

Dietary gap assessment for animal source foods

Reina Engle-Stone, PhD

Assistant Professor, Department of Nutrition

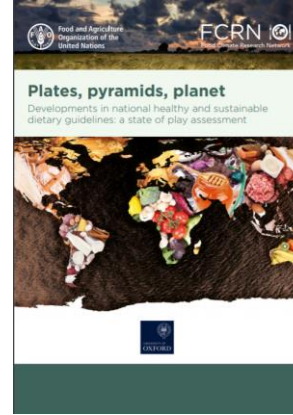
Program in International and Community Nutrition

University of California, Davis

Outline

- Approaches for assessing dietary gaps
 - Reference “healthy diet” (*where do we want to be?*)
 - Data sources for current diets (*where are we now?*)
- What are the gaps in national food supply?
 - Cameroon case study: adapted DASH diet
 - EAT-Lancet reference diet vs food supply
 - Relationship between ASF and micronutrient adequacy of the food supply
- Gaps in ASF intake among individuals

What is a healthy diet?



Examples of visual food guides from different countries.

- What is 'optimal health', and for whom?
 - Ex. promoting infant development vs preventing chronic disease among adults
- Food-Based Dietary Guidelines share common themes (Herforth et al., 2019)
 - Emphasis on variety
 - Proportionality (consume some foods more than others)
 - Consume fruits, vegetables, legumes, animal-source foods
 - Restrict sugar, fat, and salt
- But, translating these to specific quantities of foods is challenging!

Benin - Traditional round house



China - Food pagoda



Japan - Spinning top



Honduras - pot



South Africa



Ireland - Pyramid



What are current diets?

Data sources -

- National food availability
 - Food Balance Sheets
 - Impact model
- Household survey data
 - HCES/LSMS
- Individual dietary intake data
 - Dietary intake surveys
 - DHS/MICS (dietary diversity indicators)



Dietary gap assessment: Cameroon case study

Public Health Nutrition: 20(13), 2277–2288

doi:10.1017/S1368980017001173

Dietary gap assessment: an approach for evaluating whether a country's food supply can support healthy diets at the population level

Edye M Kuyper¹, Reina Engle-Stone², Joanne E Arsenault², Mary Arimond², Katherine P Adams² and Kathryn G Dewey^{2,*}

¹University of California, Davis, College of Agricultural and Environmental Sciences, International Programs Office, Davis, CA, USA: ²University of California, Davis, Program in International and Community Nutrition, 3253 Meyer Hall, One Shields Avenue, Davis, CA 95616, USA

Objective: What are the 'gaps' between current food supply and that needed to provide healthy diets for the whole population?

Dietary Gap Assessment approach



- 1) Construct a hypothetical 'healthy' reference diet for Cameroon
 - 1) Adapted DASH diet
 - 2) Expressed as kcal/capita/d consumed from each of 7 food groups (2100 kcal/d)
 - 3) Foods groups populated with specific foods based on dietary intake data

- 2) Calculate available supply of each food group (as kcal/capita/d) from FAO Food Balance Sheets
 - 1) Access food availability data from FAO
 - 2) Combine commodity items into DASH food groups

- 3) Calculate gaps by comparing food group availability with hypothetical reference diet

Hypothetical reference diet: “Cameroon DASH”

DASH: Dietary Approach to Stop Hypertension (developed in 1990s)

- Emphasizes low sodium intake, increased consumption of fruits, vegetables and wholegrain cereals, and balanced intake of lean meats, poultry, fish, eggs and low-fat dairy products
- Rigorous evaluation demonstrated significant reductions in blood pressure, particularly among study participants with hypertension (Harsha et al, 1999)
- Chose to express intake from each food group as kcal/capita/d for appropriate comparison with FBS data (based on edible portion)

Following the DASH Eating Plan

Use this chart to help you plan your menus—or take it with you when you go to the store.

Food Group	Servings Per Day			Serving Sizes	Examples and Notes	Significance of Each Food Group to the DASH Eating Plan
	1,600 Calories	2,000 Calories	2,600 Calories			
Grains*	6	6–8	10–11	1 slice bread 1 oz dry cereal† ½ cup cooked rice, pasta, or cereal	Whole wheat bread and rolls, whole wheat pasta, English muffin, pita bread, bagel, cereals, grits, oatmeal, brown rice, unsalted pretzels and popcorn	Major sources of energy and fiber
Vegetables	3–4	4–5	5–6	1 cup raw leafy vegetable ½ cup cut-up raw or cooked vegetable ½ cup vegetable juice	Broccoli, carrots, collards, green beans, green peas, kale, lima beans, potatoes, spinach, squash, sweet potatoes, tomatoes	Rich sources of potassium, magnesium, and fiber
Fruits	4	4–5	5–6	1 medium fruit ¼ cup dried fruit ½ cup fresh, frozen, or canned fruit ½ cup fruit juice	Apples, apricots, bananas, dates, grapes, oranges, grapefruit, grapefruit juice, mangoes, melons, peaches, pineapples, raisins, strawberries, tangerines	Important sources of potassium, magnesium, and fiber
Fat-free or low-fat milk and milk products	2–3	2–3	3	1 cup milk or yogurt 1½ oz cheese	Fat-free (skim) or low-fat (1%) milk or buttermilk; fat-free, low-fat, or reduced-fat cheese; fat-free or low-fat regular or frozen yogurt	Major sources of calcium and protein
Lean meats, poultry, and fish	3–6	6 or less	6	1 oz cooked meats, poultry, or fish 1 egg‡	Select only lean; trim away visible fats; broil, roast, or poach; remove skin from poultry	Rich sources of protein and magnesium
Nuts, seeds, and legumes	3 per week	4–5 per week	1	⅓ cup or 1½ oz nuts 2 Tbsp peanut butter 2 Tbsp or ½ oz seeds ½ cup cooked legumes (dry beans and peas)	Almonds, hazelnuts, mixed nuts, peanuts, walnuts, sunflower seeds, peanut butter, kidney beans, lentils, split peas	Rich sources of energy, magnesium, protein, and fiber
Fats and oils§	2	2–3	3	1 tsp soft margarine 1 tsp vegetable oil 1 Tbsp mayonnaise 2 Tbsp salad dressing	Soft margarine, vegetable oil (such as canola, corn, olive, or safflower), low-fat mayonnaise, light salad dressing	The DASH study had 27 percent of calories as fat, including fat in or added to foods
Sweets and added sugars	0	5 or less per week	≤ 2	1 Tbsp sugar 1 Tbsp jelly or jam ½ cup sorbet, gelatin 1 cup lemonade	Fruit-flavored gelatin, fruit punch, hard candy, jelly, maple syrup, sorbet and ices, sugar	Sweets should be low in fat

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Vegetables	3-4	4-5	5-6	1 cup raw leafy vegetable ½ cup cut-up raw or cooked vegetable ½ cup vegetable juice	Broccoli, carrots, collards, green beans, green peas, kale, lima beans, potatoes, spinach, squash, sweet potatoes, tomatoes	Rich sources of potassium, magnesium, and fiber
Fruits	4	4-5	5-6	1 medium fruit	Apples, apricots,	Important sources of

Servings per day

Serving size

1,600 kcal

2,000 kcal

2,600 kcal

Fat-free or low-fat milk and milk products

2-3

2-3

3

1 cup milk or yogurt
1.5 oz cheese

Lean meats, poultry, and fish

3-6

6 or less

6

1 oz cooked meats
1 egg

				1 Tbsp vegetable oil 1 Tbsp mayonnaise 2 Tbsp salad dressing	Oil, or alternatively, low-fat mayonnaise, light salad dressing	Including fat in or added to foods
Sweets and added sugars	0	5 or less per week	≤ 2	1 Tbsp sugar 1 Tbsp jelly or jam ½ cup sorbet, gelatin 1 cup lemonade	Fruit-flavored gelatin, fruit punch, hard candy, jelly, maple syrup, sorbet and ices, sugar	Sweets should be low in fat

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Fruits	4	4-5	5-6	1 medium fruit ¼ cup dried fruit ½ cup fresh, frozen, or canned fruit ½ cup fruit juice	Apples, apricots, bananas, dates, grapes, oranges, grapefruit, grapefruit juice, mangoes, melons, peaches, pineapples, raisins, strawberries, tangerines	Important sources of potassium, magnesium, and fiber
Fat-free or low-fat milk and milk products	2-3	2-3	3	1 cup milk or yogurt 1½ oz cheese	Fat-free (skim) or low-fat (1%) milk or buttermilk; fat-free, low-fat, or reduced-fat cheese; fat-free or low-fat regular or frozen yogurt	Major sources of calcium and protein
Lean meats, poultry, and fish	3-6	6 or less	6	1 oz cooked meats, poultry, or fish 1 egg‡	Select only lean; trim away visible fats; broil, roast, or poach; remove skin from poultry	Rich sources of protein and magnesium
Nuts, seeds, and legumes	3 per week	4-5 per week	1	⅓ cup or 1½ oz nuts 2 Tbsp peanut butter 2 Tbsp or ½ oz seeds ½ cup cooked legumes (dry beans and peas)	Almonds, hazelnuts, mixed nuts, peanuts, walnuts, sunflower seeds, peanut butter, kidney beans, lentils, split peas	Rich sources of energy, magnesium, protein, and fiber
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West African Food Composition Table

Table de composition des aliments d'Afrique de l'Ouest



REPUBLIQUE DU CAMEROUN
Bak - Travail - Patrie

REPUBLIC OF CAMEROON
Peace - Work - Fatherland

NATIONAL SURVEY OF MICRONUTRIENT STATUS AND CONSUMPTION OF FORTIFIABLE FOODS

Volume I
July 2011

MINSANTE

unicef

Michael & Susan Dell FOUNDATION

Helen Keller INTERNATIONAL

Cameroon DASH diet:

Target intake from each food group (kcal/capita/day) in the reference diet (2100 kcal/d)

	Scenario A: Plantains, roots, tubers as “starchy staples”	Scenario B: Plantains as fruits; roots, tubers as vegetables
Dairy (whole)	409	373
Meat, poultry, fish, and eggs	300	273
Fats and oils	98	89
Fruits	203	233
Grains (starchy staples)	813	752
Nuts, seeds, and legumes	117	107
Vegetables	160	272

Total ASF = 646 – 709 kcal/d (31-34% of total calories, based on 2100 kcal/d)
(28-30% of kcal from ASF if low-fat dairy used)

National food supply data extracted from FAO Food Balance Sheets

The screenshot shows the FAO Food Balance Sheets web application interface. At the top, there is a blue header with the FAO logo and the text "Food and Agriculture Organization of the United Nations". To the right of the logo, there are navigation links: "About FAO", "In Action", "Countries", and "Themes". Below the header, the word "FAOSTAT" is displayed in large, bold letters. Underneath "FAOSTAT", there is a horizontal menu with several tabs: "Data" (highlighted in orange), "Selected Indicators", "Compare Data", "Definitions and Standards", and "FAQ". Below the menu, there is a blue circular icon with a white hamburger menu symbol, followed by the text "Food Balance Sheets". Underneath this, there are four tabs: "DOWNLOAD DATA" (highlighted in blue), "VISUALIZE DATA", "METADATA", and "REPORT". The main content area is divided into two columns. The left column is titled "COUNTRIES" and has sub-tabs for "REGIONS" and "SPECIAL GROUPS". It contains a search bar with the text "Filter results e.g. afghanistan" and a list of countries with radio buttons: Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, and Argentina. At the bottom of this column are two buttons: "Select All" and "Clear All". The right column is titled "ELEMENTS" and contains a search bar with the text "Filter results e.g. total population - both sexes" and a list of elements with radio buttons: Total Population - Both sexes, Production Quantity, Import Quantity, Stock Variation, Export Quantity, and Domestic supply quantity. At the bottom of this column are two buttons: "Select All" and "Clear All".

FAO Food and Agriculture Organization of the United Nations

About FAO | In Action | Countries | Themes

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FAOSTAT

Home Data Selected Indicators Compare Data Definitions and Standards FAQ

Food Balance Sheets

DOWNLOAD DATA VISUALIZE DATA METADATA REPORT

COUNTRIES REGIONS SPECIAL GROUPS

Filter results e.g. afghanistan

- Afghanistan
- Albania
- Algeria
- Angola
- Antigua and Barbuda
- Argentina

Select All Clear All

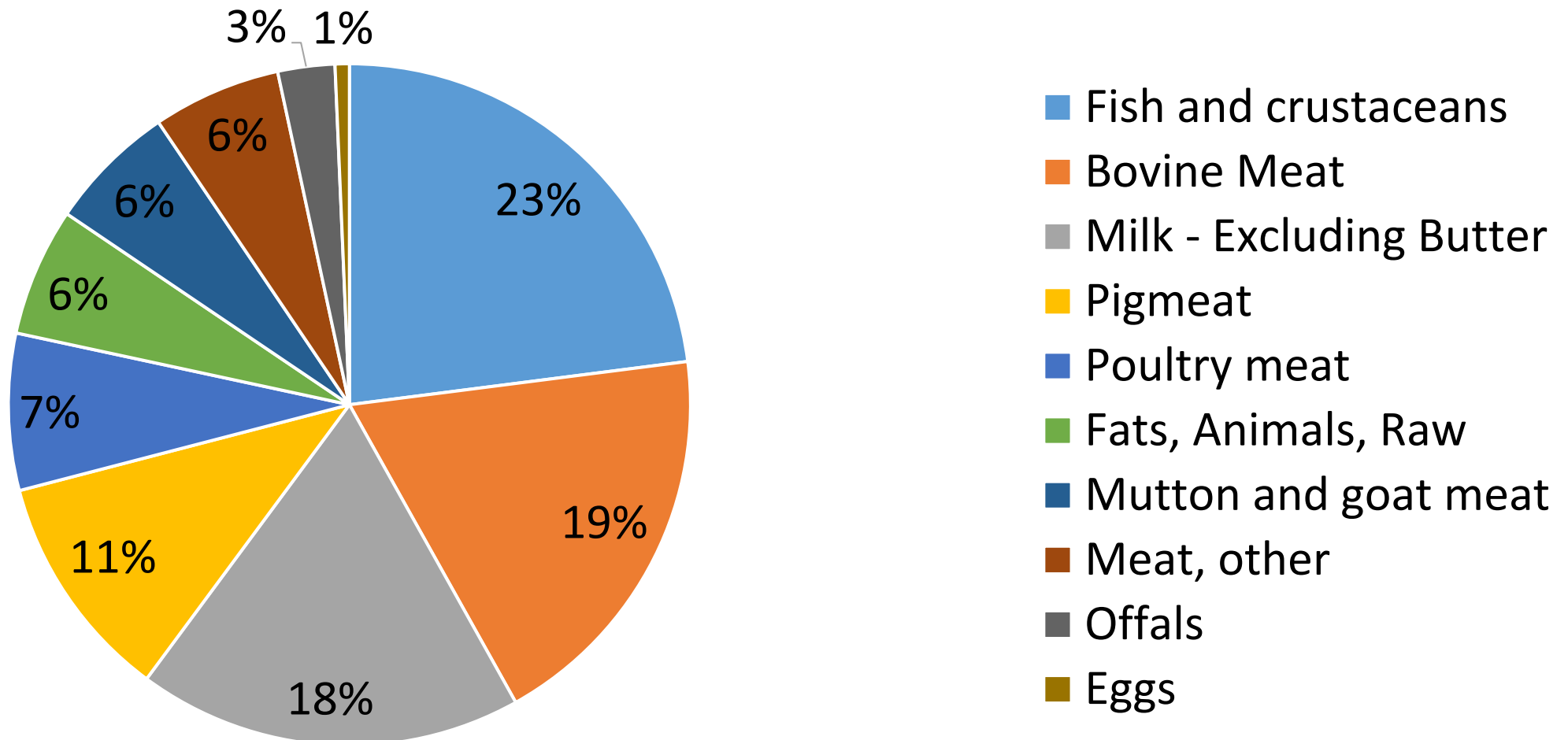
ELEMENTS

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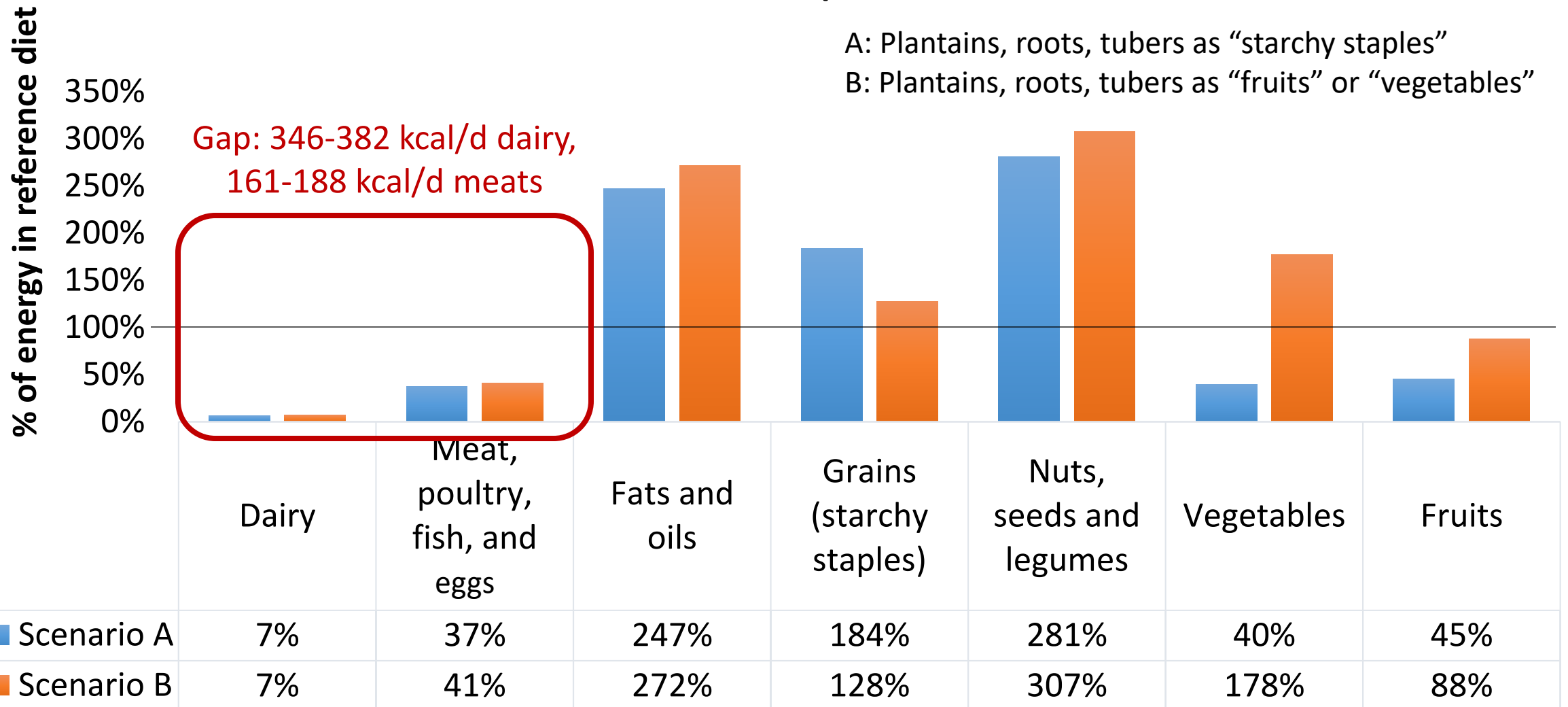
Select All Clear All

Relative amounts of animal products in the food supply (as % of kcal from ASF) Cameroon, 2011



2011 Cameroon food supply as a % of DASH reference pattern

A: Plantains, roots, tubers as “starchy staples”
 B: Plantains, roots, tubers as “fruits” or “vegetables”



Cameroon Dietary Gap Case study:

Conclusions

- Dietary gap analysis can be used to assess adequacy of the food supply with regard to meeting dietary recommendations
- Reference diet – room for further development
 - DASH developed for US population
 - Fat content of ASF affects calculations
 - Legumes, etc. probably underrepresented
- In Cameroon, analysis indicates large gaps in ASF and probably fruits and vegetables (depending on how certain foods categorized), and excess of grains, oils, legumes

Case Study 2: EAT-Lancet Commission reference diet compared to available food supply

Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems



Walter Willett, Johan Rockström, Brent Loken, Marco Springmann, Tim Lang, Sonja Vermeulen, Tara Garnett, David Tilman, Fabrice DeClerck, Amanda Wood, Malin Jonell, Michael Clark, Line J Gordon, Jessica Fanzo, Corinna Hawkes, Rami Zurayk, Juan A Rivera, Wim De Vries, Lindiwe Majele Sibanda, Ashkan Afshin, Abhishek Chaudhary, Mario Herrero, Rina Agustina, Francesco Branca, Anna Lartey, Shenggen Fan, Beatrice Crona, Elizabeth Fox, Victoria Bignet, Max Troell, Therese Lindahl, Sudhvir Singh, Sarah E Cornell, K Srinath Reddy, Sunita Narain, Sania Nishtar, Christopher J L Murray

“we quantitatively describe a **universal healthy reference diet** to provide a basis for estimating the health and environmental effects of adopting an alternative diet to standard current diets, many of which are high in unhealthy foods”

- Based on observational and experimental evidence
- Focus on chronic disease outcomes

	Macronutrient intake (possible range), g/day	Caloric intake, kcal/day
Whole grains*		
Rice, wheat, corn, and other†	232 (total grains 0–60% of energy)	811
Tubers or starchy vegetables		
Potatoes and cassava	50 (0–100)	39
Vegetables		
All vegetables	300 (200–600)	–
Dark green vegetables	100	23
Red and orange vegetables	100	30
Other vegetables	100	25
Fruits		
All fruit	200 (100–300)	126
Dairy foods		
Whole milk or derivative equivalents (eg, cheese)	250 (0–500)	153
Protein sources‡		
Beef and lamb	7 (0–14)	15
Pork	7 (0–14)	15
Chicken and other poultry	29 (0–58)	62
Eggs	13 (0–25)	19
Fish§	28 (0–100)	40
Legumes		
Dry beans, lentils, and peas*	50 (0–100)	172
Soy foods	25 (0–50)	112
Peanuts	25 (0–75)	142
Tree nuts	25	149
Added fats		
Palm oil	6.8 (0–6.8)	60
Unsaturated oils¶	40 (20–80)	354
Dairy fats (included in milk)	0	0
Lard or tallow	5 (0–5)	36
Added sugars		
All sweeteners	31 (0–31)	120

Food group	Foods	Intake, g/d	Calories, kcal/day
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**Total: 340 kcal/d from ASF
= 13.6% kcal from ASF in 2500 kcal/d reference diet**

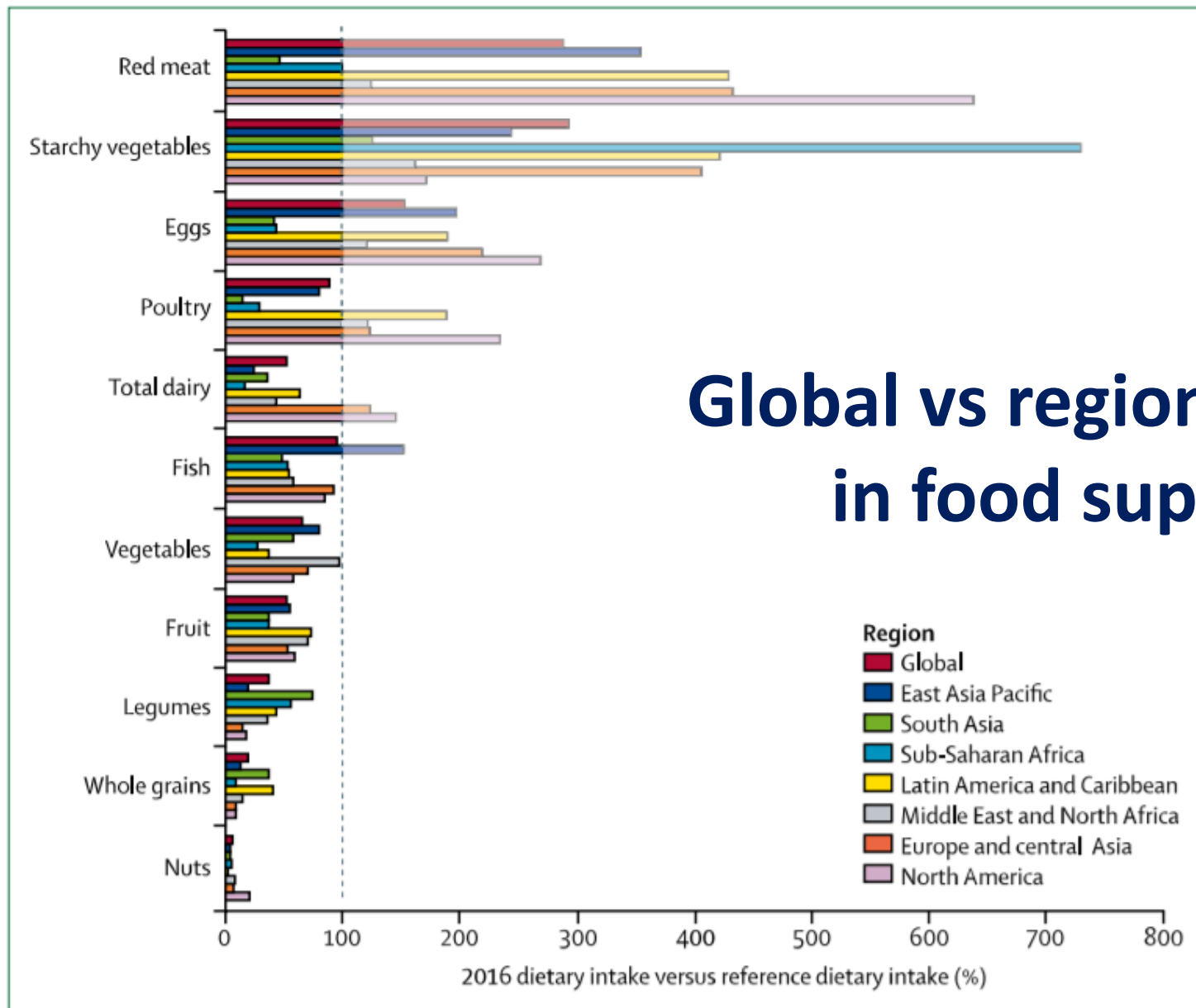
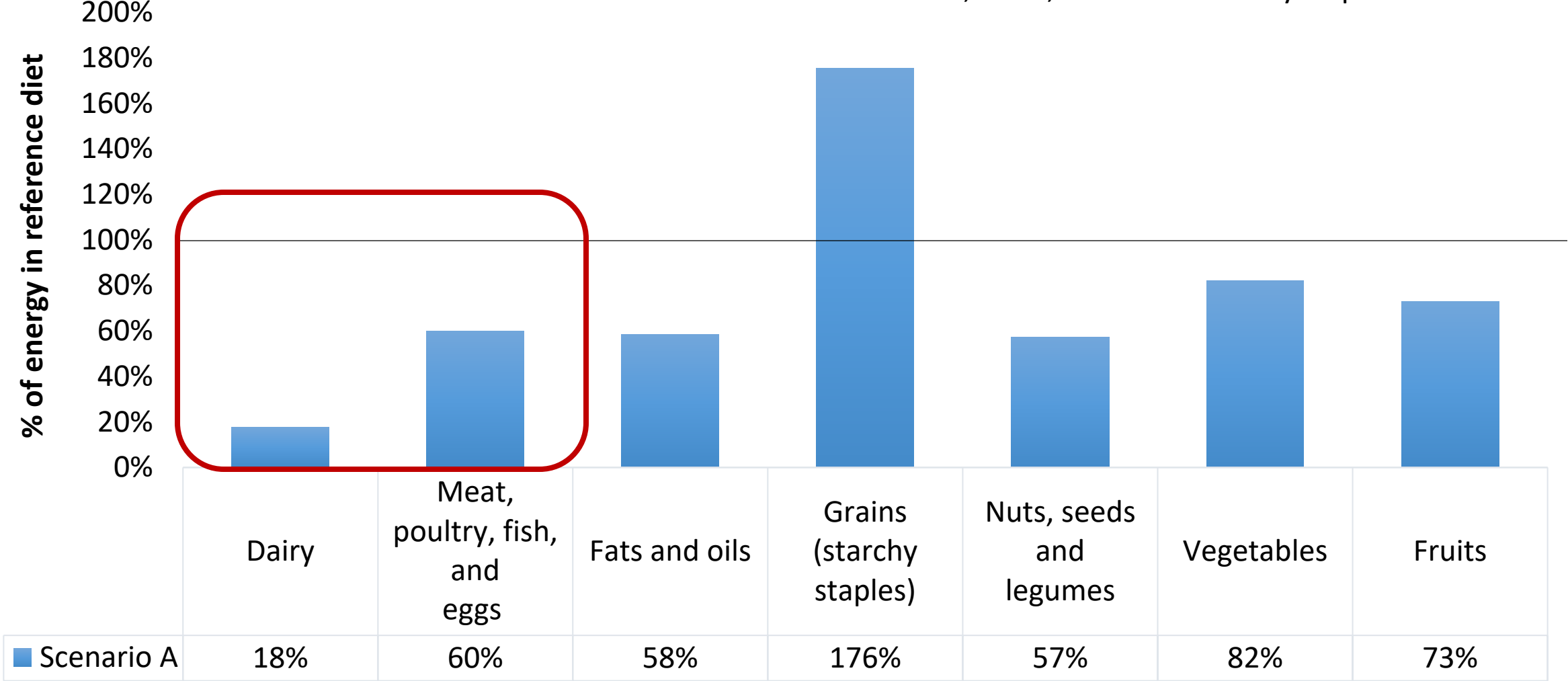


Figure 1: Diet gap between dietary patterns in 2016 and reference diet intakes of food

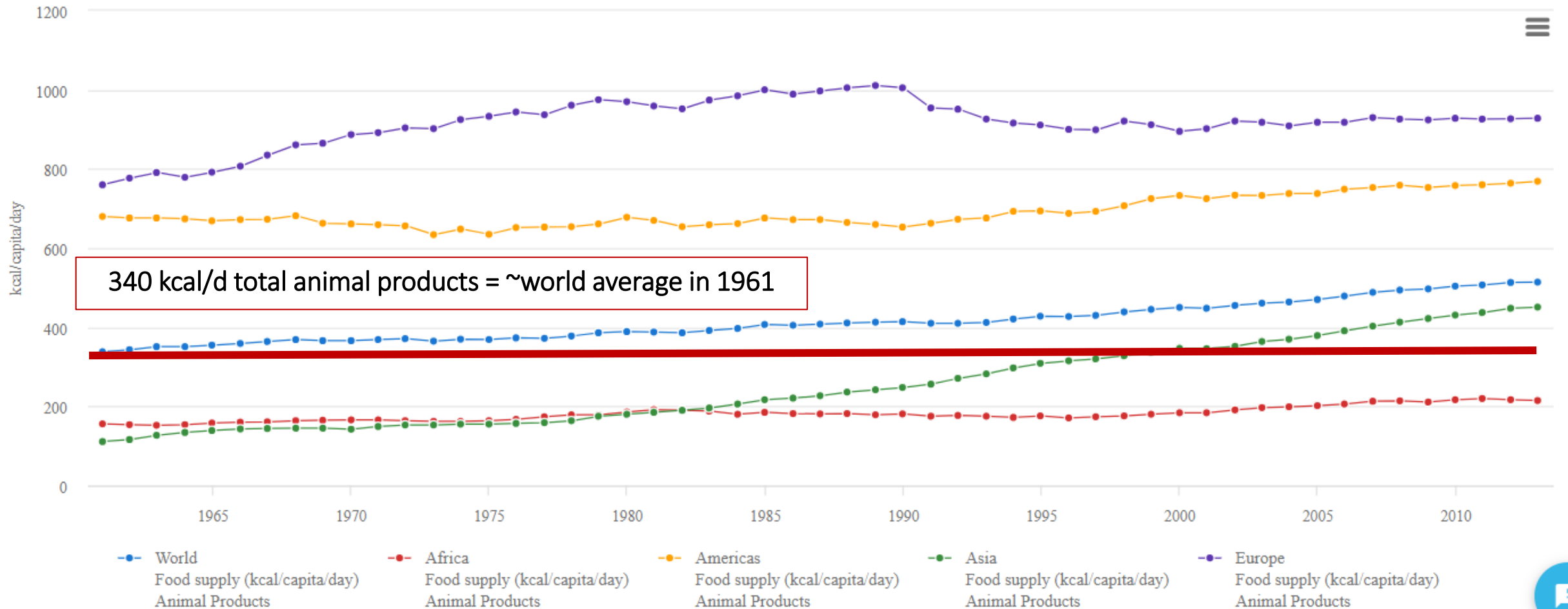
Data on 2016 intakes are from the Global Burden of Disease database.¹³⁰ The dotted line represents intakes in reference diet (table 1).

Food supply in Cameroon compared to EAT-Lancet reference diet: Gaps in ASF remain

A: Plantains, roots, tubers as “starchy staples”



Availability of total animal products (kcal/capita/d) by world region from 1961-2013

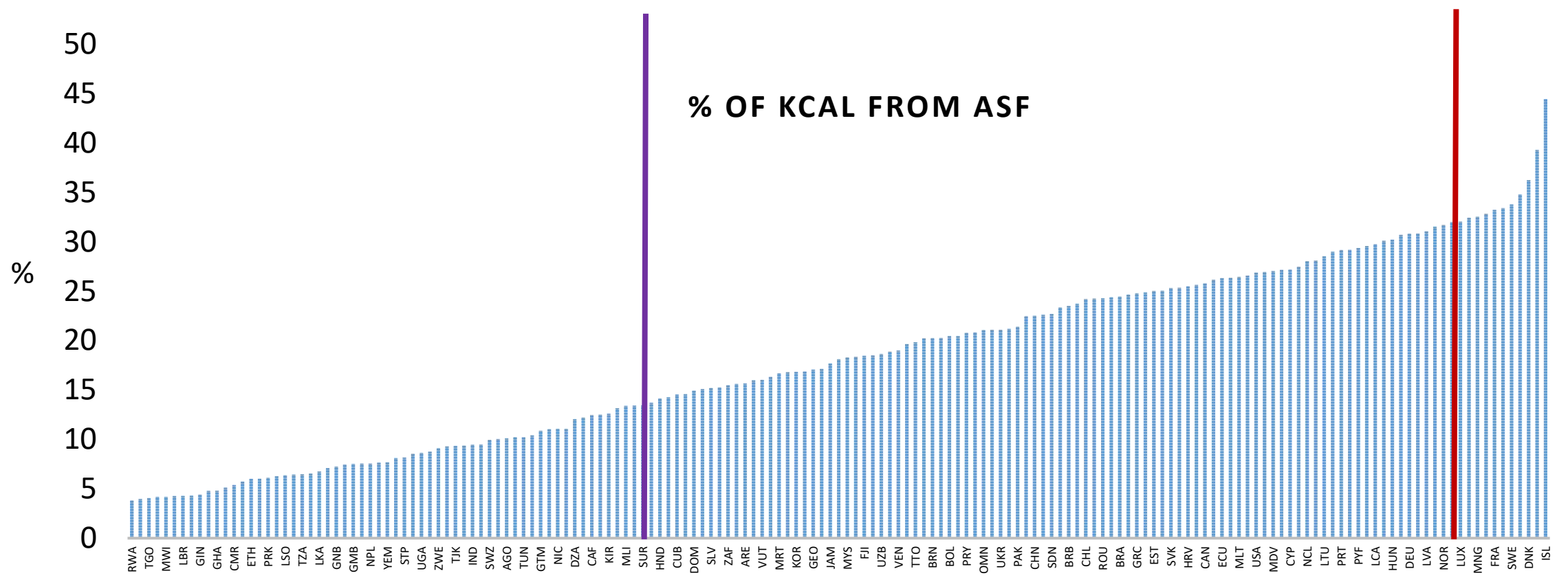


Percentage of total energy from animal products

(FAO Food Balance Sheets, 2011; n=167 countries)

EAT Lancet diet: 14%

Cameroon DASH diet: 31-34%



Global trends in dietary micronutrient supplies and estimated prevalence of inadequate intakes

Ty Beal^{1,2}*, Eric Massiot¹, Joanne E. Arsenault^{2,3}‡, Matthew R. Smith⁴‡, Robert J. Hijmans^{1,2}

1 Department of Environmental Science and Policy, University of California Davis, Davis, California, United States of America, **2** Program in International and Community Nutrition, University of California Davis, Davis, California, United States of America, **3** Department of Nutrition, University of California Davis, Davis, California, United States of America, **4** Department of Environmental Health, Harvard T.H. Chan School of Public Health, Boston, Massachusetts, United States of America

$$MDI = \frac{1}{n} \sum_{i=1}^n \min \left\{ 1, \left(\frac{M_i}{E} / \frac{RDA_i}{EER} \right) \right\}$$

Micronutrient Density Index =

micronutrient density in food supply

micronutrient density based on dietary recommendations

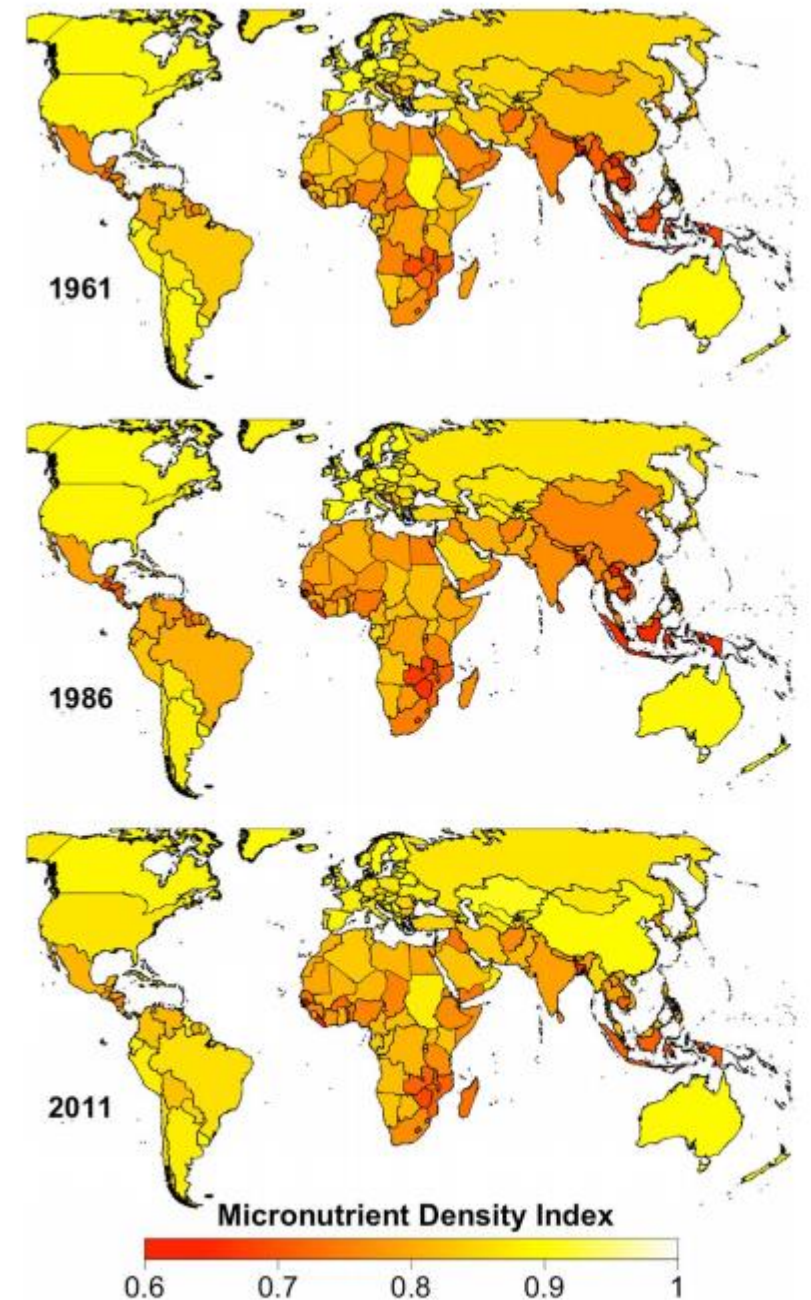
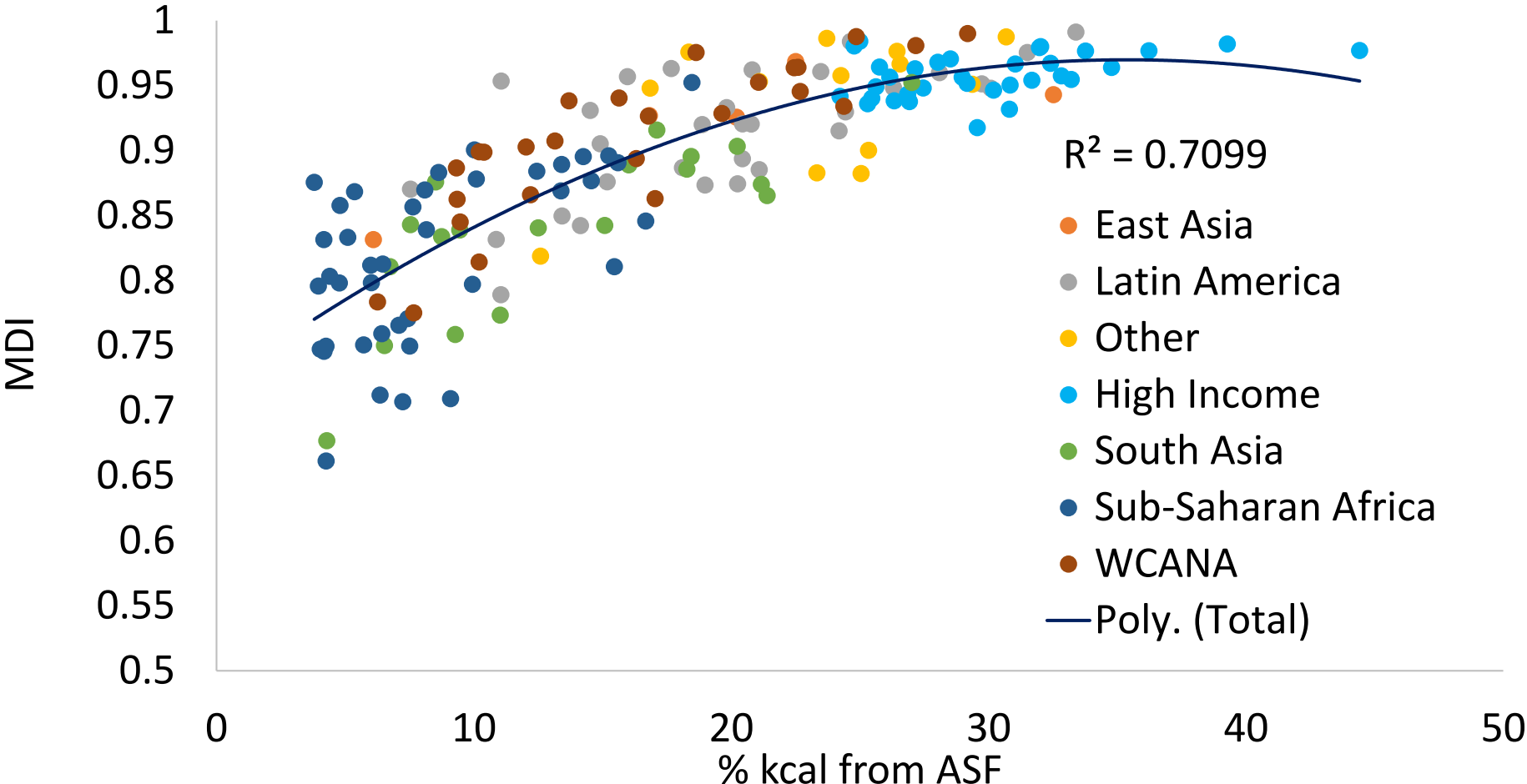


Fig 2. Country-level Micronutrient Density Index for the years 1961, 1986, and 2011. Values for countries with missing data (Libya and DRC) were estimated based on the values of neighboring

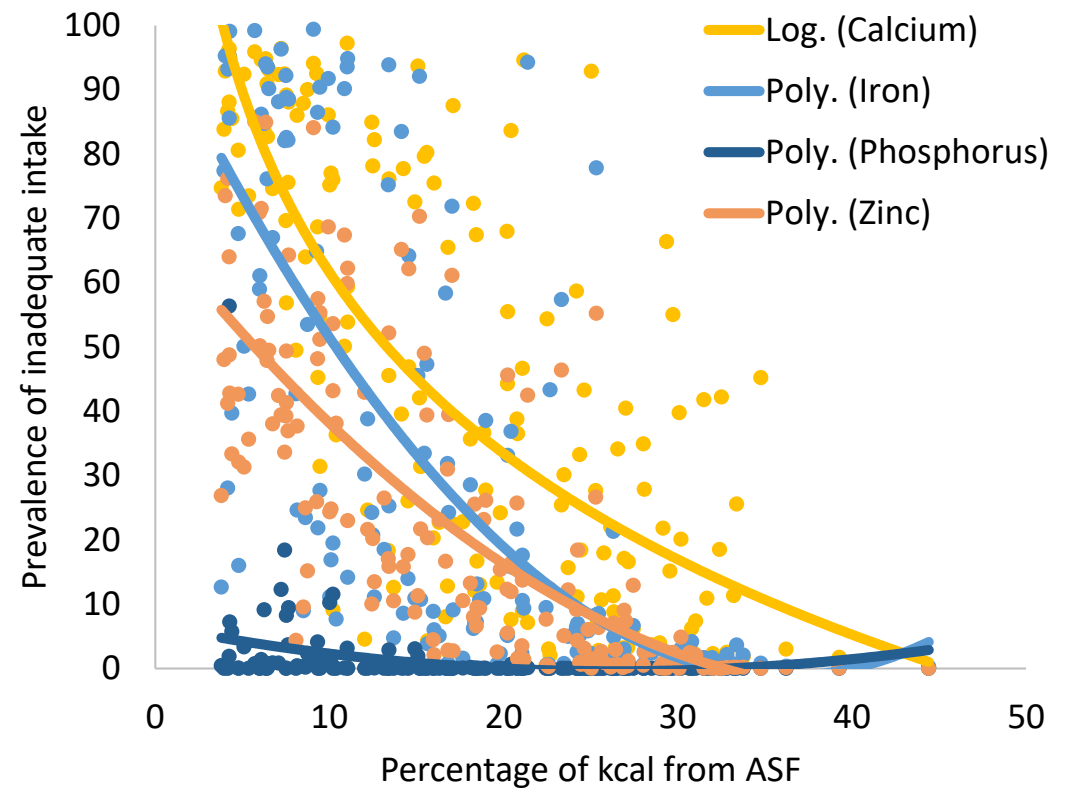
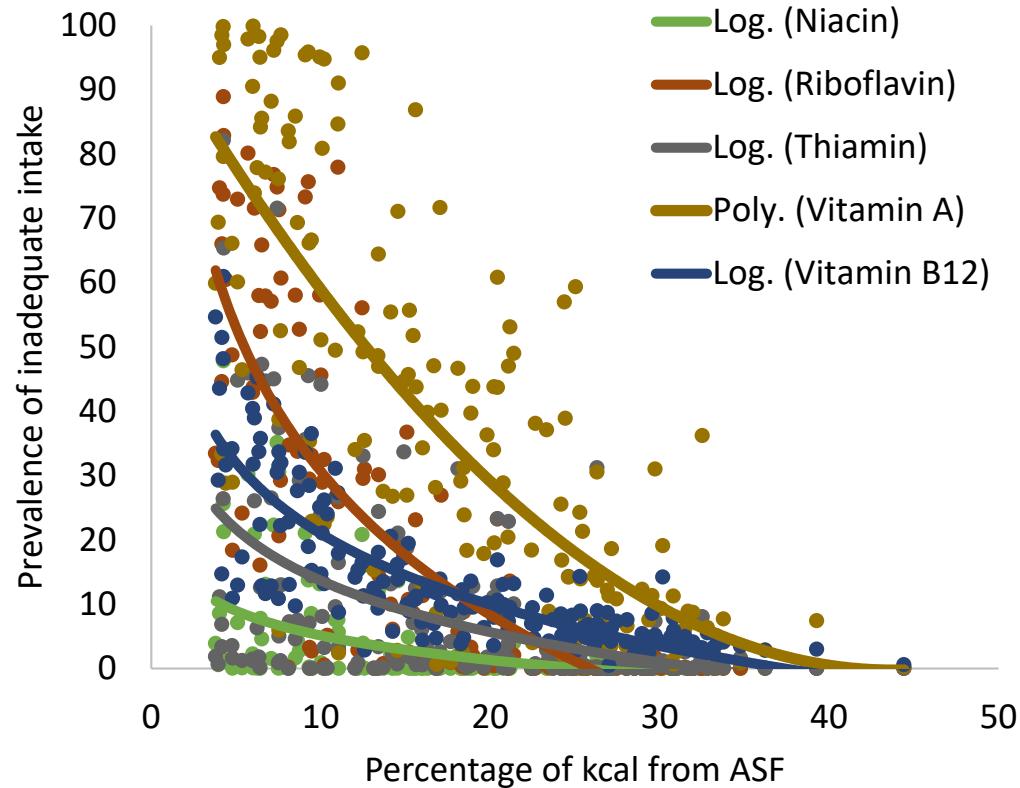
Relationship between Micronutrient Density Index (MDI) vs kcal from ASF in national food balance sheets



N=167 countries

MDI values from Beal et al., PLoS One, 2018

Relationship between percentage of energy from ASF and estimated prevalence of inadequate micronutrient intake from Food Balance Sheets in 2011, n=167 countries



For all nutrients shown, Spearman correlation coefficients were > 0.5 and $P < 0.001$

Limitations of assessing adequacy of food supply using Food Balance Sheets

- Captures national availability but not subnational distribution, intra-household distribution, or short-term seasonal effects
- Home food production/procurement and waste not well captured
- Analyses of micronutrient adequacy are ecological; rely on assumptions about bioavailability, subnational and intra-household distribution of intake

Correlation between mean micronutrient adequacies and sentinel foods among urban Zambian infants at 6 mo of age

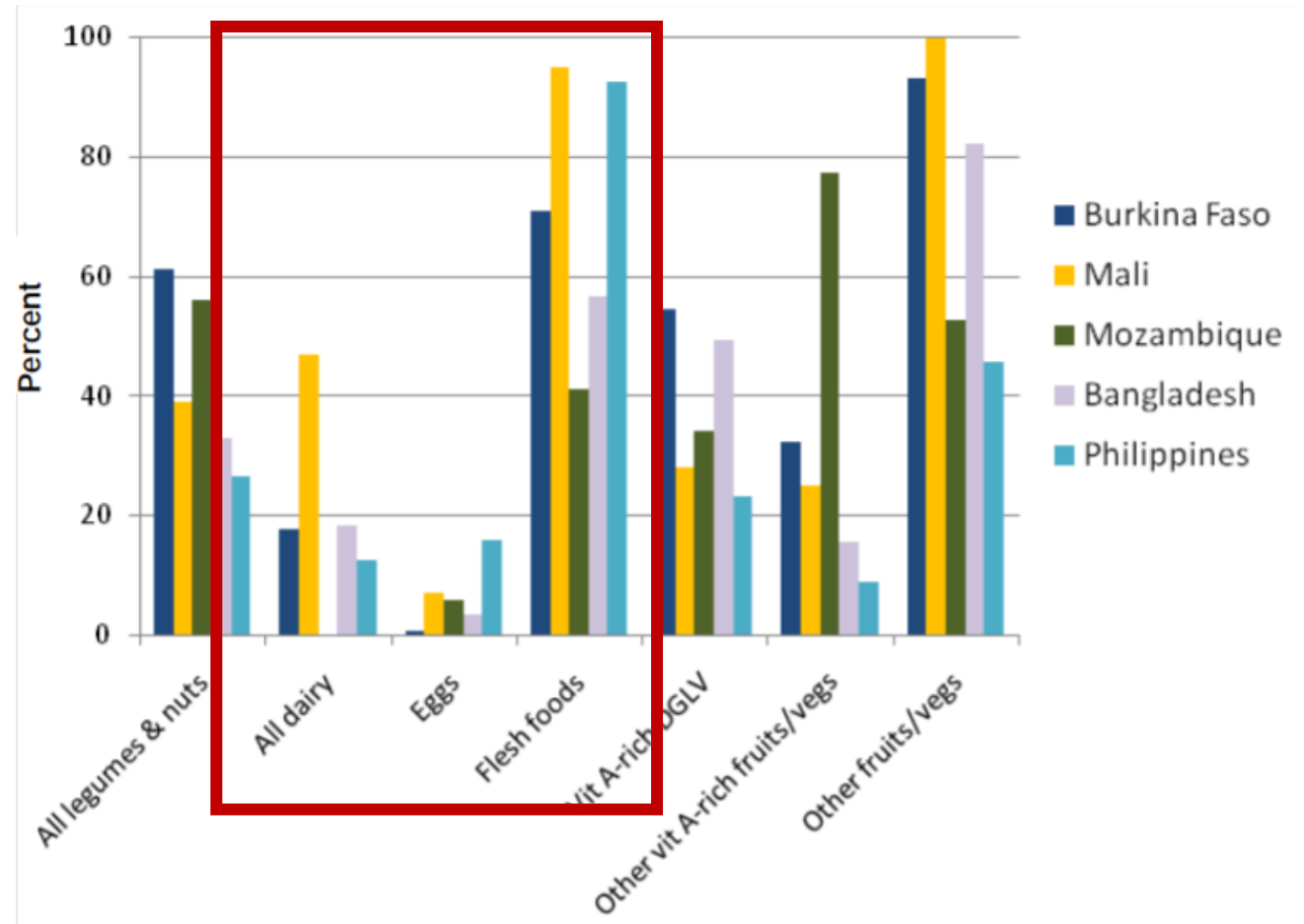
	Consuming, <i>n</i> (%)	Correlation coefficients between micronutrient adequacy and sentinel foods		
		MMDA Ca Fe Zn	Overall MMDA	MAR
Overall, <i>n</i> = 787				
Animal-source foods	555 (71)	0.58**	0.58**	0.46**
Fortified foods	480 (61)	0.68**	0.69**	0.41**
Dairy foods	508 (65)	0.63**	0.63**	0.47**
Iron-rich foods	483 (61)	0.68**	0.68**	0.41**
Flesh foods	13 (2)	-0.02	-0.003	0.05
Vitamin A-rich F&V	27 (3)	-0.03	0.02	-0.003

¹ F&V, fruit and vegetables; MAR, mean adequacy ratio of all measured micronutrients; MMDA Ca Fe Zn, mean micronutrient density adequacy of calcium, iron, and zinc; overall MMDA, mean micronutrient density adequacy of all measured micronutrients. **P* < 0.05 for Spearman rank correlation test; ***P* < 0.0001 for Spearman rank correlation test.



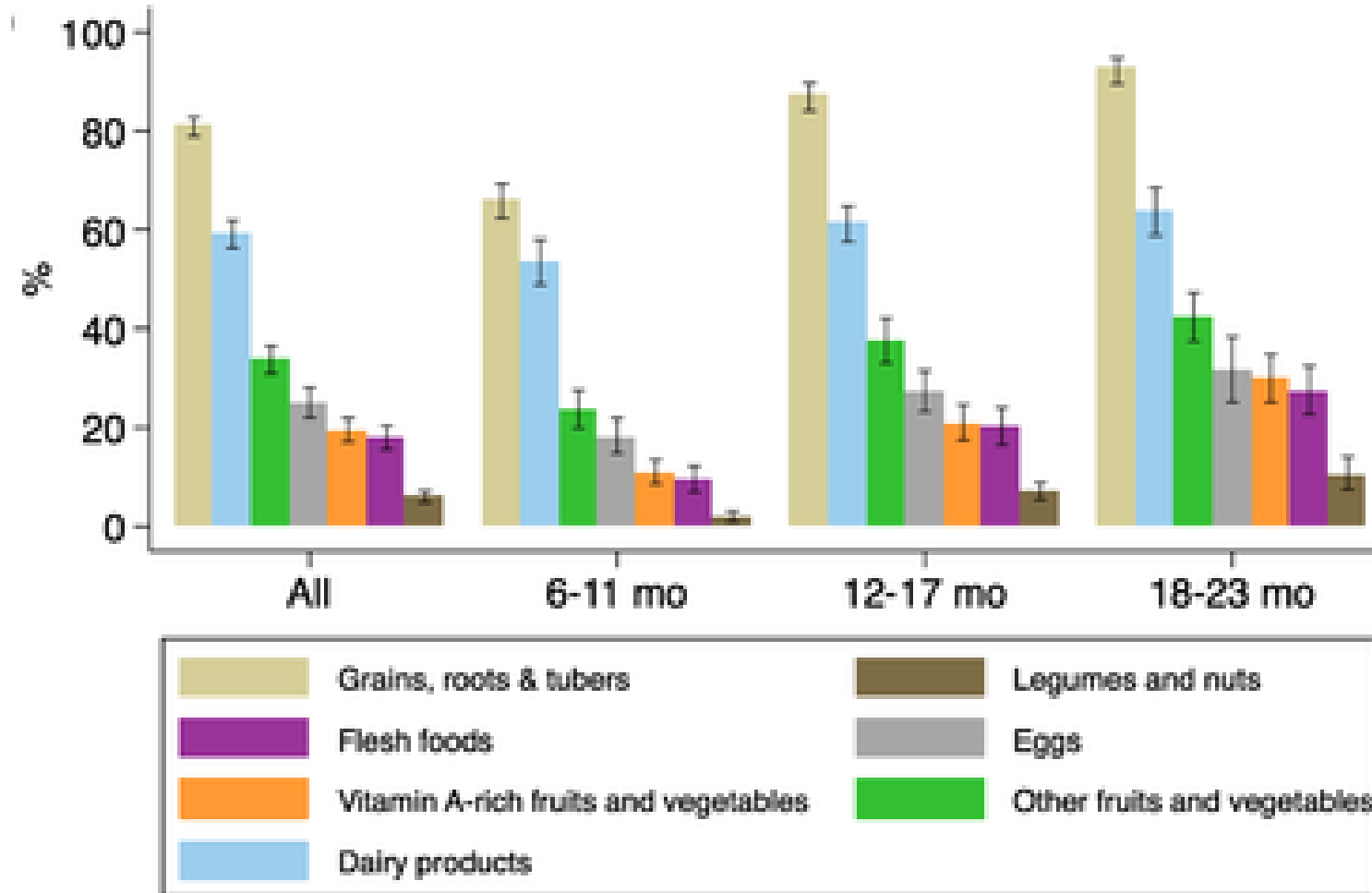
Infrequent consumption of ASF by women in LMICs

Percentage of women who consumed ≥ 15 g of selected food groups



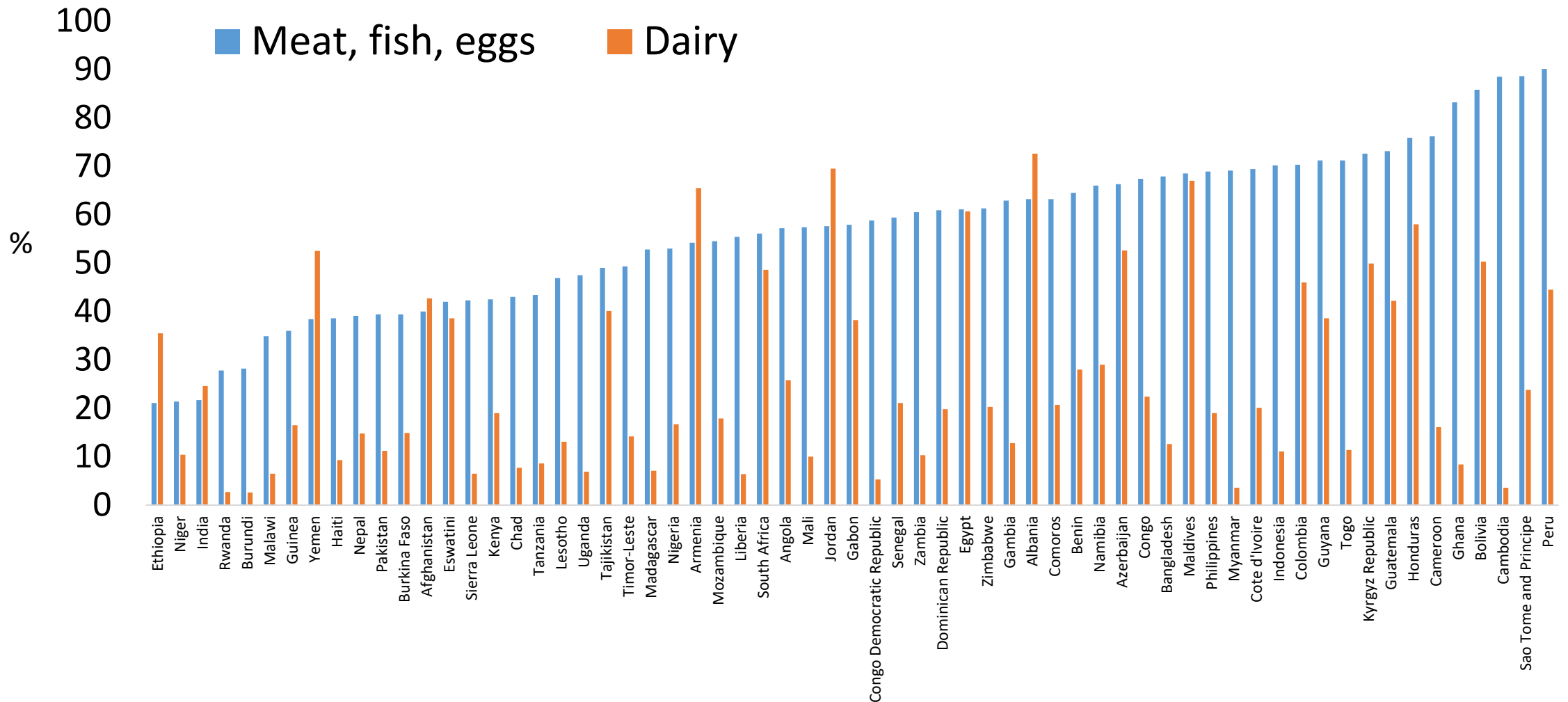
	% energy from ASF
Burkina Faso	7
Mali	12
Mozambique	4
Bangladesh	4

Consumption of ASF on the previous day among children in Pakistan



Na et al., 2018. Risk factors of poor complementary feeding practices in Pakistani children aged 6–23 months: A multilevel analysis of the Demographic and Health Survey 2012–2013

% of non-breastfeeding children 6-23 mo who consumed ASF on the previous day, by country (most recent DHS)



Conclusions

- Approaches for assessing dietary gaps
 - No consensus on “optimal” ASF intake
 - Must consider needs of specific population groups
- What are the gaps in national food supply?
 - Wide regional variation in contribution of ASF to available food energy; ASF associated with micronutrient density and adequacy
 - Analyses suggest inadequate ASF in the food supply in some countries, particularly in South Asia and sub-Saharan Africa
- ASF are infrequently consumed in many LMICs, particularly by children

Thank you!

