation of younger consumers, **color association to famine relief is likely to fade out**
- However, **nutritional benefits alone are rarely sufficient to change consumer preferences and behavior**
- **Consumers also need incentives such as good taste, affordability, cooking attributes and aspirational branding to encourage change**

"We believe all food is nutritious. For us to see the added value of the nutritional content the price has to be competitive."

Mr. Nalaila, Second headmaster, St. Mathew secondary school

4 Without demand at scale, processors cannot invest in processing equipment that can lower costs of PVA maize

- Without sufficient demand from consumers, **processors are not able to commit to milling large volumes**
- **Large scale mills use mechanized roller mills that cut labor requirements and hence labor costs**
- **The current use of hammer mills to process PVA maize is labor intensive**. It requires labor for cleaning, sorting and packing, with charges usually around 1,500 TSH per bag[1]
- Higher processing costs for PVA maize contributes to the price premium (see slide 10 & 21). The price of PVA maize flour is 2,000 TSH per kilo compared to 1,000 TSH for analogue maize – a 100% premium
- High demand from consumers would (i) **enable processors to invest in better processing technology** and (ii) **enable processors to guarantee purchase from farmers** to assure increased production volumes

"So far, we use a hammer miller – this takes a lot of labor. Maximum we can produce is ½ ton. We use the roller machine for white maize, but we don't have enough volume of PVA to use it."

Fortunatha Mmari, Co-founder, AFCO investments

Fortunatha, Co-founder, Afco investments, October 2019; Mr. Nalaila, Second headmaster, St. Mathew secondary school October 2019; (1) Ginger trader, Tanzania, TAHA project, January 2019; Dalberg interviews and analysis, 2019

Insufficient nutritional content | The nutritional content of PVA maize is not equivalent to fortification supplements

1 The government is pursuing a strong policy on nutrition; there is the potential for PVA maize to present a lower cost method of meeting nutritional standards

- The government's **policy requires all millers to fortify their maize**. In order to comply, millers must buy fortification supplements and a machine to add supplements during the milling process
- Despite subsidies, this adds to the cost of milling maize, and presents a **challenge for small-scale millers in particular**
- **Using biofortified inputs exempts small-scale millers from needing to fortify**. Thus, millers could source PVA maize to produce nutritional maize flour instead of having these additional costs
- If PVA maize can reach price parity with analogue varieties, it could present a **low-cost way for small millers to meet the required standards**

> *"If they buy biofortified then they don't need to fortify. Fortified flour is sold at the same price as regular because the inputs are subsidized"*
>
> Festo Tilia, Nutrition Office, PO-RALG

2 However, PVA maize doesn't provide the same multi-vitamin nutritional content as fortification supplements; biofortified maize flour is not a nutritional substitute for fortification

- PVA maize has a high vitamin A content, but is **missing other vitamins and minerals that are added in fortification supplements**, such as iron, zinc, vitamin B12 and folate
- Furthermore, the government places more emphasis on fortification, and **it is not clear to millers that PVA maize would be exempt from standards enforcement**
- **From a value-for-money and nutritional impact perspective, fortification supplements present a stronger case that PVA maize**
- In reality, there are **few incentives for millers to switch to PVA maize**, particularly given fortification subsidies versus the price premium for PVA maize

PO-RALG, Interview Dodoma, October 2019; Dalberg interviews and analysis, 2019; Icons by the Noun Project

School feeding could present a commercial opportunity, but success is dependent on economies of scale to drive down costs

Key Opportunities	Description
School feeding program	**Purchases by school feeding programs could generate the downstream demand required to spur investment and scale throughout the value chain.**[1] This approach could look to work across three groups of stakeholders: *1. School Boards* • The purchasing decision makers are the boards responsible for each school. Interventions could aim to help them understand and recognize biofortified crops, and subsequently include PVA maize and iron beans in school procurement • Working to increase awareness through nutrition information packs, school visits and building relationships will be key *2. School Suppliers* • Working with the registered school suppliers of food could ensure that quality is maintained and mixing of varieties does not occur. These suppliers could act as a focal point for aggregating biofortified crops across districts, specifically for school consumption • Interventions could aim to de-risk the inclusion of PVA maize and iron beans in the aggregation system, potentially through small grants and technical assistance *3. Policy-makers* • See slide 35 **With children as the target end-consumers, apprehensions regarding the yellow coloring become less significant.** Furthermore, children act as agents of change by influencing buying decisions in the home, catalyzing a market effect beyond school purchases and into the mainstream.

*The potential for this intervention requires further investigation, as **it can only be effective as a catalyst for commercialization if**:*

- *The size of school purchases delivers **sufficient volumes to drive demand** – initial estimates do not suggest significant scale*[1]
- ***Greater scale actually drives costs** down due to economies of scale in processing (see slide 28)*
- ***Millers are willing to invest in high volume processing** given i) the governments fortification requirements (slide 34), and ii) the disparate nature of purchasing through individual suppliers rather than bulk institutional purchases (slide 35)*

(1) Total school purchases are estimated at 131,000 mt/year (number of school children x average daily consumption x 200 school days per year), which equates to just 2.2% of the total maize market. Of this, approximately 30% is the addressable market through boarding school purchases.

Dalberg

Retail partnerships could offer a commercial opportunity to scale, but fortification requirements may limit adoption

Key Opportunities	Description
Retail partnerships	**Working with downstream retailers could help to increase awareness and adoption of PVA maize as a high-end product**. Although a narrow market segment, the potential is growing, and the high-end market tends to show early increased willingness to pay for nutrition. Capitalizing on these market trends and supporting retailers with new PVA maize products in packaging, marketing and promotions could spur traction in the value-add market.

Fortification is mandatory for large-scale millers, reducing the incentive to buy biofortified *(see slide 34). This is likely to limit market potential in the high-end retail channel as fortified supplements are both legally required for maize flour, and provide more nutritional content.*

Dalberg interviews and analysis, 2019

Policy and financing

Barriers in policy and finance include a lack of emphasis on biofortification, limited school feeding funds, and a finance gap

- 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 program, 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 maize crop in Tanzania, we see three main barriers in policy and finance**:

Lack of incentives for biofortification

The government's nutrition policy focuses on fortification, and disincentivizes buying biofortified

Limited school feeding funds

Funding required for school meals is often late or entirely lacking. Funding is limited and ownership is split across a number of stakeholders

Financing gap

Actors across the maize value chain have unmet financing needs which prevent greater market formalization

(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

Dalberg interviews & analysis, 2019

Lack of incentives for biofortification | Nutritional policy emphasis on fortification risks sidelining biofortification

1 **Tanzania has strong government support for nutrition in policy and legislation, with an emphasis on fortification. However, standards are unclear and the degree of implementation appears patchy**

- **Tanzania has a cross-sector, multi-stakeholder platform for nutritional governance,** consisting of the High Level Steering Committee for nutrition and the Technical Working Group for nutrition, which advocate and mainstream nutrition in government objectives
- **Tanzania has made strides to integrate nutrition in national strategies.** The National Health Policy (2003) and the National Nutrition Strategy (2012) highlight food fortification to improve nutrition
- **In 2011, the government mandated wheat and maize flour fortification** with iron, zinc, vit B12 and folic acid, and vegetable oil with vitamin A
- **A lack of capacity and funding of government institutions hampers biofortification adoption, and unequal distribution of funds across districts** leads to varying degrees of nutritional policy implementation
- The government states that **millers using biofortified inputs are exempted from fortification laws, but this messaging and the difference between the two is not made clear** to millers

2 **If fortification standards are effectively enforced, the incentive to buy biofortified varieties is reduced from both a nutritional content, legal and cost perspective**

- **Fortification is enforced for large-scale millers, reducing the incentive to buy biofortified (see slide 29)**
  - Large scale millers tend to buy from the larger-scale farmers, who are the only farmers who can afford hybrid seeds due to the increased and repeated cost (see Sankey slide 9)
  - Without demand from large-scale millers for PVA maize, adoption of the certified hybrid seed will be limited
- Whilst **small millers are nominally exempt from fortification laws,** they **tend to buy from small-scale farmers who re-use seed and cannot afford to plant hybrid seed.** Thus the likelihood of achieving commercial PVA maize adoption through this channel is also limited
  - Furthermore, **the government plans to expand application and enforcement to include all millers**
  - A South African firm has been contracted to establish fortification supplement processing in every state, and **every miller will be required to purchase a fortification machine**

BFNB, Tanzania SITAN report; Ministry of Health and Social Welfare, National Nutrition Strategy July 2011/12–June 2015/16; Guardian, Malnutrition in Tanzania: Will food fortification laws work?, 2014; TFNC, Tanzania Landscape Analysis final report, 2012; PO-RALG, Dalberg Interview, October 2019; Dalberg interviews and analysis, 2019

Limited school feeding funds | Funding for school meals is unclear, split across stakeholders and often late or entirely lacking

1 **School feeding programs aim to provide children with the sustenance they need for education. However, management of the program is devolved, with unclear funding split across stakeholders**

- **School-feeding programs aim to reduce hunger in children from low-income districts** where hunger affects learning in primary and secondary school pupils. **The estimated total maize procurement for school feeding programs is 131,000 mt/year – just 2.2% of the estimated total market**[1]
- While some day schools grow their own food, **the majority of boarding schools procure food from registered school suppliers, who provide maize and beans for the schools**. Decisions on food procurement are made by the school board, who buy in bulk according to school needs
- **School feeding programs are widely funded by government, World Food Program (WFP), and other NGOs**, while some public schools require parents to contribute to some of the food for pupils. There is not one system of funding, although in theory government District Nutrition Officers monitor procurement and spending
- **Schools are allocated a budget** by the government of **1,500 TSH per child.**[2] This limited budget means that nutritional considerations come second to the cost

2 **Funding gaps and delays constrain schools' supply of food, and presents a challenge for the adoption of biofortified crops by school feeding programs**

- **Funding has reduced significantly** since the WFP withdrew support, and NGOs often run just short-term projects
- **Government funds are regularly delayed** which means that traders are not paid on time. As a result, **many school suppliers are reluctant to procure for schools**, due to fears or non-payment or significant delays
- **Without adequate funding, schools struggle to pay for school meals**, and may be forced to source poorer quality or smaller quantities of maize, in order to reduce costs
- Thus, **solely relying on school procurement as a strategy for commercialization maize and beans carries a funding risk**

> *"Delayed payments from government causes suppliers to refuse to send food to the schools. A lot of effort is spent trying to convince suppliers to send the food regardless."*
>
> Mary Msungu, Principal Education Officer, PO RALG

(1) Total school purchases are estimated at 131,000 mt/year (number of school children x average daily consumption x 200 school days per year), which equates to 2.2% of the total maize market. Sources: Dalberg, PVA Maize Literature Review, 2019; (2) PO-RALG, Interview Dodoma, October 2019; Lukindo, Contribution of School Feeding Programs (SFPs) in Enhancing Pupil's Schooling in Primary Schools in Monduli District, Tanzania, 2018; Icons by the Noun Project

Dalberg

Financing gap | Actors across the maize value chain have unmet financing needs which prevent greater market formalization

	Inputs	Production	Transport & Storage	Milling & processing	Marketing
Existing financial relationship	• Small number of NGOs and donor agencies, such as One Acre Fund, support the provision of inputs on credit	• Large-scale farmers are able to access services from formal financial service providers • 96% of small farmers and small businesses use informal moneylenders as a credit source	• Warehouse receipting exists but remains in nascent stages • 45% of middlemen and traders advise they have access to FSPs, often	• Existing relationships for some large millers with 33% advising they have credit mechanism with commercial banks	• Large buyers are government backed • Small buyers are reliant on informal channels for credit and savings products
Needs and gaps	• Significant need for improved input credit sources and support	• Significant demand for financial products that improve liquidity • Credit at prices more affordable than those given by moneylenders	• Major unmet demand for warehouse receipt financing • Major liquidity constraints for those who do offer warehouse receipts	• Limited financial support for small millers • Insufficient knowledge on benefits of finance; 25% of processors do not like to borrow due to fear of default	• Small-scale buyers have no financial support • No provision of credit from buyers to sellers
Estimated required finance	• Agro-dealers on average need $35 per acre for inventory	• Farmers need on average $43 per acre for seed and fertilizer inputs	• Aggregators need $104 per acre to buy produce at farmgate • Aggregators need $18 in working capital for transport and storage	• Processors need $122 per acre to meet raw material and working capital needs	• Retailers needs $162 in working capital to buy processed goods • Retailers require insurance against poor quality produce and high spoilage

FAO 2012; FAO Stat, University of Cambridge, 2011; SAGCOT, 2011; FAO, 2013; SAGCOT; RATIN; Dalberg interviews and analysis, 2019

Dalberg

Working with the school feeding program would also require a policy-maker-level intervention

Key Opportunities	Description
School feeding program – policy makers	**Purchases by school feeding programs could generate the downstream demand required to spur investment and scale throughout the value chain.** Following on from slide 31, working with policy makers is an essential component in addition to the school board and supplier level. This intervention could look to promote school purchases from a top-down directional point of view, particularly with regard to clear messaging on fortification and biofortification requirements. GAIN and HarvestPlus could co-ordinate with district nutrition officials so that understanding translates into demand, and support government to track and enforce the policy.

Dalberg interviews and analysis, 2019