Agra Innovate
West Africa

Cassava commercialization - a research perspective.

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Why cassava?

- Agronomic advantages
- Flexible planting and harvesting
- Resilience to climate change.
- Staple food

However:

- Perishable (shelf life 48h) – leading to sourcing problems.
- Contains cyanogenic compounds.
- Nutritionally relatively poor, but biofortified cassava available.

Why commercialise cassava?

- Food security – population growth, increasing urban populations
- Increase small-holder incomes
- Economic growth/ Business opportunity
- Nutritional challenges e.g. vitamin A deficiency
- Reduce imports

Addressing shelf-life: Winner of Rockefeller Cassava Innovation Challenge 2017

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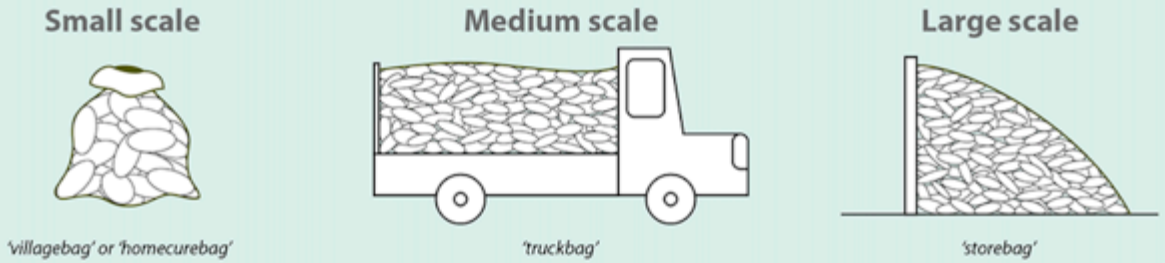
Concept



NRI CASSAVABAG

↑ MOISTURE
\+
↑ TEMPERATURE
=
10 DAYS SHELF LIFE
&
PRESERVED STARCH CONTENT

Project stages

1. Laboratory scale testing
2. Testing innovations
3. Pilot testing
4. Scaling up

Project partners

NRI, FUNAAB, SMEs
LMEs, C:AVA, IFAD
EU, ISTRC

The ROCKEFELLER FOUNDATION

Dalberg

IITA

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Which products to commericalise?

Use of cassava roots in SW Nigeria – data from GRATITUDE project.

Utilization	Share (%)	Root use (t)
Own-consumption	20%	1,500,164
Gari	52%	3,900,426
Fufu	24%	1,800,197
Lafun	3%	240,026
Industrial, incl. dry chips	1%	60,007
TOTAL	**100%**	**7,500,820**

Data from EU-funded GRATITUDE – Deliverable 1.1

Don't neglect traditional products: Gari is an excellent product…..

- Adds value to cassava
- Multiple entry points/levels
- Safe from cyanogens (grating, dewatering and roasting)
- Safe from microorganims (roasting)
- Safe from mycotoxins (rapid processing)
- Long shelf life (low moisture content)
- Convenience food/urban market
- Biofortification (Yellow Cassava)

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Ease of entry into gari processing, especially for women

- Different scales of processing result in products of similar quality.
- Scales include:
  - Individual processors
  - Women/community group
  - Small-medium scale enterprise
- Many opportunities to add value to cassava production or undertake paid work
- Renting services reduces need to own equipment

Abgajowo Processor Group outside the Private processor enterprise they hire for processing

Constraints and opportunities to current gari processing

- Environmental impact (fuel wood, liquid waste, peels)
- Safety of women undertaking processing
- Labour saving opportunities – but loss of jobs, especially for women
- Reduction in post-harvest losses
- Opportunities for mechanisation/ standardisation
- Access to new markets/new business opportunities e.g. supermarkets, export
- Biofortification (yellow cassava)/ fortification (Iron/Zinc)

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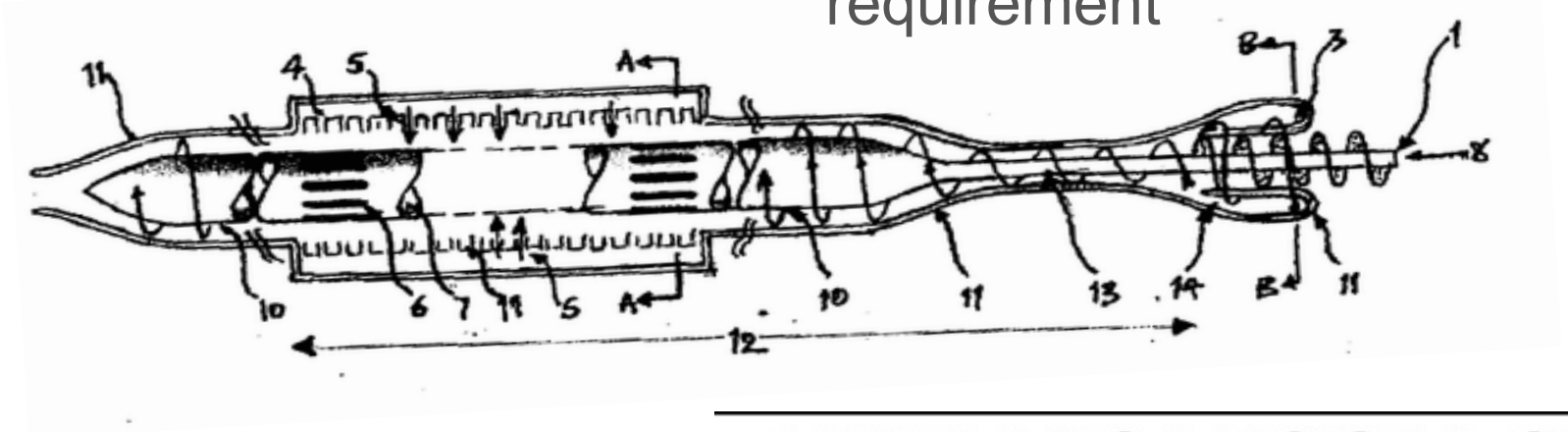
SURFACE MOISTURE REMOVAL technology ("SMR")

- For moisture located ON THE SURFACE of the particles
- Ideal for material that has been washed or processed in water

- Uses air to blow water off the particle surface
- Avoids the need to evaporate the water
- Hence much reduced energy requirement



US Patent 2014/0325867

THE WOLFSON CENTRE
for Bulk Solids Handling Technology

Beyond traditional products..

- Important to understand:
  - Markets for products
  - Relative levels of investment
  - Challenges in realizing the opportunity
- Product options:
  - High Quality Cassava Flour (HQCF) (relatively low cost – ca. $250k)
  - Starch and modified starch (higher cost – ca. $10-20 million+ for 250 tonnes/day)
  - Ethanol (higher cost ~$20 million for 33$m^3$ per day of ENA/ anhydrous alcohol from FCR or dry chips)

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C:AVA

Cassava: Adding Value for Africa

C:AVA I and II strives to develop a vibrant and competitive cassava industry (HQCF, Starch, Ethanol) based on market-led efficient production and processing, leading to a reduction in rural poverty

Aims to stimulate sales of more than two million tons of cassava into HQCF and other cassava product value chains.

Intervention 1: ***Farmers***

- Work with community groups to build capacity on cassava production
- Introduce new high-yield cassava varieties
- Ensure constant root supply

Intervention 2: ***Processors***

- Support communities on proper processing
- Introduce new processing tech-nologies or improve existing ones
- Improve quantity and quality of HQCF and other products produced

Intervention 3: ***Markets***

- Identify potential markets for HQCF
- Provide business and technical support to make case for HQCF and other product adoption

Supported by the Bill and Melinda Gates Foundation

CAVAII progress

FCR mobilisation (tonnes) without traditional products

Country	2014	2015	2016	Total
Ghana	22,431	31,182	54,313	107,926
Malawi	4,392	11,960	17,827	34,179
Nigeria	95,951	183,056	132,977	411,984
Tanzania	890	7,167	23,578	31,635
Uganda	7,823	16,485	31,677	55,985
			total	**681,236**

Grand total with traditional products: 1,057,000 tonnes (end 2016)

Sub-sector	Competing ingredient	Current / potential annual demand for cassava-based products			Medium-term potential in FCR* equivalents t/yr	Potential for smallholder involvement	Comments
		Current market tons	Theoretical demand	Achievable demand			
HQCF in bread	Hard-Wheat Flour	2,500	400,000	40,000t	160,000	~13,300	Depends on solving root supply, processing & bakery inclusion issues
HQCF in biscuits	Soft-Wheat Flour	0	80,000	16,500t	66,000	~5,500	
HQCF in snacks	Hard-Wheat Flour	12,500	18,500	12,500t	50,000	~4,200	
HQCF in paperboard	Maize Starch	0	6,000	6,000t	24,000	~2,000	Depends on buy-in from paperboard factories
Instant Fufu	Wet Fufu	500	Niche market, with potential for development as a subsidiary market for HQCF SME's				
Packaged garri	Traditional Garri	50-100	100 t	100 t	430	V. small	Niche market no potential
Cassava Starch	Maize Starch	14,000	60,000 t	25,000 t	125,000 t	~10,416	Two established & one new factory opened in April 2013
Sugar Syrups	Maize-based syrups	0	200,000 t	0	0	0	Investment is unlikely in the medium-term
Chips for export to China	Cassava Chips from Thailand & Vietnam	0	2.2 million t	0	0	0	Nigeria is unable to compete, exports are not economic
Chips for poultry Chips for fish feed	Maize-based feed	0 Very small	450,000 t 23,000t	0 23,000t	0 74,000t	0 ~6,200	Depends on cost of maize, cassava & protein ingredients & access to pelletisation
Ethanol industrial	Imported ethanol	0	60 million litres	Industrial alcohol = 20 million litres E10 = 0 Home-cooking ~7.5 million litres	140,845 t	~11,737	The economics of E10 do not look favourable, cooking fuel is attractive but the business case requires clarification. Industrial alcohol offers a reasonable opportunity for smallholder inputs
Ethanol in petrol (E10)	Ordinary petrol without ethanol	0	700 million litres		0	0	
Ethanol for cooking	Kerosene & firewood (including charcoal)	0	1 billion litres		53,000 t	~4,416	
Cassava-based beer	Barley-based beer	0	30,800t[a]	15,400t	61,600t	~5,133	Dependant on firm commitment from breweries & tax incentives
Total					**~755,000 t**	**~63,000**	

* = Tons of fresh cassava roots (FCR) a = Cassava grits adjusted to 14% moisture or equivalent in wet-cake (~40% moisture)

Starch

Photograph and figures supplied by A. Graffham

- Significant financial investment
- Consider supplies of root
- Sure of the market
- Internationally traded
- Native cassava starch, low value, high volumes (e.g. $368/tonne FOB Bangkok)
- Modified starch, more value, less volumes (e.g. $720/tonne FOB Bangkok)
- Modified starch generally gives better margins – but requires additional investment.

Ethanol

Photograph and figures supplied by A. Graffham

- **Industrial alcohol / denatured alcohol** (93-94% ethyl alcohol) l. Toxic for humans. Industrial uses including cooking stoves.
- **Extra neutral alcohol (ENA)** – More distillation required. ENA is ~190° proof and is of sufficient purity for use in beverages (diluted to ~40% alcohol). ENA is mainly used for beverage and industrial purposes (such as plastics industries)
- **Anhydrous Alcohol** – Anhydrous alcohol is ~200° proof and contains between 99.8 and 99.9% ethyl alcohol Industrial and medical purposes. Also suitable as a biofuel.
- Capital and energy intensive requires a relatively large-scale ~33m^3 is the smallest scale of production for a sensible investment. Capital investment of ~US$20 million.

HQCF

Cassava

↓

Peel/wash

↓

Grate

↓

Press → Pressed cake

↓

Dry → Cassava grits

↓

Mill and bag → HQCF

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C:AVA
Cassava: Adding Value for Africa

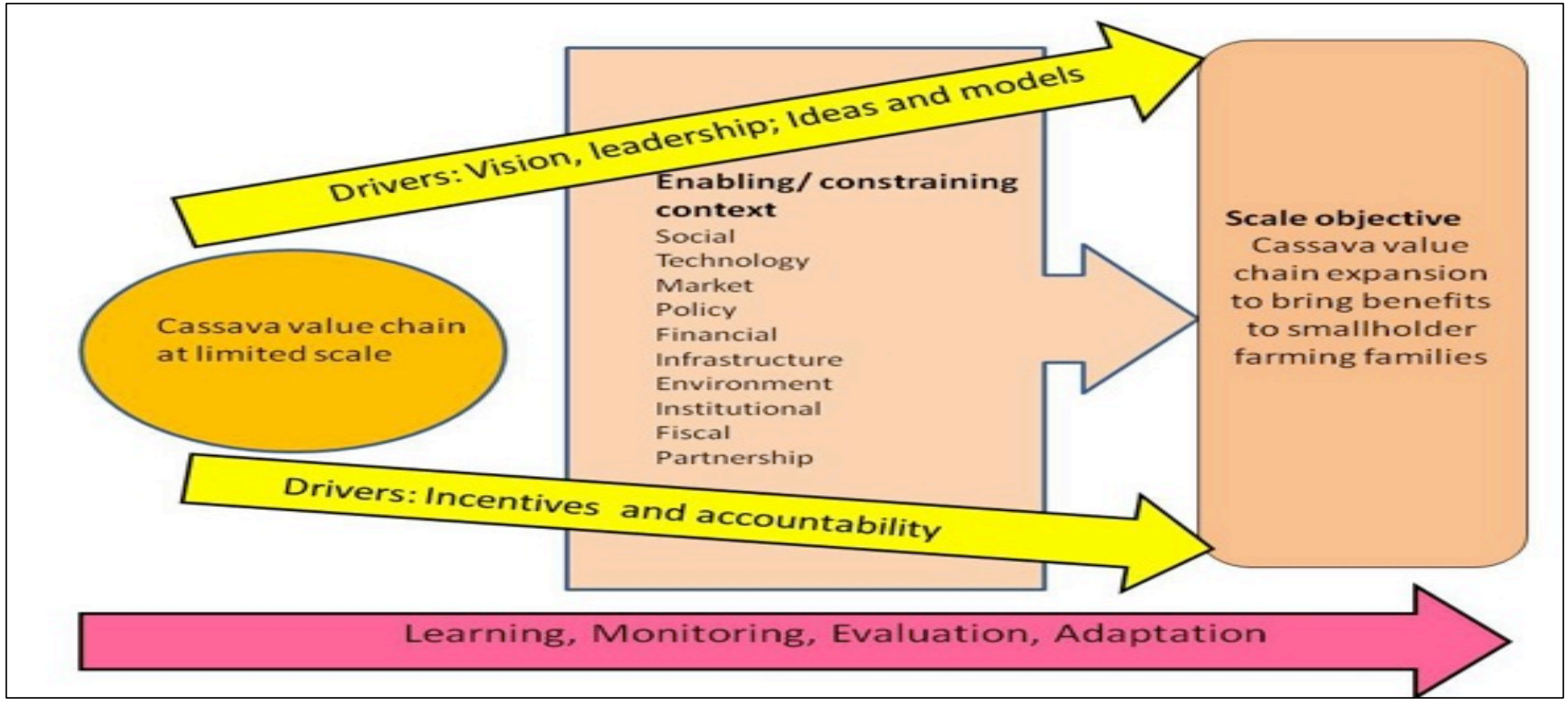
Lessons learned from CAVA that influenced scaling up and scaling out strategies in CAVAII

Study methodology

Key steps in the study method were:

- **Review of C:AVA documentation**
- **Interviews with C:AVA personnel** to identify drivers, enablers, and constraining influences in each country and for the project as a whole.
- **Participatory analysis by country managers and coordinators** of the relative importance and influence of the drivers and enabling or constraining influences.
- **Results were shared for validation** in a CAVA team meeting.
- **Project working paper prepared**, which contributed to the development of a CAVA Phase II.
- **Paper published** in *Food Chain*.

Conceptual framework: Scaling up cassava value chains - pathways, drivers, and enabling and constraining factors



Hartmann et al. (2013) and Linn (2012).

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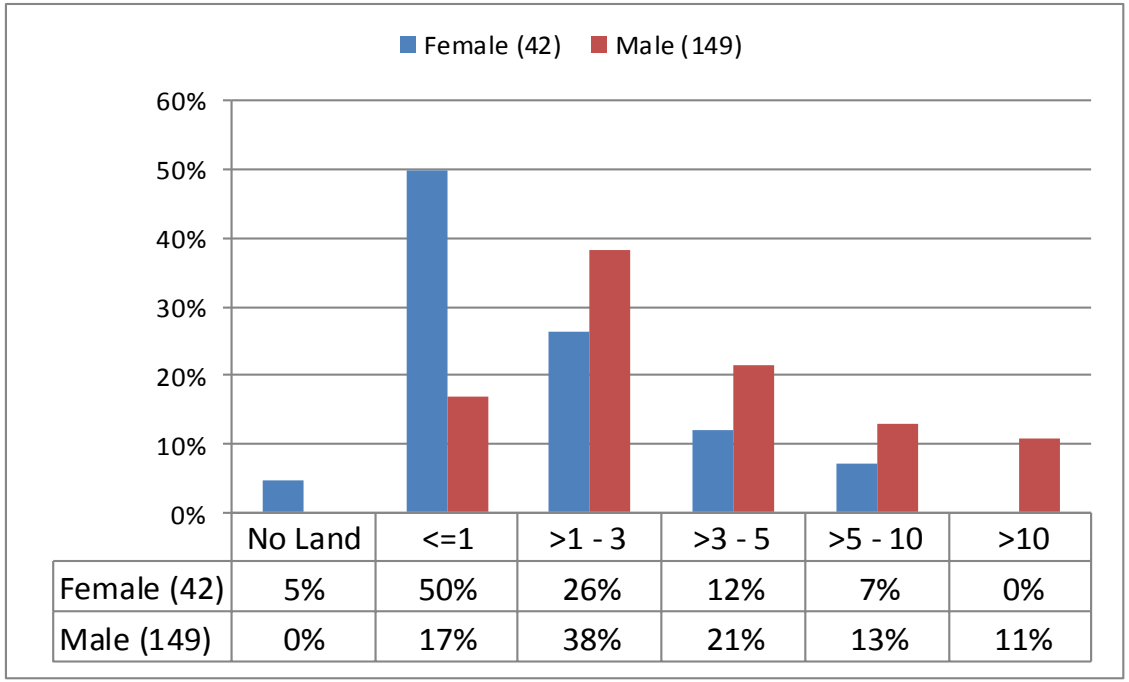
Findings – scale/gender

- Better resourced, males better position to respond to, and manage the risks offered by, new commercial opportunities.
- Significant support needed for women and less well-resourced, many of whom are food insecure.
- Enterprises may need help to source from these target groups.
- In Nigeria only 45 % of female-headed households working with C:AVA had > 1 hectare of farmland, compared to 87 % of male-headed households.



	No Land	<=1	>1 - 3	>3 - 5	>5 - 10	>10
Female (42)	5%	50%	26%	12%	7%	0%
Male (149)	0%	17%	38%	21%	13%	11%

Farm size (ha) by gender of household heads of households working with C:AVA in Nigeria
***Source*: data from C:AVA Impact Study in Nigeria**

Incentives and accountability

- Commercial incentives vary greatly among different countries, value chain models, and over time.
- Competitiveness of HQCF compared to alternatives is a key driver for end users.
- Motivating farmers in the short term without fostering dependency, while working towards longer-term value chain benefits, is a challenge.

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i. Institutional context

The entire value chain.

- Developing Small holder inclusive is long-term process involving entire chain.
- Value chain actors sharing business ethos find doing business easy = sustainable
- Increased demand carefully balanced with increased supply

Farmers/processors.

- Skills key to success
- Constraining factors overcome with TA and organizational capacity building
- Prior investments = launch pad

Intermediaries.

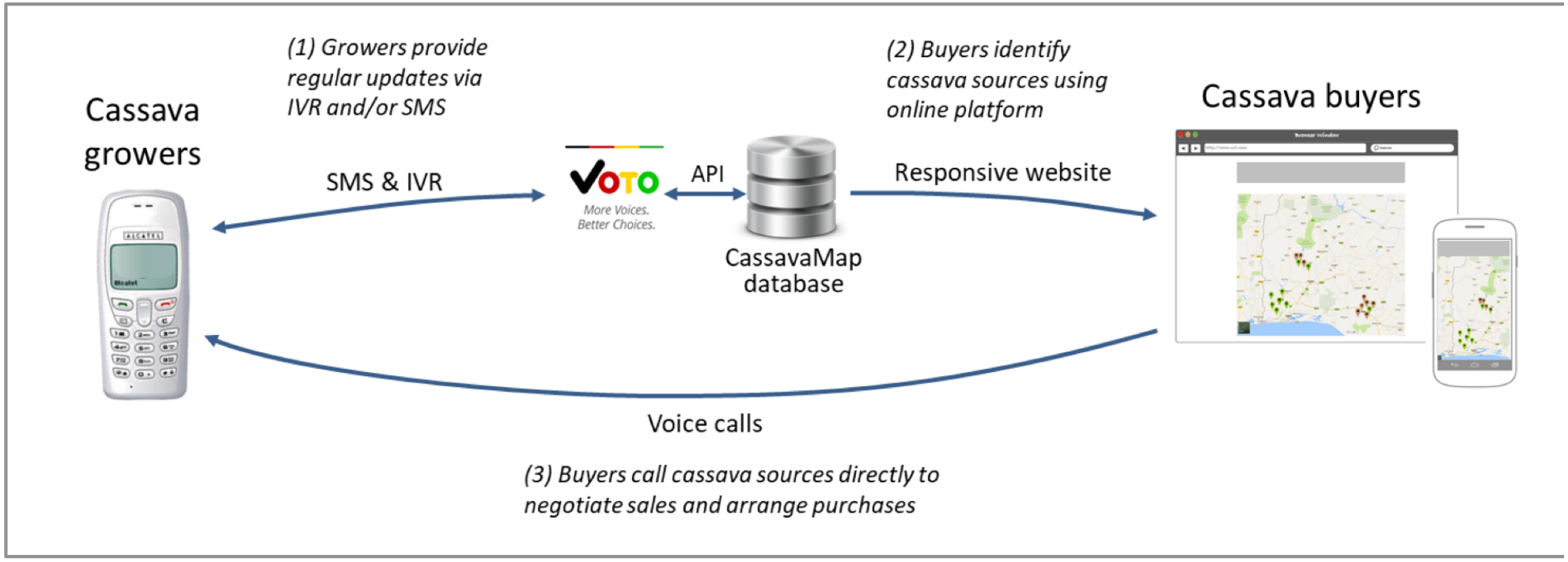
- Smaller enterprises more interested than large.
- Buying roots only from SHF significant risk for medium- and large-scale processors
- Both practical knowledge and skills business skills needed for success

End users.

- Awareness-raising creates interest, but decision making depends on capacity - technical knowledge, equipment & skills.
- Few examples of provision of services to other actors in the HQCF value chain

Figure 1 below shows an overview of the initially proposed core functionality of CassavaMap.

Figure 1: CassavaMap service outline



i. Institutional context

Service providers.

- **Private sector-led approaches** can provide strong motivation and resources, enterprise management skills, and guaranteed market.
- **NGOs often have well-motivated** staff, strong accountability structures, an ethos of farmer empowerment and gender inclusivity, and target vulnerable groups.
- **Public sector advantage** is continuity of presence and technical skills and policy linkages.
- Service providers require **capacity building** in value chain development, business management & strengthening farmer organizations

Ii. Infrastructural context

- Infrastructural challenges (roads, electricity, and water supplies) are important constraints to cassava value chains.
- Mobile phone technology facilitates trade of cassava products in rural areas.

iii. Technological context

- Efficient technology is key to making cassava processing profitable, but requires technological innovation and capacity building of local equipment fabricators.
- Sun-drying technology is suitable for smallholders and starting SMEs but poses logistical challenges for scaling up of HQCF production.

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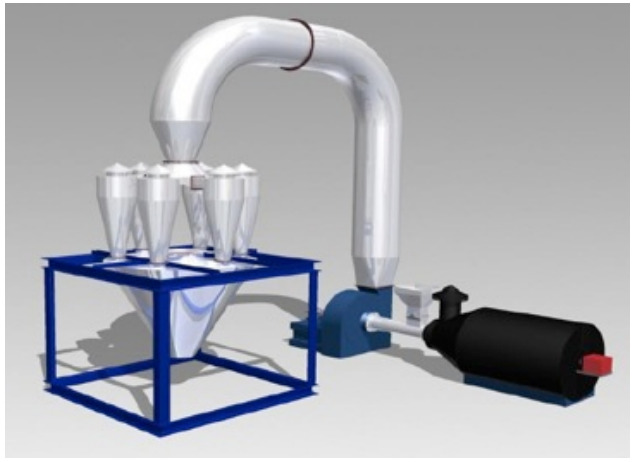
Small scale flash drying is a Nigerian success story led by several companies

Development of Improved Flash Dryers for SMEs (2009-2016)

- Current 6 Cyclone flash dryer
- 2.92Mj/kg of HQCF
- Output ranging from 330-500kg/hr dependent on capacity of heat exchanger
- >90% reduction in costs for heat energy
- Developed solid-waste systems to replace diesel & kerosene



iv. Financial context

- Working and investment capital for intermediaries and processors is a constraining factor and requires more engagement from industrial end users.

v. Policy and regulatory context

- The policy and regulatory environment in the 5 C:AVA countries has not been strongly conducive to cassava value chain development.
  - ➢ In Nigeria, a policy on HQCF inclusion in wheat flour was reversed, then re-introduced following changes in government. This created an unpredictable environment

Cracking the HQCF into wheat flour challenge

- New research on “Shaping, Adapting and Reserving the Right to Play: Responding to Uncertainty in High Quality Cassava Flour Value Chains in Nigeria” **Journal of Agribusiness in Developing and Emerging Economies.**
- Conceptual framework based on complex adaptive systems to analyse the slow development of the value chain for High Quality Cassava Flour (HQCF) for partial substitution of wheat in flour in Nigeria, with a specific focus on key stakeholders adaptation to **uncertainty.**
- Sources of uncertainty: policy changes; demand and supply (minimum volumes) of HQCF; availability and price of cassava roots; and supply and cost of energy.
- Research organizations and government have **shaped** value chain through the development of new technology and policy initiatives.
- Farmers have **adapted** by selling cassava roots to rival value chains (e.g. gari, fufu),
- Processors **adapted** by switching to rival cassava products, reducing energy and transport costs and by vertical integration.
- Because of the uncertainties in the supply of HQCF, the milling industry has **reserved the right to play**, and continued to rely on imported wheat.
- **Vertical integration** offers wheat milling industry a potential solution to uncertainty in the supply of HQCF but care will be required to ensure the social and environmental outcomes

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Beyond primary processed products

With growing urban markets potential exists but not yet developed for products made from HQCF/starch/ modified as is common in Brazil

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Conclusions

- Cassava is important and importance will grow (climate change).
- Significant opportunities for “improved” traditional products.
- Opportunities for improved nutrition through fortification/ biofortification.
- Need further processing innovations to improve efficiency, reduce energy use and protect environment.
- New primary products (HQCF, starch and ethanol) provide additional opportunities
- Secondary processed products likely to increase in importance and become business opportunities.

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