INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE
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Agriculture and Nutrition: From New Research to New Policies

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https://www.ifpri.org/project/advancing-research-nutrition-and-agriculture-arena

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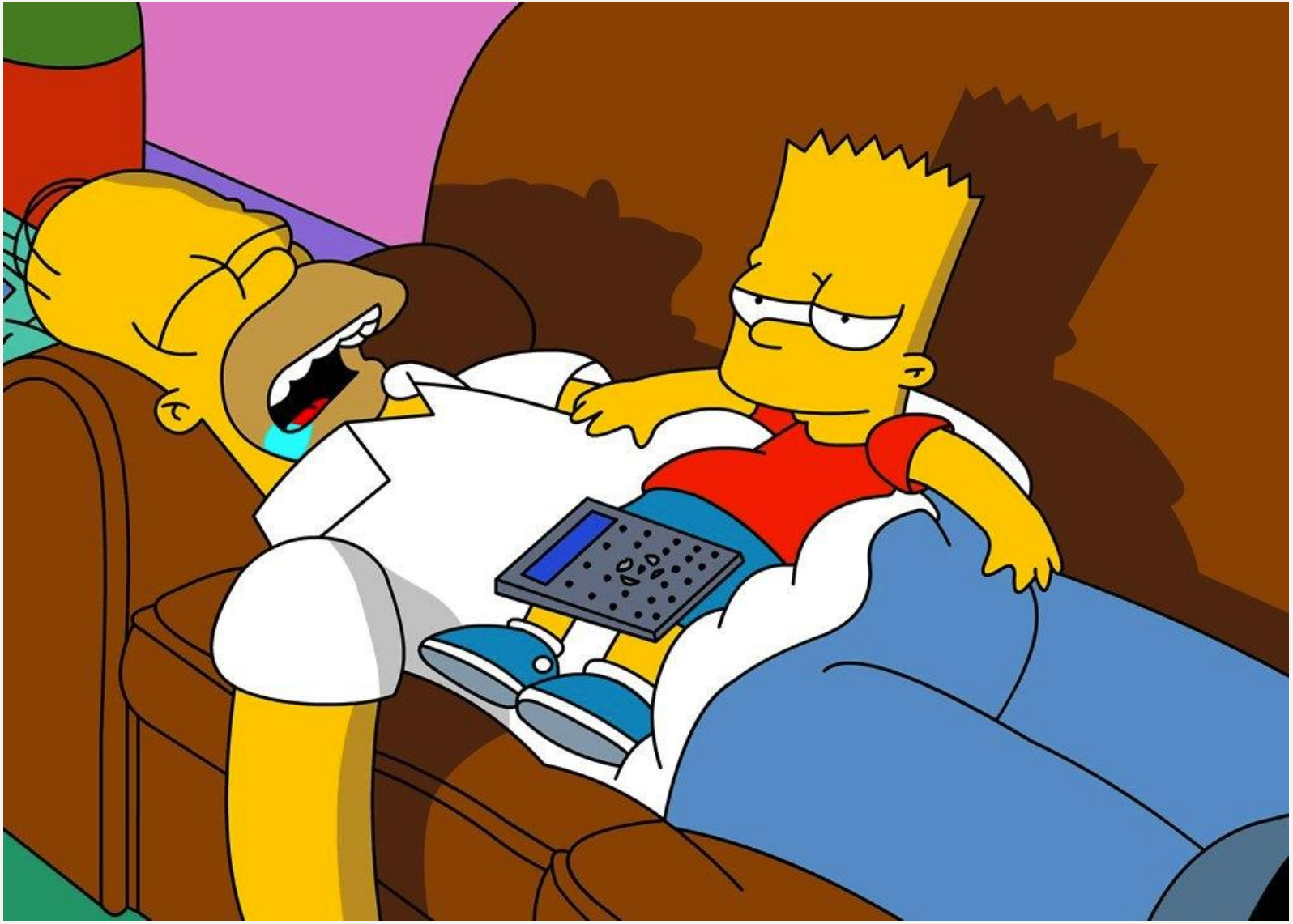
Association for International Agriculture and Rural Development (AIARD)
54th Annual Conference and 2018 Future Leaders Forum

For those suffering from caffeine deficiency….



… some takeaway messages

Agriculture can do a lot to solve malnutrition, for 2 sets of reasons

Poverty & undernutrition still remain predominantly rural problems

1. Many of the world's undernourished live in rural areas
2. Those rural poor would benefit from ag productivity gains
3. They would benefit from improved access to basic services, improved hygiene (rural services, ag & health extension)

"Agriculture" can improve diets for rural *and* urban populations

1. Nutritious foods very expensive in poor countries (relative prices)
2. The high cost of nutritious food constraints dietary diversity, even among infants/young children
3. Food policies can alter those relative food prices

Background

- **Agriculture and nutrition in development have largely evolved independently, and only recently become more integrated**
- **Worth reflecting on the evolution of these two fields, and asking what the current state of knowledge is**

A short history of agriculture & development

1950s: rapid population growth: specter of Malthus!

1960s: raising yields of staple cereals: **Green Revolution**

1974: 1st global food crisis & formalization of CGIAR

1970s-present: Promoting Green Revolution in Africa

1980s-present: Food system diversification in Asia, LAC

2008: 2nd global food crisis & improved agricultural funding

2008-now: tradition income focus augmented by nutrition

Income-nutrition tradeoffs?

CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health

A short history of nutrition & development

1950s: Protein-malnutrition (*Kwashiorkor*) main concern

1955: Protein Advisory Group

1950-1974: Protein-rich foods

1968: *Protein Crisis* report

1974: "Great Protein Fiasco" protein deficiency oversold

1975: Micronutrient councils

1977: Protein group dissolved

1990s: Micronutrient scale-up

2000s: Revisionism & debate: supplements, biofortification, diets (role of protein & ASFs)?

THE LANCET

Volume 304, Issue 7872, 13 July 1974, Pages 93-96

Dogma Disputed

THE GREAT PROTEIN FIASCO

Donald S. Mclaren

The Rise and Fall of Protein Malnutrition in Global Health

Richard D. Semba

Wilmer Eye Institute, Johns Hopkins University School of Medicine, Baltimore, Md., USA

Advancing Research on Nutrition and Agriculture (ARENA) Project

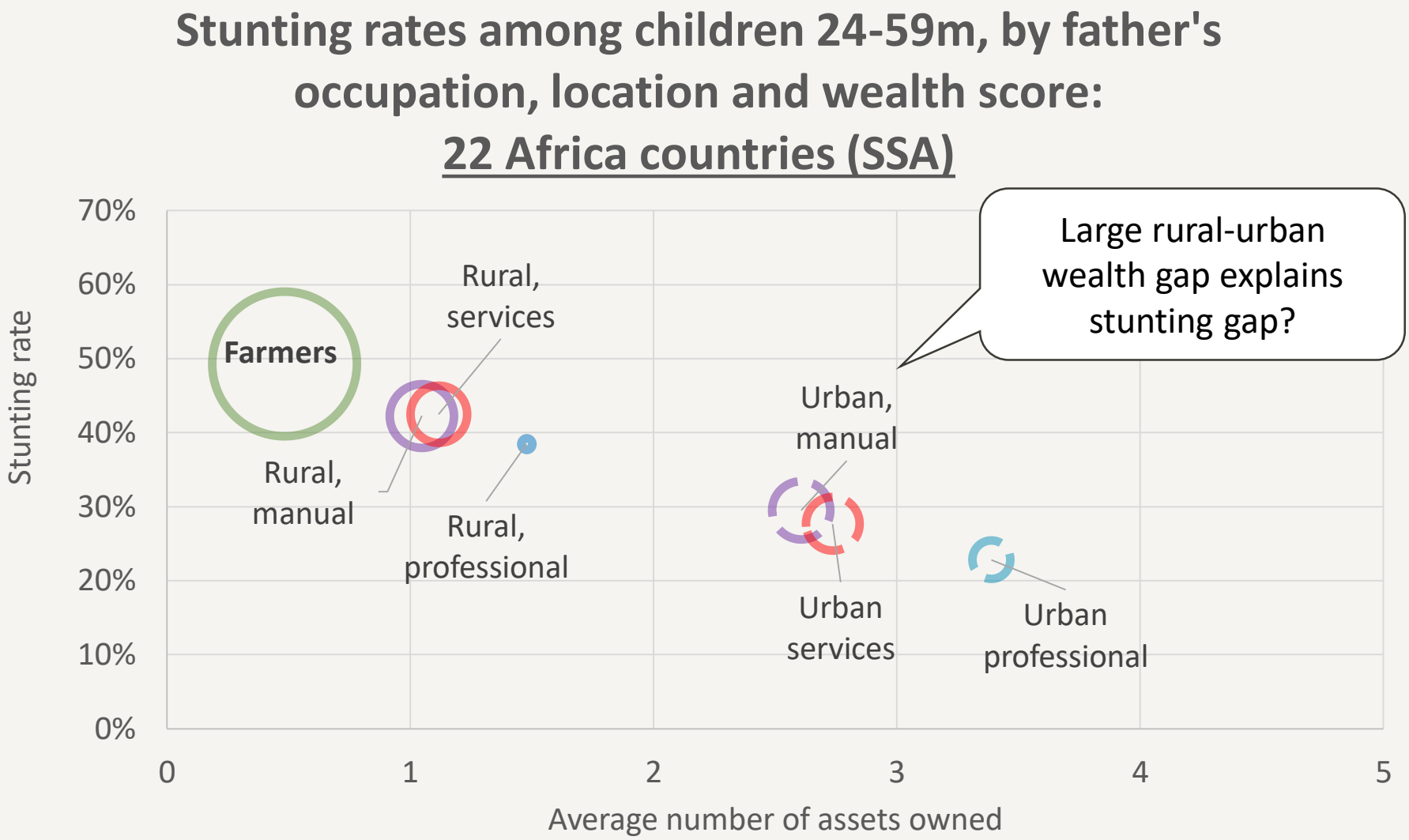
Geography: Global; South Asia & Africa; Ethiopia & Bangladesh

Demographic Health Surveys + GIS data	Economic & Agricultural Surveys	Consumer Price Surveys	Economywide Simulation Models
• DHS linked to data on agriculture, infrastructure, agroecology, climate, etc • 60 countries, most SSA & SAS • Anthropometric data >1m kids • Data on diets for 300K children aged 6-23 months	• IFPRI Feed-the-Future surveys in Ethiopia & BGD • LSMS-ISA • Detailed agric. production & marketing data • Special livestock & nutrition modules	• ICP price data for 180 countries, 2005, 2011 • ICP price data for 30 countries from 1970-2011 • Consumer price survey, Ethiopia: monthly data for 120 markets, 2001-2016	• CGE models link households to macroeconomy • Ex ante & ex post assessments of food policies • Allows spillovers of investments on prices, wages, etc • Cost-benefit analysis • Distributional implications

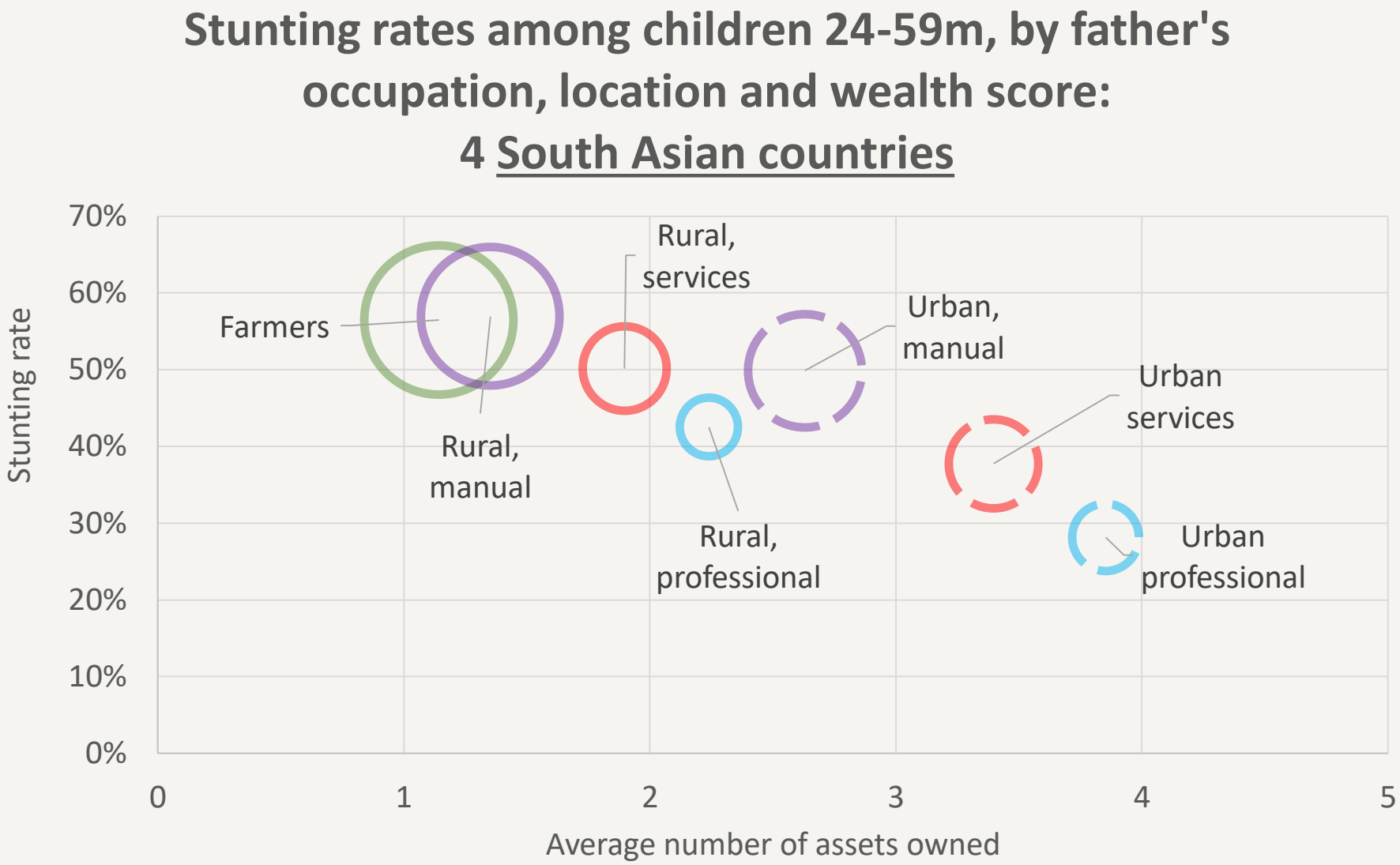
Scientific publications: American J. of Ag Econ., J. of Nutrition, Agricultural Systems, Econ. & Human Biology, Agricultural Economics, World Development, Global Food Security, etc

The problem of rural malnutrition

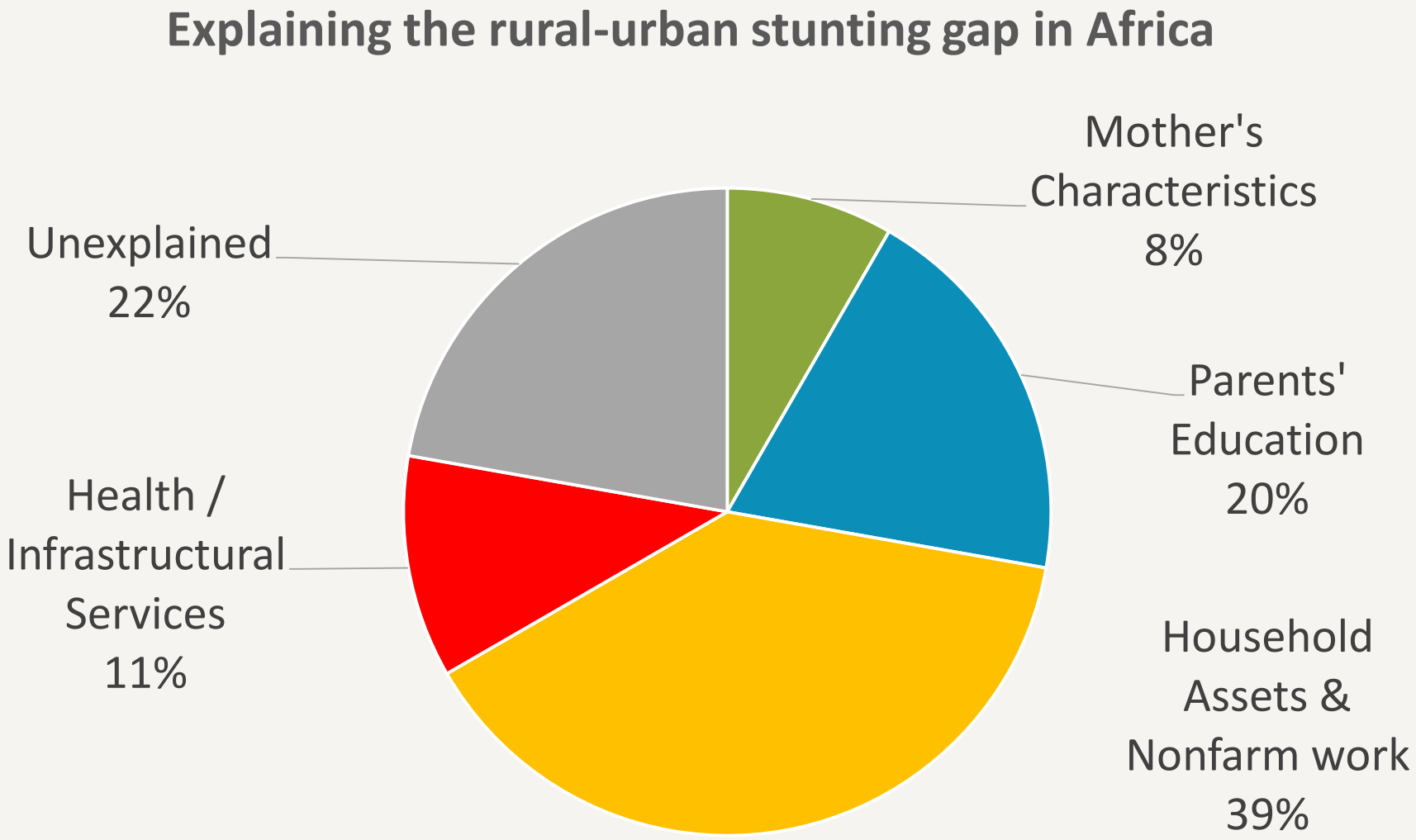
Stunting rates by livelihood: Africa



Stunting rates by livelihood: Asia



Why are rural children so much worse off?



Reducing the harm of agricultural livelihoods

- Agricultural households face other disadvantages from living and working on farms:
  - *strenuous labor, exposure to chemicals, poor WASH conditions*
- In ARENA, we focused on animal WASH issues
- SHINE project: young children found consuming dirt & chicken feces
- Impacts on diarrhea & environmental enteropathy (gut damage) and also respiratory infections (Avian flu, sub-clinical infections)?

Major concern: poultry are the most widely owned livestock!

	Rural	Urban	Total
Sub-Saharan Africa (27)	52.6	20.0	41.6
South Asia (5)	27.1	7.0	20.8
Other LDC (14)	46.3	9.6	28.8
All 46 countries	35.0	10.7	26.9

Reducing the harm of agricultural livelihoods

In rural Ethiopia, livestock ownership is almost universal (93%), and 45% keep at least 1 animal in the main house overnight

Livestock type	Owns Livestock (% of households)	Corralling animals in the main house overnight (% owners) [a]
Poultry	48%	48%
Cattle	58%	23%
Goats, sheep	52%	31%
Pack animals	42%	18%

Animal feces observed in 40% of compounds in 3 countries

	Bangladesh	Ethiopia	Vietnam
Animal feces in compound (%)	41%	38%	42%
Human feces in compound (%)	5%	16%	1%
No toilet[3] (%)	4%	16%	5%

Reducing the harm of agricultural livelihoods

In Ethiopia owning poultry predicts greater child growth (HAZ), but only if poultry are kept out of the house (away from children)

	Simple test: owning poultry	Adding "Poultry in house"
Owns poultry	0.168**	0.291***
Poultry in house		-0.250**

Observed animal feces in compound negatively associated with child growth (HAZ) in Bangladesh & Ethiopia, but not Vietnam

	Bangladesh	Ethiopia	Vietnam	Pooled
Animal feces	-0.13*	-0.22*	0.03	-0.11**

Do Green Revolutions improve nutrition?

- Given how much the poor depend on agriculture, growth in agricultural productivity should improve nutrition via income gains
- More income means more expenditure on nutritional goods
- Intuitive, but no previous evidence from the Green Revolution
- We looked at Bangladesh 1996-2011: a late Green Revolution
- Rice yields grew by **70% over 1996-2011**
- Synthetic district panel: mix nutrition & agricultural surveys
- Allows us to do difference-in-difference regressions:
  - net out time-invariant confounding factors (e.g. ecology)
- Test whether changes in rice yields predict changes in nutrition
- Simple statistical approach, but very novel in the literature

Cereal yields and child nutrition

Growth in rice yields in Bangladeshi districts has significant associations with weight gain, but not with linear growth

	1	2	3	4	5	6
	HAZ score	Moderate stunting (HAZ<-2)	Severe stunting (HAZ<-3)	WHZ score	Mild wasting (WHZ<-1)	Moderate wasting (WHZ<-2)
Rice yields	-0.14	0.18	-0.05	0.79**	-0.23*	-0.15
	(0.34)	(0.16)	(0.10)	(0.30)	(0.12)	(0.14)
Age control	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.42	0.35	0.41	0.28	0.33	0.41
Sample size	109	109	109	109	109	109

Cereal yields and child nutrition

Growth in rice yields has significant associations with timely introduction of complementary foods, but not diet diversity

	1	2	3
	Complementary foods (%)	Minimum dietary diversity (%)	Dairy consumption (%)
Rice yields	0.47*	-0.04	-0.17
	(0.25)	(0.13)	(0.17)
Child age con			
Time varying			
Time effects			
Fixed effects	Yes		
R-squared	0.87	0.88	0.44
Sample size	109	89	109

Growth in yields may have led to earlier introduction of solid foods (mainly rice); May explain weight gain

Dietary diversity & dairy consumption were associated with stunting, but growth in rice yields did not directly improve dietary diversity

Agriculture's impacts on diets (rural/urban)

- Young children have high calorie requirements, but also need a wide range of micronutrients
- Protein quality hypothesis: animal sourced foods provide essential amino acids not easily obtained from vegetal foods (MN-rich too)
- Infants and young children need especially nutrient-dense foods because of small stomachs

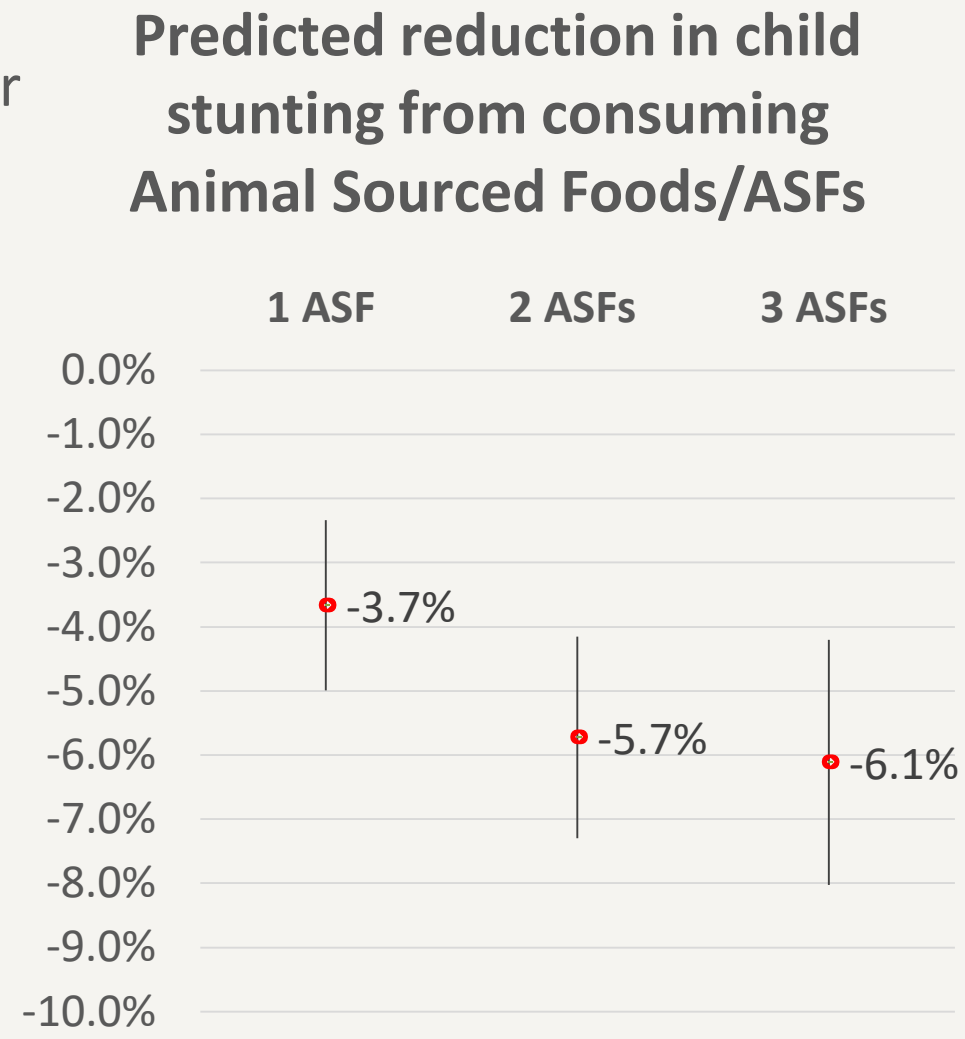
Dietary patterns in developing countries

T1. What did 130,432 young children in 49 countries eat yesterday?

	Latin America & Caribbean	N. Africa & West Asia	Asia (south, central, SE)	Africa, West & Central	Africa, South & Eastern
Fortified cereals	8.8%	9.4%	14.5%	6.8%	8.4%
Cereals, roots, tubers	89.8%	78.8%	76.8%	72.2%	71.3%
Legumes/nuts	46.3%	24.1%	16.9%	20.5%	24.1%
Vit A-rich fruit/veg	55.1%	28.5%	41.0%	40.9%	53.6%
Dark green fruit/veg	18.8%	15.4%	28.6%	30.9%	43.0%
Other fruit & veg	51.4%	34.8%	24.6%	18.1%	20.0%
Dairy	57.5%	64.9%	38.4%	20.8%	18.7%
Eggs	47.3%	30.9%	15.8%	12.2%	13.0%
Meat/fish	56.3%	30.9%	23.2%	39.7%	33.6%
White/red meat*	53.1%	24.1%	13.6%	15.5%	17.1%
Fish*	NA	8.0%	12.8%	31.5%	21.1%

Animal sourced foods (ASFs) & stunting

- ASFs rich in high quality protein, micronutrients & other growth-inducing nutrients
- Different ASFs have different nutrient profiles, suggesting they may be complements
- e.g. milk rich in calcium, b12, but has no iron
- Controlling for lots of things, we see large impacts of consuming 2+ ASFs daily
- Not shown: fruit consumption also a robust predictor of stunting reduction (~2%)



Why are diets so poor in poor countries?

- Economists: Poor people are poor! Raise incomes! (agriculture?)
- Nutritionists: Nutritional knowledge is poor!
- Could **high relative food prices** present an additional constraint?
- Do relative prices dictate specific pathways of diet diversification?
- Are some foods more/less expensive in low income countries?
- To capture this we come up with a novel measure of relative prices:
  - *Ratio of 1 calorie of a given food (e.g. eggs) to 1 calorie of cheapest cereal*
- Motivations for staple cereal calories as a basis of comparison:
  - *Poor people care about calories: hunger is a strong motivator*
  - *Cereals are a universally important calorie-dense staple*
  - *Cereals are tradable, so prices influenced by international productivity*

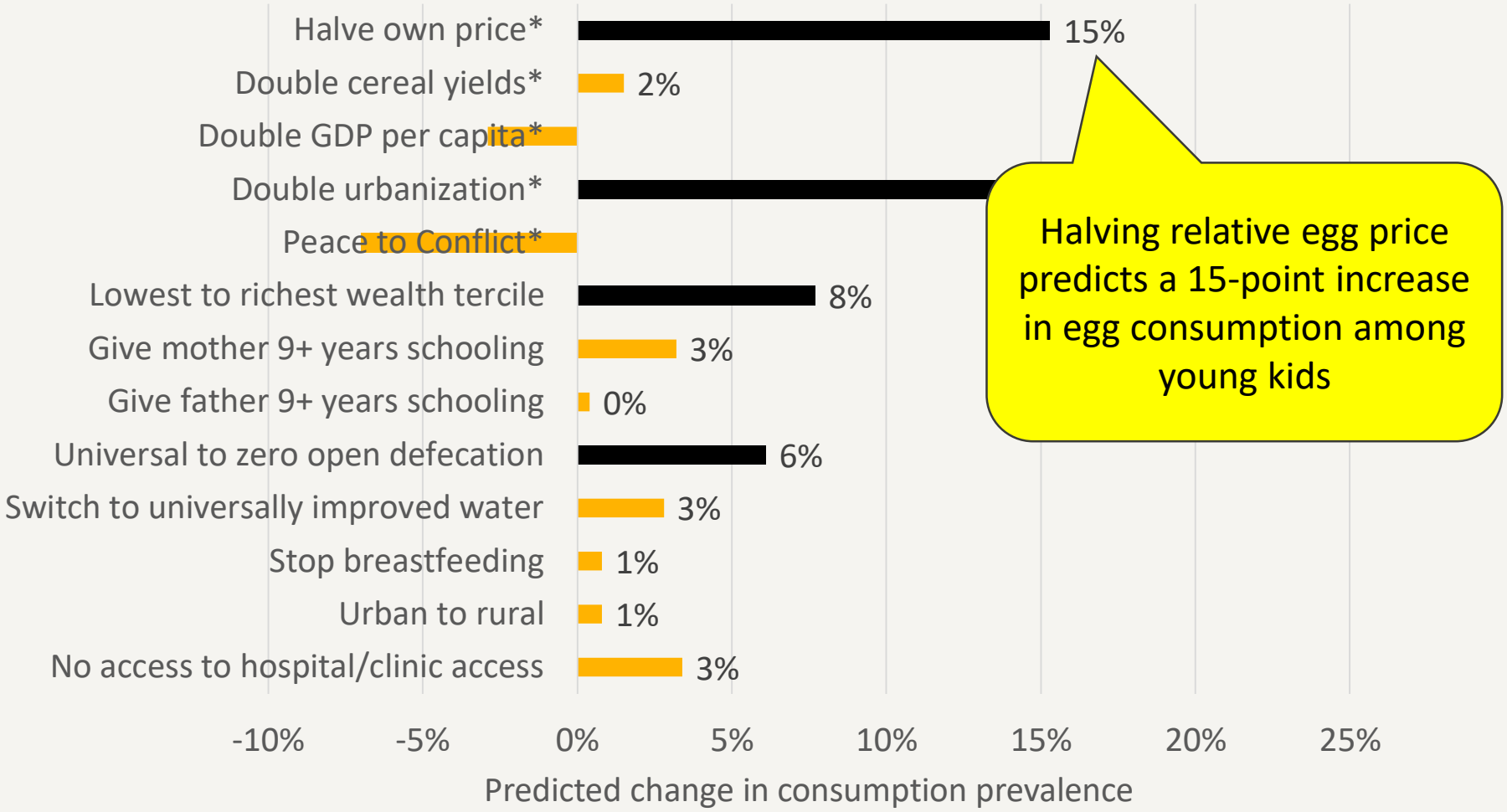
High prices constrain dietary diversification

Table 3. 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

Fig 1. Predictors of 24-hr recall egg consumption among kids 6-23m

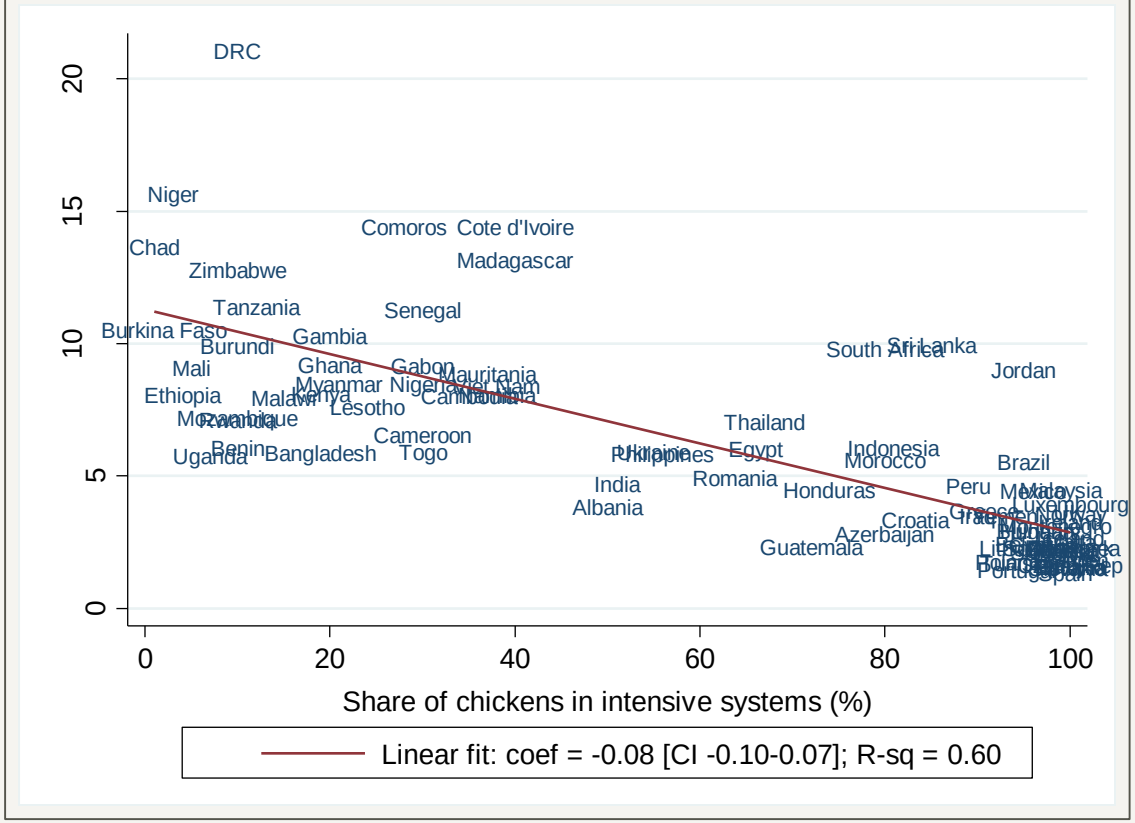


Constraints to dietary diversification

- 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

F1. Egg prices & share of chickens in intensive systems



Research & Policy Implications: Major findings

Agriculture must play a critical role in solving rural malnutrition

1. Many of the world's undernourished live in rural areas
2. Those rural poor would benefit from ag productivity gains
3. They would benefit from improved access to basic services
4. Benefit from more concerted efforts to reduce the hazards of agricultural living: chemical input exposure, strenuous labor, animal WASH

Agricultural and food policies can play a critical role in driving down the prices of nutrient-rich foods:

- Many current ag-nutrition projects too small & too local
- Biofortification
- Commercialization essential to increase productivity in perishables
- Trade policies important: Import chickens but produce eggs yourself
- Learn from diversification success stories: e.g. milk in Asia

- Thank you

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