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Animal sourced foods and child stunting

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Introduction



Why do we care about stunting?

- Globally, 160 million children under the age of 5 are stunted
- Stunting in early life – a marker of poor nutrition – is linked to adverse physical, cognitive & economic development
- Most stunting manifests in the first 1000 days of life (Victora, et al., 2009), especially over ages 6-24 months

Why do kids start to fall behind at ~6 months?

- Poor diets: Rapidly increasing nutrient requirements no longer met by breastmilk, poor feeding frequency, inadequately diversified diet
- Infection: Infant's weak immune system is highly vulnerable to increased exposure to pathogens ... diarrhea, EED, etc

Introduction



Surprisingly, dietary determinants of stunting somewhat neglected

- Diets are elusive: Individual “usual” diets are hard to measure
- Diets hard to experiment on: Surprisingly little evidence in LDCs
- Household surveys used to link dietary diversity indicators to stunting, but associations tend not to be robust

For child growth, diversifying into ASFs may be especially crucial

- Since 1974, protein deficiency concerns largely sidelined
- Yet ASF proteins contains essential amino acids that can't be synthesized within the body: seminal role in programming growth
- ASFs also dense in a wide range of micronutrients linked to growth
- Multiple ASFs preferable: e.g. dairy rich in calcium, but no iron

Introduction



Empirical evidence linking ASFs to child growth is varied

- Handful of ASF interventions do find sizeable growth impacts
- Nutrition-sensitive livestock interventions also sometimes show signs of impact, but typically also use behavioral interventions
- Observational studies link growth to livestock ownership (East Africa)
- Historical studies link adult heights to ASF consumption patterns

Weak evidence on constraints to ASF consumption among children

- Economic studies focus on constraints to *household* consumption
- Sociological studies focus on cultural constraints (e.g. eggs in Africa)
- Nutrition interventions assume knowledge is the major constraint

Research questions



In light of these knowledge gaps, this paper offers three contributions

- 1. ASF consumption patterns:** Use DHS data on 130,432 children aged 6-23 months from 49 low and middle income countries
- 2. ASFs & stunting associations:** Use this dataset to estimate associations between dietary patterns and stunting; go beyond aggregated diversity metrics to look at specific food groups
- 3. Constraints to ASF consumption:** We look at price, wealth and “knowledge” constraints to document the main factors driving ASF consumption patterns in poor countries

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LEAD ARTICLE WITH COMMENTS

TRAVIS J. LYBBERT, TIMOTHY K.M. BEATTY, TERRANCE M. HURLEY, AND TIMOTHY J. RICHARDS • *American Journal of Agricultural Economics Volume 100: A Century of Publishing the Frontiers of the Profession*

WILLIAM G. TOMEK • *AJAE at Age 100: On Changes in Content*

GORDON RAUSSER • *Comments for American Journal of Agricultural Economics Volume 100: A Century of Publishing the Frontiers of the Profession*

STEVE BUCCOLA • *Analytical Currents in the AJAE's First Century*

KATHLEEN SEGERSON • *Comments for AJAE 100th Anniversary Issue*

MADHU KHANNA • *The Evolution towards Peer-Reviewed Invited Papers in the American Journal of Agricultural Economics*

ASSA MEETING INVITED PAPERS

WILLIAM A. MASTERS, YAN BAI, ANNA HERFORTH, DANIEL B. SARPONG, FULGENCE MISHIL, JOYCE KINABO, AND JENNIFER C. COATES • *Measuring the Affordability of Nutritious Diets in Africa: Price Indexes for Diet Diversity and the Cost of Nutrient Adequacy*

DEREK HEADEY, KALLE HIRVONEN, AND JOHN HODDINOTT • *Animal Sourced Foods and Child Stunting*

LIANG LI AND THOMAS REARDON • *An Economic Model of the Evolution of Food Retail and Supply Chains from Traditional Shops to Supermarkets to E-Commerce*

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BOOK REVIEWS

The Telegraph

Animal-sourced foods vital to combating malnutrition and stunting in the developing world



Editors

TIMOTHY BEATTY, TERRANCE HURLEY,
TRAVIS LYBBERT, TIMOTHY RICHARDS

OXFORD
UNIVERSITY PRESS

Data



- Data on 130,432 children from 49 countries covered by the Demographic Health Surveys (DHS) between 2006 and 2014
- **Child diets:** Since mid 2000s, DHS have collected information on 12 food groups their youngest children consume in the past 24 hours.

These 7 food groups used to classify minimum dietary diversity (MDD) as 4+ food groups

Table 1. Food groups listed in the DHS phases 5 & 6

Aggregated food groups in DDS (7 groups)	Disaggregated food groups (12 groups)
(1) Starchy staples	(1) Grains; (2) Roots/tubers
(2) Legumes/nuts	(3) Legumes/nuts
(3) Vitamin-A rich fruits/vegetables	(4) Vit-A rich fruits; (5) Vit-A rich vegetables
(4) Other fruits/vegetables	(6) other fruits (7) dark green leafy vegetables, (8) other vegetables
(5) Dairy	(7) Cow's milk; (8) Infant formula
(6) Eggs	(9) Eggs
(7) Flesh foods	(10) Meat/organs; (11) Fish
	(12) Fortified infant cereals

Going to define an ASF indicator but also use more specific groups



- **Stunting:** height-for-age Z score < -2
- **ASF prices:** Use “calorie price ratios” (CPRs) from Headey et al’s (2017) analysis of 2011 International Comparison program data
- CPR is the price of 1 calorie of cheapest food in a given food group relative to 1 calorie of cheapest staple cereal in each country

Table 3. Classification of cereals & specific ASF products in ICP 2011 data

Food group	# products	Specific products used to construct minimum price
Cereals	13	Rice (5), bread products (5), maize flour, maize, tortilla
Cow’s milk, fresh	2	Pasteurized fresh milk, unskimmed or low-fat
Cow’s milk, long-life	3	Condensed milk, powdered milk, UHT
Meat, fresh	20	Whole chicken (2), chicken breast, chicken leg; Beef/veal (7 varieties), Lamb/mutton (4 varieties), Pork (4 varieties), Goat (1 variety); all unprocessed.
Chicken eggs, fresh	2	Large brown eggs, medium brown eggs
Fish, fresh	5	Fresh Carp, Mackerel or Tilapia; canned Sardines or canned Tuna

Methods



- **Descriptives:** unweighted consumption patterns by child age
- **Multivariate regressions:** pooled across country with survey fixed effects (averages of within-country variation), saturated with control variables (wealth, education, health services, WASH, etc)
- **Age disaggregation:** benefits of improved diets not instantaneous but cumulative, so expect larger effects for older kids (e.g. 18-23m)
- **Problems:** Omitted variables bias, attenuation bias, imprecision...

ASF consumption patterns



Stunting and ASF indicators by region, children 6-23 months of age

	All children	Latin America & Caribbean	Middle East & North Africa	South, Central & SE Asia	West & Central Africa	Eastern & Southern Africa
Stunted	31.5%	22.5%	25.9%	37.7%	32.9%	37.4%
Child consumed:						
Any ASF	62.0%	82.9%	75.5%	56.8%	52.0%	49.3%
1 ASF only	35.8%	27.8%	38.2%	43.7%	35.4%	36.4%
2 ASFs	20.3%	36.2%	30.3%	13.8%	13.5%	12.0%
3 ASFs	8.5%	20.6%	11.0%	4.3%	4.4%	3.2%

ASF consumption patterns



ASF consumption patterns by region, children 6-23 months of age

	All children	Latin America & Caribbean	Middle East & North Africa	South, Central & SE Asia	West & Central Africa	Eastern & Southern Africa
Dairy	35.4%	52.1%	64.0%	37.7%	20.6%	18.6%
Eggs	22.4%	45.3%	30.2%	15.5%	12.1%	13.1%
Meat/fish *	37.9%	55.9%	30.1%	22.7%	39.4%	33.7%
Red/white meat	24.3%	51.3%	23.6%	13.2%	15.4%	17.4%
Fish	19.6%	N/A	7.6%	12.6%	31.3%	21.0%

*Fish consumption data are not available for Peru.

ASFs and stunting



Least squares regressions of stunting against aggregated food groups

Sample:	6-23 mo children	6-11 mo children	12-17 mo children	18-23 mo children
Any ASF	-0.023***	-0.016***	-0.011**	-0.040***
	(-0.003)	(-0.005)	(-0.006)	(-0.006)

- Fruits also have significant associations

controls: other food groups, child & hh level, sub-national fixed effects, rural area, survey fixed effects

ASFs and stunting



Regressions of stunting against individual ASFs / multiple ASFs

Sample: 18-23 mo children

	(1)
Dairy	-0.034***
	(-0.006)
Eggs	-0.013**
	(-0.006)
Meat/Fish	-0.021***
	(-0.005)

controls: other food groups, child & hh level, sub-national fixed effects, rural area, survey fixed effects

ASFs and stunting



Regressions of stunting against individual ASFs / multiple ASFs

Sample: 18-23 mo children

	(1)		(2)
Dairy	-0.034***	1 ASF	-0.037***
	(-0.006)		(-0.007)
Eggs	-0.013**	2 ASFs	-0.057***
	(-0.006)		(-0.008)
Meat/Fish	-0.021***	3 ASFs	-0.061***
	(-0.005)		(-0.010)

controls: other food groups, child & hh level, sub-national fixed effects, rural area, survey fixed effects

High prices constrain dietary diversification



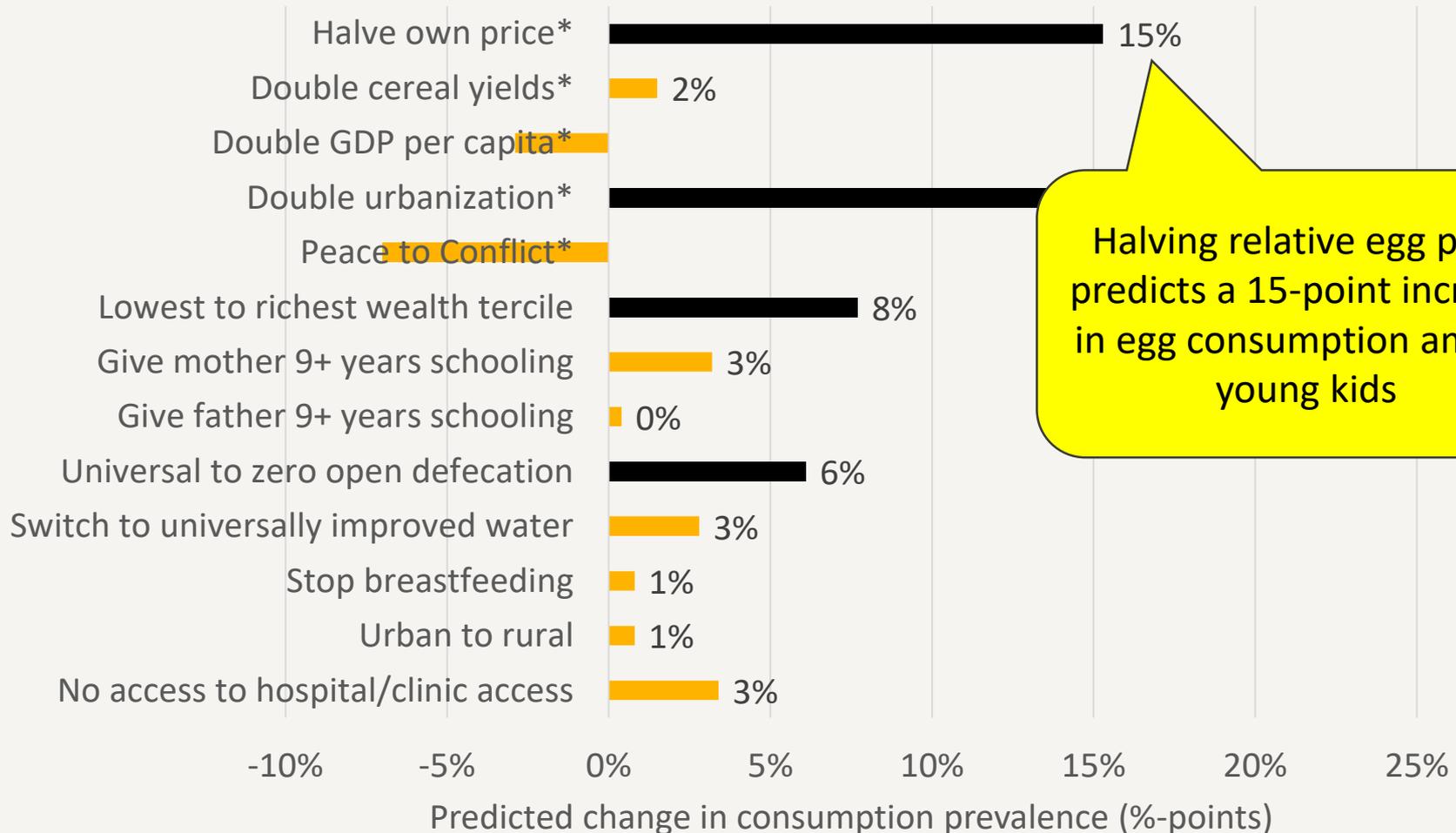
Cereal-relative calorie price ratios for various foods, by region

	Roots & tubers	Legumes	Cow's milk, fresh	Cow's milk, Proc.	Chicken eggs	Meat	Fish	Fortified baby cereal
High income countries	1.6	1.2	3.2	2.2	3.0	2.0	4.3	5.0
Latin America & Caribbean	1.2	2.2	3.9	3.0	4.9	3.2	3.4	9.6
North Africa & Western Asia	2.1	2.1	10.1	3.1	6.1	6.2	6.0	16.1
South, Central & South-East Asia	1.5	2.0	7.8	3.8	6.2	6.5	5.3	16.4
Western & Central Africa	1.0		16.5	4.0	9.9	5.3	5.0	23.4
Eastern & Southern Africa	1.7		13.9	5.8	9.1	5.6	6.1	18.6

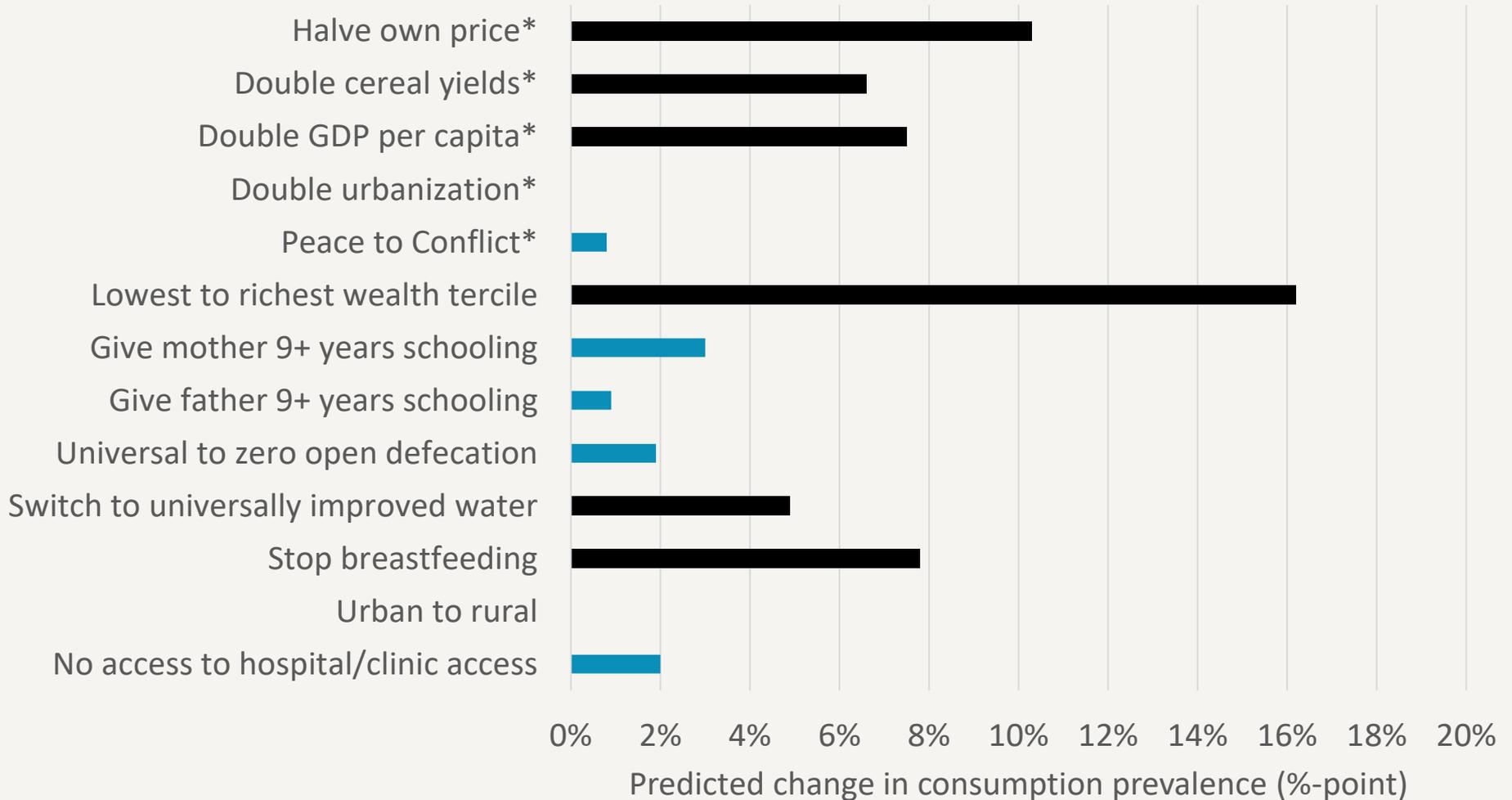
Constraints to ASF consumption: Eggs



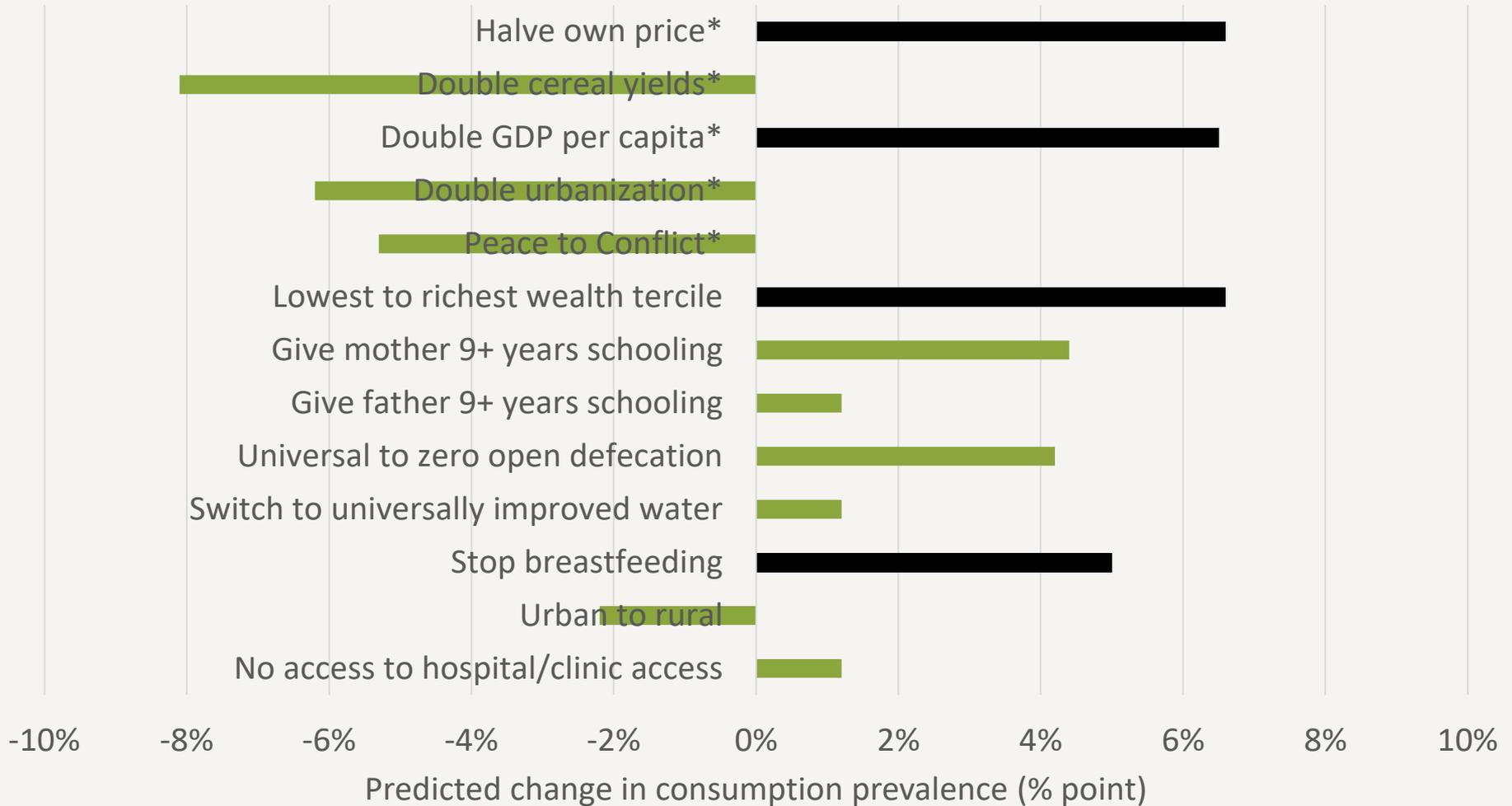
Predictors of 24-hr recall egg consumption among kids 6-23m



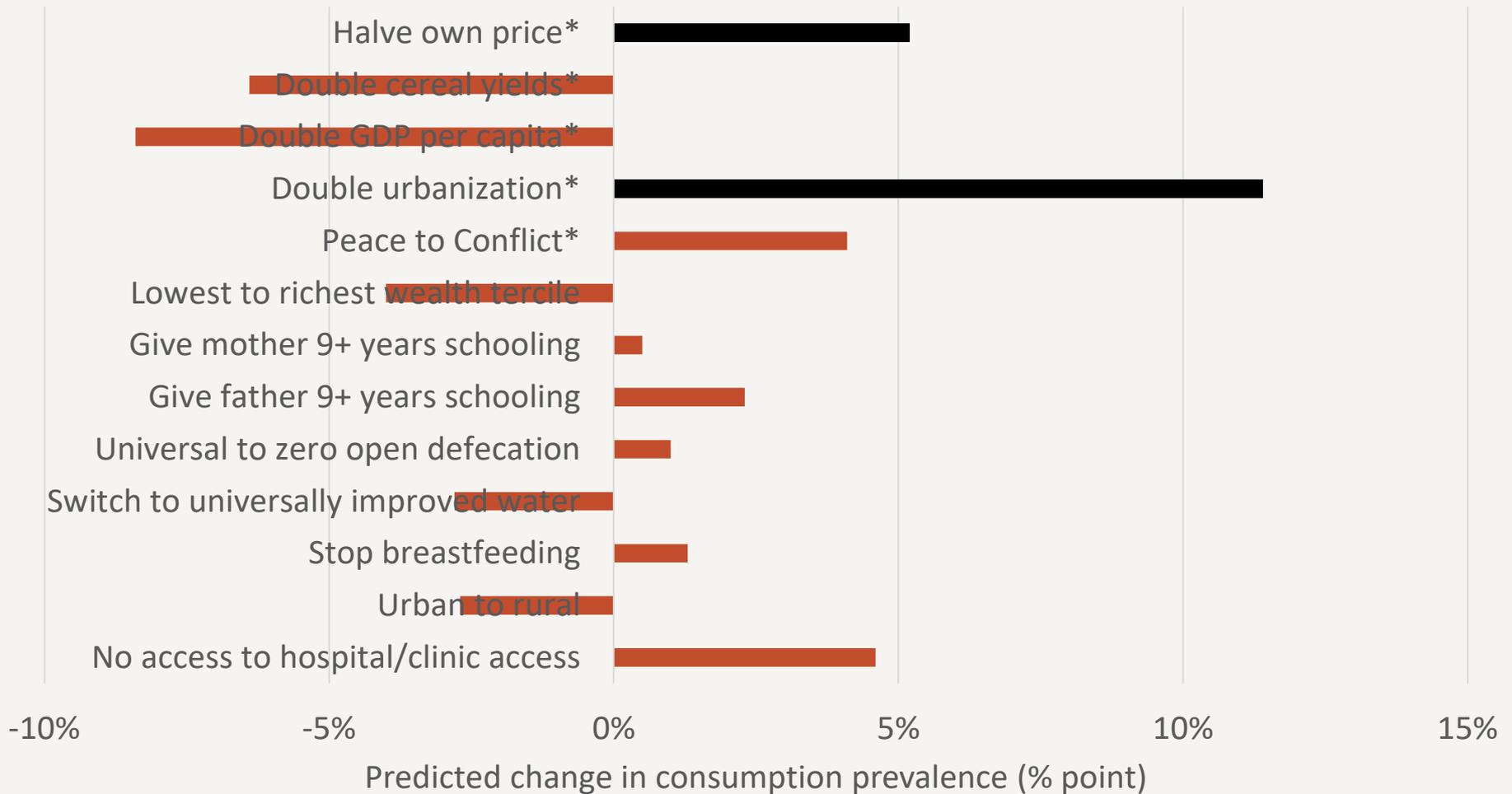
Constraints to ASF consumption: Dairy



Constraints to ASF consumption: Meat



Constraints to ASF consumption: Fish



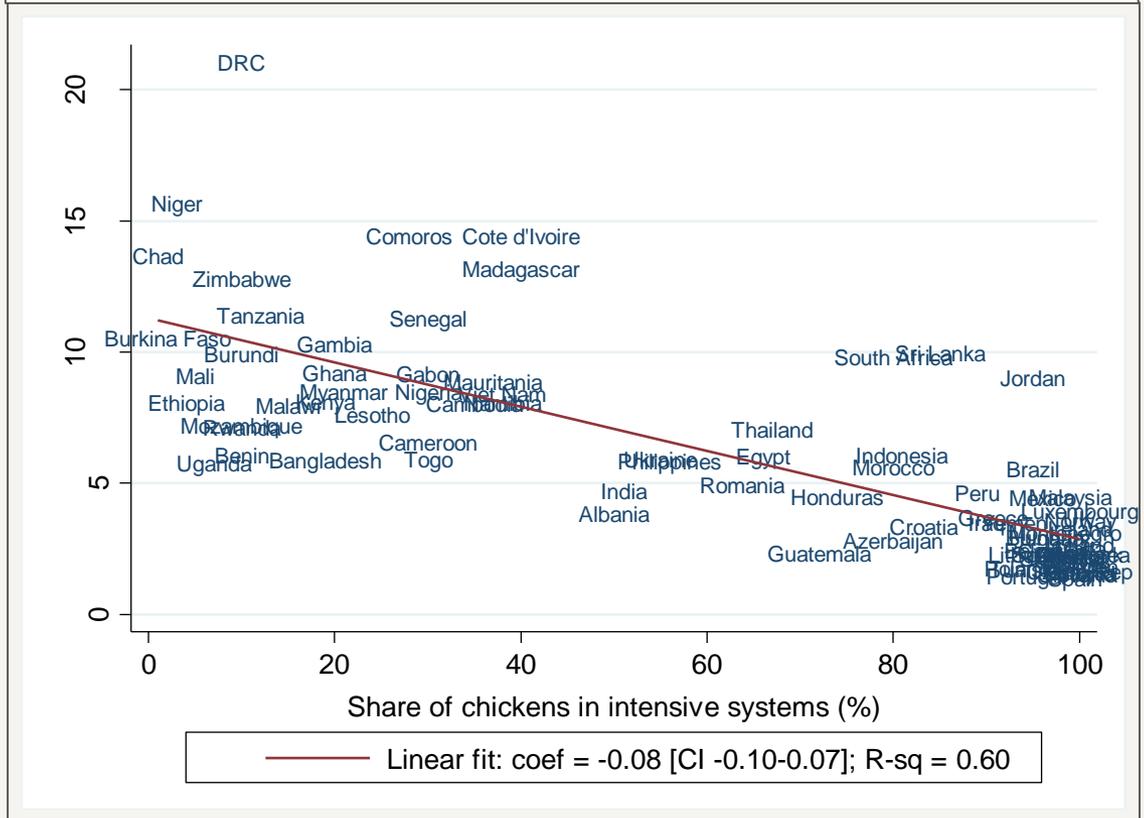
Constraints to dietary diversification



- Poor people face a double economic burden: poverty & high prices
- Why are nutrient-rich foods so expensive?

- Highly perishable; difficult to trade long distance
- Limited trade means relative prices largely set by local productivity levels
- Productivity is low in poor countries: e.g. backyard poultry very widespread, but children don't eat eggs
- Egg prices are lower when poultry is commercialized

Egg prices & share of chickens in intensive systems



Conclusions



- Nutritionists have long emphasized important nutrient properties of ASFs, including renewed interest in protein quality
- Only limited evidence linking ASF consumption to improved growth outcomes, and little work exploring constraints to ASF consumption
- In this paper we find:
 1. **ASF consumption still low in Africa & Asia:** ~50% of kids with 1+ ASFs
 2. **Diverse ASF consumption patterns:** fish strikingly important in many countries where dairy is less important; meat/egg consumption low
 3. **ASF consumption strongly associated with growth:** consuming a diverse array of ASFs seems more beneficial than any single ASF
 4. **ASFs are very expensive relative to cereals:** especially true for fresh milk and eggs; fish and meat relatively cheap in some places
 5. **Multiple constraints to ASF consumption:** High prices are a constraint for all ASFs, and wealth often a constraint (especially for dairy)

Conclusions



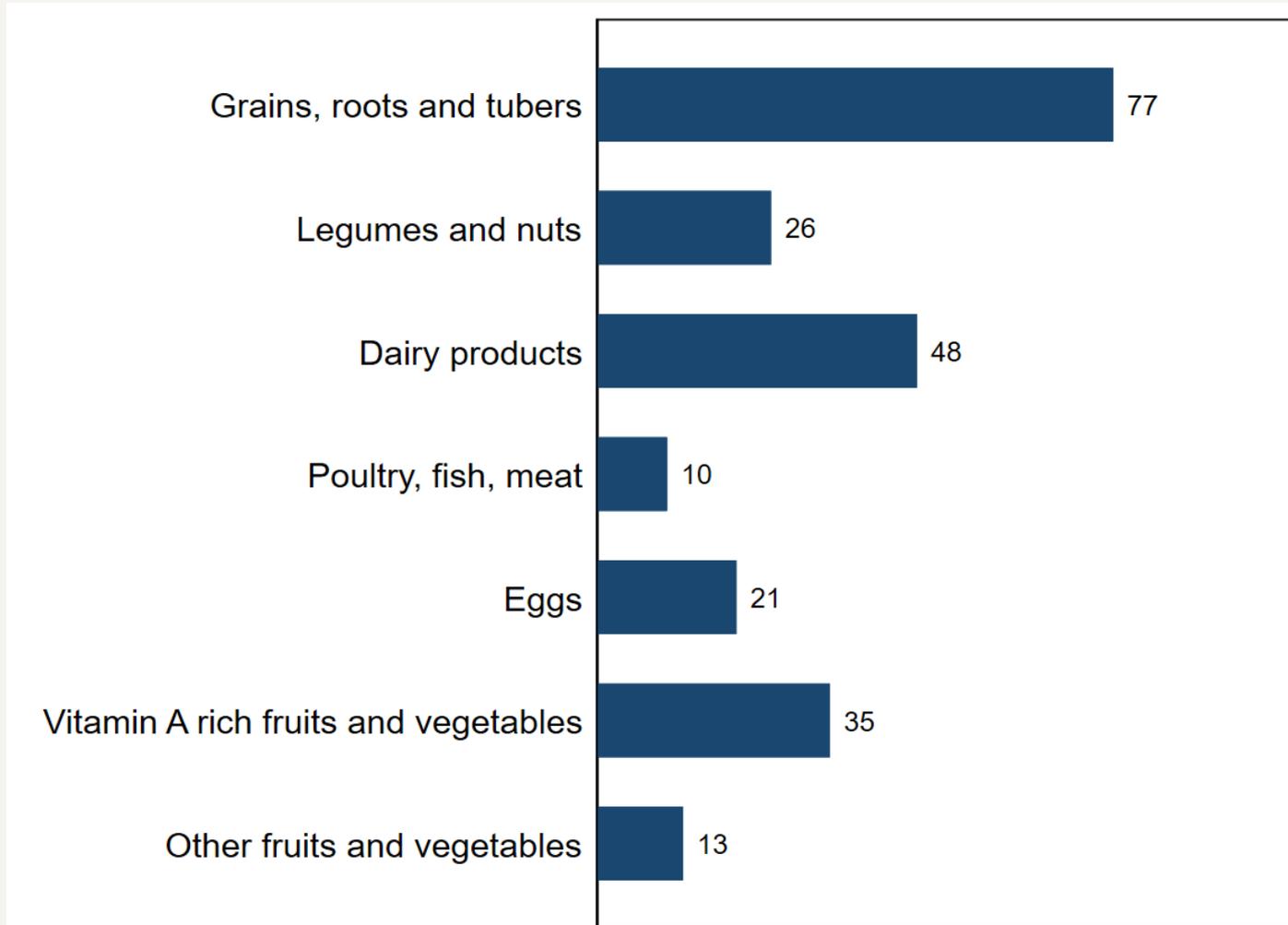
Policy implications

1. Focus on dietary diversification, but ensure that it includes a ***strong emphasis on ASFs***, including multiple ASFs
2. Knowledge constraints may still be important, but critical to use production, value chain and trade policies to ***reduce ASF prices***
3. Factor in ***environmental implications***: vast differences in GHG emissions from different types of ASF production
4. Factor in ***human health externalities***: livestock production has zoonotic disease risks, including enteric and pulmonary infections that are negative associated with child health & growth outcomes
5. Need to pay close attention to **food safety**: meat and dairy require cold chains

Ethiopia specific results



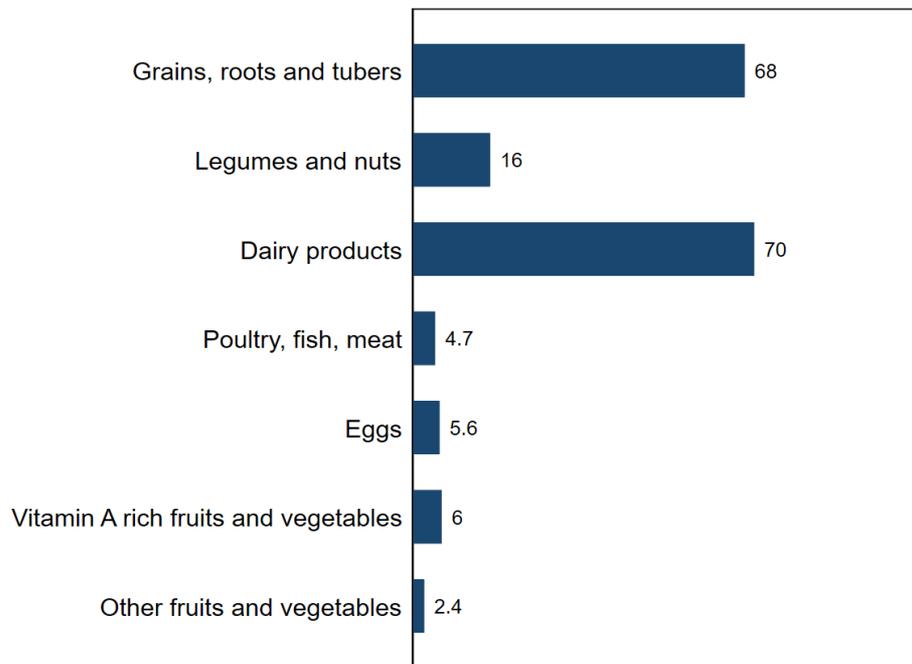
Snapshot of child (6-23 mo) diets through the 2016 DHS:



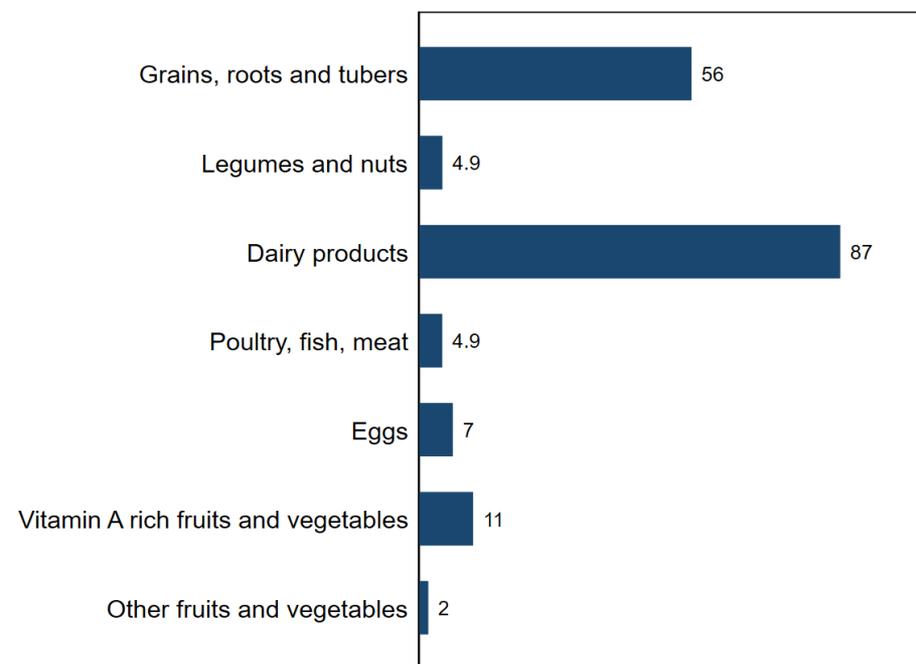
But considerable regional variation (1/3)



Afar



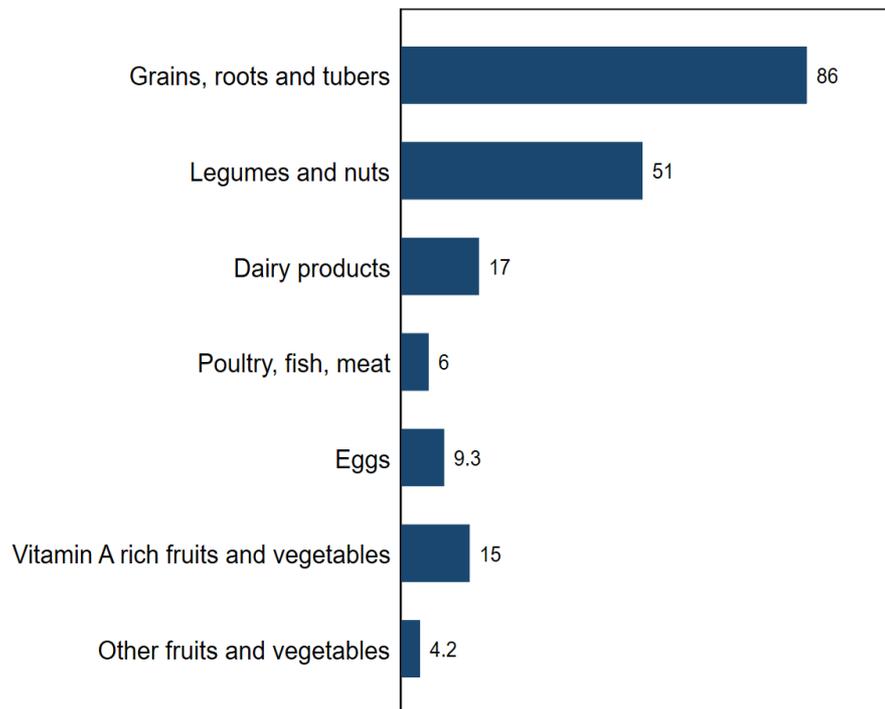
Somali



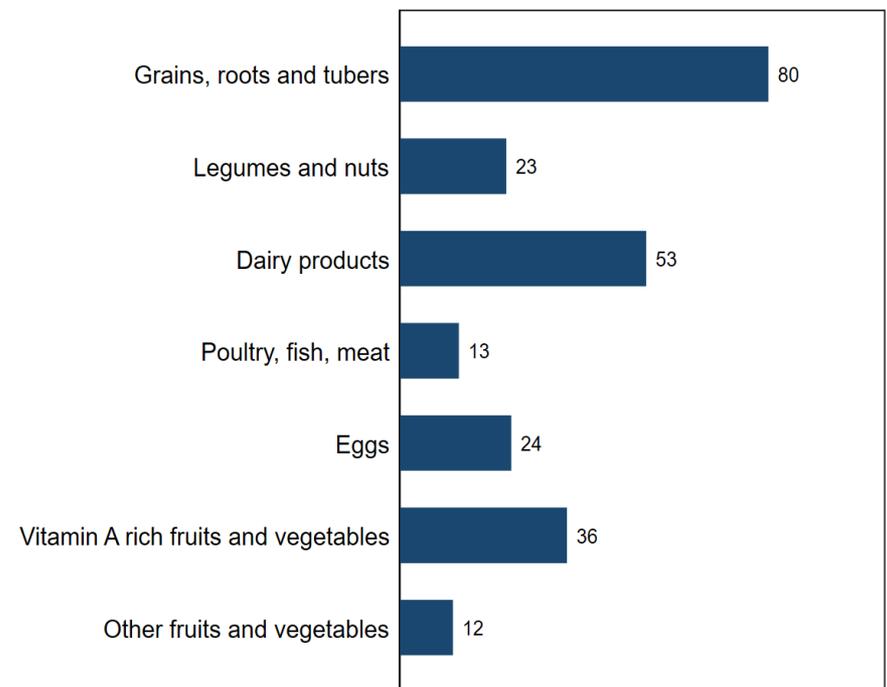
But considerable regional variation (2/3)



Amhara



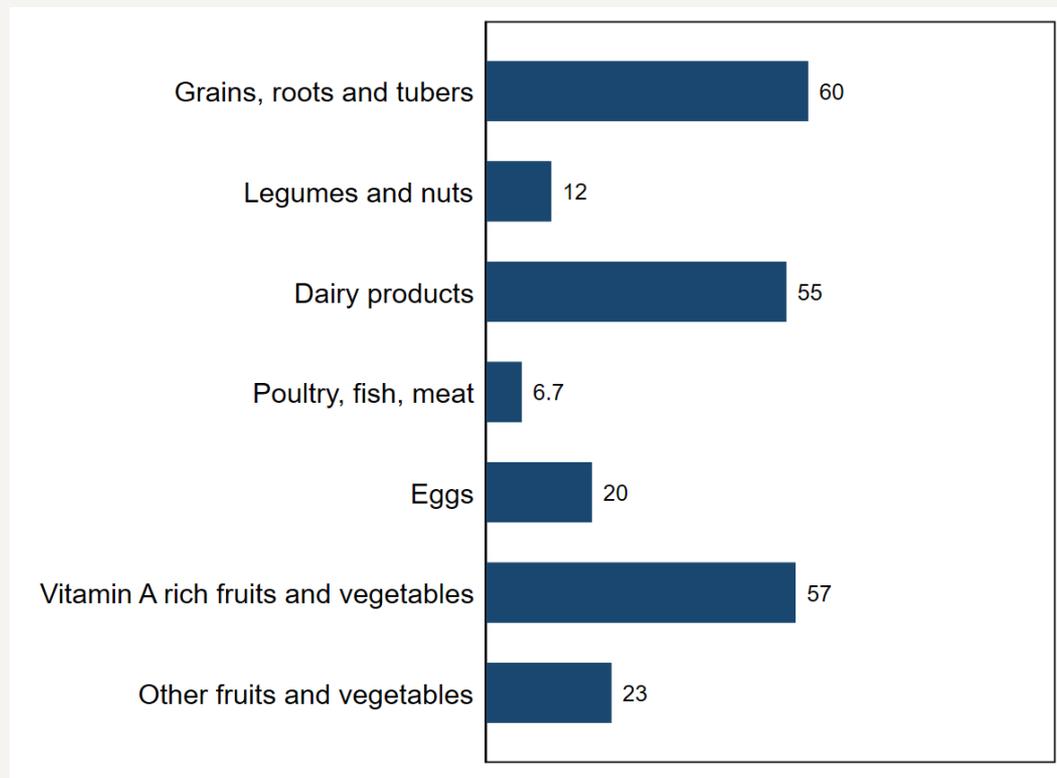
Oromia



But considerable regional variation (3/3)



SNNP



Policy implications



- Increasing ASF consumption is likely to require very different strategies depending on:
- Which region we're working in:
 - Current diets (traditions, food taboos) vary
 - Role of religious practices (Orthodox fasting in particular) vary
 - Current livestock production levels and potential to further expand vary
- Which ASF products we're focusing on:
 - Dairy and meat require more complex value chains (cold value chains)
 - Currently very localized production and consumption and hence (?) not affordable for most rural consumers.
 - Eggs are relatively more tradable and somewhat more affordable, especially if we consider child consumption.
 - Challenge is that egg sales provide access to cash so households are reluctant to give these to children.