Nationally representative estimates of the cost of adequate diets, nutrient level drivers, and policy options for households in rural Malawi

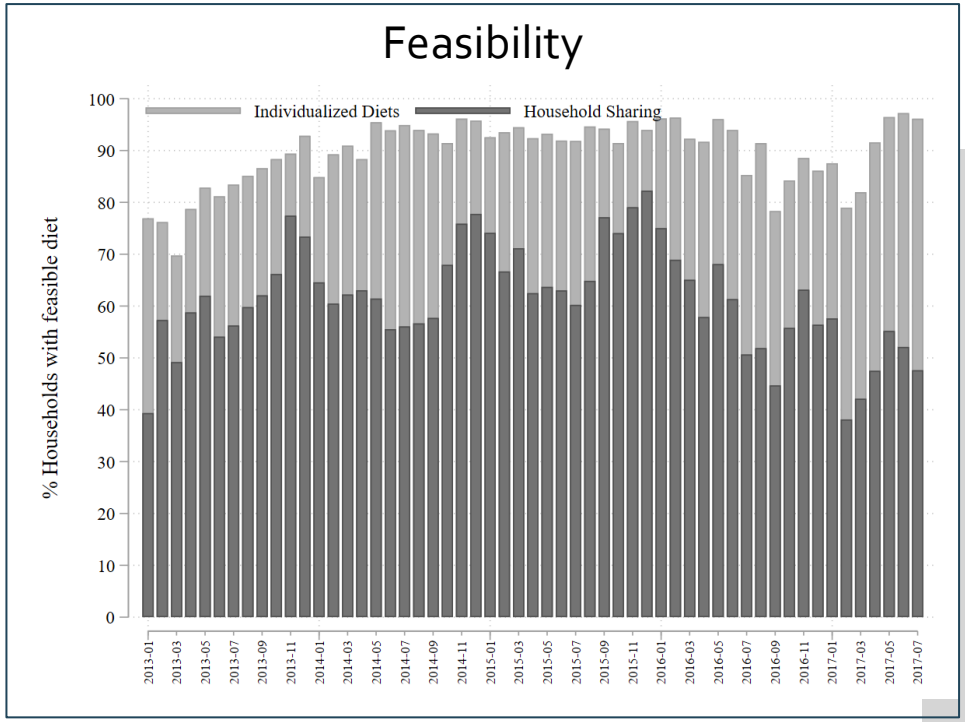
Kate Schneider, PhD MPA

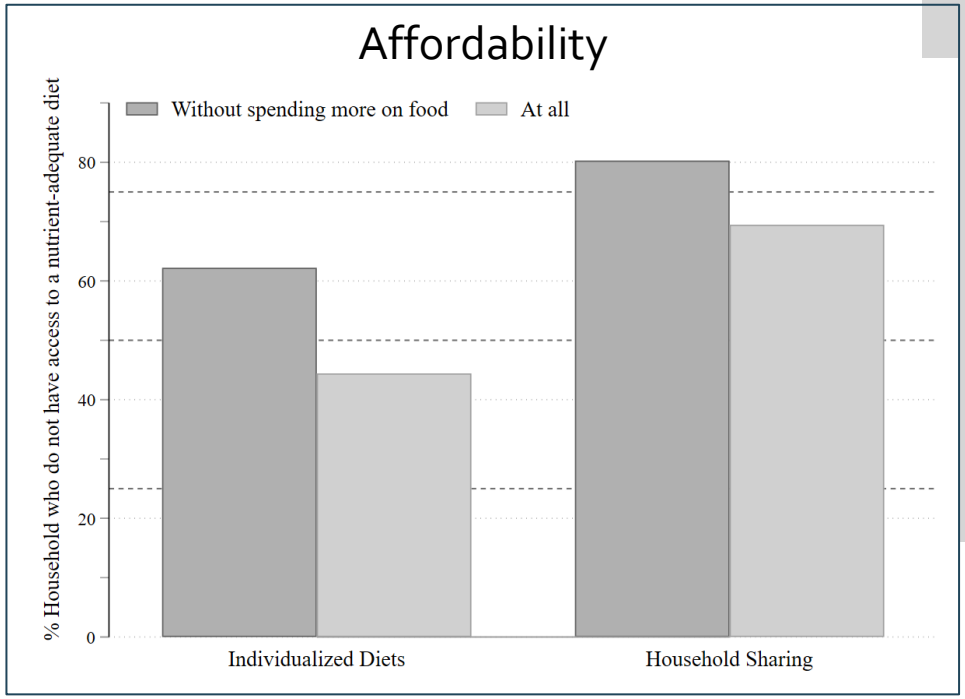
Fellow, School of Advanced International Studies

Johns Hopkins University

Background

- Least-cost diets measure how well a food system provides access to nutritious diets for all (Masters et al 2018, Bai et al 2020, FAO 2020, Herforth et al 2020, Ragunathan et al 2020).
- Most analyses rely on the cost for a woman of reproductive age; where families share meals a household-level metric complements individual measures.
- Meeting the needs for a whole household requires a very nutrient-dense diet, that was found to be more expensive and less feasible than diets meeting only individual needs for all types of persons.



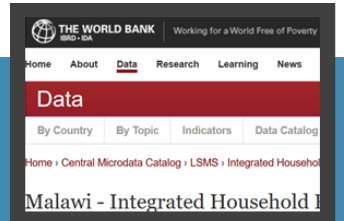


Research questions

1. What drives the high cost and infeasibility of nutritious shared diets for whole households?

2. What policy options could improve availability and affordability?

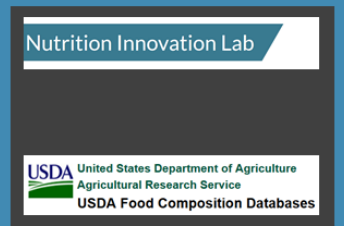
- Nutrient shadow prices reveal the cost of nutrients, arguably underused in human nutrition (Håkansson, 2015).
- Analysis of feasibility by household size and composition.
- Policy scenarios can identify which actions throughout the food system would be most effective to increase access to nutrient adequate diets (Global Panel, 2020).



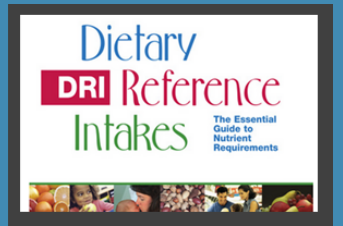
Integrated Household Panel Survey
Malawi NSO & World Bank (2010, 2013, 2016/17)

CPI Market Price Data
Malawi NSO (Jan 2013 – July 2017)

Data



Malawi FCT
SAMRC, LUANAR, Nutrition Innovation Lab



Dietary Reference Intakes
Institute of Medicine, US & Canada

Methodologies

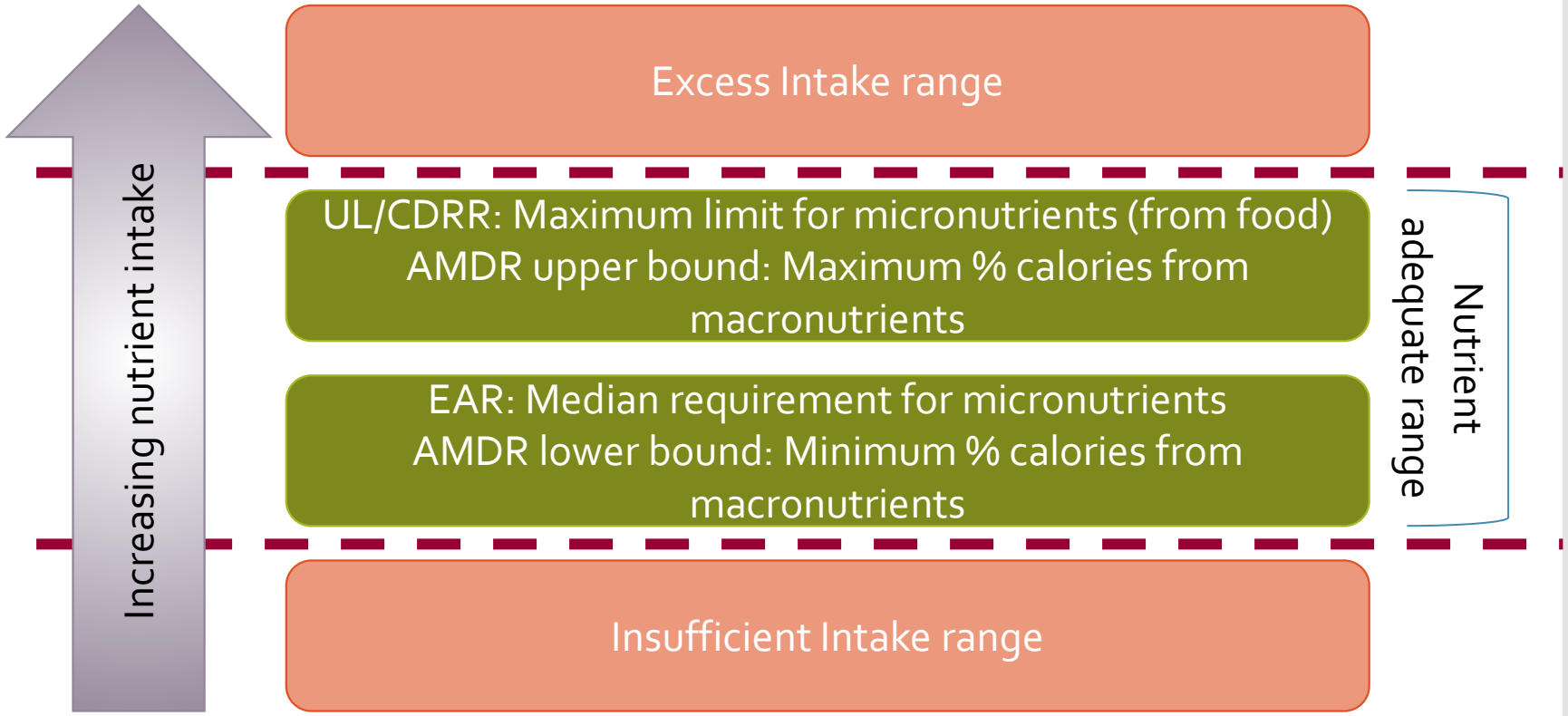
- Least-cost diets meeting shared household nutrient needs
- Nutrient shadow prices
- Policy scenario modeling

Policy Scenarios

1. Lower price of eggs (10, 15, and 20%).
2. Increased availability of dried fish.
3. Increased availability and lower price of groundnuts (10%).
4. Lower price of fresh milk (10%).
5. Increased availability of powdered milk.
6. Soil biofortification (for maize).

Individual Nutrient Requirements

Dietary Reference Intakes (DRIs) define an adequate diet



Nutrients included: Energy, Carbohydrates, Protein, Lipids, Vit A (Retinol UL), Vit C, Vit E, Thiamin, Riboflavin, Niacin, B6, Folate, B12, Calcium, Copper, Iron, Magnesium, Phosphorus, Selenium, Zinc

Household Nutrient Requirements

Nutrient density satisfies neediest member.

$$HHLower_{hj} = \sum_m E_m * max_m\{MinimumNeed_{j,m}/E_m\}, j = 1, \dots, 19$$

$$HHUpper_{hj} = \sum_m E_m * min_m\{MaximumTolerance_{j,m}/E_m\}, j = 1, \dots, 13$$

$$HHE_h = \sum_m E_m$$

h = household
m = household member
j = density of each nutrient
e/E = energy

Least-cost diets

Food items and quantities that meet nutrient requirements at lowest total cost:

$$CoNA: minimize\ C = \sum_i p_i * q_i$$

Subject to:

$$\sum_i a_{ij} * q_i \geq Lower_j\,, \quad j = 1, \ldots, 19$$

$$\sum_i a_{ij} * q_i \leq Upper_j, \quad j = 1, \ldots, 13$$

$$\sum_i a_{ie} * q_i = E$$

$$q_1 \geq 0, q_2 \geq 0, \ldots\ q_i \geq 0, \text{for all foods } i = 1, \ldots 51$$

e/E = energy
p_i = food price for item *i*
q_i = food quantity for item *i*
a_{ij} = nutrient contents

Riboflavin and B12 largely drive the diet cost.

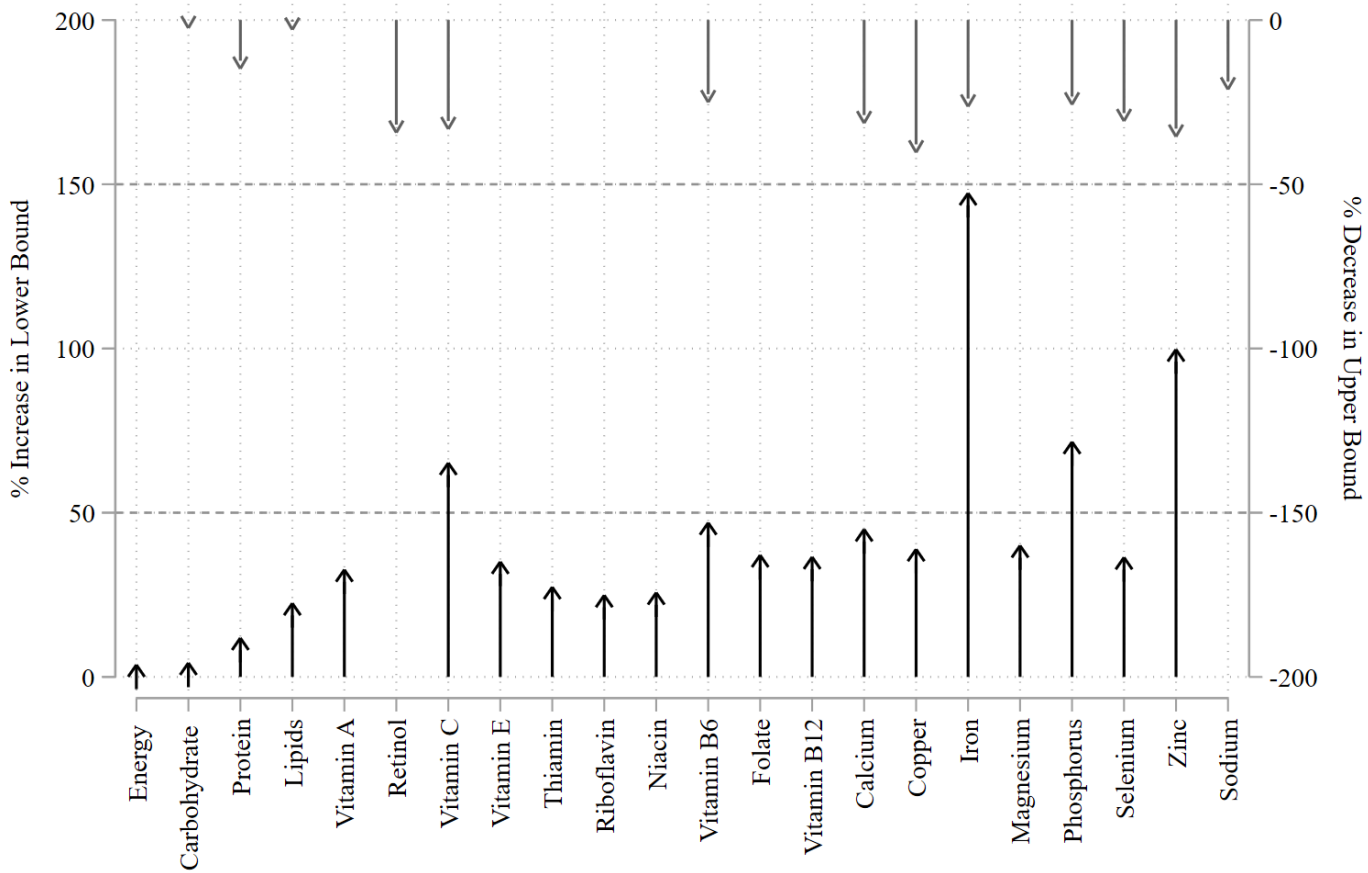
Cost rises $2.57 per household per day for a 1% increase in riboflavin need.

Diet cost, feasibility, and nutrient semi-elasticities

	Mean	(SE)
Household cost per day (2011 US$)	10.06	(0.28)
Per 1,000 kcal	1.21	(0.01)
Per person	2.32	(0.03)
Diet Feasible (% HH-Months)	59.37	(1.58)
Semi-elasticities – Lower Bound*		
Riboflavin	2.57	(0.19)
Niacin	0.01	(0.00)
Vitamin B12	0.14	(0.01)
Selenium	0.01	(0.00)
Semi-Elasticities – Upper Bound*		
Copper	-0.24	(0.01)
Iron	-0.01	(0.00)
Zinc	-0.01	(0.00)

Household sharing increases nutrient requirement lower bounds and decreases upper bounds (maximum tolerance) in terms of nutrient density.

Percent Difference in Nutrient Bounds from Individual Diets to Household Sharing



How does household composition drive feasibility or cost?

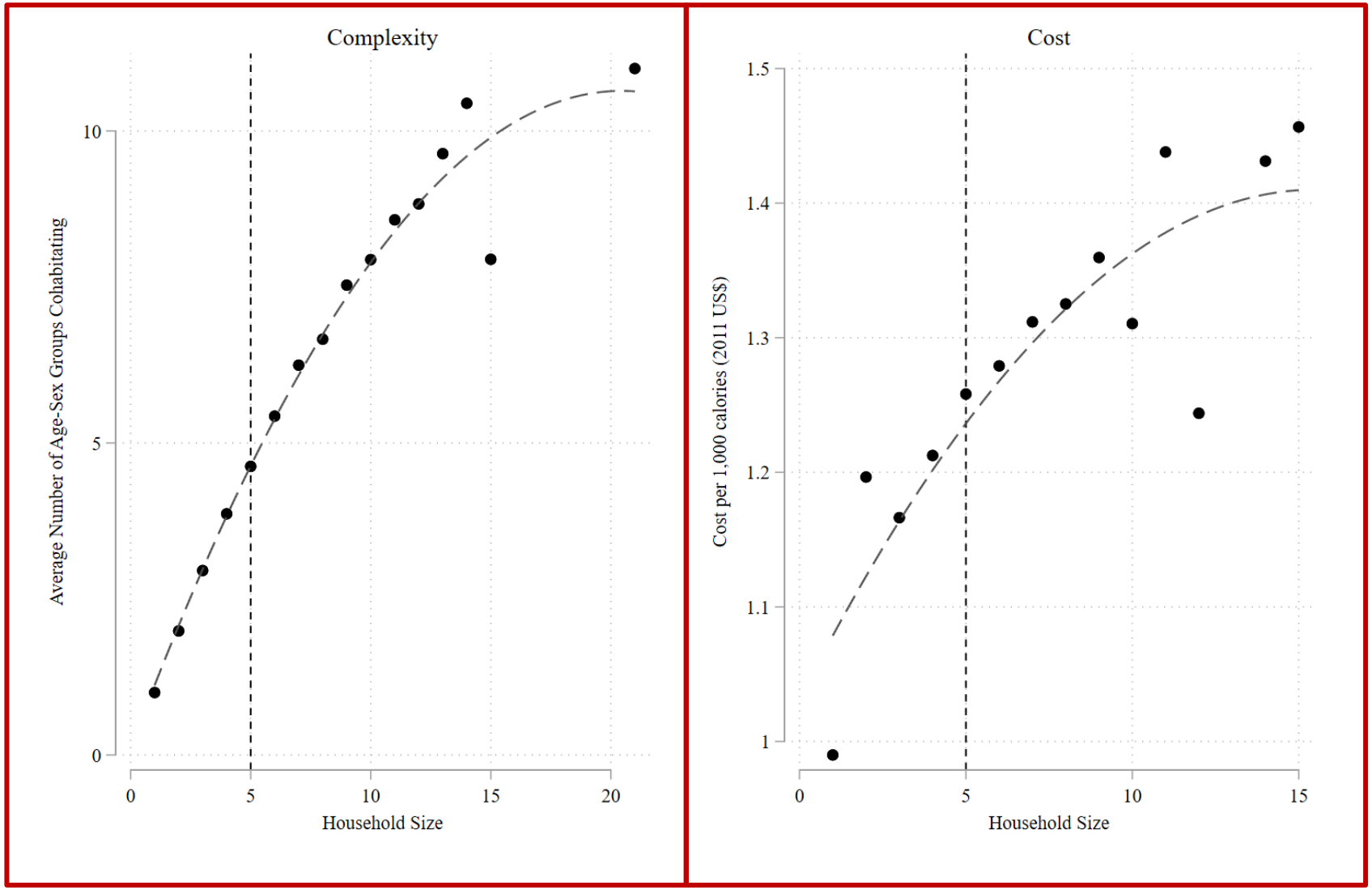
Household composition, diet feasibility, and diet cost

	Households (%)	Feasibility (%)		Cost per 1,000 kcal (2011 US$)	
		Mean	(SE)	Mean	(SE)
Most common compositions					
Older child(ren), adolescent(s), male and female adults	15.6	38.67	(2.78)	1.32	(0.02)
Older child(ren), male and female adults	12.0	69.93	(2.61)	1.28	(0.02)
Young child(ren), older kid(s), male and female adults	8.7	82.02	(2.36)	1.19	(0.02)
Young child(ren), older child(ren), male and breastfeeding female adults	7.0	55.04	(2.65)	1.31	(0.02)
Young child(ren), older child(ren), adolescent(s), male and female adults	5.8	61.58	(2.10)	1.28	(0.02)
Total	49.4	58.99	(1.85)	1.27	(0.01)

Notes: Population statistics corrected using sampling weights. Composition types sorted by frequency observed. Definition of age groups aggregates the age groups in the DRIs as follows: Young children = 3 and below, Older children = 4-13, Adolescent = 14-18, Adult = 19-69, Older adult = 70 and above. All prices expressed in 2011 US Purchasing Power Parity (PPP) dollars.

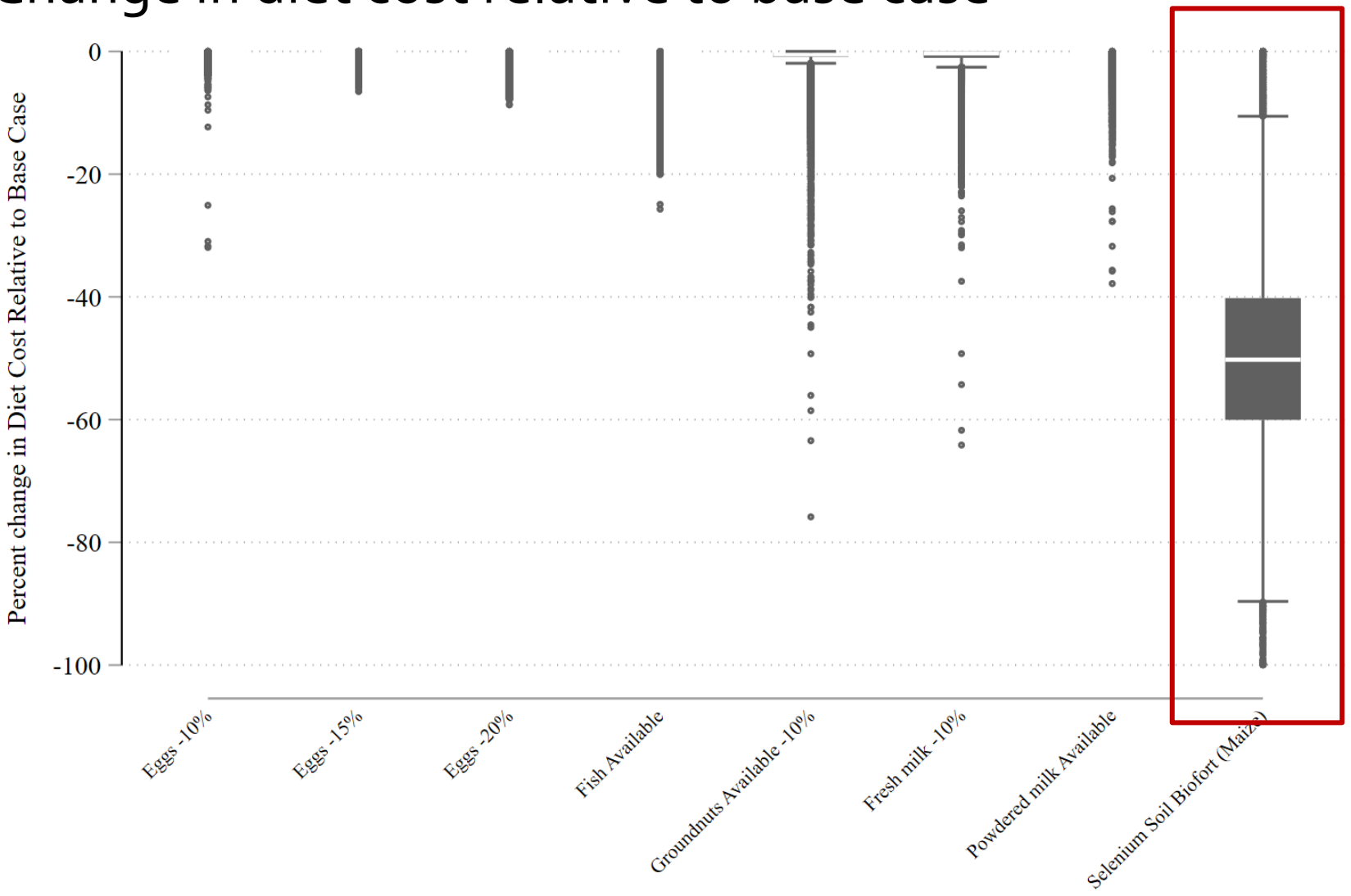
How does household composition drive feasibility or cost?

Household size, composition, and cost per 1,000 calories



Selenium biofortification is a promising option

Change in diet cost relative to base case



Selenium biofortification is a promising option

Impact on cost, feasibility, and nutrient shadow prices.

	Base case		Soil fortification	
	Mean	SE	Mean	SE
Household cost/day (2011 US$)	10.06	(0.28)	5.91	(0.18)
Per person	2.32	(0.03)	1.22	(0.02)
Diet Feasible (% HH-Months)	59.37	(1.58)	94.94	(0.52)
Semi-Elasticities – Lower Bound*				
Riboflavin	2.57	(0.19)	2.62	(0.17)
Niacin	0.01	(0.00)	0.00	(0.00)
Vitamin B12	0.14	(0.01)	0.10	(0.01)
Selenium	0.01	(0.00)	0.00	(0.00)
Semi-Elasticities – Upper Bound*				
Copper	-0.24	(0.01)	-0.01	(0.00)
Iron	-0.01	(0.00)	-0.00	(0.00)
Zinc	-0.01	(0.00)	-0.01	(0.00)

All prices expressed in 2011 US Purchasing Power Parity (PPP) dollars.

Conclusions

- Riboflavin is by far the costliest nutrient to obtain in rural Malawi's food system, followed by B12.
- The feasibility of an adequate diet varies more by household composition than the cost of the diet if it is available.
- As household size increases, the cost per 1,000 of an adequate shared diet also rises, largely irrespective of composition.
- Selenium is the nutrient hindering the feasibility of adequate diets.
- Selenium biofortification of maize would reduce the diet cost by half and result in near universal feasibility of an adequate diet.