

“Market-led approaches to plant breeding in Sub-Sahara Africa; Insights and benefits from changing practices”

Applying DLB approaches in Sorghum Improvement in Uganda

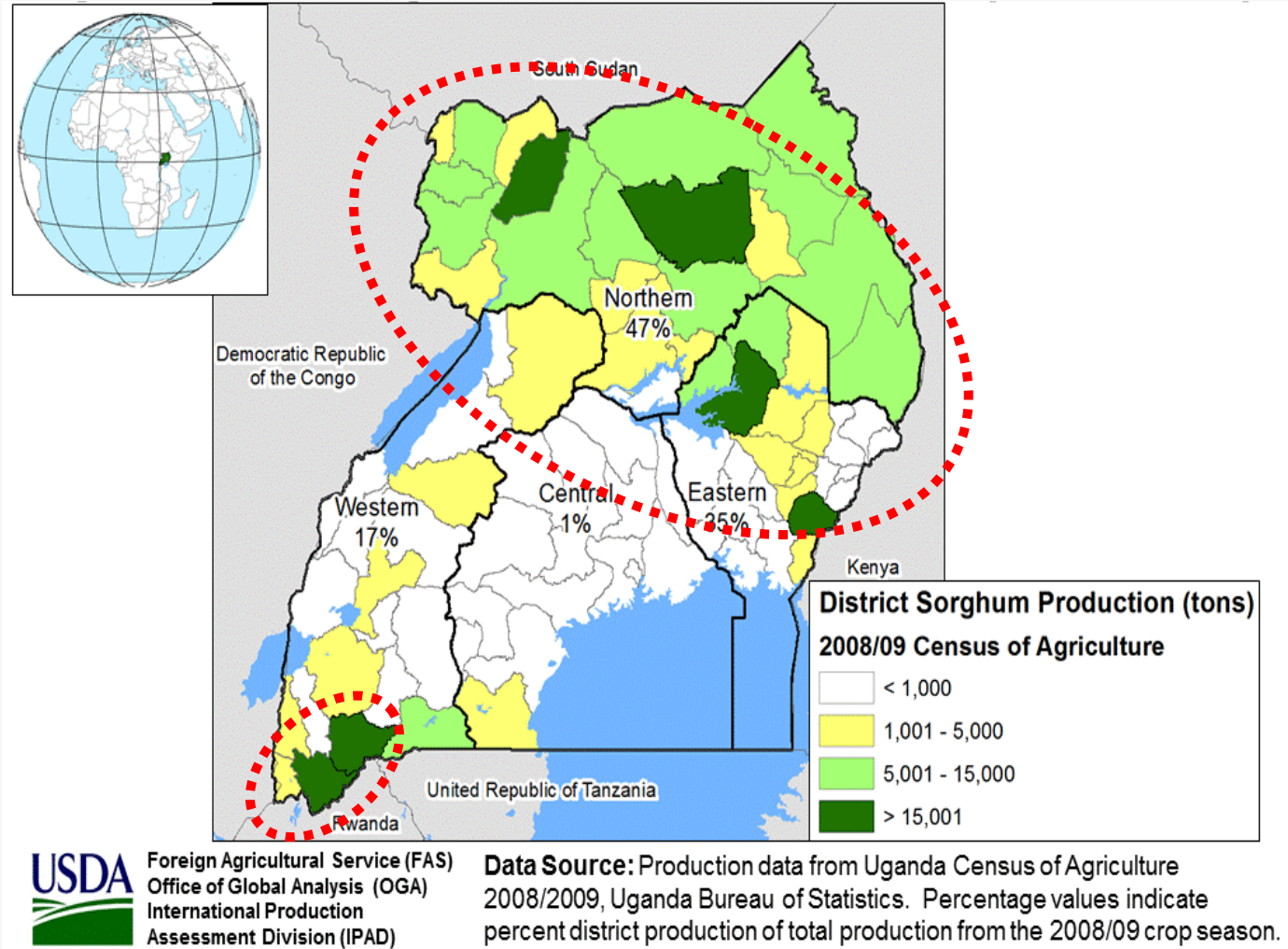
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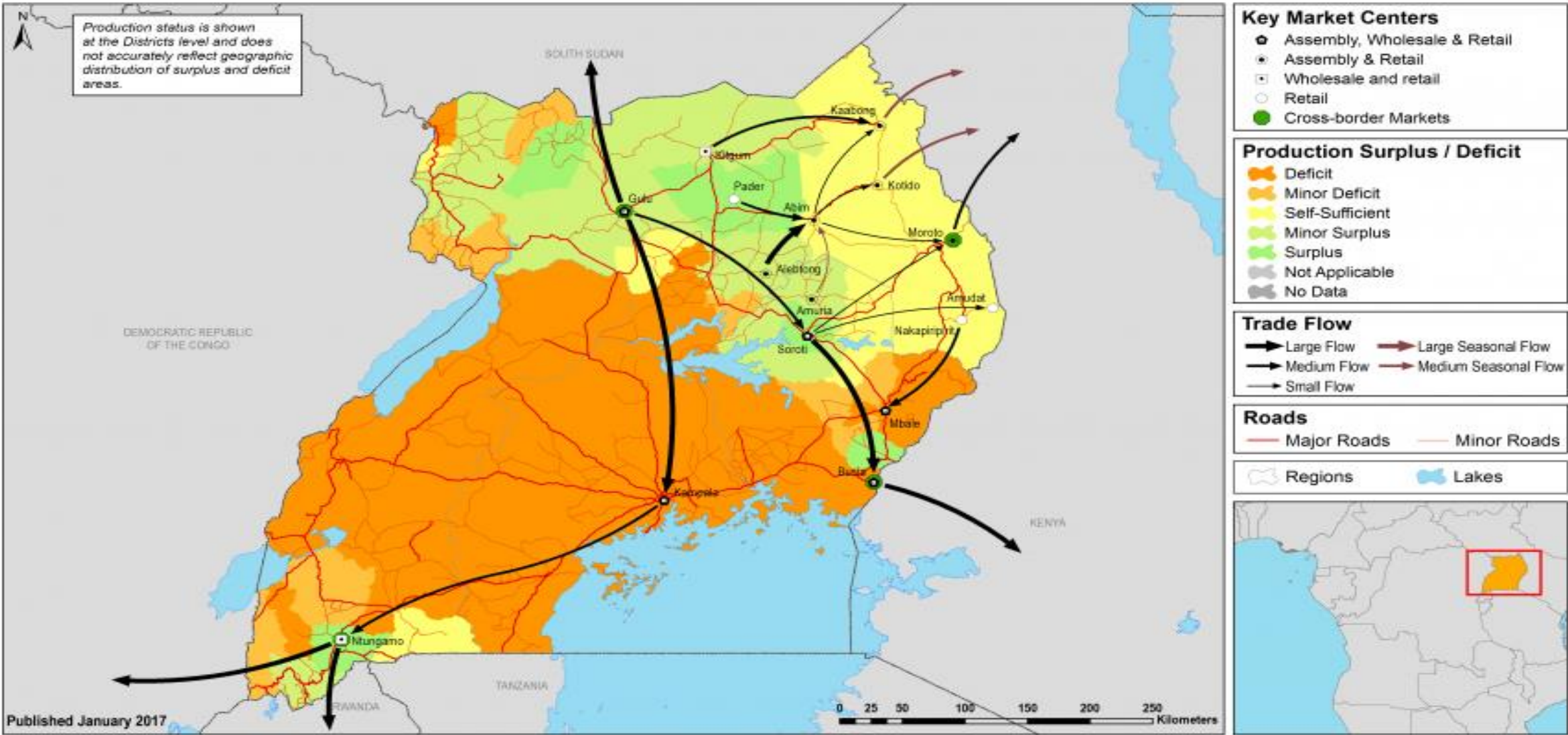


The Business
of Plant Breeding

FEW FACTS ABOUT SORGHUM

- ❖ Sorghum is the 2nd most important cereals in Uganda after maize and occupies 400,000ha of arable land
- ❖ Cultivated in the low land areas of eastern and northern regions and upland south western highlands.
- ❖ Sorghum is grown mostly by subsistence farmers as food security and income
- ❖ Production is characterised by limited or no use of inputs like quality seed, fertilizer, pesticide mostly in marginal land
- ❖ Productivity is very low, below genetic potential (Lubadde et al., 2019)





FEWS NET Production and Trade Flow Maps provide a summary of the geography of marketing systems that are relevant to food security outcomes during an average marketing year or season. The maps are produced by FEWS NET in collaboration with stakeholders from local government ministries, market information systems, NGOs, and private sector partners, using a mix of qualitative and quantitative data.

Uses of sorghum in Uganda



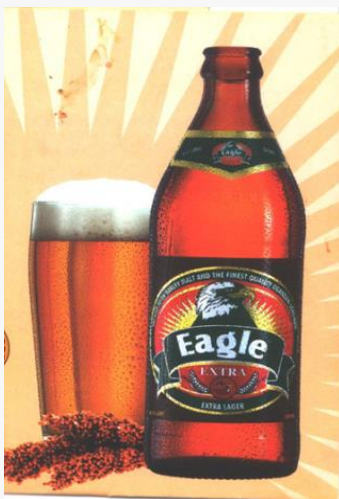
Food



Flour



Non alcoholic beverage
(sorghum and millet)



Beer



Forage

(Lubadde et al., 2019)

Micronutrients in sorghum

Crop	Average content at baseline (mg/kg)		Final target content (mg/kg)		Additional content through breeding (mg/kg)	
	Fe	Zn	Fe	Zn	Fe	Zn
Rice	2	16	13	24	11	8
Wheat	30	25	52	33	22	8
Maize	30	25	52	33	22	8
Pearl millet	47	47	77	58	30	11
Sorghum	30	20	60	32	30	12

Considering 90% retention of both Fe and Zn after processing, and 5 and 25% bioavailability for Fe and Zn, respectively, except Fe in rice grain where bioavailability is 10% (adapted from Bouis and Welch, 2010).

❖ Can contribute significantly to fighting malnutrition due to micronutrient deficiency (Fe and Zn)

Production challenges



Kernel smut



Ergot disease



Sorghum midge



Striga



Leaf blight



Drought stress



Limited value addition

Source: MaRCCI Breeding program, Kabayolo; Lubadde et al., 2019

www.demandledbreeding.org



Research goal

To develop and disseminate high-yielding, early-maturing and stress-resilient sorghum varieties (Hybrids and OPVs) that are widely adapted to the different agro ecologies of Uganda with farmer preferred attributes, targeting for food and brewery industries

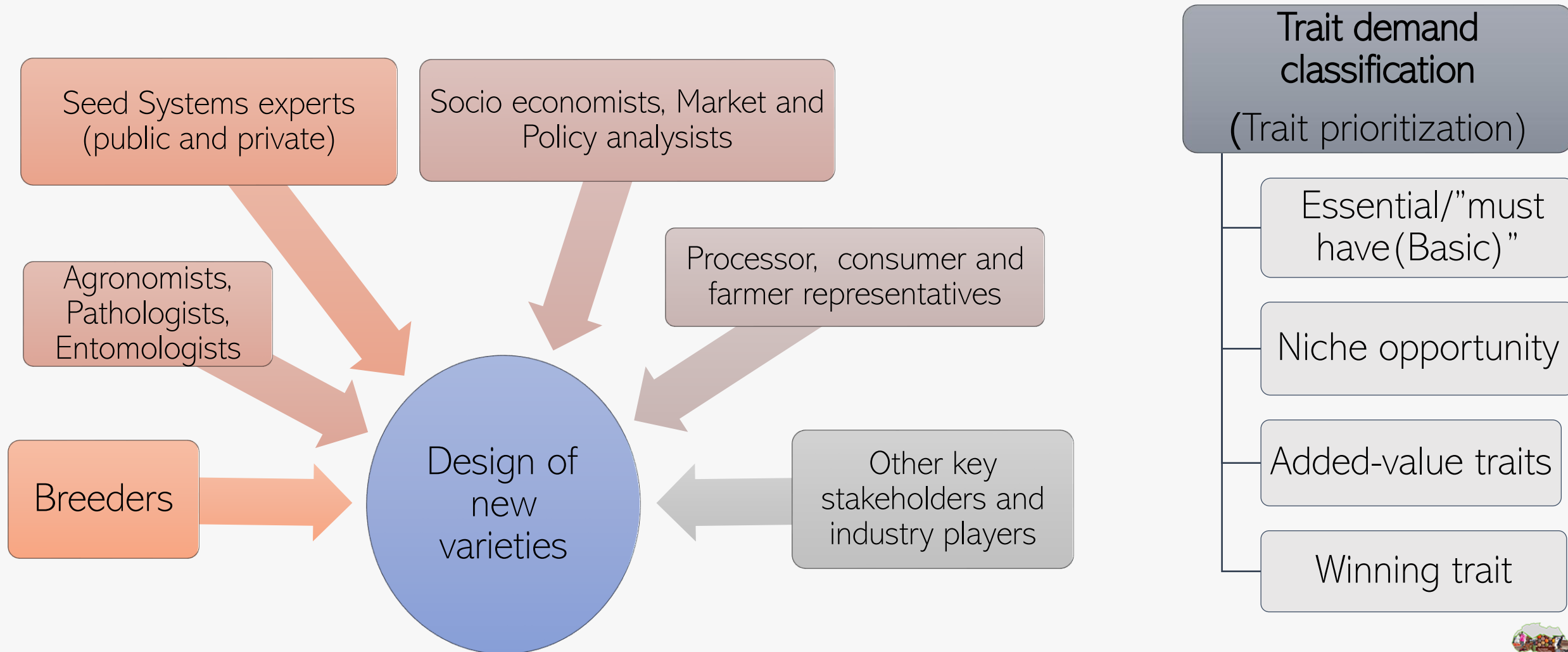
- **Breeding**

- ❖ High yields, drought, striga and disease resistance traits and nutritional traits
- ❖ Farmer and market preferred traits
- ❖ Integrate marker assisted selection and conventional breeding.
- Efficient Seed production and delivery System
- Crop management practices
- Markets to match increased production and demand

Summary traits focus

- ∴ Yield and early to medium maturity
- ∴ Disease resistance: ergot, leaf blight, anthracnose
- ∴ Drought tolerance
- ∴ Low phosphorus
- ∴ Striga tolerance
- ∴ Iron and Zinc contents
- ∴ Industry: bakery (brown seeded) and brewery (white seeded)

Stakeholder engagement during variety design and development process



PP Design Team		
Person	Area of Expertise	Name of organization
<i>DIO</i>	<i>Breeder</i>	<i>MaRCCI, Makerere University</i>
<i>EW</i>	Breeder	NARO
<i>MTS</i>	Seed Systems	MaRCCI, Makerere University
<i>WJ</i>	Seed Systems	NARO
<i>AE</i>	Agronomist	NARO
<i>OH</i>	Socio economist	NARO

Product profile – clients and markets

PP Design Team Lead/Champion	<i>DIO</i> <i>MaRCCI, Makerere University</i>
Product profile descriptors	
Product profile name	Sorghum for food, bakery, and beverages
Crop	Sorghum bicolor (L.) Moench
Country(s)	Uganda
Geographic region(s)	Northern, Eastern, West Nile, and Central
Market segment and positioning	<i>New emerging market for OPVs and Hybrids for industrial use (food, bakery, and beverages)</i>
Name of target variety(s) or landrace to be replaced strengths, weaknesses	<i>Epuripuri and NAROSOG1, Strengths, OPV varieties with tolerance to drought, striga, medium maturity. Weakness; Susceptible to diseases</i>
Date PP created (dd.mm.yyyy)	12.9.2020

Target client and use	
Value chain primary clients/customers:	farmers ,processors, bakery and brewery industry,
Market scale:	Local, national and regional markets
Use:	food, bakery and brewing
Type of processing:	milled and brewed
Market class:	White seed types

Target crop producers and production system	
Number of farmers (min–max range)	
% ratio: male to female farmers (min–max range)	20-30% male, 70-80% female
Production system: open field (+/- irrigation),	open field
Area of production system (ha)	~over 280,000 ha
Growth habit:	NA
Expected level of inputs:	Medium fertilizer, low crop protection chemicals
Typical yield range of target system (e.g. 0.8–1.5 t/ha)	0.8-2t/ha, (under farmer conditions)
Cropping system:	Monocrop, and intercrop mixed cropping
Mechanization:	Mainly hand threshing
Agroecological zone(s)	Low to mid altitude areas
Total seed or vegetative propagation material market (tonnes/numbers)	10,000 -15,000 tones

Client/customer	Driver	Trait category	Preference group: Women (W) Men (M) Youth (Y) W+M+Y (All)	Trait demand classification: 1. Essential/"must have" 2. Niche opportunity 3. Added-value 4. Winning trait	Target traits	Trait description (Quantitative measures)	Name of benchmark variety	Performance required compared to benchmark variety < , = , > etc.
Farmer	Productivity	Yield	All	1	Grain yield for food	>3200	NAROSOG1,2&4	>
		Biotic stress resistance	All	1	Anthracoese, Ergot and Smut	<4.0 on 1-9 scale	NAROSOG1,2&4	<4.0
			All	1	Turcicum leaf blight (TLB)	<4.0 on 1-9 scale	NAROSOG1,2&4	<4.0
			All	1	Shoot fly	(<40% stem shoofly dead hearts respectively)	NAROSOG1,2&4	<40%
				3	Stem borer	<4.0 on 1-9 scale	NAROSOG1,2&4	<4.0
		Abiotic stress tolerance	All	3	Drought tolerance and stay green trait	Post flowering drought tolerance	NAROSOG1,2&4	<4.0
			All	1	Striga resistance	<4.0 on 1-9 scale	NAROSOG1,2&4	<4.0
			All	3	Heat tolerance at seedling stage		NAROSOG1,2&4	
	Crop management	Plant architecture	All	1	Plant height	1.0-2.0m	NAROSOG1,2&4	<4.0
	Market value and price	Grain appearance	All	3	Dry grain	White/brown/red grain colour	NAROSOG1,2&4	=
	Crop duration	All	3	Early to medium maturity	90-120 days	NAROSOG1,2&4	=	
Processor	Raw material quality specification	Brewing	All	3	Malting white/grey	>80% extract	NAROSOG1&3	
				3	Feed – white grain	<5% tannins	NAROSOG1&3	=
Consumer	Satisfaction	Nutrition	All	3	Micronutrients	High Fe (>45mg/kg); Zn >32 mg/kg)	non	>
Seed producer	Scalability and cost	Seed genetic purity	All	1	seed germination	>98%variability and >99% uniformity	NAROSOG1,2&4	> 9

Identify high performing Hybrid and OPV sorghum line to fit a product profile



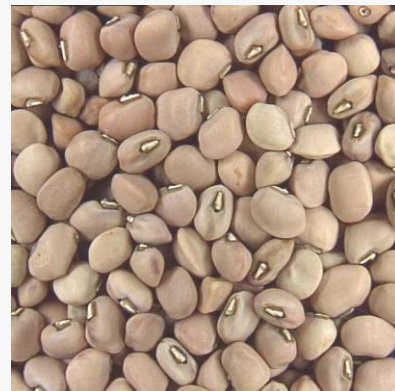
Scaling this approach developing product profiles for unique market segments in sorghum and cowpea

- Forage sorghum



Cowpea

- Seed (white and brown seeded types)



- Vegetable and Forage



Acknowledgements



#APBAConf21 