

Maize Meal Fortification: Markets, Feasibility and Costs

Evidence from Kenya, Uganda and Zambia

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**The USAID SPRING Project:
Strengthening Partnerships, Results and Innovations in Nutrition Globally**

HarvestPlus and PHND, IFPRI

Outline

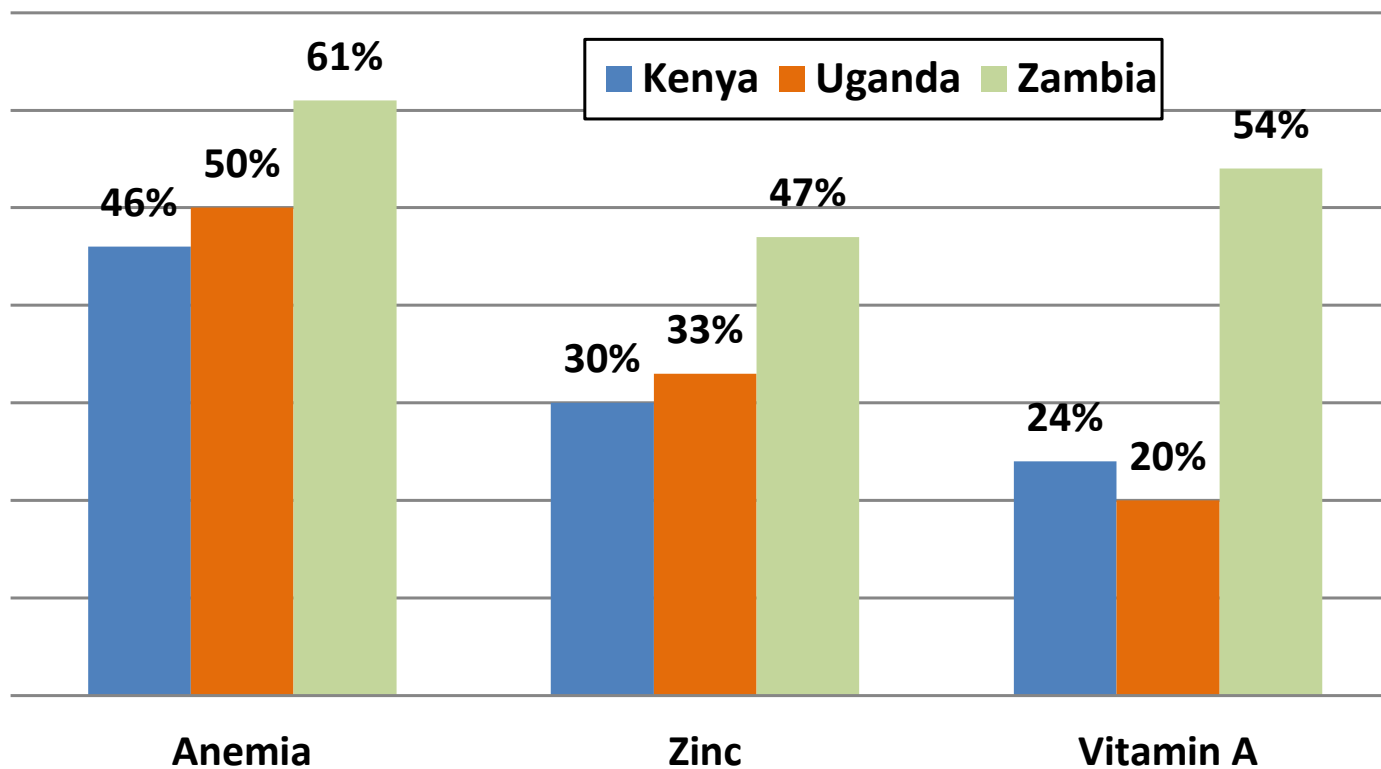
1. Context: Kenya, Uganda and Zambia
2. Examining maize meal markets
 - a. To better understand issues concerning the feasibility of fortifying hammer milled meal
 - b. Consumer's view/demand side: Household Consumption and Expenditure Survey (HCES)
 - c. Miller's view/supply side: Industry data
3. Estimate incremental, private sector costs of maize meal fortification (2011 primary data)
4. Affordability from millers' and consumers' perspectives

Top Maize Consuming Countries

Country	Quantity (kg/capita/yr)	Relative to Lesotho	Ranking
Lesotho	149.3	100%	1
Malawi	133.1	89%	2
Mexico	120.5	81%	3
Zimbabwe	110.4	74%	4
Zambia	110.2	74%	5
South Africa	103.7	69%	6
Timor-Leste	89.3	60%	7
Guatemala	86.2	58%	8
Bosnia and Herzegovina	81.8	55%	9
Honduras	78.6	53%	10
Kenya	77.2	52%	11
Togo	73.7	49%	12
El Salvador	72.8	49%	13
Swaziland	69.7	47%	14
Namibia	68.4	46%	15
Nicaragua	68.1	46%	16
Venezuela	64.3	43%	17
Egypt	60.3	40%	18
Tanzania	58.1	39%	19
Benin	55.4	37%	20
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Uganda	22.4	15%	54

Of the top 20: 12 African, 5 Central American, 3 Others

Micronutrient Deficiencies Among Children 6-59m



SOURCES: KN: A=2010 MIS, Z=2008/9 DHS; VA=1999 VMNIS. UG: A=2011 DHS, Z=2011 DHS, VA=2006 DHS. ZM: A=2010 MIS, Z=2010 CSO, VA=2003 NFNC

Current State of Fortification

- Kenya: 2011 a mandate to fortify all packaged maize meal (~roller meal) by July 2012.
- Uganda: 2012 mandate to fortify maize meal in all mills with a capacity of 20MT/d by July 2013.
- Zambia: Has had sugar fortification since 1998. In 2008, a project to voluntarily introduce maize meal fortification was halted mid-stream by the Ministry of Health, and remains suspended. The fortification program still functions, and a reassessment of maize and wheat is underway.

The Consumption-Based View of Maize Meal Fortification

1. How many households are consuming maize?
2. How many are consuming maize meal?
3. What types of maize meal are they consuming?
4. Are there maize meal market insights for better understanding fortification policy options?

Household Consumption and Expenditure Surveys (HCES)

HCES: A generic label for a family of multi-purpose surveys that capture information on food acquisition and/or consumption, including:

- Household Budget Surveys (HBS)
 - Uganda UHBS 2006
- Integrated Household Budget Surveys (IHBS)
 - Kenya KIHBS 2006
- Living Conditions Monitoring Surveys (LCMS)
 - Zambia LCMS 2006

Key characteristics of the household consumption and expenditures surveys

	KENYA Integrated Household Budget Survey (KIHBS 2006)	UGANDA National Household Survey (UNHS 2006)	ZAMBIA Living Conditions Monitoring Survey (LCMS 2006)
1. Sample Size			
a. Households	13,212	7,421	18,662
b. Persons	66,725	38,543	80,919
2. Statistically Representative	Province, n=8	Region, n=4	Province, n=9
3. Recall Period	7 days	7 days	14 days
4. Number of Foods	161	61	39
5. Sources of Food/Acquisition Method			
a. Purchases	Yes, and consumption from purchases	Yes, and consumption from purchases	Only purchases
b. Consumption from own production	Yes	Yes	Yes
c. Received in-kind	Yes	Yes	Yes

Key Characteristics of the HCES-2

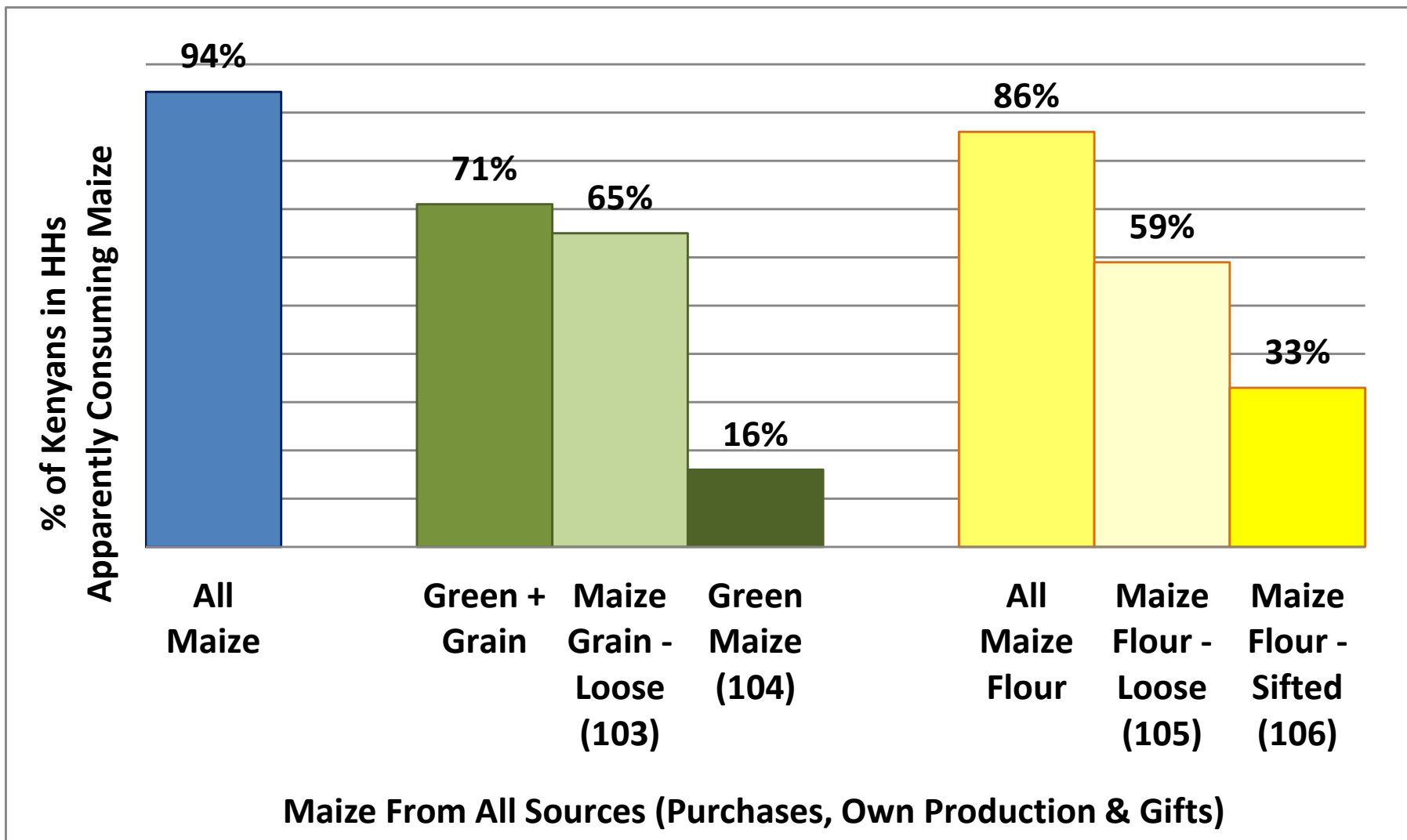
KENYA

UGANDA

ZAMBIA

6. Maize Food Items	4 items	3 items	4 items
	1-Grain 2-Green (cob) 3-Sifted flour (Roller) 4-Loose flour (Hammer)	1-Grain 2-Cob 3-Flour	1-Grain 2-Breakfast (Roller) 3-Roller Meal (Roller) 4-Pre-milled Hammer

KENYA: Maize Consumption by Maize Form



KENYA: Consumption from all Sources and from Exclusively Purchases of Roller and Hammer Maize Meal

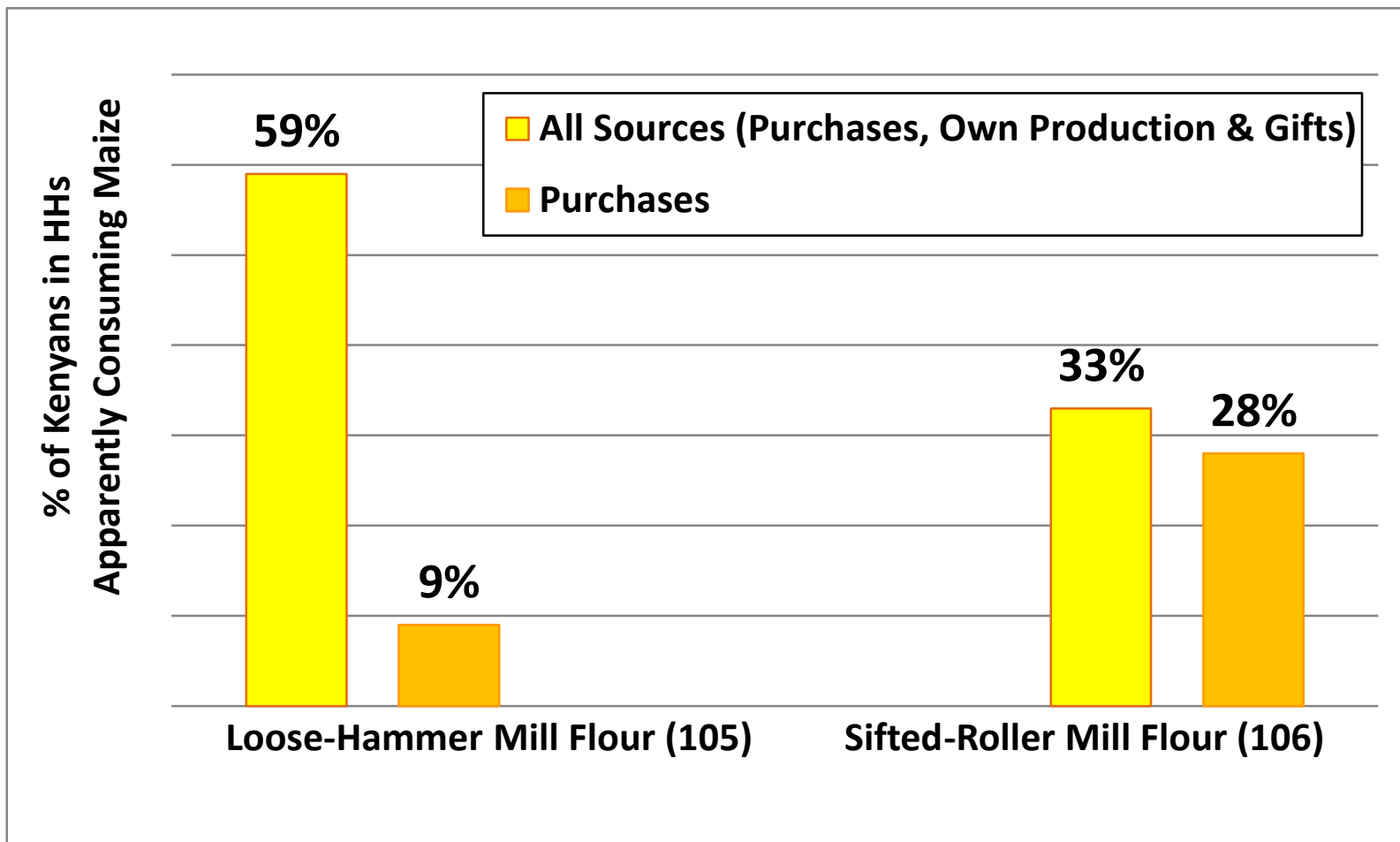
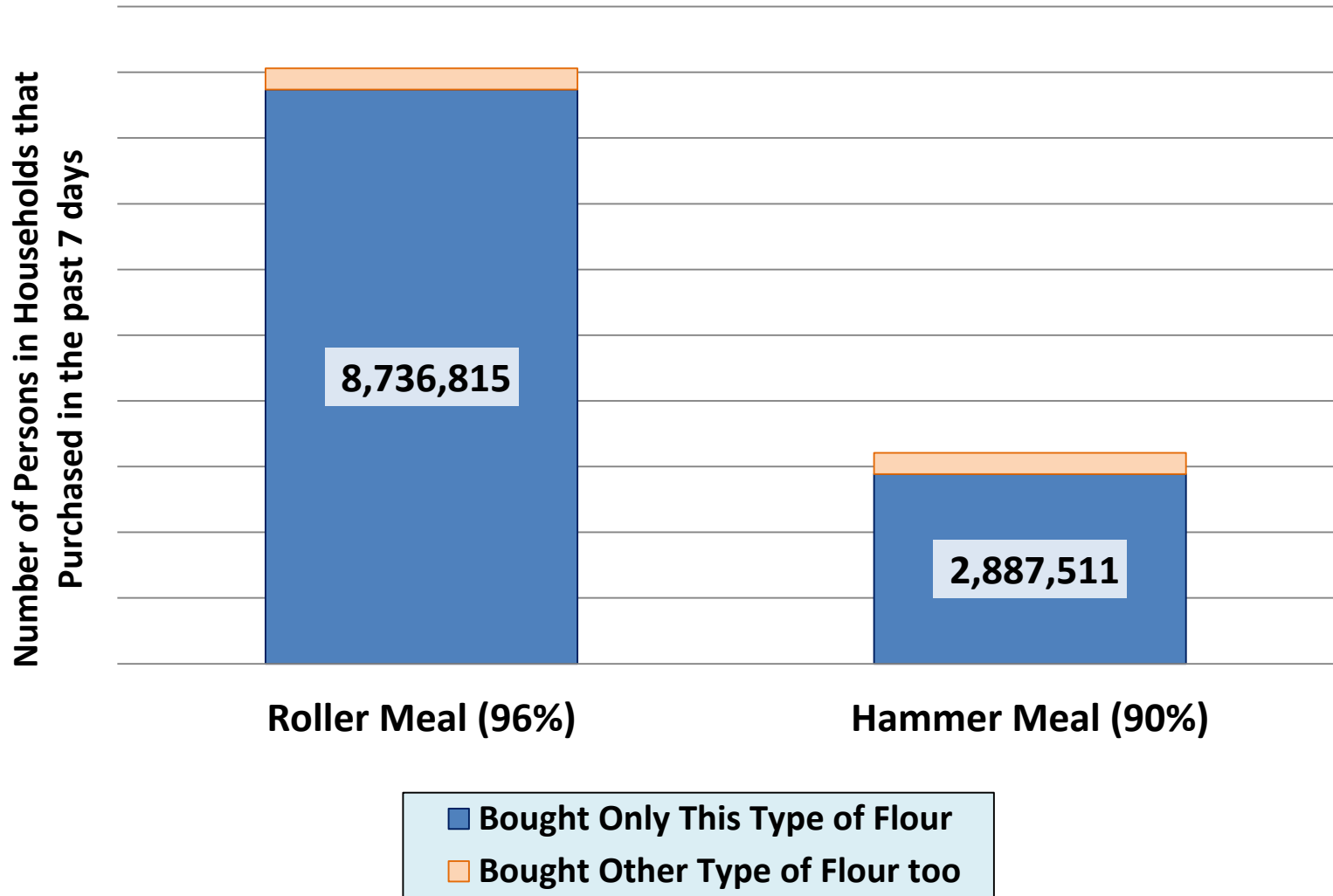
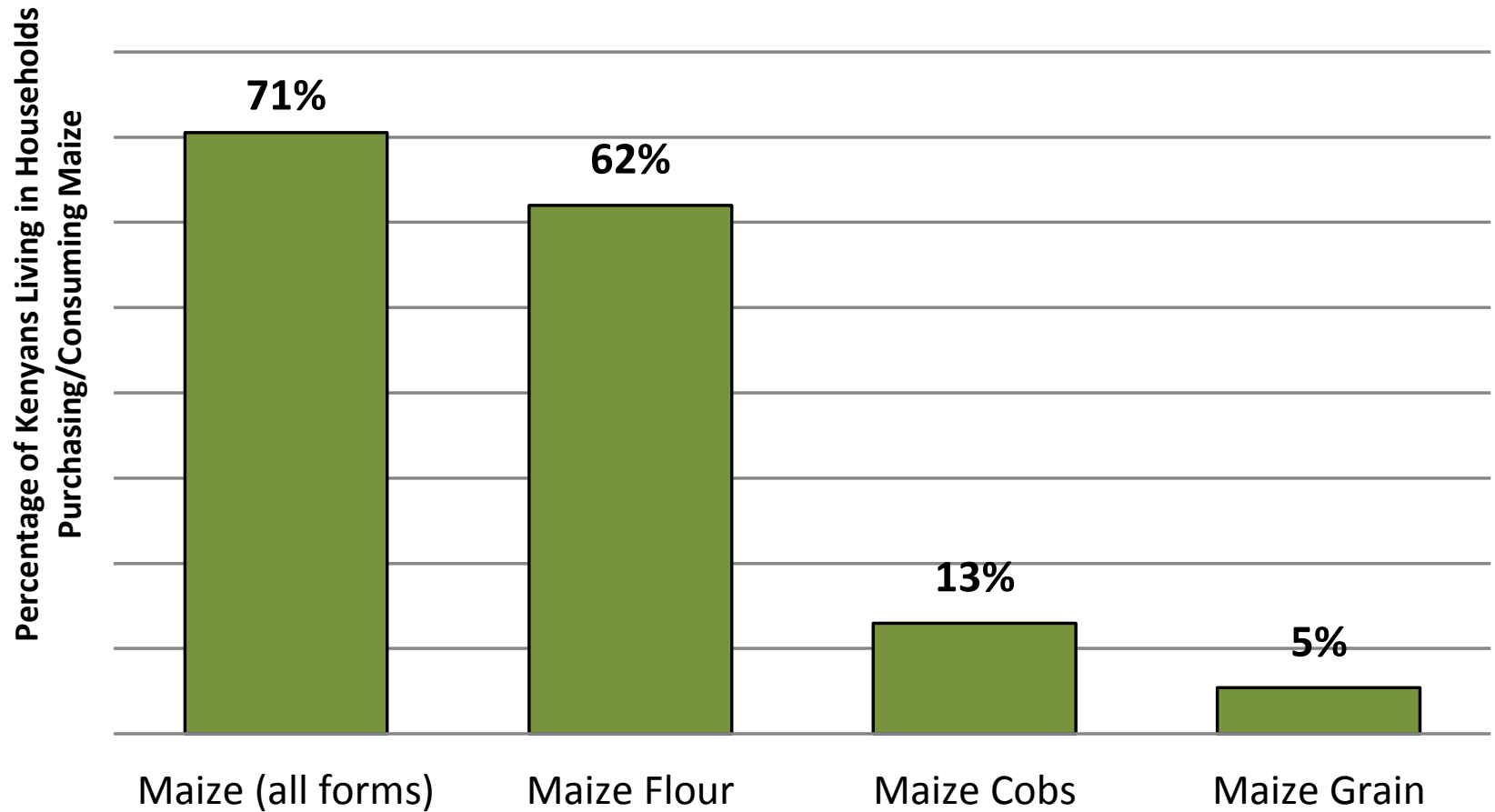


Figure 4. KENYA: Maize Meal Market Segmentation



Maize Apparent Consumption by Maize Form, Uganda



Maize Flour Apparent Consumption by Source, Uganda

Percentage of Kenyans Living in Households Purchasing/Consuming Maize

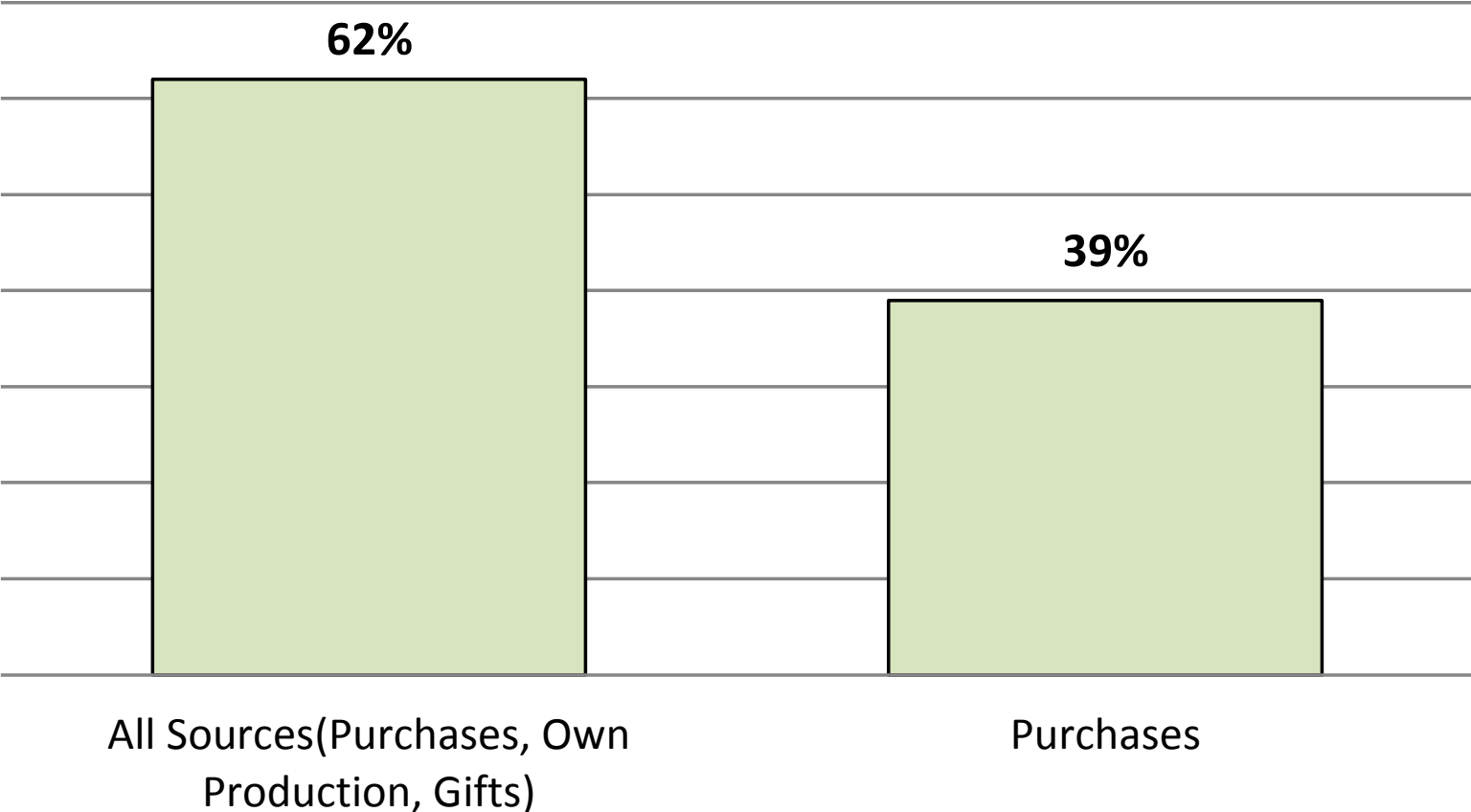
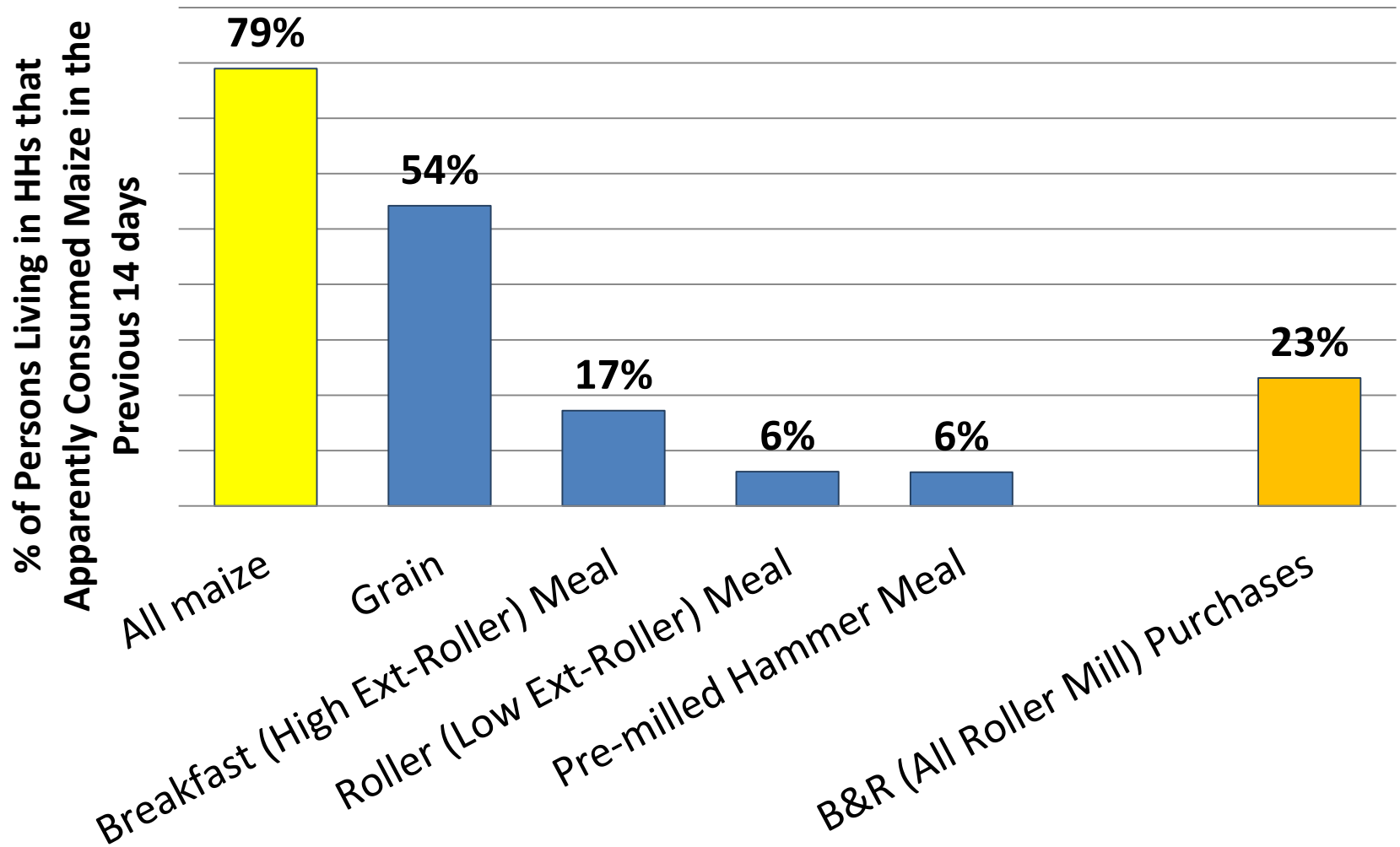
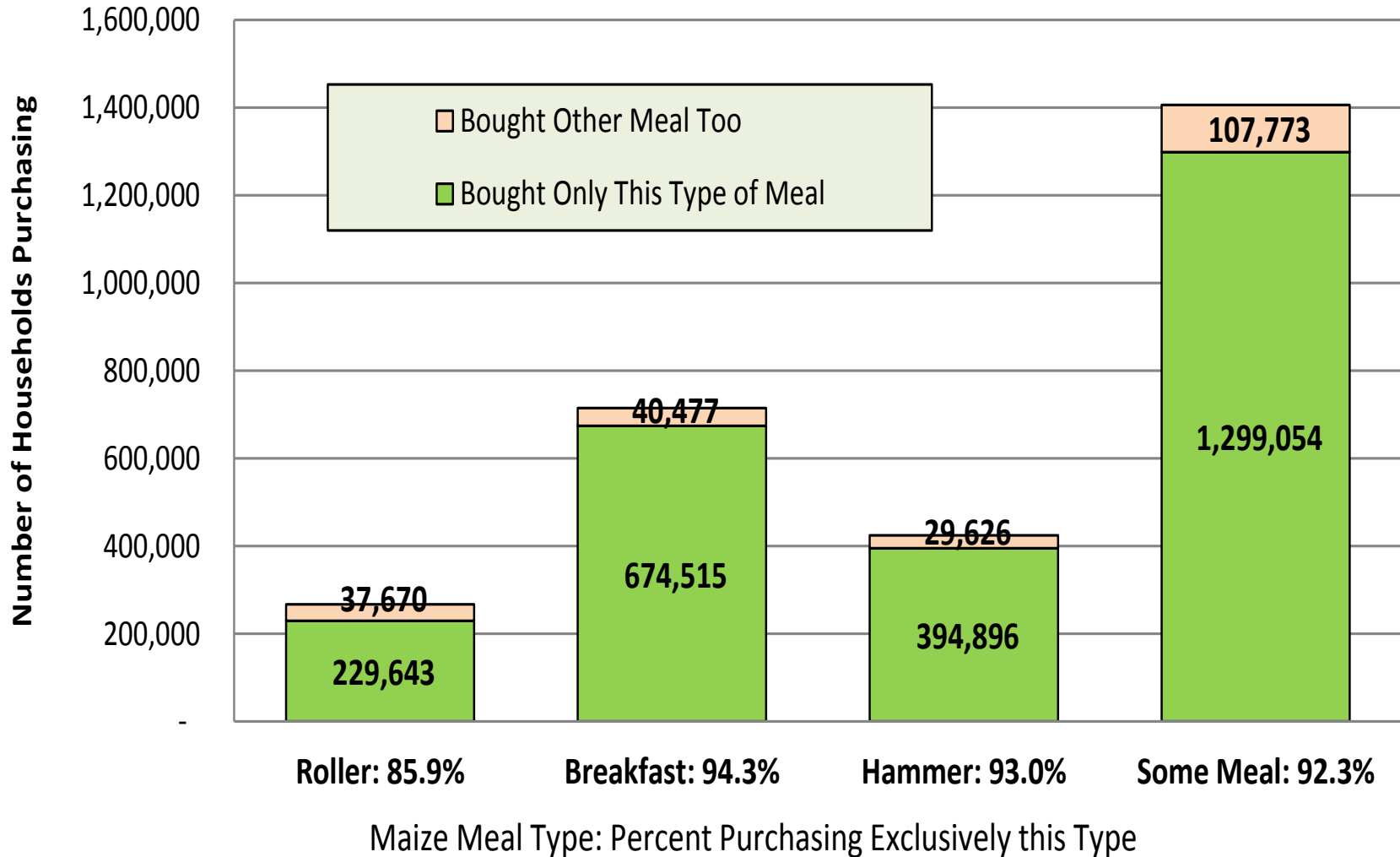


Figure 7. ZAMBIA: Maize Consumption-All Forms and Sources



Maize Meal Market Segmentation, Zambia 2010

Number and Percent of Households Purchasing Only One Type of Maize Meal



Household Ownership of Hammer Mills, Zambia 2010

1. Households owning at least one or more hammer mills

- a. Number: 73,039
- b. Percentage: 3%

2. Hammer mills

- a. Total number: 92, 808
- b. Number used commercially: 5,968
- c. Percent used commercially: 6%

3. Number of households per hammer mill

- a. Nationwide average: 27
- b. Provincial ranges: 8 to 205
- c. Provincial average: 92

Source: Calculations using LCMS 2010 database

Is it Feasible to Fortify the Maize Meal Produced by Hammer Mills?

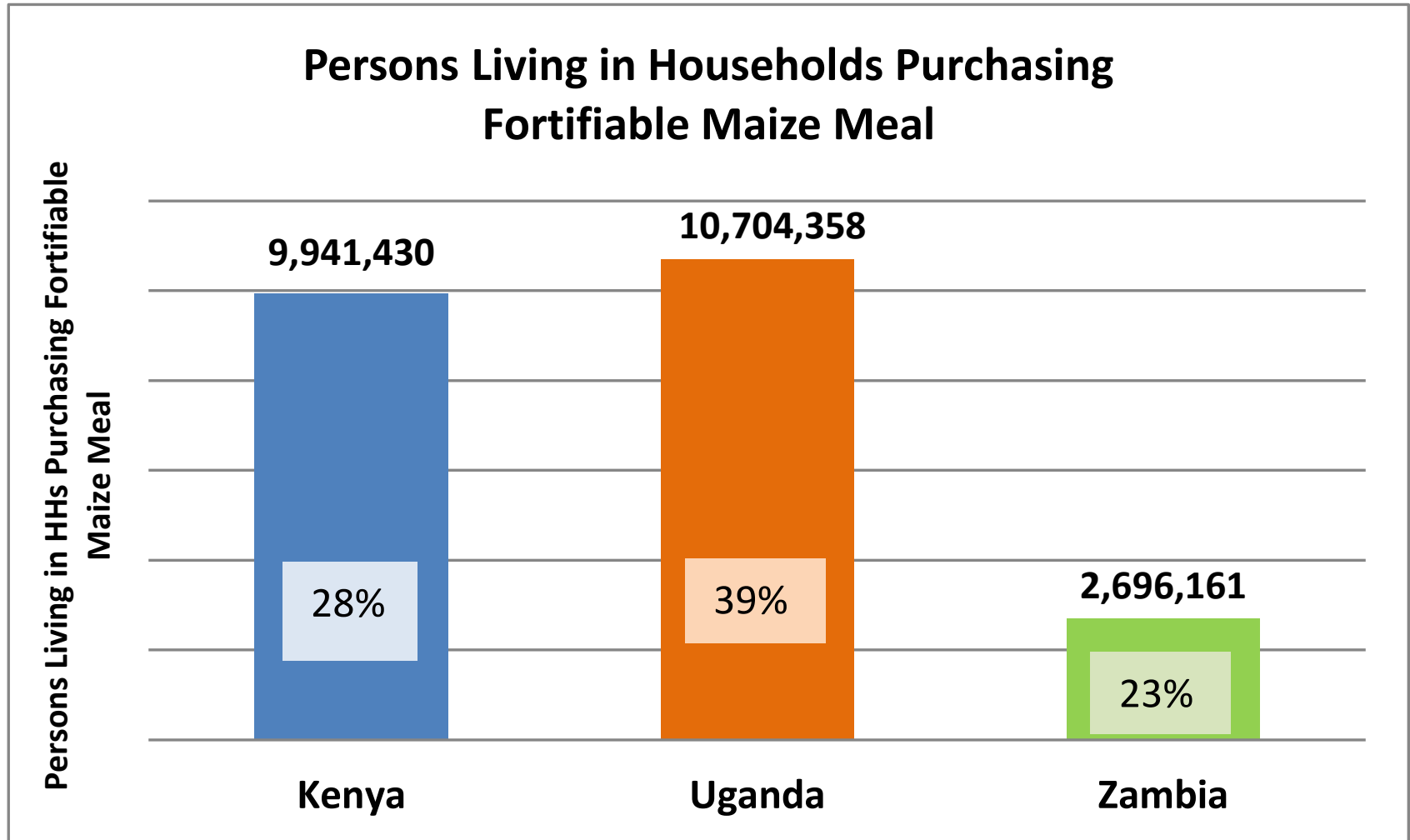
- **The long-standing arguments against them:**
 - Hammer mills' simple technology and small scale introduce more opportunities for human error
 - The viability of a premix market that is physically and economically accessible to hammer mills—on a continuous basis—is questionable
- **HCES evidence from Zambia suggests:**
 - Identifying, locating, training and monitoring hammer mills would overwhelm already over-stretched public food monitoring systems
 - **But** it would enable expanding coverage to persons who are not covered by roller milled meal

What is the view of the 3 countries? How have they officially defined “fortifiable”?

- Only the output produced by large, industrial scale mills is “fortifiable”
 - Kenya: Only packaged (sifted-roller meal).
 - Uganda: 4 mills (2 roller, 2 hammer with ≥ 20 MT/day)
 - Zambia: 33 roller mills

HCES-Based Best Estimates of Coverage

Given the specificity of their food item categories: Zambia's estimate is likely to be the most accurate, Uganda's the least. Uganda is likely to be over-estimated.



The Supply / Production-Based View

1. How many mills are producing fortifiable maize meal?
2. How much maize meal are they producing?
3. What are the additional costs they incur to fortify?

Estimating the Incremental, Private Sector Costs of Fortification: Step 1

1. Identified large scale maize millers
 - a. Kenya: 20 rollers mills
 - b. Uganda: 4 mills; 2 roller, 2 hammer > 20MT/d
 - c. Zambia: 33 roller mills
2. Categorized mills as small, medium and large by output.
 - a. Size is intended to capture systematic differences in technology and costs (economies of scale)
 - b. Size categories varied by country
3. Selected 1 or 2 maize millers of each size category: A total of 9 millers in the 3 countries

Kenya's 20 Largest Maize Mills

	Company	Capacity (MT/Year)	Size Category
1	Ungaa-Nairobi Mill	240,900	Larger
2	Mombasa Maize Millers - Mombasa	222,650	Larger
3	Eldoret Grains	158,775	Larger
4	Mombasa Grain Milling Co	120,450	Larger
5	Pembe-Lunga Lunga Road	98,550	Meduim
6	Mombasa Maize Millers - Nairobi	93,075	Meduim
7	Capwell	87,600	Meduim
8	Kitui Flour Mills	87,600	Meduim
9	United Millers	85,775	Meduim
10	Maize Milling Co Ltd	73,000	Meduim
11	Uzuri Foods	65,700	Meduim
12	TSS Grain	54,750	Meduim
13	Chania Feeds	52,560	Meduim
14	Pembe-Lunga Lunga Road	51,100	Meduim
15	Kitale Industries	47,450	Small
16	Mombasa Maize Millers - Kisumu	43,800	Small
17	Nairobi Flour Mills	43,800	Small
18	Osho Grains	43,800	Small
19	Eastern Flour Mills	43,800	Small
20	Kabansora	36,500	Small

TOTAL CAPACITY: 1,751,635
ESTIMATED OUTPUT: 767,313

Uganda's 20 Largest Maize Mills

	Company	Roller Mill?	Main Location	Mill Size/ Type*	MT /Day
1	Sunrise Commodities & Millers	Yes	Kampala	Larger	60
2	Maganjo Grain Millers		Wakiso	Larger	30
3	Seba Foods	Yes	Mbale	Larger	30
4	Kent Grain Millers		Soroti	Larger	20
5	Ungaa Millers Ltd	Yes	Kampala	Medium	17
6	Opio Robert Equator Mills		Soroti	Medium	14
7	Ebju James		Soroti	Medium	11
8	William Grain Millers		Kasese	Small	7
9	Buyale Maize Farmers		Masindi	Small	6
10	Masindi S&G Growers Ltd		Masindi	Small	6
11	Nayda and Co.		Arua	Small	5
12	Jofa Miller		Jinja	Small	5
13	Nako millers		Masindi	Small	4
14	Agnes Milling Centre Soroti	Yes	Soroti	Small	4
15	Twino Grain Millers		Kasese	Small	4
16	Hamsa Khemis		Arua	Small	3
17	Nelson Leta		Arua	Small	3
18	Arua Best Foods & Beverages		Arua	Small	2
19	Pony Enterprises		Arua	Small	2
20	Agro Vet farmers		Masindi	Small	2
Total					235

Sources: GAIN & PSFU 2012; FBRC-NARL, 2009

Roller Maize Mills in Zambia

	Province	Company	Production Level	Percent
1	Lusaka	National	11	8%
2	Lusaka	GBM	10	7%
3	Lusaka	Superior	3.5	3%
4	Lusaka	Shabco	4.2	3%
5	Lusaka	A1	4.2	3%
6	Lusaka	Simba	7	5%
7	Lusaka	APG	3.3	2%
8	Lusaka	Ghiradi	5	4%
9	Lusaka	Perfect	2.7	2%
10	Lusaka	Chat	8.3	6%
11	Lusaka	Bartner	1.5	1%
12	Copperbelt	Chimanga	10	7%
13	Copperbelt	Nkana	2	1%
14	Copperbelt	HM	4	3%
15	Copperbelt	Jamas	9.5	7%
16	Copperbelt	Olympic	3.5	3%

	Province	Company	Production Level	Percent
17	Copperbelt	Antelope	unkown	
18	Copperbelt	Lite-Star	1.7	1%
19	Central	National	3.5	3%
20	Central	FVG	unkown	
21	Central	Mumbwa	2	1%
22	Central	Chimisoro	5	4%
23	Southern	National	3.5	3%
24	Southern	APG	14	10%
25	Southern	Mutupa	unkown	
26	Southern	Kapinga	3	2%
27	Western	APG	3.5	3%
28	Luapula	Mansa	5	4%
29	Eastern	Kwacha	2	1%
30	Northern	Isanya	5	4%
31	Northern		unkown	
32	Northweste	Solwezi	1.5	1%

TOTALS: 139.4 100%

Production levels are MT/hr

Estimating the Incremental Private Sector Costs of Fortification: Step-2

4. Structured interviews with key management and production officials of the selected plants
5. Estimated incremental capital and recurrent costs

INCREMENTAL FORTIFICATION COSTS OF A LARGE KENYA MAIZE MILLER

(In US\$)

A. CAPITAL COSTS

Feeder and installation costs for two dossifiers	16,000
Annualized Capital Costs:	1600

B. ANNUAL RECURRENT COSTS

1. Premix Costs

Annual premix at target addition rate of 171g/MT (KS 168) flour (kg)	23,731
Annual amount of maize flour produced expressed in (MT)	138,778
Premix cost per kg (Seaboard -inclusive of freight clearance and license fees and transport)	23.56
Total Annual Premix Costs:	559,102

2. Internal QA /QC Testing Costs and lab personnel

On spot tests Iron at 100 Ksh/test	6,240
One quality controller 10% on fortification-specific activities: 40,000 Ksh/month	600
Two laboratory technicians with monthly pay of 35,000 KSh (fortification 25% time)	2,625
Total Annual In-Plant QA Costs:	2,625

3. External Quality Control Monthly sent to UK/US every two months two samples

Vitamin and Iron with other micronutrient @ 80,000 Ksh per sample	12,000
Average Total Cost per Plant:	12,000

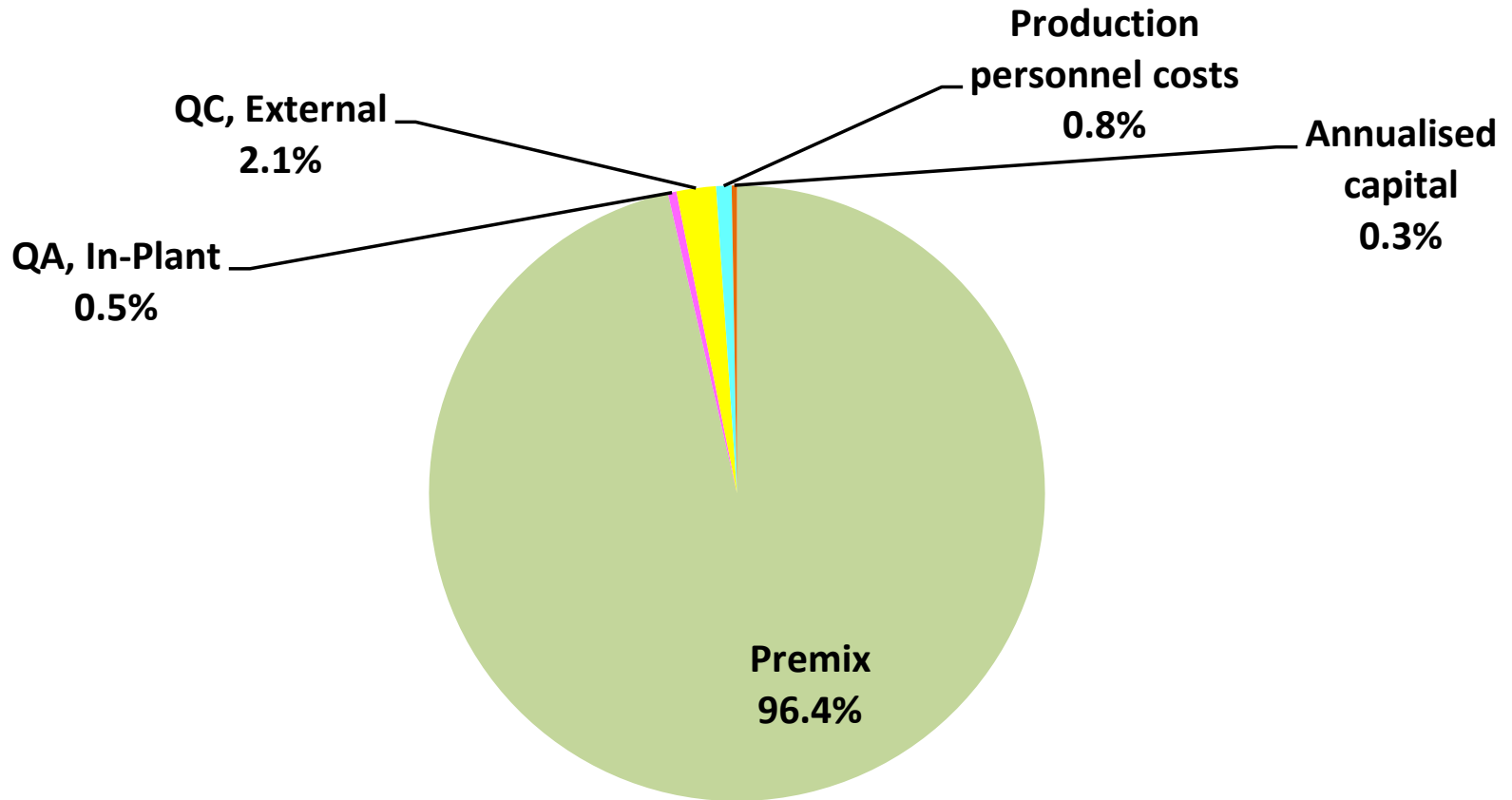
4. Incremental Production costs

Average annual operating costs	600
Average annual maintenance costs at 7% estimates	1,120
Production supervisors 1 per shift for two shifts @ 60,000 Ksh 10% on FF	1,800
Mixing persons 2 per shift for two shifts @ 7800Ksh 25% on FF	1,170
Total Annual Production-Related Costs:	4,690

TOTAL COSTS

580,017

Annual Incremental Costs of Maize Meal Fortification in a Large Mill in Kenya



Estimating the Incremental, Private Sector Costs of Fortification: Step-3

6. **Estimated the additional cost per metric ton for each of the sampled mills**
7. Estimated the total cost of fortifying all of the output of each plant size category from the plant size-specific average cost/MT of the sampled mill
8. **Total national costs were estimated as the sum of the total cost of each plant size category**
9. More than half of the studies were ex ante → these estimates provide a general order of magnitude, and not precise, definitive estimates (Most of Kenya's costs are actuals.)

Kenya National Maize Meal Fortification Cost

Cost Item	Plant Output (MT / Yr):	Small 10,000-30,000	Medium 30,000-70,000	Large > 70,000	Nation-wide, All Plants
1	Average Cost Per Plant	98,716	127,213	453,465	173,673
2	Number of Plants	5	10	3	18
3	Total Output of the Plant Size Category	116,617	320,168	325,528	762,313
4	Premix Cost per kg	18.75	27.00	23.56	24.14
5	Total Annual Cost	493,580	1,272,132	1,360,395	3,126,106
6	Premix Cost Percent of Total Fortif. Cost	89%	97%	96%	95%
	a. All Mills Paying Lowest Premix Price	493,580	766,492	1,344,216	2,604,287
	b. All Mills Paying Highest Premix Price	685,995	1,272,132	1,984,954	3,943,080
7	Average Cost per MT	4.23	3.97	4.18	4.10

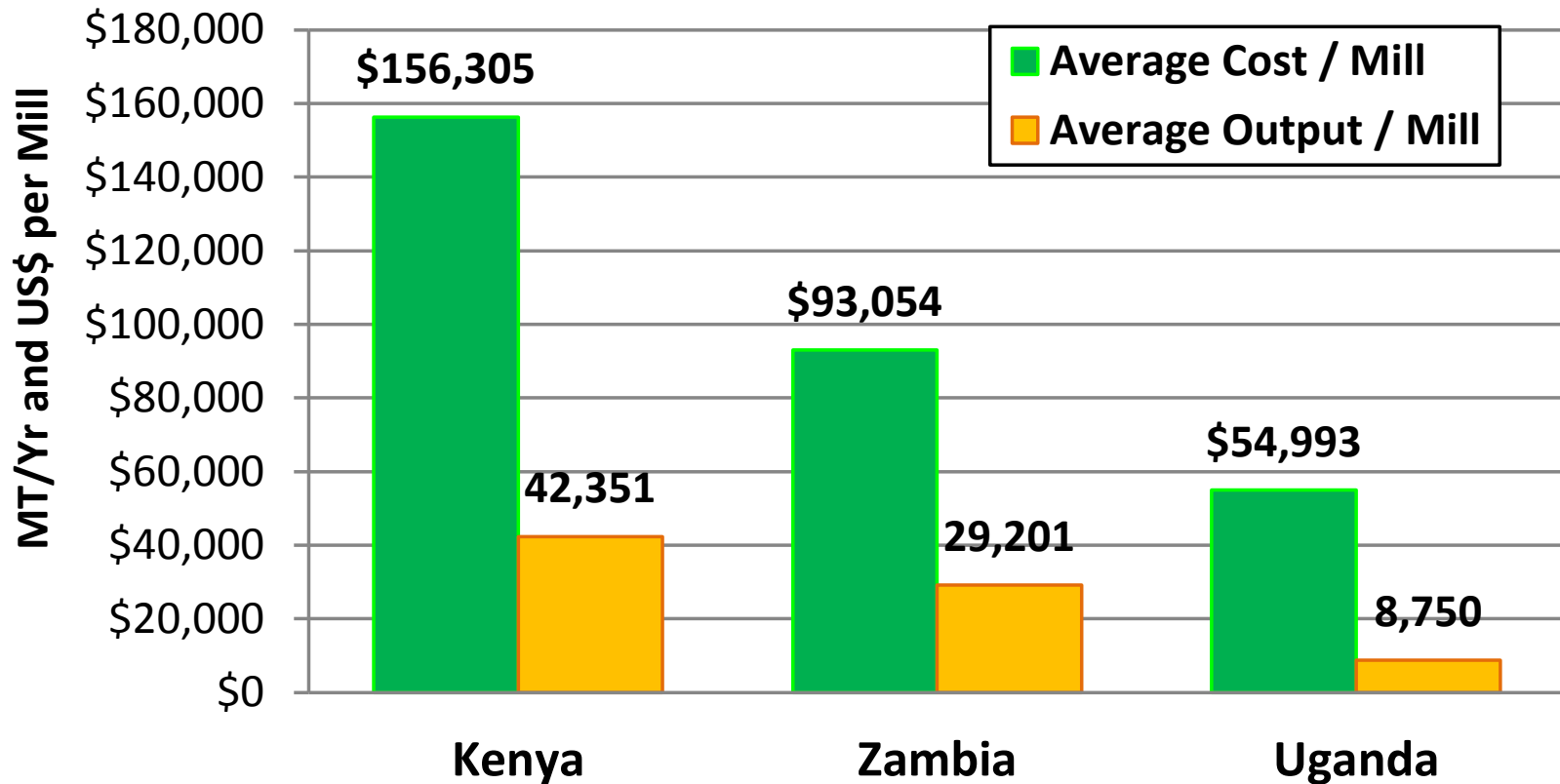
Lowest priced premix reduces total incremental fortification costs by 17%.

The highest priced premix adds 26% to total costs.

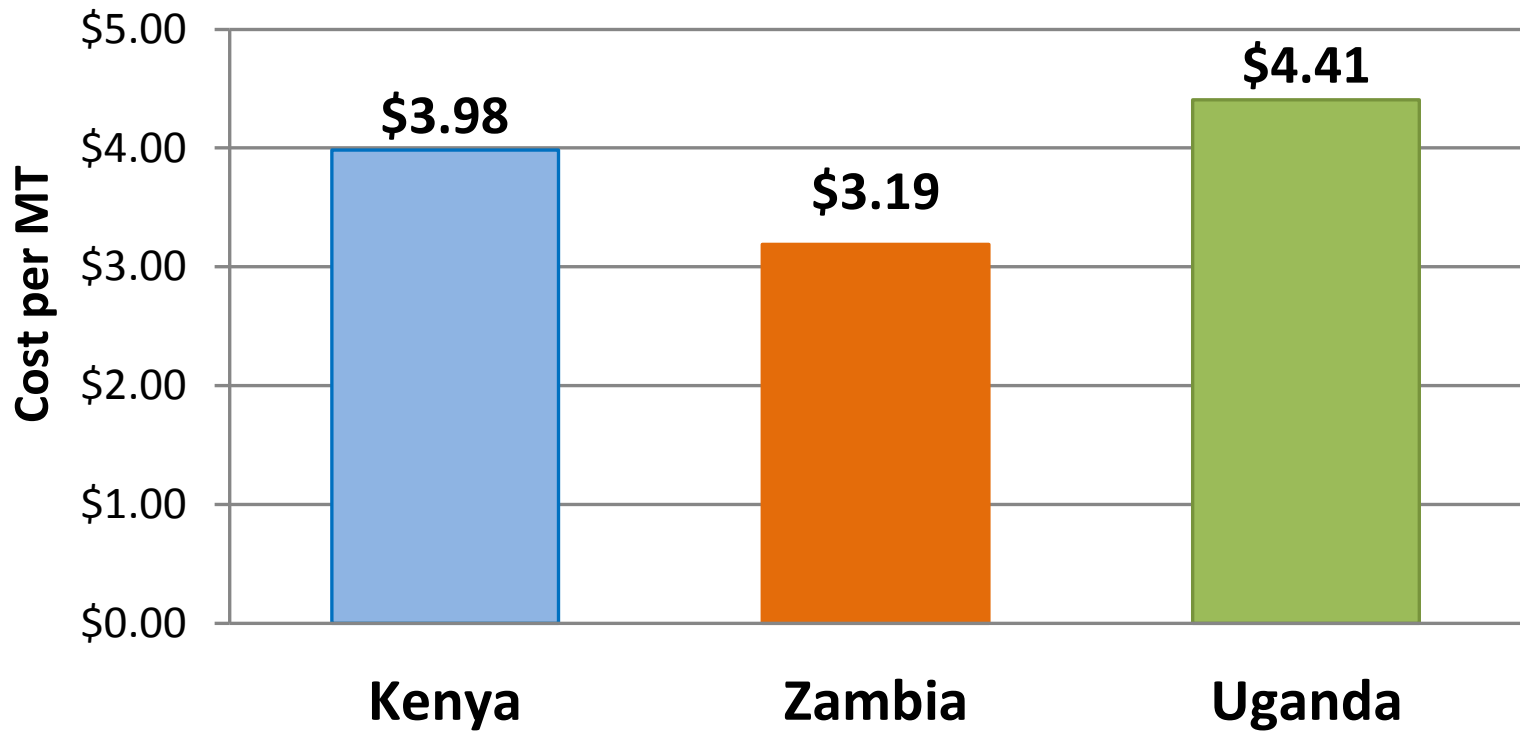
Comparing Annual Incremental Costs of Fortification

Cost Item	Kenya		Uganda		Zambia	
	US\$	% costs	US\$	% costs	US\$	% costs
1. Premix	2,979,287	96.4%	169,596	65%	2,741,579	89%
2. QA / In-Plant lab testing	26,841	0.5%	19,714	4%	39,600	1%
3. QC / External lab testing	52,724	2.1%	2,786	3%	0	0%
4. Production-related costs	54,386	0.8%	24,454	24%	205,054	7%
5. Annualized capital costs	12,868	0.3%	3,420	3%	84,546	3%
TOTAL COSTS:	3,126,106	100%	219,971	100%	3,070,779	100%

Average Annual Output and Average Annual Cost per Mill



Average Incremental Cost per MT of Fortified Maize Meal



Incremental Private Sector Fortification Costs: The Consumer's Perspective

(In US\$)

	Kenya	Uganda	Zambia
1 Maize meal consumer price/Kg (Pre-fortification)	\$0.44	\$0.69	R: \$0.30 B: \$0.44
2 Maximum increase in price due to fortification-- assuming full cost is passed onto consumer	0.09%	0.07%	0.09%

Assuming consumption levels remain constant, fortification will result in at most an increased expenditure as a percent of household income of:

3 All Households consuming fortified maize meal:	0.03%	0.002%	0.2%
4 HHs among poorest 40% of HHs consuming fortified maize meal:	0.07%	0.005%	0.8%

Conclusions & Observations

- 1. HCES provide a tool for better understanding coverage and market structures**
2. Premix costs comprise the overwhelming share of the total incremental costs of fortifying maize meal
- 3. Premix costs vary substantially**
4. Premix issues are not only price, but quality. What is the role, vision and exit strategy of GAIN's Pre-Mix Facility?
- 5. Incremental fortification cost per mill is significant, but is likely to be passed on to the consumer**
6. The annual cost per household consuming fortifiable maize meal is relatively modest—even among the poorest 40%