The Challenge & Opportunities for Sweetpotato Post-Harvest Utilization in SSA

SPHI

Sweetpotato for Profit and Health Initiative

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The Challenge of 2008

How to improve the value chain for sweetpotato given its bulky nature, undiversified use, and image as a poor person's food?

Attributes & Deficiencies of Sweetpotato

Attributes:

- High yields (usable mass · area-1 · time-1)
- Nutritional
- Vitamin C
- Vitamin A (orange-fleshed)
- Soluble & Insoluble fiber
- Polyphenols
- Low glycemic index
- Wide production geography
- Relatively high stress tolerance (temperature water)
- Low fertility & land quality req.
- Length of production cycle
- Yield security (produces something)

Deficiencies

- Production costs
- **Bulky – high transport cost**
- **Storage requirements/ perishability**
- **Limited diversified use**
- **Flavor**
- **Heartburn/flatulence**
- Asexually propagated
- Yield stability across different zones

Structural Determinants of Sweetpotato Markets in SSA

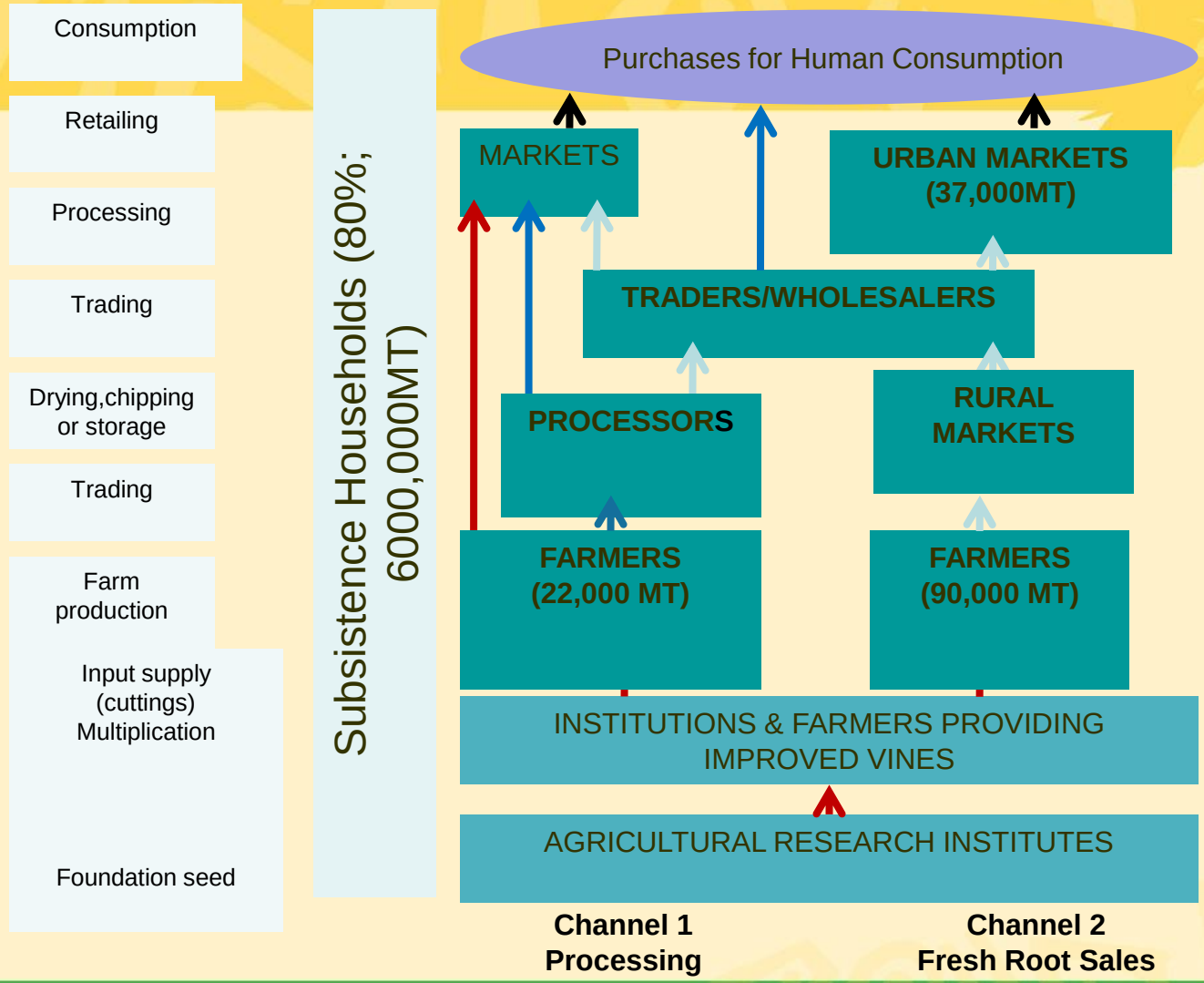
- Localized production in dispersed production zones
- Seasonal supply of a bulky and perishable product
- High transaction costs and marketing margins
- Thin markets and marked price variability
- Low urban consumption as fresh roots

Leads to 2 Driving Hypotheses:

- Structural change in sweetpotato markets will require interventions across the value chain

- Farmer investment in improved management techniques or improved root quality will require access to robust markets

Sweet Potato Value Chain



Challenge of Consistent Supply

FRESH ROOTS:

- Poor handling during harvesting
- Poor handling during transport (extended bags)
- Few practice fresh root storage
  - Need for immediate cash
  - Lack of knowledge
  - Inappropriate methods (too costly structures)
  - Increases sugar content & there is moisture loss

- Few practice curing (toughens skin & heals wounds)
  - In ground curing (removing canopy XX days before harvest)
  - Out of ground curing (29°C 90-95% Rel humidity for 4-7 days)

DRIED CHIPS

- Exists in some zones with prolonged dry season
- For OFSP –must avoid initial over-drying & there is high beta-carotene degradation after storing > 2 months

The Opportunities for Nutritional Impact Increasingly Recognized

- Orange-fleshed varieties can contribute to reducing vitamin A deficiency
  - van Jaarsveld et al., AJCN 81, 1080-87, 2005.
  - Low, JW et al., J. of Nutr. 137: 1320-1327, 2007
  - Hotz, C. et al., Brit. J. of Nutr. 1-14, 2011
- It doesn't take much to make a difference:
  100-125 gms for a young child

- Increasing interest in purple-fleshed varieties
  - Anthocyanins contribute the color (food colorant)
  --anti-oxidant, anti-carcinogenic, anti-diabetes

- All good sources of vitamins C & E, potassium, dietary fiber, polyphenols
- Relatively low glycemic index compared to staples
- Leaves rich source of lutein; good protein content compared to other leaves

The Opportunities for Diversified Use are Immense

Human Food	*Industrial*	*Livestock Feed*
Fresh	Starch	Swine (Pigs)
Canned	Flour	Cattle
Puree (Boiled & Mashed)	Alcohol	Goats
Baby Food	B-amylase	Chickens
Juice	Food coloring	Guinea Pigs
Crisps (thinly sliced/fried)	Citric Acid	Other
Chips (fries/thickly sliced)	Fructose	
Noodles	Glucose	
Bread	Maltose	
Biscuits	Monosodium Glutamate	
Donuts	Biofuel	
Cakes & other bakery products		
Snack foods (extruded)		

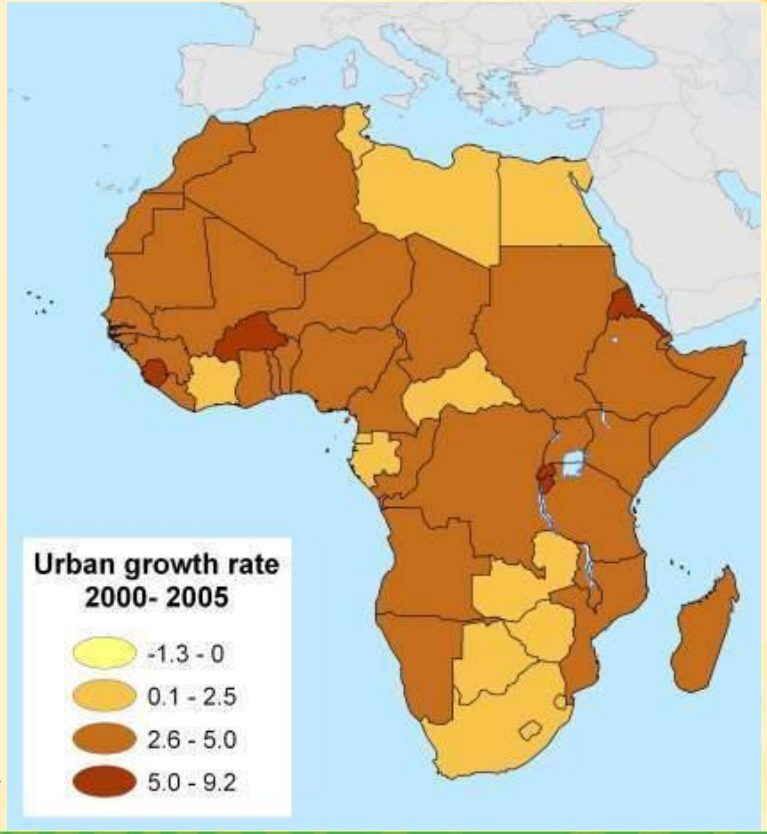
Asia, particularly China, lead with a diversity of products

58% feed
10% processing
12% fresh
8% seed
12% waste

Form	Total amount/Price (RMB Yuan)	Added value (compared with fresh root)
Fresh root	1 ton/400 RMB	
Coarse starch	160Kg/400RMB	0%
Refined starch	152Kg/456 RMB	14%
Instant noodle	137Kg/2055 RMB	414%

Why Should We Care About Sweetpotato Product Development?

1) SSA has the fastest growing urbanization rates in the world
2) Rural farmers need markets, and sweetpotato can be widely grown by all classes
3) Due to their bulkiness, fresh sweetpotato becomes expensive in urban centers distant from production areas
4) Urban consumers want convenient foods that are less time-consuming to prepare
5) Wheat & rice, staples popular with urban consumers, often are imported commodities
6) Sweetpotato is often considered a crop of the poor– it has an image problem
7) Diabetes is on the rise among better off urban consumers & VAD is a problem among the poor



What Products Make Sense for Africa?

Very different conditions & preferences in China vs SSA

1) Average yields in China: 17 t/ha
2) Average yields in SSA: 6 t/ha
   --- Less surplus to sell
   --- Food security 1st priority
   --- Strong fresh root market
   --- High cost/kg for processing compared to alternatives (e.g. cassava)

Therefore:

1) Does the product make economic sense?
2) Who is our target market?
3) Should we focus on healthy products?

Key question to address:

Use of puree vs flour

1.25 kgs fresh root..
1 kg puree

4-5 kgs fresh root..
1 kg flour

Suggested Starting Point

- Get an understanding of your markets
  - What products are out there?
  - What do they cost?
  - Who is buying them?
  - What are the estimated quantities being sold?
- Is it a candidate for consideration?
  - Can sweetpotato replace a significant percentage of the key ingredients?
  - What would it cost to make the product with and without sweetpotato?

Products in Mozambique	Major ingredients	Units per batch (MT)	Unit selling price (MT)	Revenue (MT)	Total cost (MT)	Net return to labor (MT)	Net return per unit sold	
							MT	US$
Bread buns	Wheat flour, yeast, improver	2,880	1,000	2,880,000	2,414,000	466,000	162	**0.007**
Twisted Berlin bun	Wheat flour, sugar, yeast	270	1,000	270,000	249,817	20,183	75	**0.003**
Coconut sugar bar	Coconut, sugar	600	500	300,000	245,000	55,000	92	**0.004**
Biscuit	Wheat flour, sugar, yeast	150	1,000	150,000	138,700	10,300	69	**0.003**
Fried doughnut	**Wheat flour, sugar, oil**	**70**	**500–1,000**	**58,310**	**22,350**	**25,060**	**258**	**0.015**

Must Pay Attention to Relative Prices

- Must understand the prices of the alternative ingredients & how they fluctuate during the year
- Must develop test products and get feedback from relative consumer target groups

Sensitivity analysis examining ratio of prices of wheat flour and orange-fleshed sweet potato root and its effect on net return to labor of golden bread buns compared with pure wheat flour buns[a]

Relative price		Total cost of wheat flour (MT)	Net return to labor per batch			% increase in net return per golden bread bun	Net return to labor per golden bread bun (US$)
Kg wheat flour/kg raw sweet potato root	Kg wheat flour/kg cooked sweet potato root		Wheat flour bun (MT)	Golden bread bun (MT)	Golden bread bun (US$)		
1.5	1.25	4,575	142,906	152,468	6.35	6.7	0.024
1.8	1.50	5,490	128,776	143,990	6.00	11.8	0.023
2.1	1.75	6,405	113,076	134,570	5.61	19.0	0.021
2.4	2.00	7,320	98,946	126,092	5.25	27.4	0.020
3.1	*2.50*	*9,150*	*70,686*	*109,136*	*4.55*	*54.4*	*0.017*
3.4	*2.75*	*10,065*	*56,556*	*100,658*	*4.19*	*78.0*	*0.016*
3.5	*2.84*	*10,402*	*50,276*	*96,890*	*4.04*	*92.7*	*0.015*
3.5	2.90	10,614	47,136	95,006	3.96	101.6	0.015
3.7	3.00	10,980	40,856	91,238	3.80	123.3	0.014
4.0	3.25	11,895	26,726	82,760	3.45	209.7	0.013
4.3	3.50	12,810	12,596	74,282	3.10	489.7	0.012

For OFSP Products, Must Determine How Much Beta-carotene is in the Final Product

- Need to have nutrient analysis done. It is the *trans*-beta-carotene (BC) that is fully converted into vitamin A. Most BC in sweetpotato is *trans*, not *cis* but processing can effect the ratio.
- Varieties differ… Use medium to dark intensity OFSP for products
- Be careful about claims..

Variety[a]	β-Carotene content[b]		β-Carotene and vitamin A content[b]	
	Total β-carotene (µg/g bun)	Trans-β-carotene (µg/g bun)	Trans-β-carotene (µg/60 g bun)	**Vitamin A (µg RAE/60 g bun)[c]**
Medium intensity				
Resisto (fresh)	19	15	890	**74**
Persistente (fresh)	20	15	879	**73**
Gabagaba (fresh)	21	16	969	**81**
Lighter intensity				
TIB4 (fresh)	13	9	549	**46**
LO-323 (fresh)	12	9	540	**45**

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Be Careful About What You Can Claim

- The potential contribution of any product to improved nutrient intakes depends on the age and sex of those consuming it
- The US Food and Drug administration guidelines: per reference amount
  --a good source of vitamin A if it contains 10% to 19% of the daily value
  --an excellent source if it contains 20% or more of the daily value

Variable	60-g bun	110-g bun
Total β-carotene (µg)	1,132	**2,078**
Trans-β-carotene (µg)	890	**1,631**
Vitamin A value (µg RAE[a])	74	**136**
% contribution to vitamin A dietary reference intake[b]		
Children 1–3 yr	25	**45**
Children 4–8 yr	19	**34**
Children 9–13 yr	12	**23**
Non-pregnant women ≥14 yr	11	**20**
Pregnant women	10	**18**
Lactating women	6	**10**
Men ≥14 yr	**8**	**15**

a. 12 µg of *trans*-β-carotene = 1 µg of retinol = 1 µg of retinol activity equivalents (RAE)

Way Forward

- Products have potential… focus on public-private sector partnerships to develop economically viable products with significant markets
  -- private sector has marketing expertise & funds for advertisement
- Educate the consumer; willingness to pay increases when knows nutritional benefits
- Invest in improved fresh root storage & financial services to support that
- Improve storage of puree without refrigeration
- Improve nutrient composition analysis & shelf life studies