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Women's Diets, Roles in Agriculture, and Nutrition:

Findings from Nepal, Uganda, and Tanzania

Keith P. West, Jr., Dr.P.H., M.P.H., R.D. **Alexandra Bellows, MS** **Nassul Kabunga, PhD, MSc**

Feed the Future Innovation Lab for Nutrition

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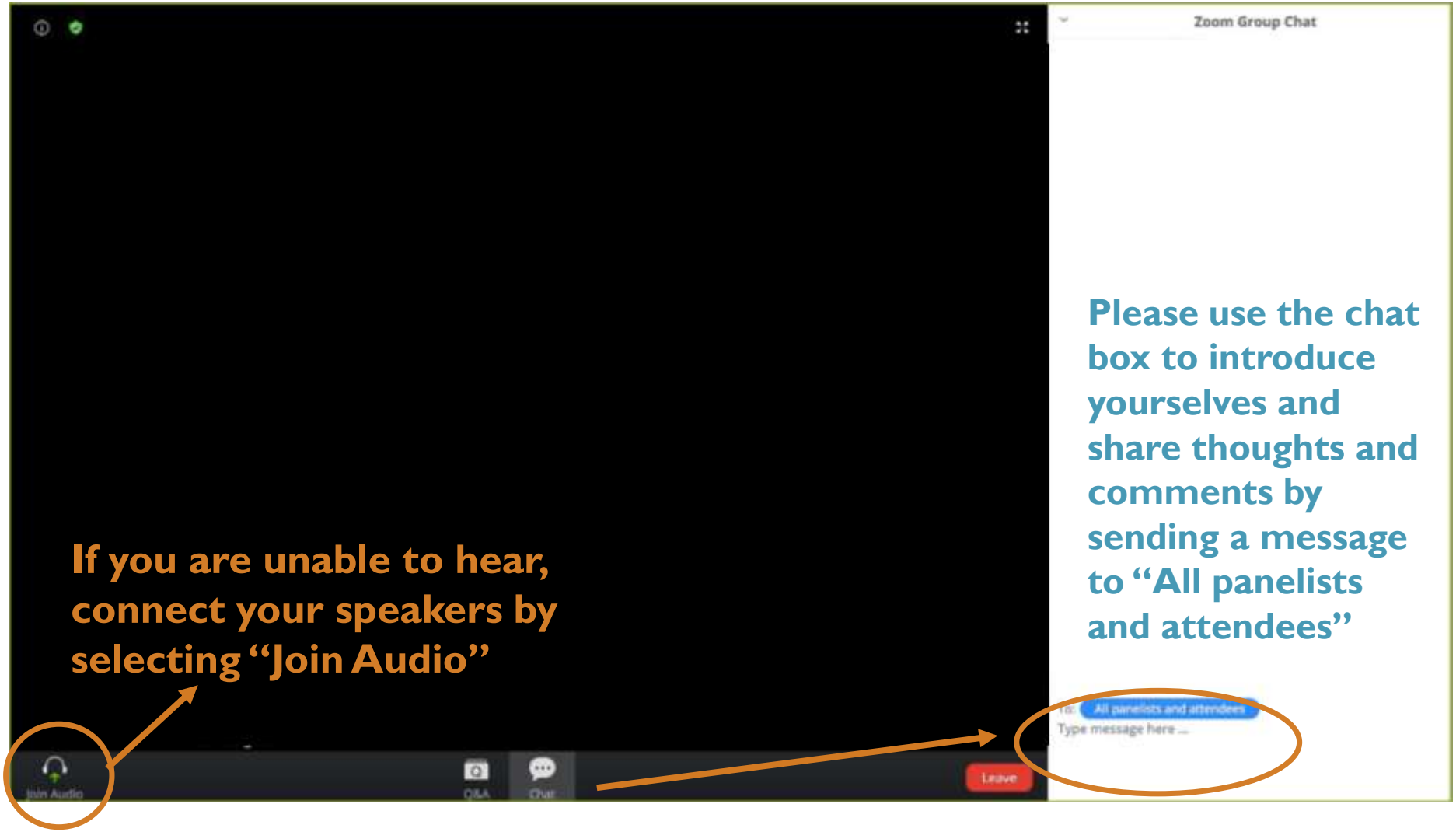

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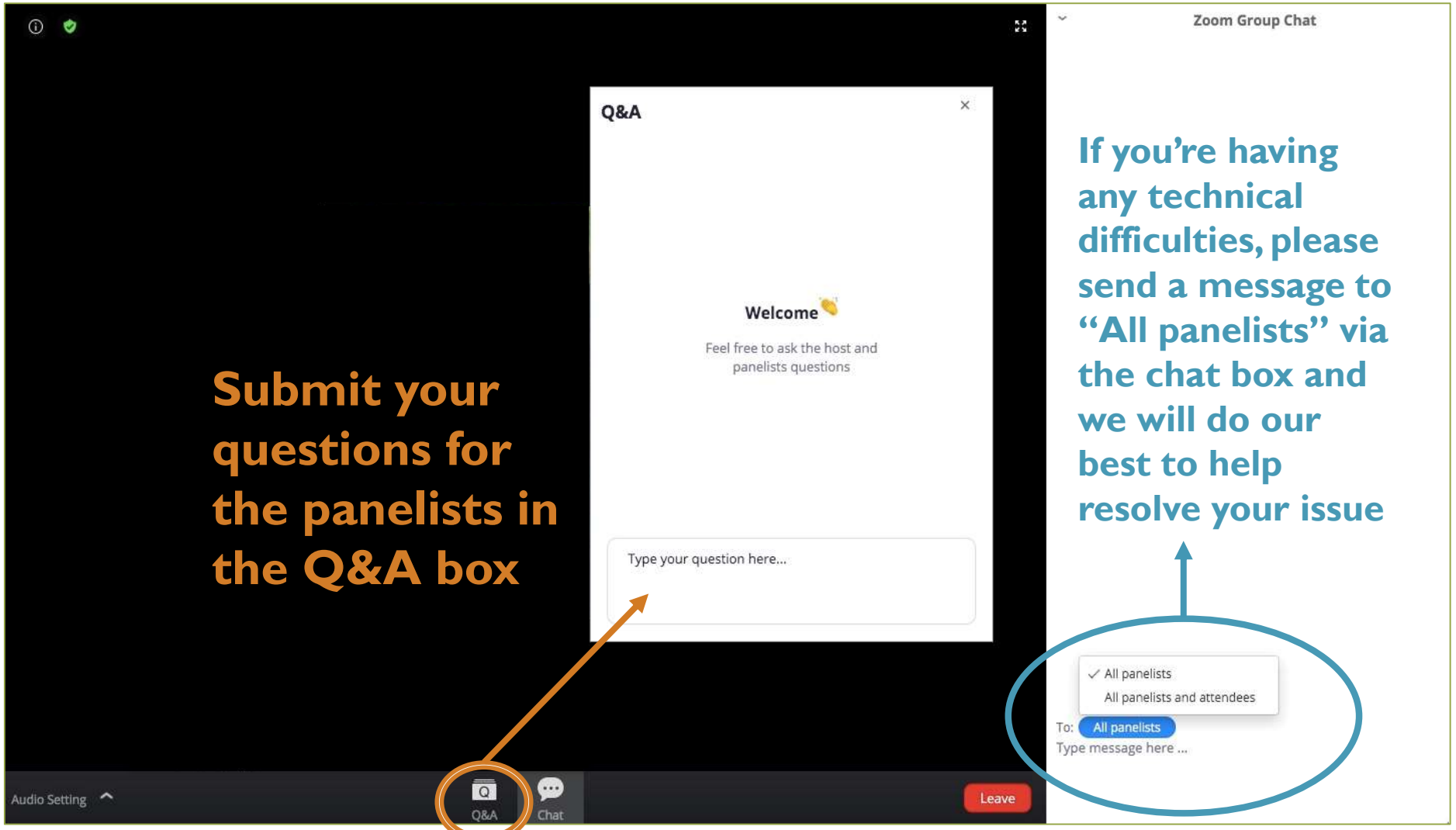
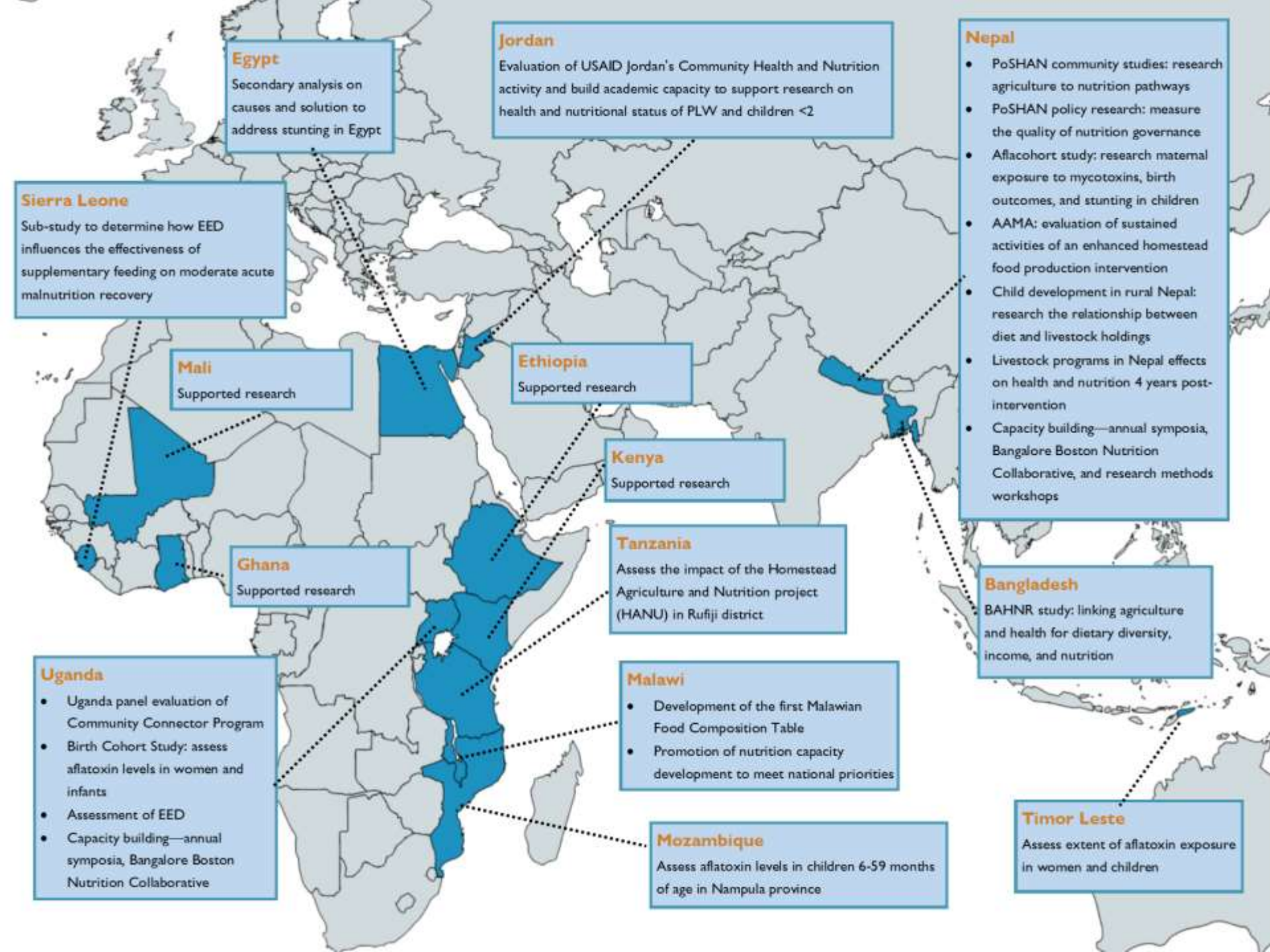
Q&A AND CHAT




Egypt
Secondary analysis on causes and solution to address stunting in Egypt
Jordan
Evaluation of USAID Jordan's Community Health and Nutrition activity and build academic capacity to support research on health and nutritional status of PLW and children <2
Nepal
PoSHAN community studies: research agriculture to nutrition pathways
PoSHAN policy research: measure the quality of nutrition governance
Aflacohort study: research maternal exposure to mycotoxins, birth outcomes, and stunting in children
AAMA: evaluation of sustained activities of an enhanced homestead food production intervention
Child development in rural Nepal: research the relationship between diet and livestock holdings
Livestock programs in Nepal effects on health and nutrition 4 years post-intervention
Capacity building—annual symposia, Bangalore Boston Nutrition Collaborative, and research methods workshops
Sierra Leone
Sub-study to determine how EED influences the effectiveness of supplementary feeding on moderate acute malnutrition recovery
Mali
Supported research
Ethiopia
Supported research
Kenya
Supported research
Tanzania
Assess the impact of the Homestead Agriculture and Nutrition project (HANU) in Rufiji district
Ghana
Supported research
Bangladesh
BAHNR study: linking agriculture and health for dietary diversity, income, and nutrition
Uganda
Uganda panel evaluation of Community Connector Program
Birth Cohort Study: assess aflatoxin levels in women and infants
Assessment of EED
Capacity building—annual symposia, Bangalore Boston Nutrition Collaborative
Malawi
Development of the first Malawian Food Composition Table
Promotion of nutrition capacity development to meet national priorities
Mozambique
Assess aflatoxin levels in children 6-59 months of age in Nampula province
Timor Leste
Assess extent of aflatoxin exposure in women and children

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Nepal Nutrition Intervention Project, Sarlahi (JHU)
Institute of Medicine, Tribhuvan University
Nepal Agricultural Research Council
District offices and officials in 21 districts
Respondents and their families across the Mountains, Hills, and Terai

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IFPRI
Office of the Prime Minister
District Local Governments for Kamwenge, Kisoro, Agago, Lira, Dokolo and Kole
USAID Mission in Uganda
FHI360

Tanzania
Ifakara Health Institute
Sokoine University
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INNOVATION LAB FOR NUTRITION
WEBINAR SERIES

Women's Diets, Roles in Agriculture, and Nutrition:
Findings from Nepal, Uganda and Tanzania

WEDNESDAY, SEPTEMBER 2ND
9:00AM - 10:30AM (ET)

EILEEN KENNEDY
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KEITH WEST
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If Its Grown in the Household, Mothers Eat More

PoSHAN Community Studies in Nepal

Keith P. West, Jr., Dr.P.H., R.D..

George G. Graham Professor of Infant and Child Nutrition, Center for Human Nutrition & Sight for Life Global Nutrition Research Institute, Dept of International Health, Johns Hopkins Bloomberg School of Public Health, Baltimore, MD USA

on behalf of ***Johns Hopkins University and Nepal-based Nutrition Innovation Lab Teams***

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NUTRITION AND HEALTH CONCERNS IN SOUTH ASIA

- Women's diets often at-risk of inadequacy, including Nepal.
- Women are at high risk of micronutrient deficiencies, attributed to chronic poor diet.
- Nepal is amidst a "Nutrition Transition", with modest increases in expendable income and a flood in markets of snack foods.
- Home production offers a direct pathway for improving quality of diets of women but more data are needed to reveal the direction, strength, robustness and responsiveness along this pathway to program interventions.

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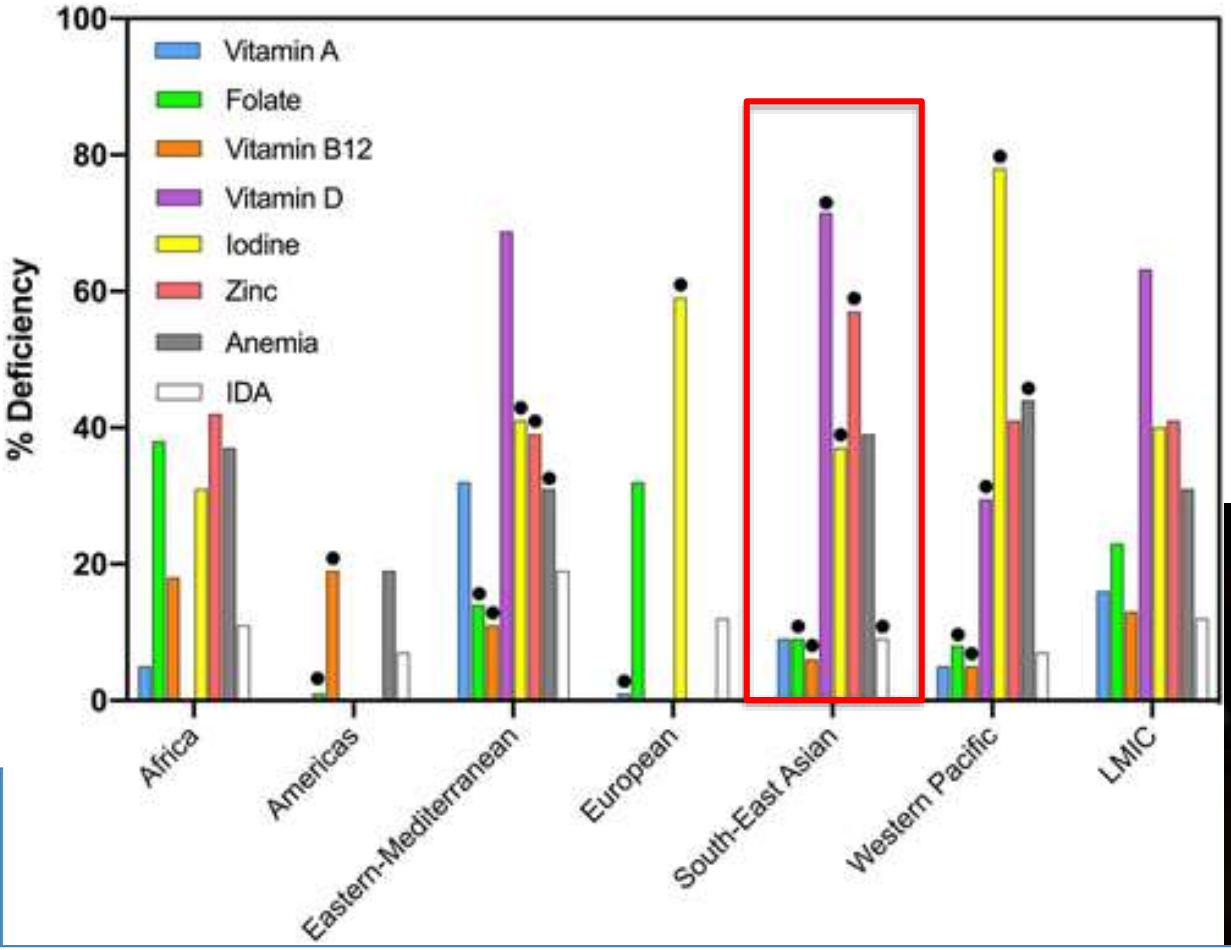
Micronutrient Deficiencies among Women: Global & Regional View



Black dots denote data from 1-2 countries in a region;
Missing bars reflect lack of data for that nutrient

Bourassa et al
Annals NY Acad Sci
2019;1444:6-21

Photo: Paul Joseph Brown

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Antenatal Micronutrient Deficiencies in East-Central Terai, Nepal

Jiang T et al J Nutr 2005;135:1106

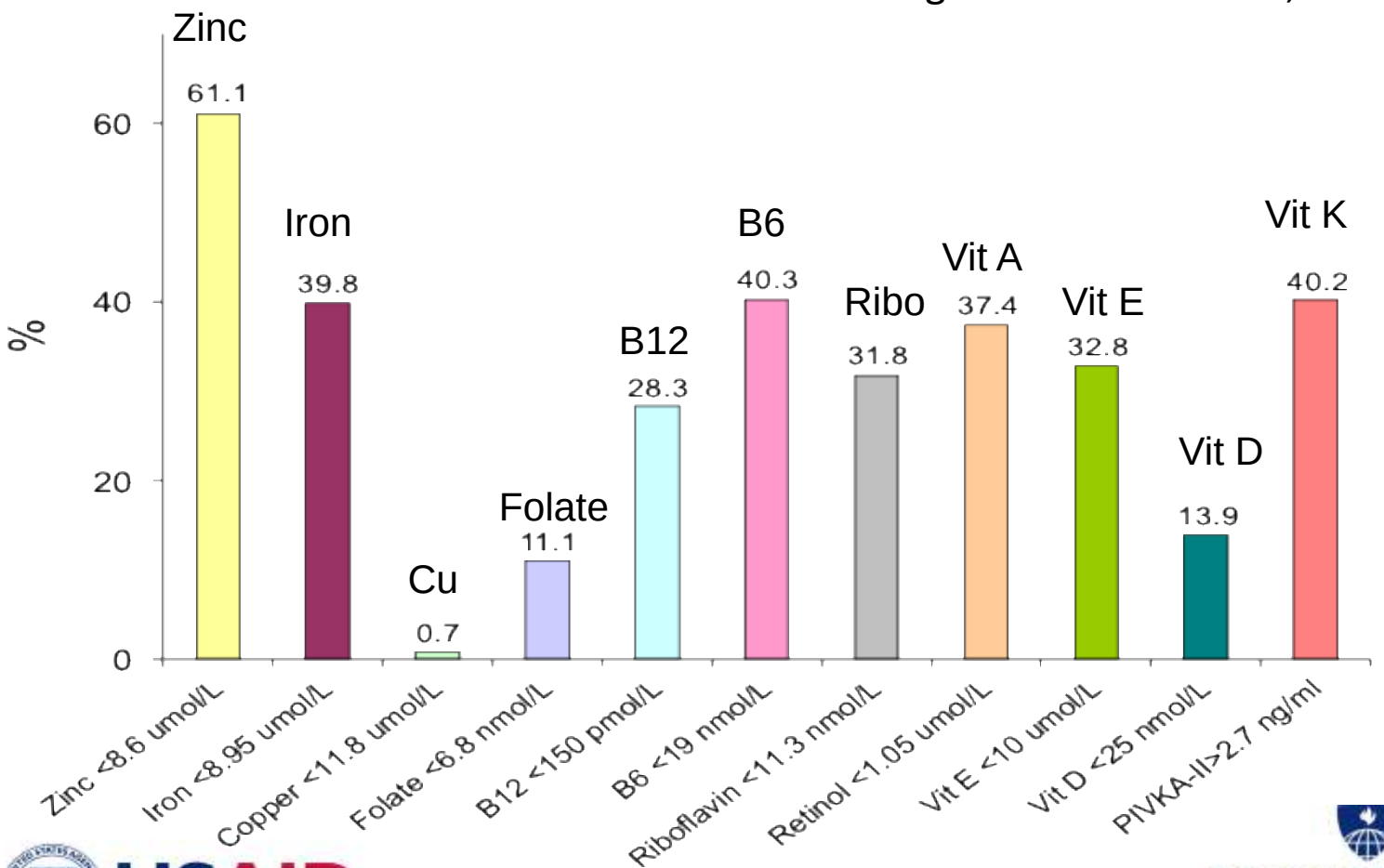
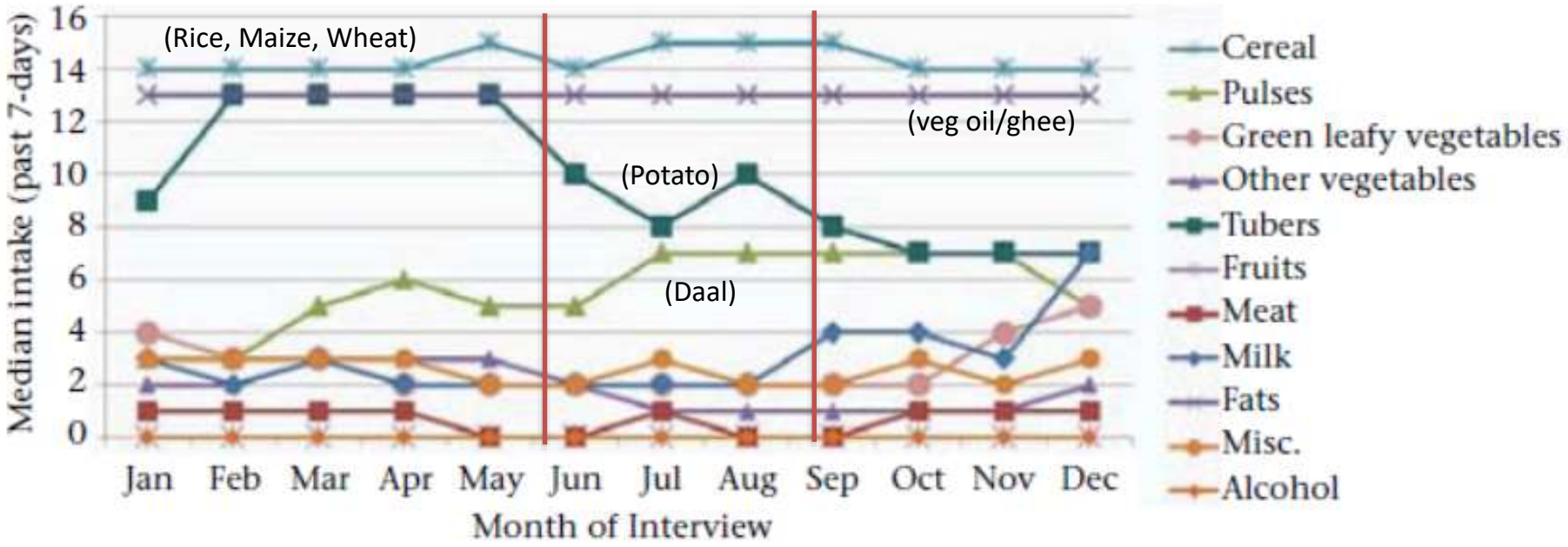


Figure 2. Women's median consumption of year-round food-groups by month of interview in the NNIPS-2 Cohort Follow-up Survey, Sarlahi, Nepal



Campbell RK et al J Health Popul Nutr 2014;32:198-216

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Monsoon: Not Worst, Not Best Season for Vegetables and Fruits

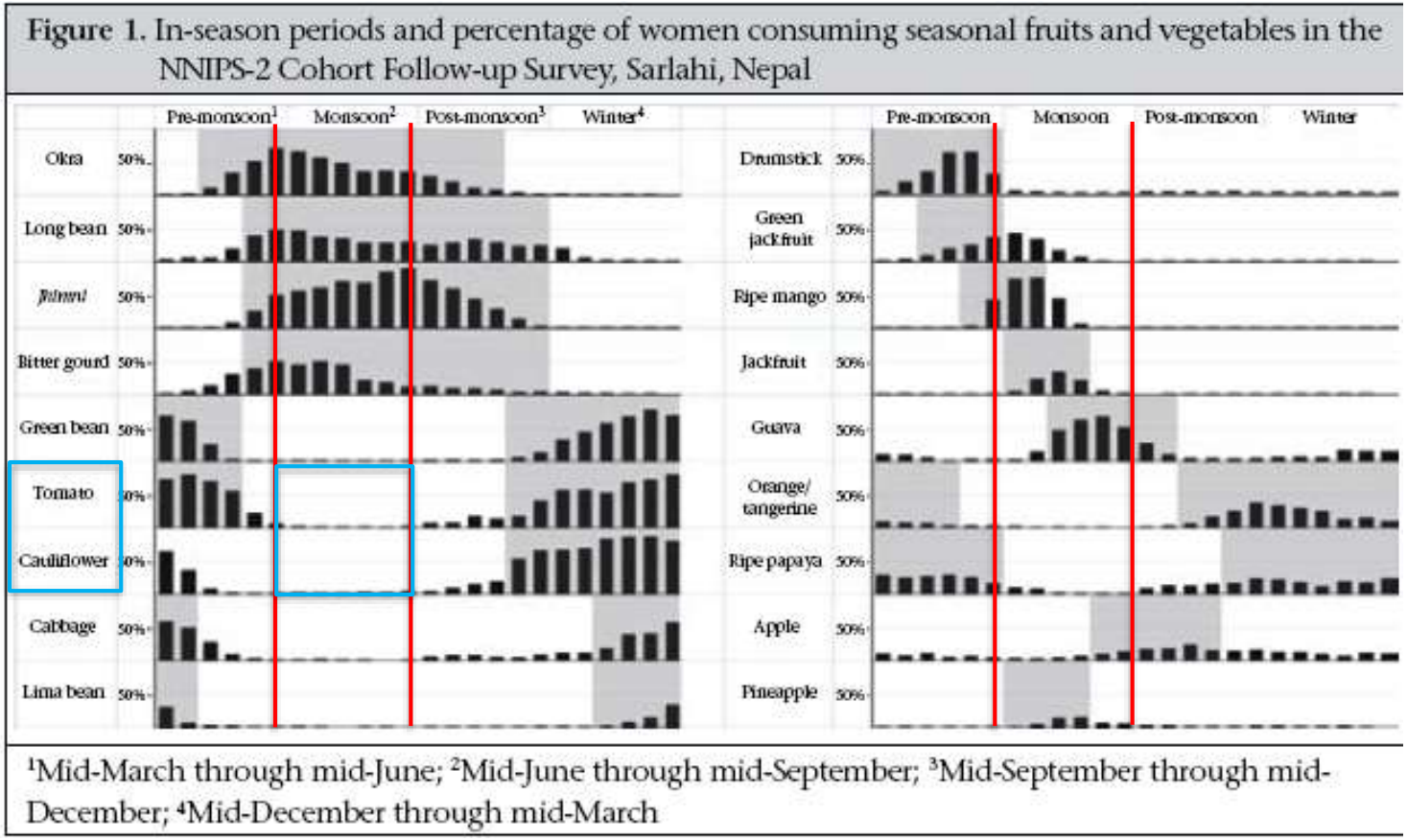

Figure 1. In-season periods and percentage of women consuming seasonal fruits and vegetables in the NNIPS-2 Cohort Follow-up Survey, Sarlahi, Nepal

[1]Mid-March through mid-June; [2]Mid-June through mid-September; [3]Mid-September through mid-December; [4]Mid-December through mid-March

Campbell RK et al J Health Popu Nutr 2014

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AGRICULTURE TO NUTRITION PATHWAYS

PoSHAN Community Studies within the Feed the Future Nutrition Innovation Lab

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PoSHAN Community Studies: Series of Agriculture-to-Nutrition Surveys

To assess - mid-June to mid-Sept, 2013-2016, in a nationally representative sample of Village Development Committees (VDCs, sub-districts) -

- **Agricultural Practices**: Types, amounts and disposition of foods grown: (a) animals past year and (b) crop harvests rainy & dry season
- **Market Availability:** Local market surveys
- **Household SES/Food Security:** Wealth index and HFIAS past month
- **Foods Purchased**: Past month
- **Dietary Intake:** Past week, 7-day food frequency (42-item) in mothers
- **Nutritional and Health Status:** Anthropometry, morbidity histories, etc.

To Construct Pathways that could be improved in future via agricultural, marketing, nutrition and other public health services

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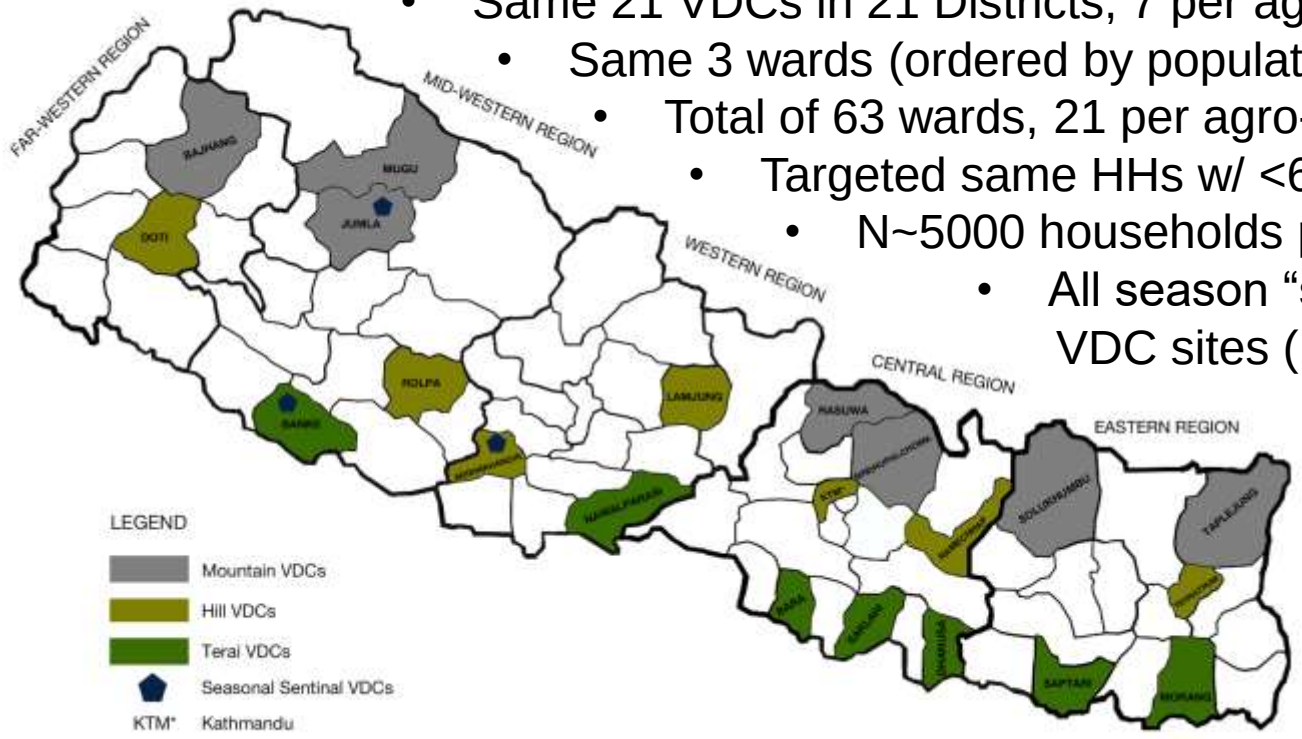
PoSHAN Survey Sites

- Same 21 VDCs in 21 Districts, 7 per agroecological zone
- Same 3 wards (ordered by population) per VDC
- Total of 63 wards, 21 per agro-zone
- Targeted same HHs w/ <6 yr olds
- N~5000 households per year
- All season "sentinel" VDC sites (1 per zone)



Klemm RDW et al. Pathways from Agriculture-to-Nutrition: Design and Conduct of the National PoSHAN Surveys of Nepal. Journal of Food Security 2018;6:79–89.

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AIMS

In a consecutive series of national surveys -

- Summarize mid-year, 7-day food frequencies of mothers across the mountains, hills and Terai of Nepal;

- Estimate direction, strength and stability of association between -
  - Maternal intakes of staples, animal source foods (ASFs), vegetables & fruits and HH production of same foods during the year;
  - Maternal intakes of these foods as a function of HH expenditure on such foods in the previous month

- Reveal the relative merit of household food production (and food expenditure) in improving dietary intakes of women

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ANALYTICAL APPROACH

- Estimate median (IQR) 7-day food frequency: **2013, 2014 & 2016 ***

- Calculate odds ratios (95% CIs) of mothers consuming specific foods more often than national median frequency, in HHs -
  - Growing animal sources of food in the past year,
  - Growing specific crops (rainy or dry season) in past year,
  - Purchasing specific foods in the previous month.

- Adjusted for agro-zone, maternal age, wealth index & cluster

- Further adjusted for either purchasing or growing food

*Mid-2015 survey limited to Tarai following earthquake in Hills & Mountains in April/May 2015
Thorne-Lyman A et al PLoS One 2018;13:e0205438

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ACHIEVED SAMPLE SIZES PER YEAR

Annual National Surveys			
Total	**2013**	**2014**	**2016**
Households screened	9316	10689	12143
Eligible households	4379	5096	5173
Households interviewed	4286	4947	5097
Women interviewed	4509	5202	5458

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MEDIAN (IQR) MATERNAL WEEKLY INTAKE FREQUENCIES IN NEPAL, MAY-AUGUST 2013-16

Foods	2013	2014	2016
Rice	**14 (14,18)**	**14 (14, 18)**	**14 (14, 18)**
Daal	**7 (4, 14)**	**7 (4, 14)**	**8 (4, 14)**
Vegetable Oil	**16 (14, 21)**	**21 (14, 21)**	**21 (14, 21)**
Meat/Poultry	**1 (0, 2)**	**1 (0, 2)**	**1 (0, 2)**
Dairy	**2 (0, 7)**	**1 (0, 7)**	**2 (0, 7)**
Egg	**0 (0, 1)**	**0 (0, 1)**	**0 (0, 1)**
DGLV	**2 (1, 4)**	**2 (0, 4)**	**3 (1, 5)**
Carotenoid Veg & Fruits	**1 (0, 4)**	**1 (0, 3)**	**0 (0, 3)**
Carrot	0 (0, 0)	0 (0, 0)	0 (0, 0)
Pumpkin, ripe	0 (0, 0)	0 (0, 0)	0 (0, 0)
Mango, ripe	0 (0, 3)	0 (0, 2)	0 (0, 2)
Papaya, ripe	0 (0, 0)	0 (0, 0)	0 (0, 0)
Jackfruit, ripe	0 (0, 0)	0 (0, 0)	0 (0, 0)

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MEDIAN (IQR) MATERNAL WEEKLY INTAKE FREQUENCIES IN NEPAL, MAY-AUGUST 2013-16

Foods	2013	2014	2016
Other Vegetables	**5 (2, 10)**	**5 (2, 9)**	**5 (2, 9)**
Gundruk	0 (0, 0)	0 (0, 0)	0 (0, 0)
Green Beans	1 (0, 3)	0 (0, 2)	0 (0, 2)
Green Peas	0 (0, 0)	0 (0, 0)	0 (0, 0)
Gourd	1 (0, 4)	1 (0, 4)	1 (0, 4)
Okra	0 (0, 2)	0 (0, 2)	0 (0, 2)
Eggplant	0 (0, 0)	0 (0, 0)	0 (0, 1)
Cauliflower	0 (0, 0)	0 (0, 0)	0 (0, 0)
Other Fruits	**2 (0, 7)**	**2 (0, 8)**	**3 (0, 11)**
Guava	0 (0, 0)	0 (0, 0)	0 (0, 0)
Orange	0 (0, 0)	0 (0, 0)	0 (0, 0)
Apple	0 (0, 0)	0 (0, 0)	0 (0, 1)
Banana	0 (0, 0)	0 (0, 0)	0 (0, 1)
Tomato	0 (0, 4)	0 (0, 6)	0 (0, 7)
Snacks	2 (0, 4)	2 (0, 4)	2 (0, 5)

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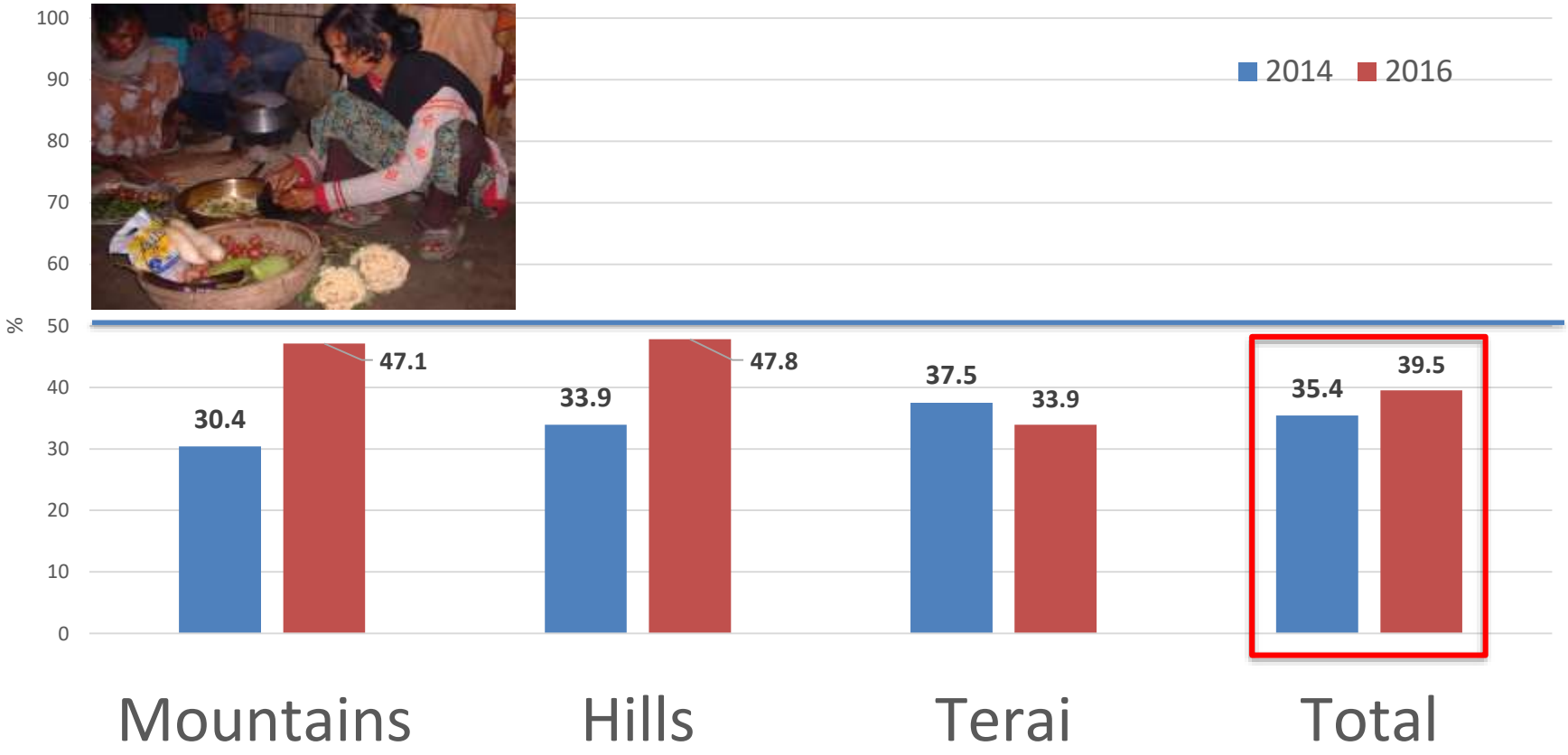
Minimum Dietary Diversity* for Women in 2014 & 2016

* Eating from 5 or more FAO designated food groups in past 24 hours



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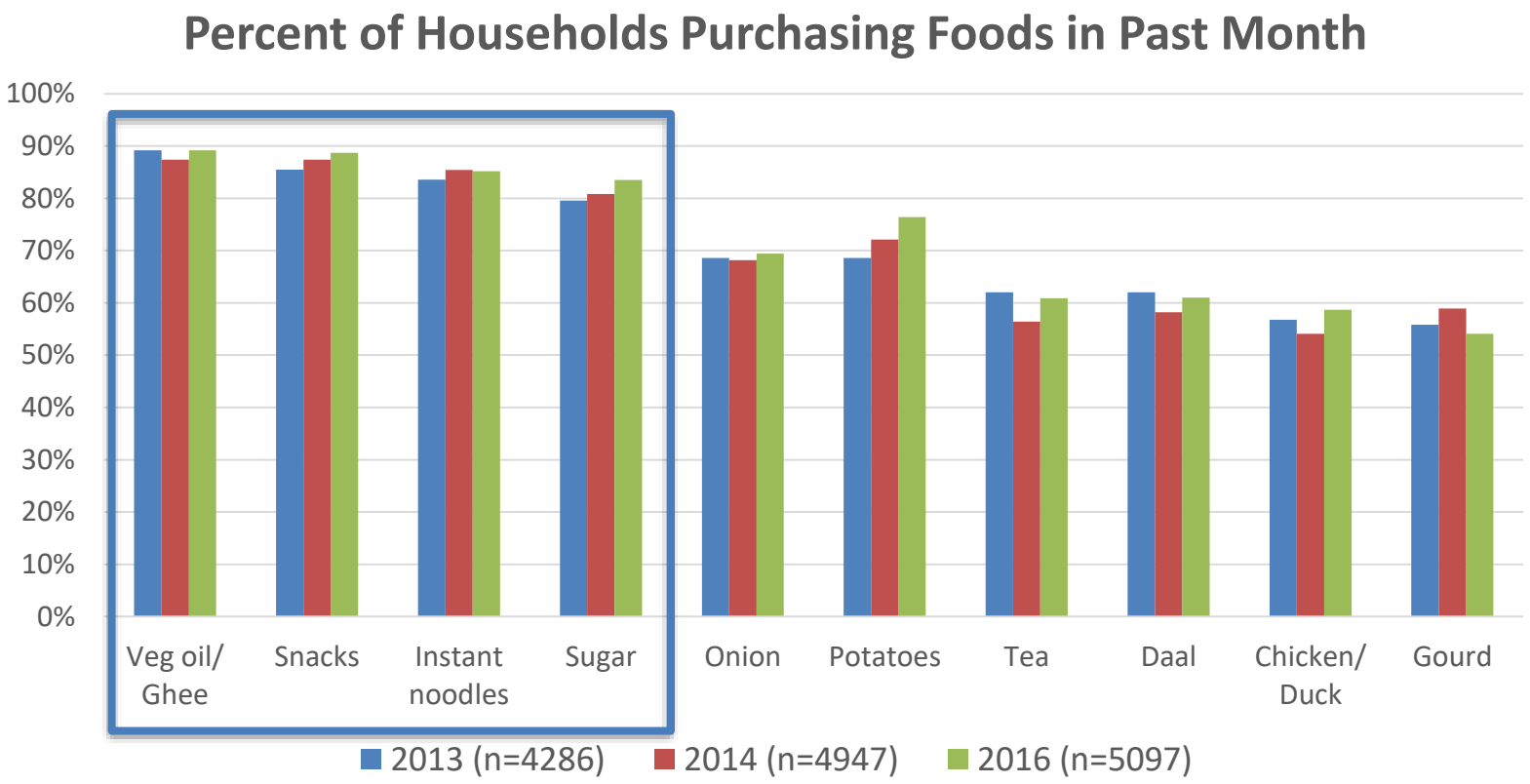
MARKET SURVEY FINDINGS 2013, 2014 & 2016



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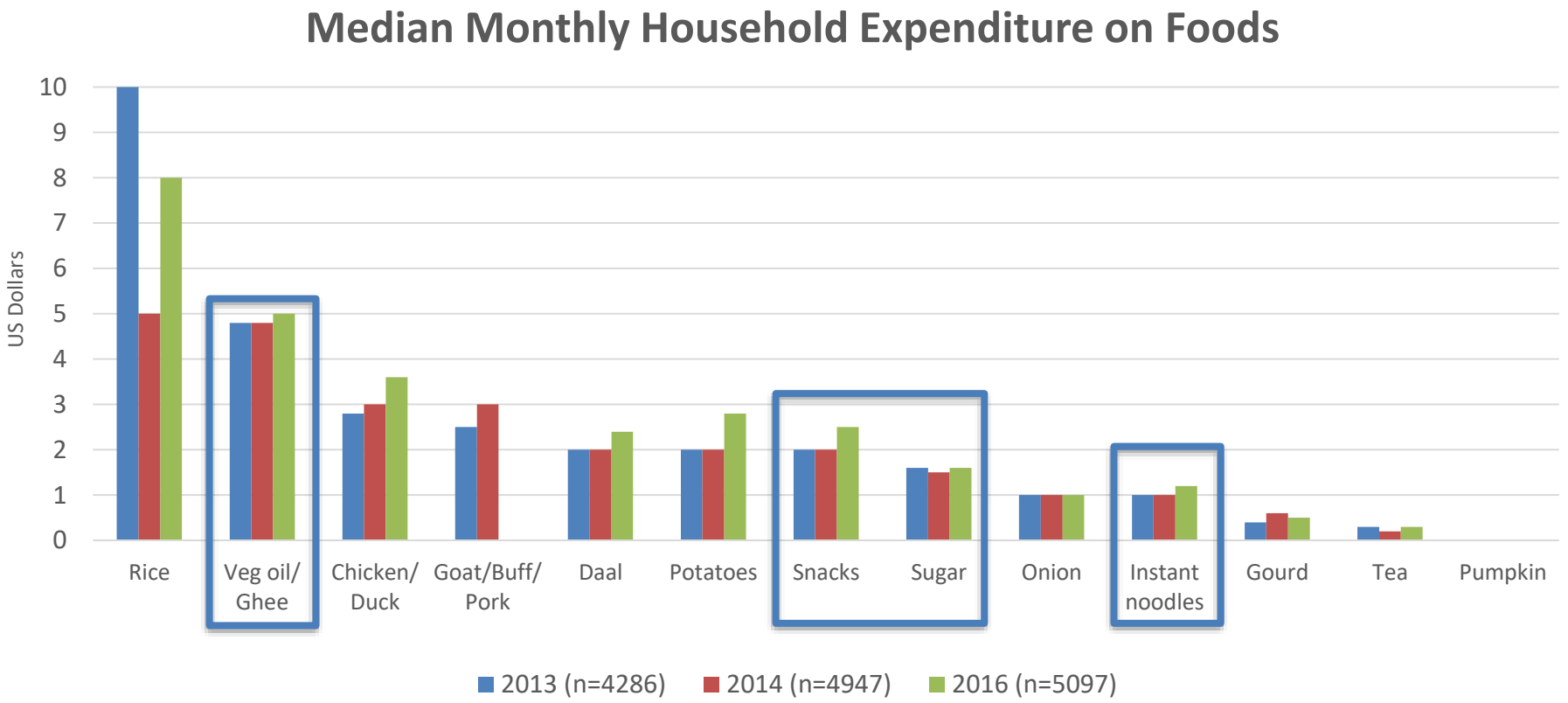
MARKET SURVEY FINDINGS 2013, 2014 & 2016



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PRODUCTION, PURCHASING & RELATIVE ODDS OF CONSUMING ILLUSTRATIVE FOODS IN 2013 & 2016…

Animal source foods: Egg, chicken, meats, dairy

Staples: Rice, lentils/daal

Vegetables: DGLVs, cauliflower

Fruit: Papaya

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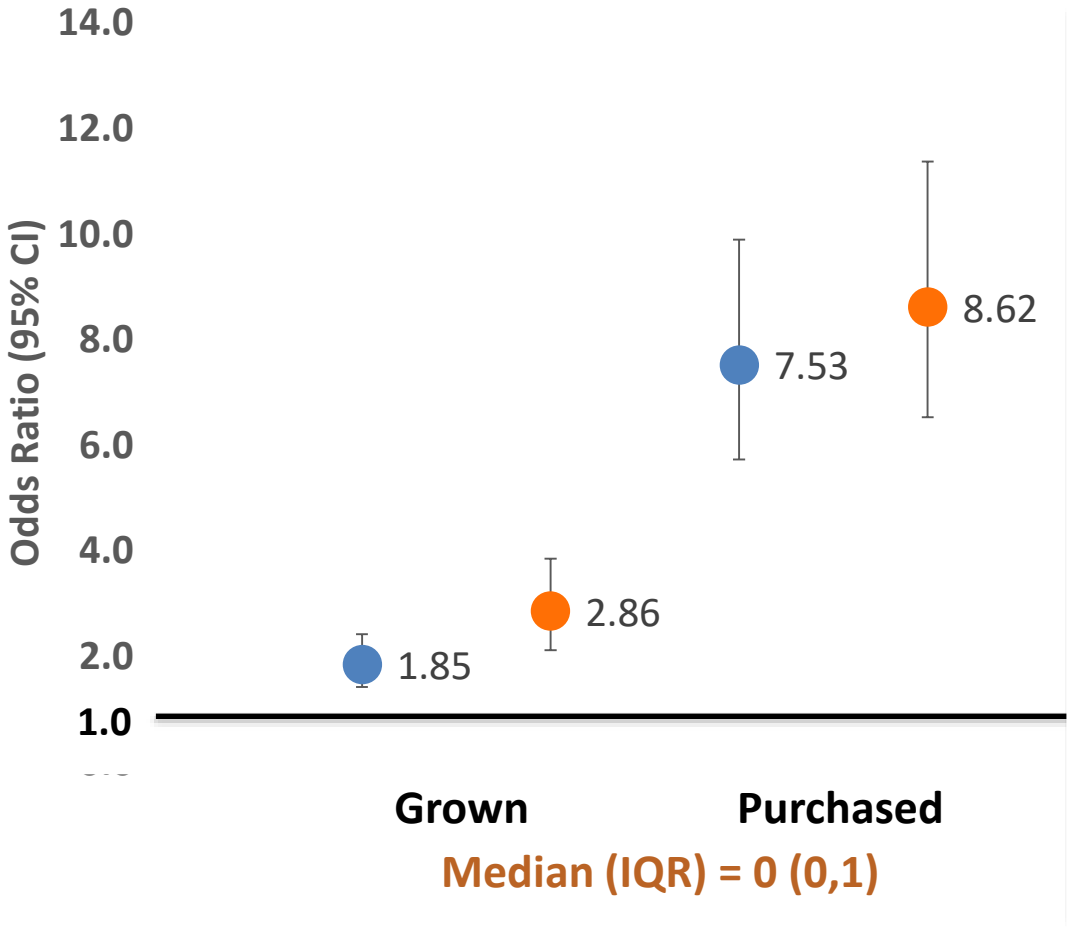
Odds of Women consuming Eggs > National Median Frequency



Median (IQR) = 0 (0,1)

2013

- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

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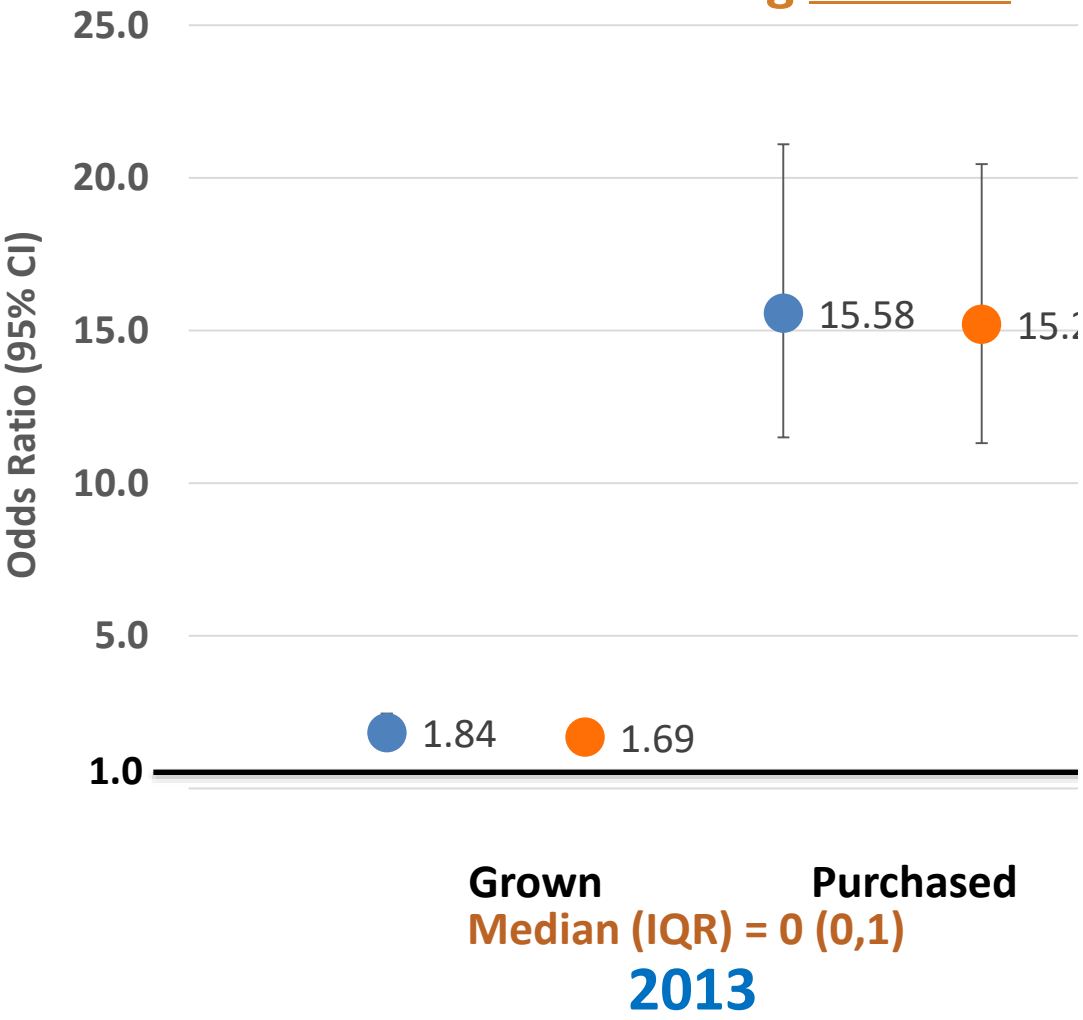
Odds of Women consuming Chicken > National Median Frequency

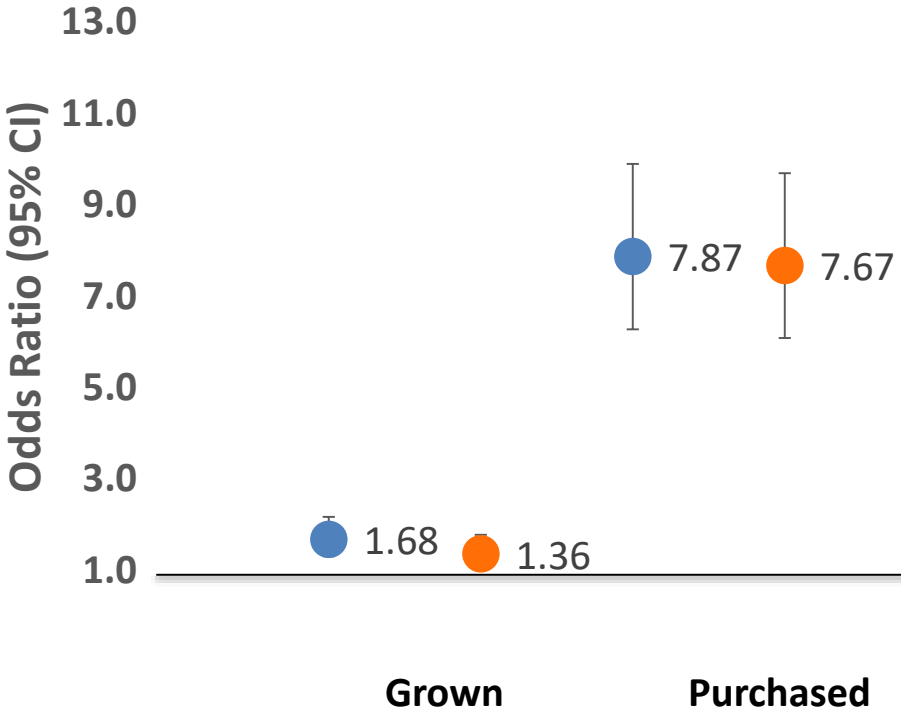


Median (IQR) = 0 (0,1)

2013

- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

Odds of Women consuming Meat* > National Median Frequency



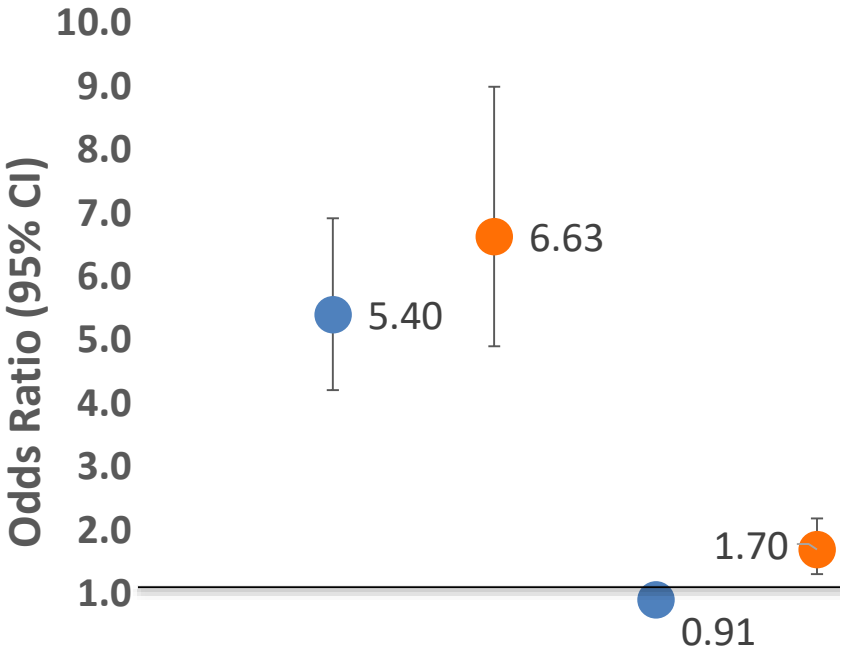
Median (IQR) = 1 (0,3)

2013

- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

* Meat sources include goats, buffalo and hogs

Odds of Women consuming Dairy > National Median Frequency

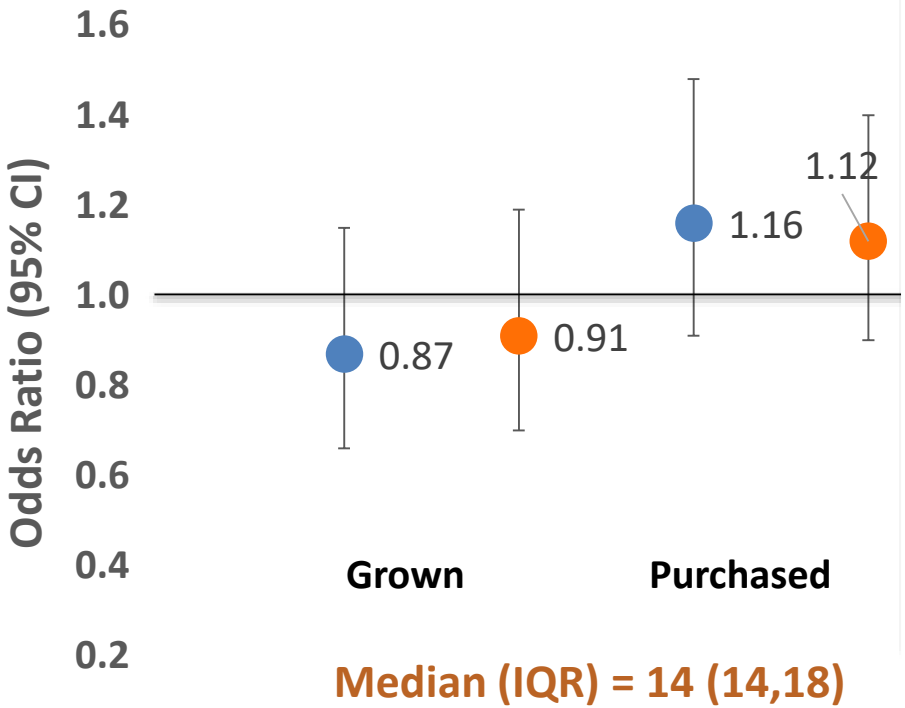


Median (IQR) = 2 (0,7)

2013

- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

Odds of Women consuming Rice > National Median Frequency

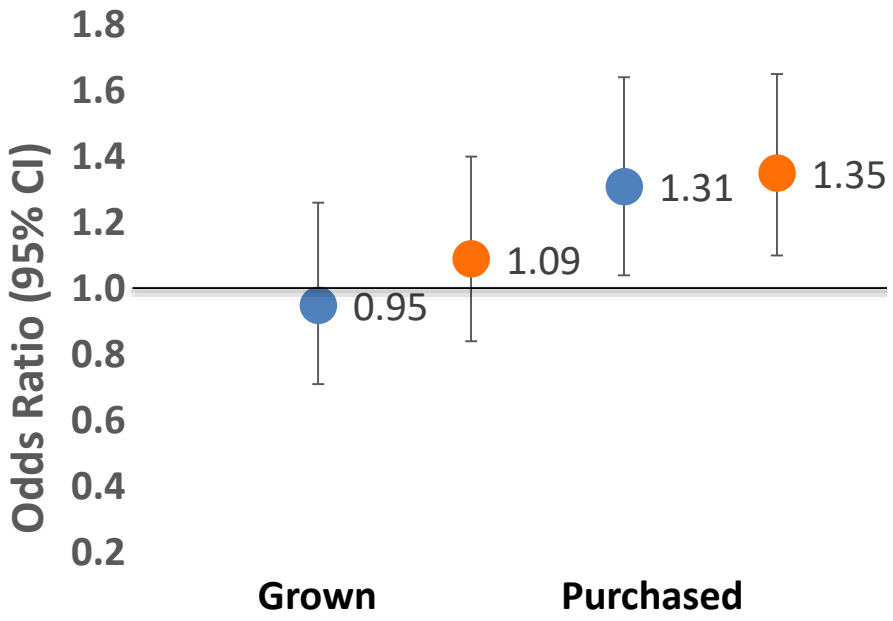


Median (IQR) = 14 (14,18)

2013

- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

Odds of Women consuming Daal > National Median Frequency

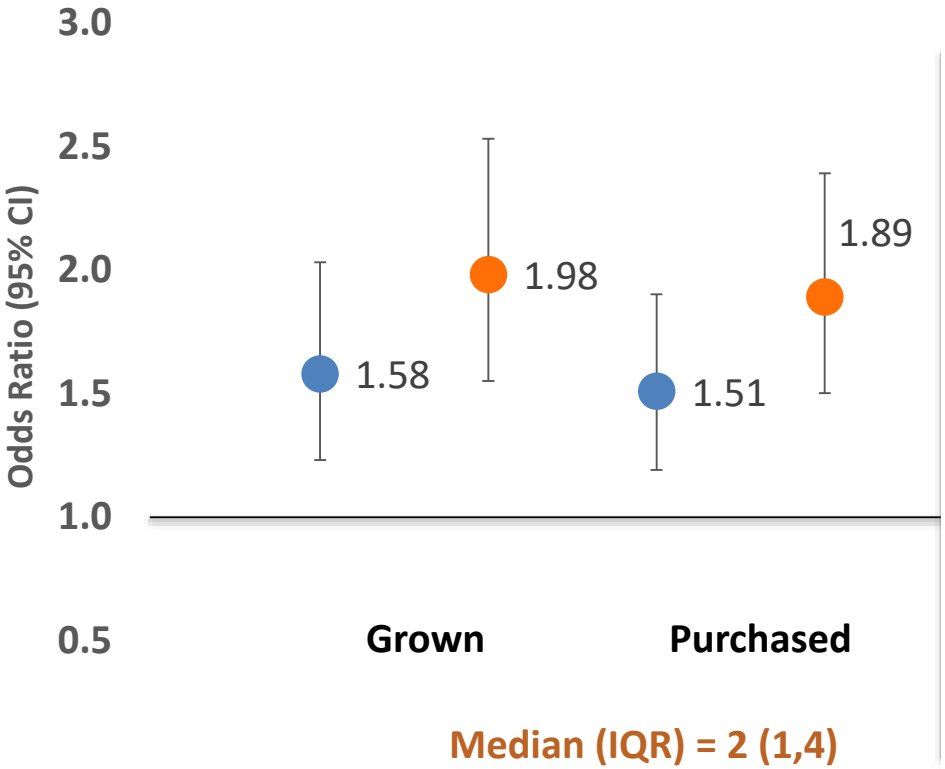


Median (IQR) = 7 (4,14)

2013

- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

Odds of Women consuming DGLV > National Median Frequency



Median (IQR) = 2 (1,4)

2013

- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

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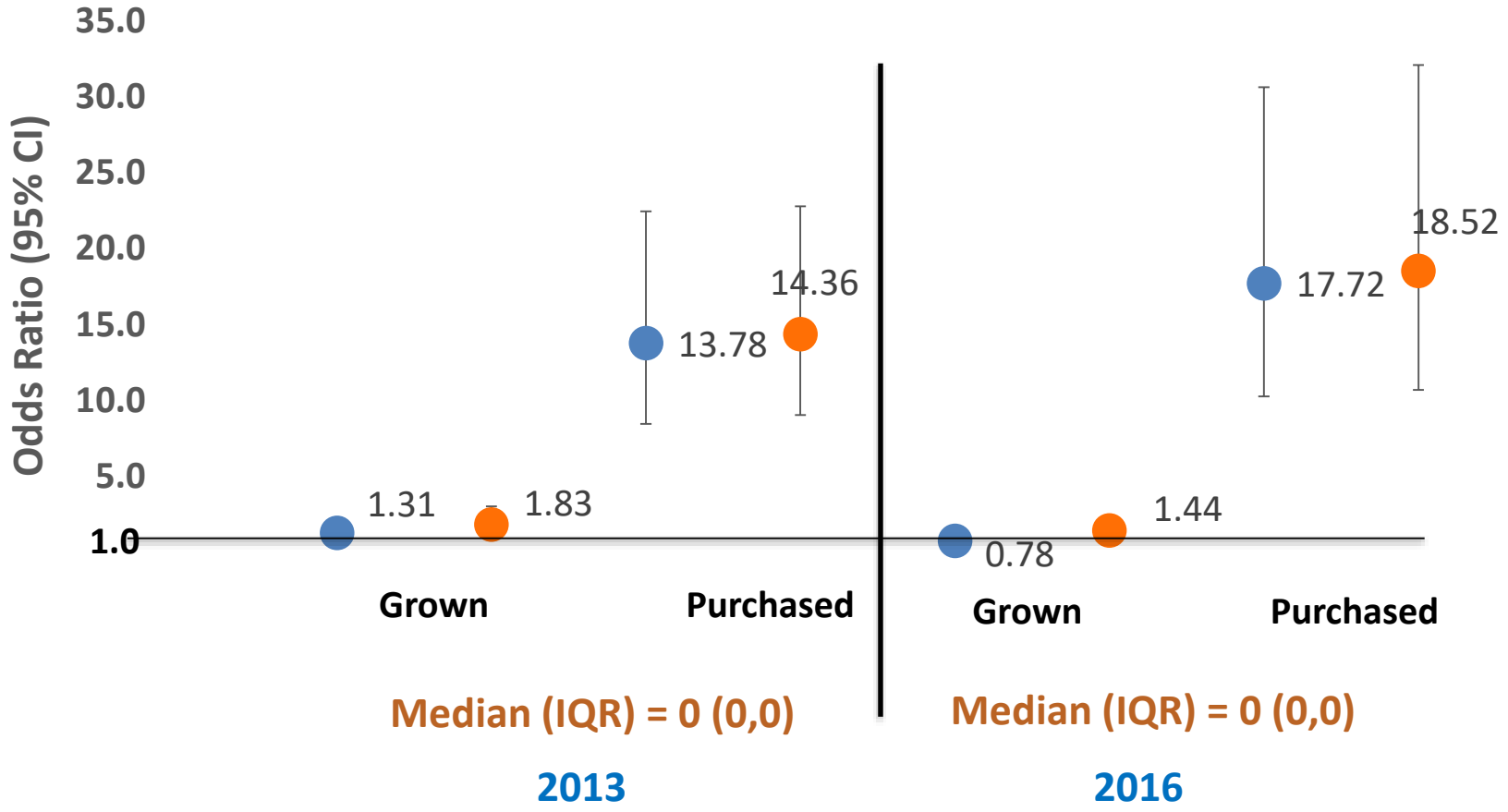
Odds of Women consuming Cauliflower > National Median Frequency



- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

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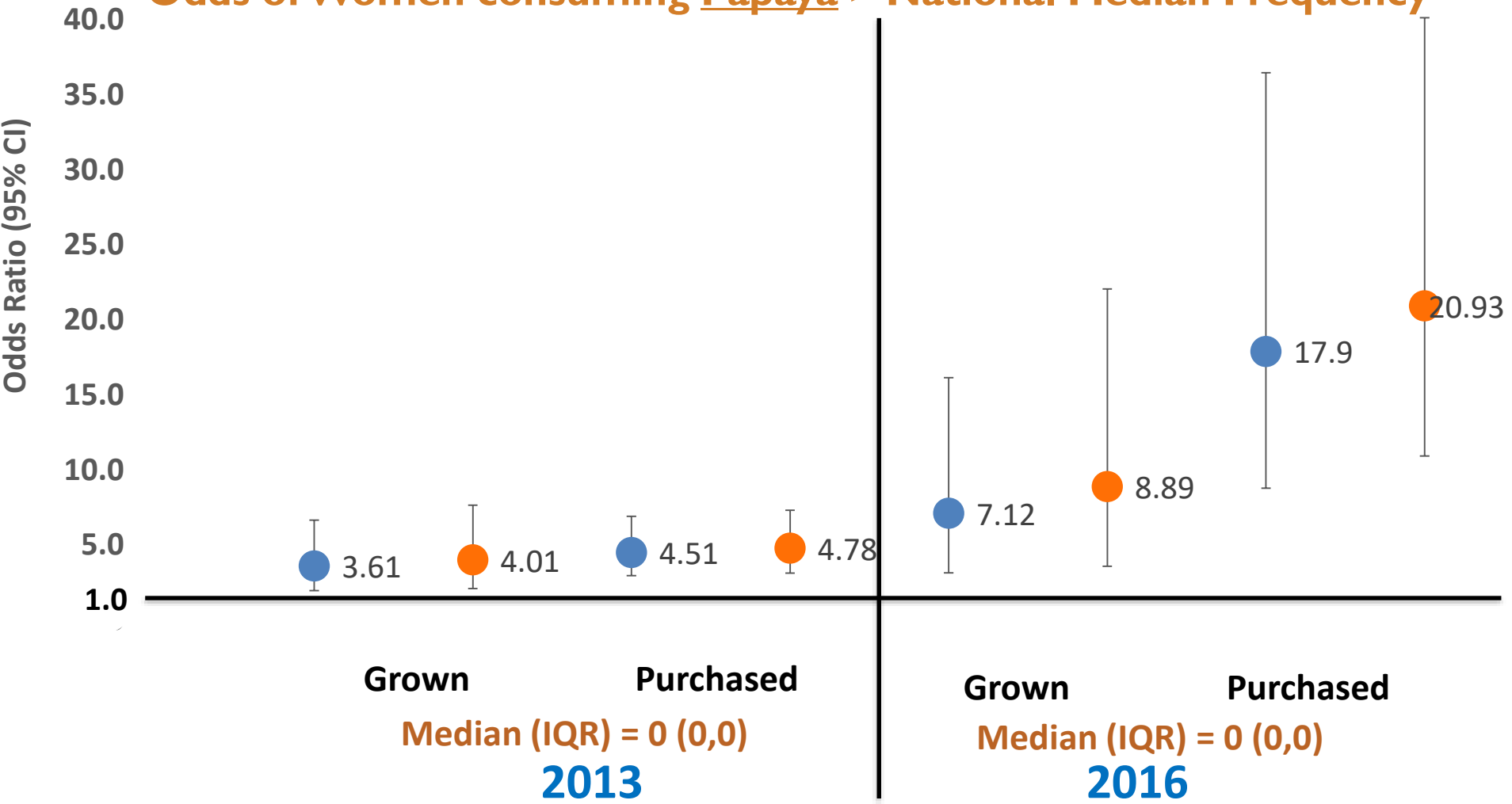
Odds of Women consuming Papaya > National Median Frequency



- Adjusted for agro-zone, wealth, maternal age and design effect
- Also adjusted for whether also purchased or grown

MATERNAL DIET IN NEPAL

- Average maternal dietary intakes remain meager from year to year except for some increases at the 75%ile:

  Daily: Two rice meals, one with daal and one with a vegetable other than DGLV, which is eaten 2-3 times a week

  Any animal source food eaten every other day

  Any fruit is eaten 2-3 times a week

  Oil is consumed 3 times a day and snack foods twice a week

- 40% of women chronically meeting a threshold for minimum dietary diversity, likely to be causing multiple micronutrient deficiencies.

HOME FOOD PRODUCTION AND MATERNAL DIET

- Relative odds of mothers eating foods more often than national median, if producing vs not, are stable across years.
- Mothers from HHs raise **chickens/eggs, goats, buffalo and hogs** are **~1.5 to 4 times** more likely to consume meat and eggs more often than national average.
- Mothers from HHs growing **vegetables or fruit** are **~1.5 to 4 times** more likely to consume these foods more often than national average.
- Adjusting ORs for purchasing ~strengthens ORs, but depends on food.
- Mothers purchasing foods are far more likely to eat those foods more often than national average. Exception is dairy (milk).
- Growing staples (e.g., rice, lentils/daal, potatoes) has little effect on relative odds: foods are eaten regardless of source.

ASSESSMENT APPROACH

- Monsoon: dietary “mid point” season: not best, not worst.
- Repeat, same-season surveys: allows stability of dietary intakes and home food production-to-diet pathways to be evaluated across years
- Seasonality requires multiple assessments during year
- Assessing same sites by same protocol limits sources of extraneous variation
- Odds ratio approach, with a national median threshold (not = desirable equilibrium), provides an interpretable, normative metric to evaluate relative diet-agriculture relationships; other frequency thresholds are possible

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- National Planning Commission, Government of Nepal
- Child Health Division, Ministry of Health and Population, Government of Nepal
- District Govt of Nepal Offices and officials in 21 districts across Nepal
- Nepal Agricultural Research Council, Nepal
- Institute of Medicine, Tribhuvan University, Kathmandu
- Respondents and their families across the Mountains, Hills and Terai
- New ERA Pvt Ltd, Kathmandu, Nepal
- Nepali Technical Assistance Group (NTAG), Kathmandu Nepal
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- Johns Hopkins Bloomberg School of Public Health Research Team (JHU)
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FURTHER ENGAGEMENT RESOURCES

- Dr. Keith P. West's email address - **kwest1@jhu.edu**

- Site for accessing PoSHAN survey data

  Johns Hopkins University Dataverse - https://archive.data.jhu.edu/dataverse/PoSHAN_Surveys

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The Relationship Between Dietary Diversity Among Women of Reproductive Age and Agricultural Diversity in Rural Tanzania

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AGRICULTURE IN TANZANIA

- The Tanzanian government has prioritized growth in agriculture to achieve reductions in poverty and improve food security (United Republic of Tanzania 2011)
- Agriculture accounts for 28% of GDP (World Bank 2017)
- 65% of the adult population are employed in agriculture (World Bank 2019)
- 83% of farms are run by small holder farmers who contribute 75% of agricultural output (FAO 2018)
- Smallholder farmers sell 35% of their agricultural products (FAO 2018)
- Most common crops grown by smallholder farmers are maize, cassava, paddy, sorghum and bananas (FAO 2018)

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Original Research

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The Relationship Between Dietary Diversity Among Women of Reproductive Age and Agricultural Diversity in Rural Tanzania

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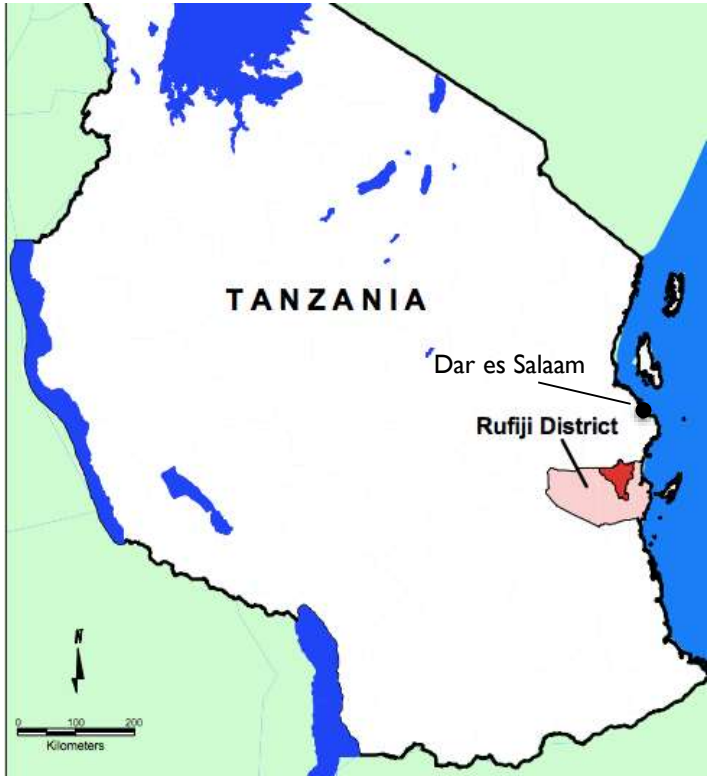
STUDY METHODS

- Cross-sectional study from baseline survey of a cluster randomized clinical trial promoting homestead gardening intervention
- **Sample size:** 1006 women
- **Study Location:** 10 villages in the Rufiji river delta
- **Inclusion criteria:** Households with a woman of reproductive age (18-49 years), at least one child less than 36 months, and access to land for agricultural use



Source: Mwageni et al. (1998). Rufiji DSS: Tanzania essential health interventions project. Tanzania Ministry of Health.

DATA COLLECTION

- Baseline data collection: August to October 2016
- During household visits collected information on household demographics, woman's health, agricultural production, physical activity, women's empowerment, food security, and dietary intake
- Dietary diversity scores were calculated from 30-day food frequency questionnaire. Foods were categorized into ten food groups using FAO guidance (FAO and FH360 2016)
- Agricultural diversity scores were categorized using two methods
  1) Crop Nutritional Functional Richness: crops categorized into 7 food groups consistent with dietary diversity scores
  2) Crop Species Richness: number of crop species grown

RESULTS

Study Population

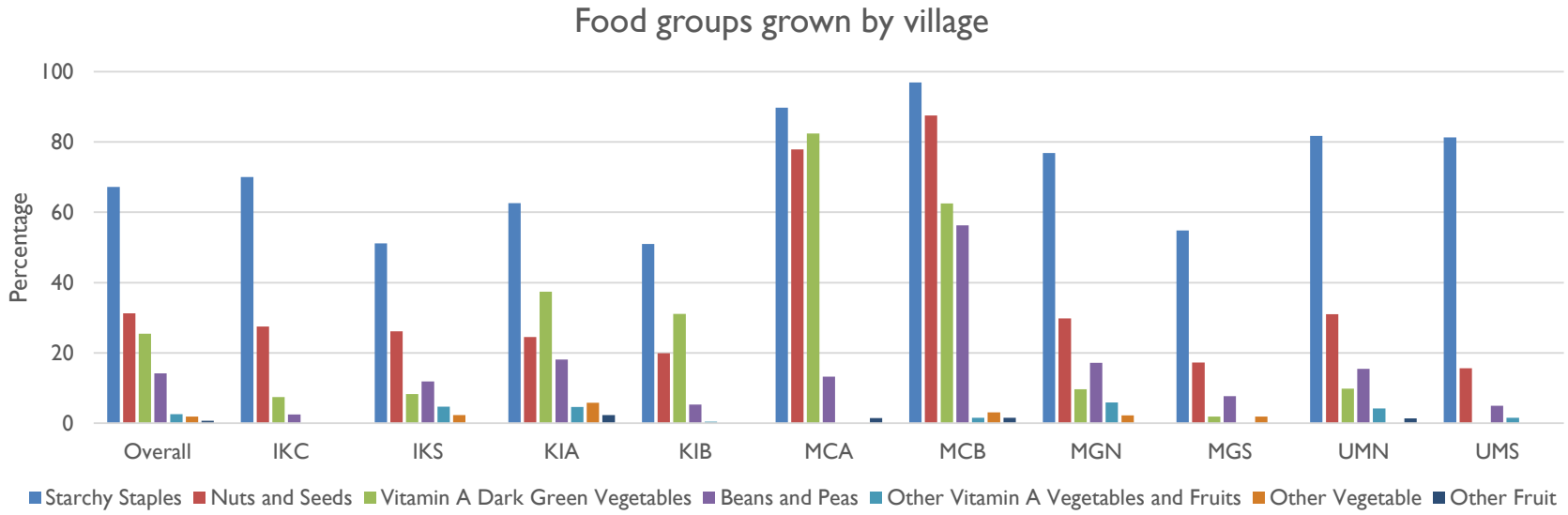
- Average household size: 7 individuals per household
- 33% of women reported no formal education and 58% reported some primary education
- 51% of households reported experiencing some form of food insecurity in the last month
- 73% of households participated in agriculture and average size of land was 0.85 hectares
- 30% of households reported ownership of livestock

RESULTS

Crops grown by households

- Households grew an average of 3 crops from an average of 1.5 food groups.

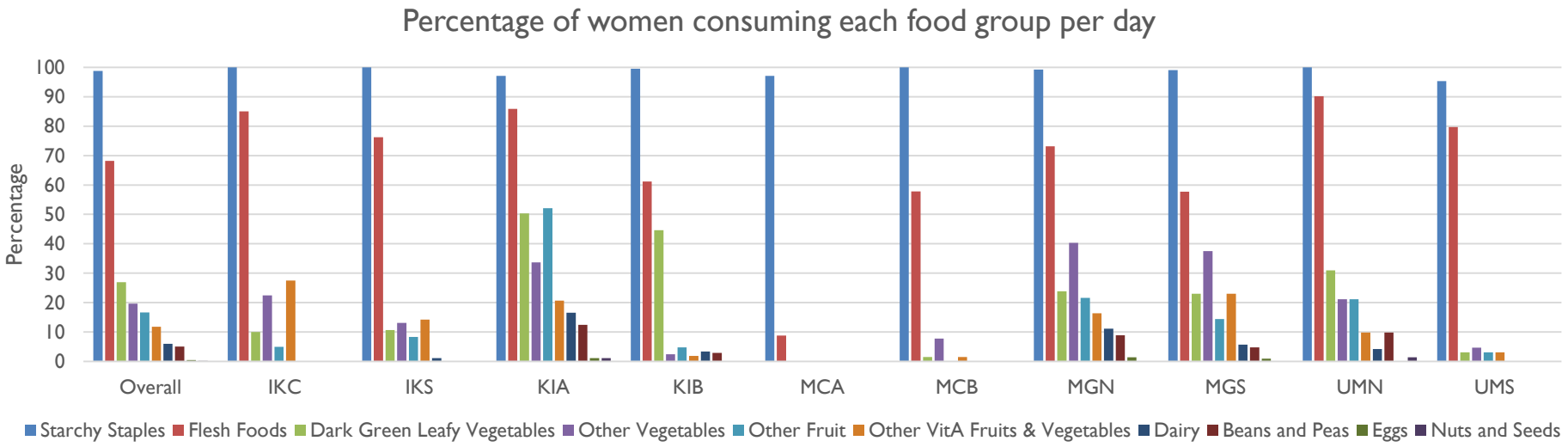
- 5 most common crops grown: maize, rice, sesame, cassava, cashews



RESULTS

Dietary Diversity

- Women consumed an average of 3 food groups per day
- Five most common foods consumed: ugali, fried fish, okra, fresh fish, rice



RESULTS

Table 3. Factors Associated With Dietary Diversity Among Tanzanian Women of Reproductive Age.

	Bivariate Analysis[a]		Multivariate Analysis[b]	
Variable	Estimate (95% CI)	*P* Value	Estimate (95% CI)	*P* Value
Crop Nutritional Functional Richness Score				
Score 1	Ref (1.00)		Ref (1.00)	
Score 2	0.23 (0.01 to 0.44)	.02[c]	0.16 (-0.06 to 0.37)	.04[c]
Score 3+	0.32 (0.01 to 0.63)		0.30 (-0.01 to 0.61)	
Crop Species Richness Score				
Score 1	Ref (1.00)		Ref (1.00)	
Score 2 to 3	−0.09 (−0.36 to 0.18)	.31[c]	−0.12 (−0.39 to 0.14)	.45[c]
Score 4+	0.13 (−0.17 to 0.44)		0.09 (−0.20 to 0.40)	
Ownership of livestock	0.35 (0.16 to 0.53)	.0002	0.30 (0.08 to 0.44)	.005
WRA participation in cash crop production	0.30 (0.11 to 0.48)	.0017	0.22 (0.03 to 0.41)	.02
WRA participation in food crop production	0.07 (−0.11 to 0.25)	.43	0.003 (−0.17 to 0.18)	.96
Growing at least 1 crop	0.16 (−0.04 to 0.35)	.11	0.06 (−0.14 to 0.26)	.57
Growing dark leafy green vegetables	−0.01 (−0.23 to 0.21)	.93	−0.03 (−0.24 to 0.19)	.78
Growing starchy staples	0.02 (−0.16 to 0.20)	.83	−0.07 (−0.26 to 0.11)	.41
Growing pulses	0.51 (0.27 to 0.75)	<.0001	0.50 (0.27 to 0.74)	<.0001
Growing other vegetables	0.62 (0.08 to 1.17)	.03	0.64 (0.11 to 1.17)	.02
Growing other vitamin A-rich fruits and vegetables	0.09 (−0.54 to 0.73)	.77	−0.07 (−0.69 to 0.54)	.81
Growing nuts or seeds	−0.02 (−0.22 to 0.17)	.80	−0.10 (−0.29 to 0.09)	.29

Abbreviations: CI, confidence interval; WRA, women of reproductive age.
[a]Bivariate model adjusted for village pairs to account for clustering.
[b]Multivariate model adjusted for average amount of money spent on food per person, number of people living in the household, woman education level, household wealth index (categorical), land size (categorical), and village pairs.
[c]*P* for trend.

CONCLUSIONS

- Agricultural production diversity is associated dietary diversity among women in this study
- Higher dietary diversity is associated with correlates in the agricultural income pathway, including livestock ownership, cash crop production, and growing pulses intended for the market
- Interventions that promote agricultural production diversity may be effective at improving diets and nutritional status among women and children, but market access may play a prominent role in this relationship.

ONGOING RESEARCH

- Crop production diversity, women's empowerment and distance to markets in relation to maternal dietary quality (Madzorera et al. Under Review)
- Assessment of homestead food production intervention on dietary diversity and food security after 1 year (Blakstad et al. Under Review)
- Assessment of homestead food production intervention on dietary diversity and food security after 2 year (Mosha & Blakstad et al. In Progress)

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WOMEN'S EMPOWERMENT, CASH CROPS AND CHILD GROWTH IN UGANDA

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MOTIVATION

Agriculture and cash income

- Cash income is very important for livelihoods in many societies including those in rural agro-based communities
  - cash can increase the household's capacity to purchase improved diets (hence improving dietary quality and diversity)
  - cash facilitates households to buy other essential non-food items (e.g. health, transport, housing, etc.)
- For many rural agro-based households, selling part of their own farm produce serves as an important source of cash
- Agricultural commercialization, and specifically promotion of cash crops is considered a feasible way to generate cash with broader implications for welfare and nutrition

MOTIVATION

Agricultural commercialization and nutrition

- Evidence on the linkages between agricultural commercialization and nutrition is sparse, mixed and inconclusive:
  - in some cases, agricultural commercialization is claimed to make smallholder households worse-off in terms of food security and nutritional outcomes.
  - the burden of the adverse effects of agricultural commercialization are felt most by the vulnerable groups within the households (women, children)
- Available evidence being insufficient, there are calls for more robust analysis based on sound research design to unpack any underlying associations
  - other studies emphasize that welfare and nutritional benefits of agricultural commercialization can only be leveraged through the gendered-lens.

MOTIVATION

Women empowerment in agriculture and nutrition

- Increased women's autonomy and empowerment in agriculture are beneficial to household welfare with some substantial contributions to the reducing undernutrition because:
  - empowered women contribute to improved child nutrition through dietary quality and improved infant and young feeding practices
  - women are often perceived vital in safeguarding children's interests
- Yet, women's ownership and participation in decision-making of key household production resources is still quite constrained in most low income countries
  - for cash crops, men are usually the main asset owners and decision-makers

OBJECTIVES

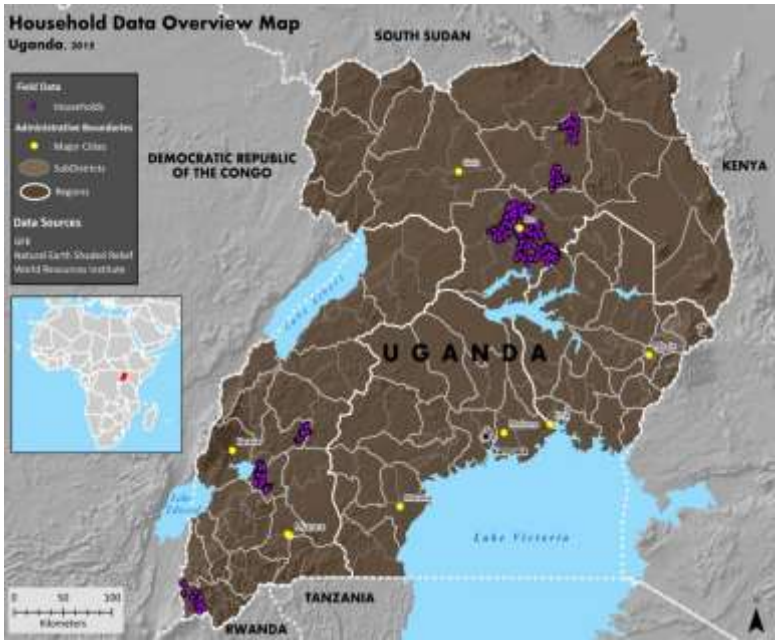
- **The main objective of this study was to:**

"…rigorously test the assumption that when women are given the opportunity to own and/or make decisions in relation to cash crops, they will put children's interest at the fore and use the cash income raised to improve children's nutrition status."

- **Unlike previous studies:**
  - we use a large panel dataset covering most of Uganda over a long period of time
  - we employ advanced analytical methods to account for observed and non-observable characteristics at the individual, household and contextual level
  - we test for robustness of methods and results; and examine the heterogeneity effects across different children categories (based on gender and age)

DATA

Panel Survey Data



- Panel dataset from 6 districts in Uganda by the FtF Innovation Lab for Nutrition
  - 2 Southwest (Kisoro & Kamwenge)
  - 4 North (Agago, Kole, Dokolo & Lira
- ~3,200 households in in each survey round in 2012, 2014 and 2016;
- ~over 12,000 children (0-5 years)
- Collected a range of data ranging from agriculture, nutrition, health, endowments, gender, etc.

- Child anthropometry (body measurements) on a large sample of children (0-5 years) was conducted in every survey round to determine child linear growth.

DATA

Cash cropping household subsample

- Analysis is restricted to a subsample of households that:
  - had children 6–59 months (with anthropometry taken)
  - grew traditional cash crops (i.e. coffee, cotton, sunflower, sugarcane and sesame) six months prior to each survey round
- In total, we identified 3,983 child observations in the 3 survey rounds

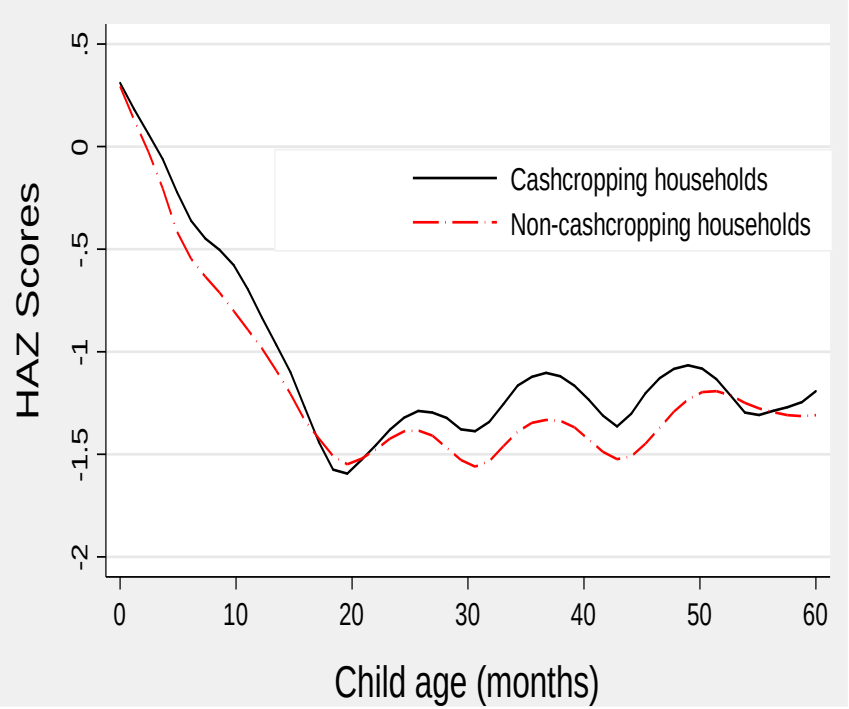
Survey round	2012	2014	2016	**Total**
Sample size	1,837	1,075	1,071	**3,983**

DATA

Dependent variable:

Child nutritional status

- Under 5 nutrition status was determined based on linear growth metrics.
- Child HAZ scores, standardized for age and sex, were computed based on the WHO growth reference standards.
- Child stunting prevalence was defined as HAZ score < −2 standard deviations and reflects long-term inadequate nutrition and/or poor health



Mean child HAZ by age in months, relative to the WHO standard for children under age 5 in cash-cropping and non-cash cropping Ugandan households

DATA

Primary exposure: Women empowerment

- Women empowerment is multidimensional and context-specific.
- In this analysis, we define women's empowerment as a woman's ability to make strategic choices in life (Kabeer 1999):
  - able to negotiate increased decision-making roles in their households and to fully utilize available resources—particularly when this ability had been limited
- Evidence on the associations between various indicators of women empowerment and child nutrition outcomes is inconclusive and often insignificant
  - likely due to limitations in study designs and analytical methods.
  - Failure to address context-specificity, which raises endogeneity concerns that potentially undermine reliability of the actual relationships.

DATA

Primary exposure: Women empowerment

- The survey tool included questions that aimed to measure women's relative power within the household in agricultural production and asset holdings.
- Our analysis of women's empowerment in cash cropping considered 3 questions:
  1. actual ownership (and responsibility) over cash crop production;
  2. actual control (decision on whether/who to purchase inputs and sell output); and
  3. who makes decisions on how to use revenues from sale of cash crops.

→ In the analysis, 2 and 3 were implicitly inseparable, combined to form "decision-making"

- Household respondents would either select:
  a) main man (often the male household head in a predominantly patriarchal society);
  b) main woman (usually the wife); or
  c) jointly (both main man and main woman)

ANALYTICAL APPROACH

Potential selectivity bias (confounding)

- Confounding concerns could make it difficult to draw unbiased conclusions on the relationship between women empowerment regimes (ownership and decision-making of cash crops) and child nutrition outcomes:
  - selection bias could stem from unobserved factors that influence women empowerment in and child nutrition simultaneously e.g. egalitarian views
  - reverse causality: well-nourished children may earn women more respect from their husbands/community, rendering such women more independent in cashcrop ownership and decision-making

ANALYTICAL APPROACH

Multinomial Endogenous Treatment Effects models

- To counter confounding and given the multinomial nature of the women empowerment variable (3 outcome possibilities: woman, man or joint), we employed 2-stage Multinomial Endogenous Treatment Effects (METE) models
  - the 1st stage predicts the factors that determine women empowerment regimes (i.e. belonging to sole man, sole woman or joint ownership and decision-making)
  - the 2nd stage estimates the effect of the women empowerment regimes on child HAZ with a selectivity correction term from the first stage.
- The METE model is combined with Correlated Random Effects (CRE)
  - to further control for time-invariant unobserved household-level heterogeneity that may be correlated with observed covariates
  - we included the mean of time-varying household level explanatory variables.

ANALYTICAL APPROACH

Identification instruments

- METE models are robustly identified with the use of instrumental variables (IVs)
- The level of women empowerment may highly depend on people's immediate societal norms, rules and perceptions, i.e. the *"cognitive neighborhoods".*
- Based on these, we constructed 3 potential IVs our modeling.
    1. Household head's marital status (civil, traditional and common law—with legal, religious and cultural obligations) including cohabiting.
    2. The proportion of other households in the parish (excluding the household itself) where women solely and/or jointly owned cash crops
    3. The proportion of other households in the parish (excluding the household itself) where women solely and/or jointly made decisions on sale and use of revenues.

RESULTS

Women empowerment and child nutrition: cash crop ownership

Result I: After accounting for other observed and unobserved characteristics, sole woman ownership of cash crops (vs. sole man) increases child HAZ scores by 0.59 points

- This translates into 14% reduction in stunting *(results not shown here)*

Result 1I: Indeed confoundedness exists: Women empowerment is not random and may affect consistency of estimates on child nutrition outcomes if not accounted for

- Unobservable x-tics limit women to own cash crops, which ultimately reduce child HAZ scores

Table 1: CRE-METE estimates for cash crop ownership on child HAZ

Cash crop ownership regimes	Full sample 6-59 months
Sole woman ownership	0.585*** (0.172)
Joint ownership	0.221 (0.135)
Selection terms-ownership	
Sole woman ownership	-0.547*** (0.210)
Joint ownership	-0.126 (0.176)
N	***3,540***

*** *indicates p<0.01, figures in parenthesis are clustered SEs*

RESULTS

Women empowerment and child nutrition: cash crop decision-making

Result III: After accounting for other observed and unobserved characteristics

- Sole woman decision-making on cash crops (vs. sole man) increases child HAZ scores by 0.64 points (or 20% reduction in stunting).
- Joint decision making (vs. sole man) increases child HAZ scores by 0.31 points (7% reduction in stunting).

Confoundedness also exists for decision-making (negative selection bias)

- Women empowerment is not random and may affect consistency of estimates on child nutrition outcomes if not accounted for

Table 2: CRE-METE estimates for cash crop decision-making on child HAZ

Cash crop decision-making regimes	Full sample 6-59 months
Sole woman decision-maker	0.638*** (0.160)
Joint decision-making	0.306** (0.139)
Selection terms-ownership	
Sole woman decision-maker	-0.617*** (0.193)
Joint decision-making	-0.234 (0.173)
N	***3,540***

****, ** indicates p<0.01, 0.05 respectively*
Figures in parenthesis are clustered SEs

RESULTS

Heterogeneity effects of women empowerment across child subsamples:

Result IV: Woman empowerment (ownership and decision-making) is beneficial for all child groups

- However, stunting effects (*results not shown*) were much more precisely estimated for sole woman ownership in older children (>2 years) and for male children

TABLE 3: Estimates for woman empowerment in cashcrops on child HAZ subsamples

	Sub-samples of children categories			
Panel A: Cashcrop ownership regimes	<2 years	2-5 years	Boys	Girls
Sole woman ownership	0.617***	0.525**	0.765***	0.618***
	(0.237)	(0.245)	(0.248)	(0.203)
Joint ownership	0.365	0.177	0.170	0.310*
	(0.222)	(0.152)	(0.170)	(0.160)
Panel B: Cashcrop decision-making regimes				
Sole woman decision-making	0.479*	0.639***	0.744***	0.646***
	(0.268)	(0.196)	(0.208)	(0.210)
Joint decision-making	0.136	0.376**	0.114	0.406**
	(0.285)	(0.162)	(0.161)	(0.166)
Number of observations	1,046	2,494	1,771	1,769

****, **, * indicates p<0.01, 0.05, 0.1, respectively. Figures in parenthesis are clustered SEs*

CONCLUSIONS

- Women in Uganda and other countries in similar contexts own less or no assets and play constrained roles in decision-making of income-generating activities
- Literature shows that women's autonomy and/or empowerment can be beneficial to household welfare with implications for improved child nutrition outcomes
- Other literature shows mixed relationships between agricultural commercialization and child nutrition. Nutrition benefits may be leveraged through a gendered lens.
- Yet, evidence based on sound study design and rigorous analysis is still limited
- This study analyzed empirically the relationship between women empowerment in cash crops in Uganda and child growth outcomes.
- We use relatively lean but relevant indicators of women empowerment (i.e. sole woman or joint ownership relative to sole man ownership or decision making)

CONCLUSIONS

- We employ mixed multinomial methods with instrumentation in a large panel dataset to address confounding issues often associated with women empowerment
- We find large and consistent associations between women empowerment regimes (ownership and decision-making of cash crops) and child HAZ scores.
  - women empowerment in cash crops reduces stunting by at least14%, which is rarely achieved by many standalone interventions in developing countries
  - results are much more convincing than previously appreciated because potential confounders are well accounted for
- Heterogeneity analysis shows that women empowerment benefits all child categories, but probably more for older children (above 2) and for boys.

CONCLUSIONS

- The study shows that intra-household dynamics and bargaining power in relation to agriculture-mediated cash plays an important role in child nutrition
- The consequences of less empowered women in cash-cropping communities are clearly negative with respect to child nutrition. However, they can only be well revealed when advanced analytical frameworks are employed as is done here
- For policy implications, results underscore the importance of ensuring that agricultural development efforts including agribusiness and agricultural market access interventions are not blind to women empowerment
- Further research is required to understand how/what more empowerment women do differently with the cash generated to achieve better child nutrition outcomes.

FURTHER ENGAGEMENT

Dr. Nassul Kabunga's email address – nassul.kabunga@tufts.edu

Q&A

THANK YOU

- To register for any of these events, you can visit **NutritionInnovationLab.org** or **AdvancingNutrition.org**.
- Recordings and slides for each webinar will also be posted on our websites.

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