Farm production and child diets: Role of child age and household wealth

Prajula Mulmi[3], **William A. Masters**[1], Shibani Ghosh[1], Grace Namirembe[1], Ruchita Rajbhandary[2], Swetha Manohar[2], Binod Shrestha[2], Rolf Klemm[2,3], Keith P. West, Jr[2], Patrick Webb[1]

[1] **Friedman School of Nutrition Science & Policy, Tufts University**
[2] Bloomberg School of Public Health, Johns Hopkins University
[3] Helen Keller International

Selected paper for presentation at the annual meetings of the Agricultural and Applied Economics Association, 1 August 2017

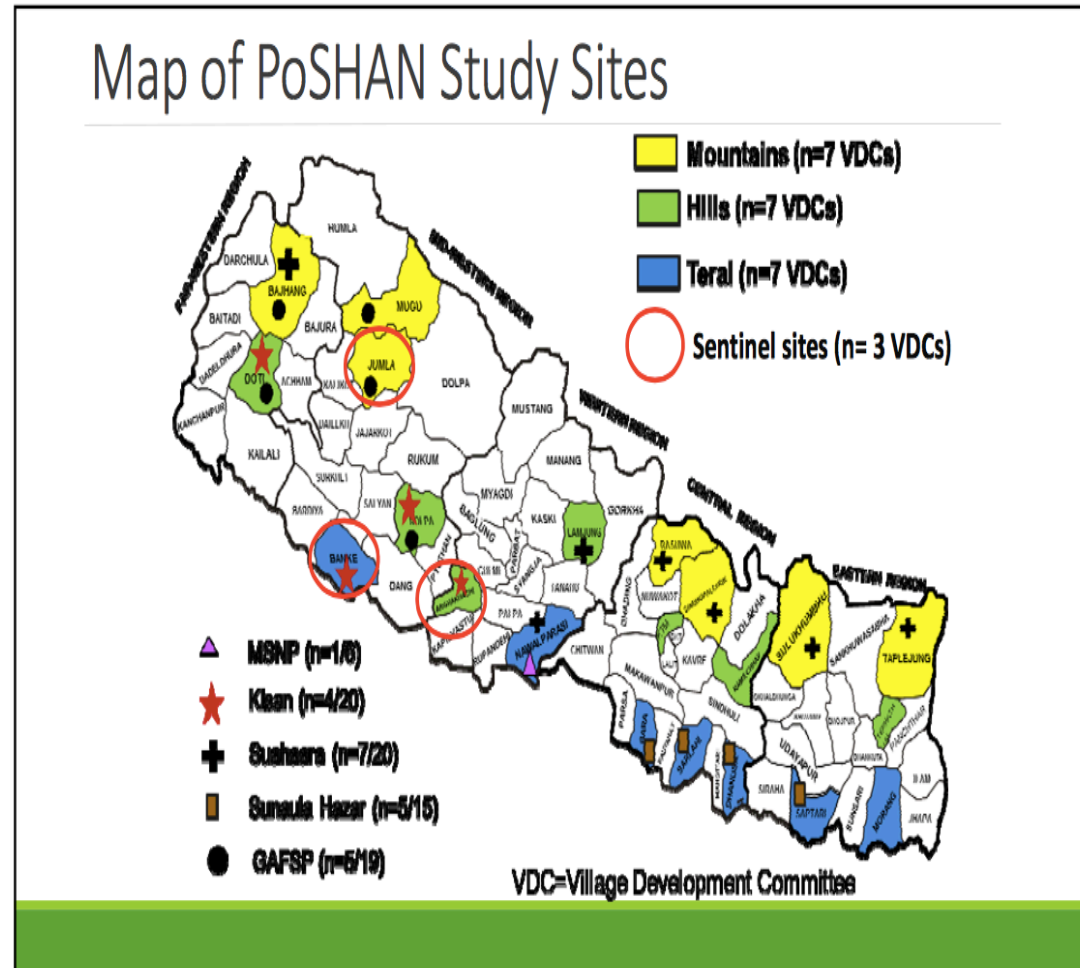**Feed the Future Innovation Lab for Nutrition**

What is the link between a family's food production and their child's diet quality?
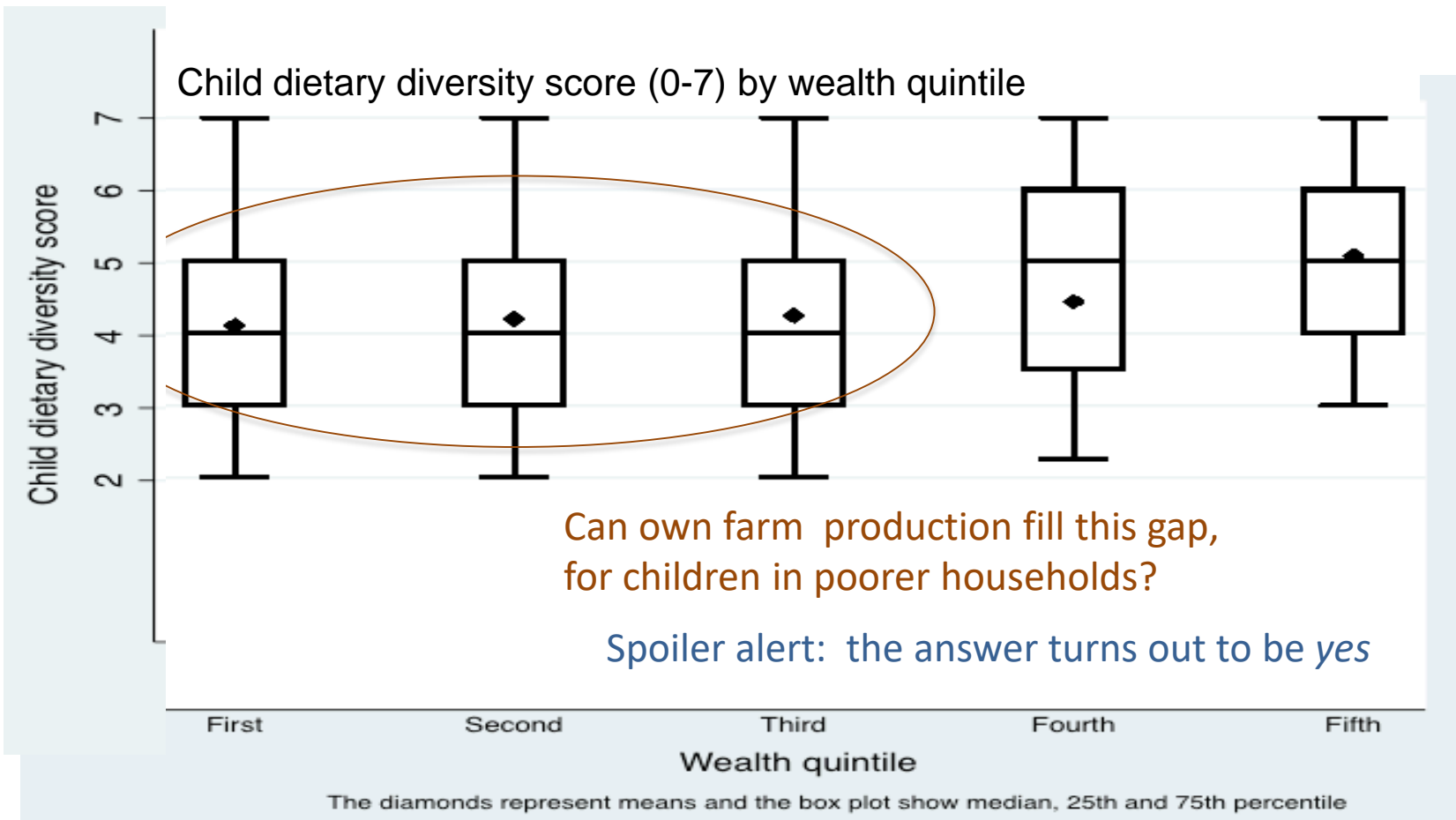
- **There is now a large literature showing a positive link between what farm families grow and what their children consume**
  - Especially for *more remote* households, further from food markets, who are more reliant on own production (e.g. Shibatu et al., 2015)

- **We use two rounds of PoSHAN survey data (2013 & 2014) to test two key hypotheses about *how* and *for whom* production is linked to intake:**

  1) Is farm production linked to intake only for *older* children?
     Older children can consume the family diet, whereas infant feeding requires special care

  2) Is farm production linked to intake only for *poorer* households?
     Poorer families may depend on their own farm, whereas richer ones can buy childrens' food

- **Outcomes are**
  - Diet diversity: whether child consumes ≥ 4 of 7 food groups
  - Individual food groups: whether child consumes that food group

Our sample spans a very wide range of agro-ecological and socioeconomic conditions
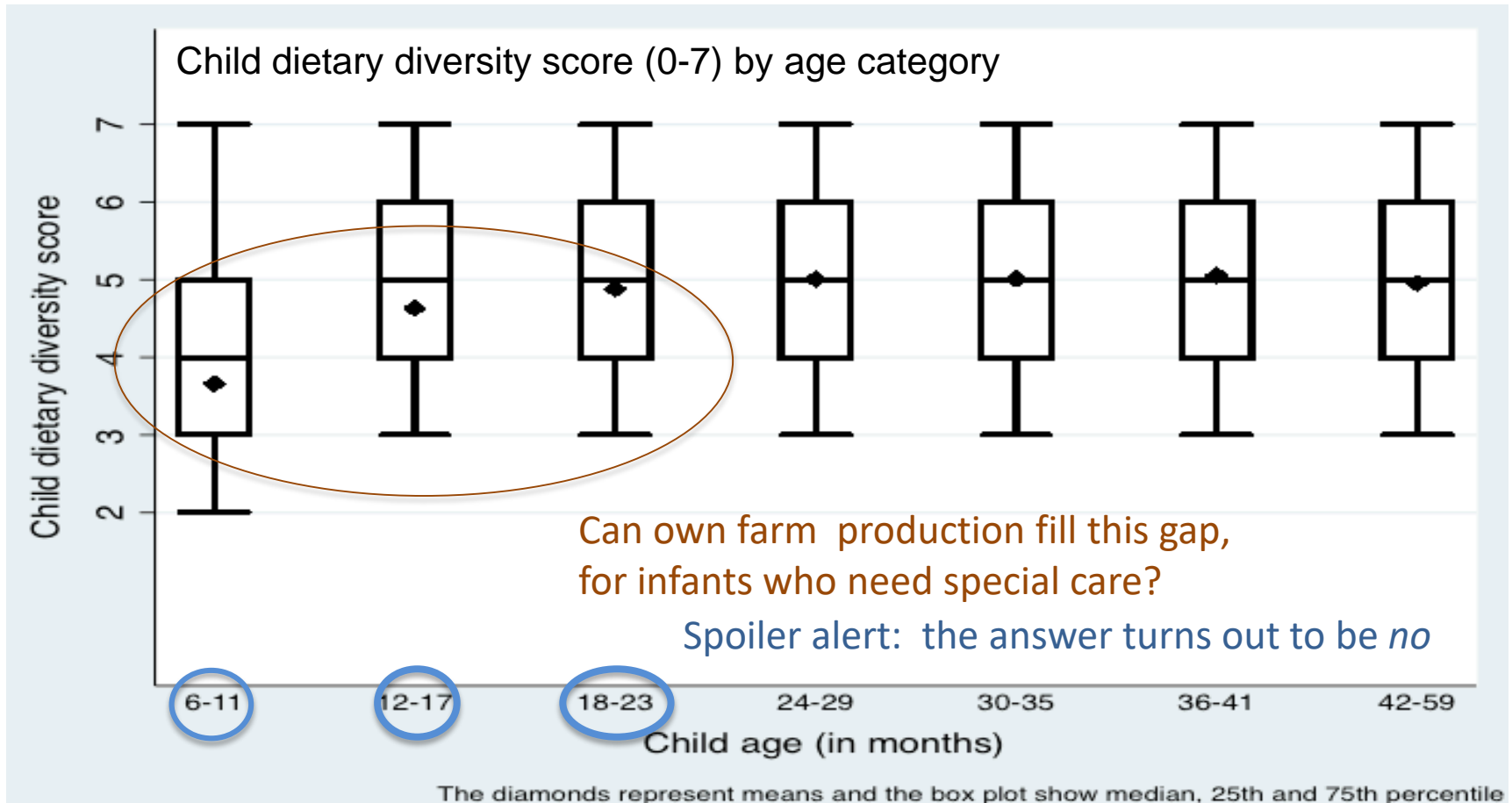
- Two rounds of household panel data (2013 – 2014)

- Representative of wards from the 21 VDCs

- Sampling strategy: SRS for VDCs and PPS for wards

- Data on: child and maternal nutrition, anthropometrics, diet diversity, food security, agricultural practices and types of food grown and marketed, and demographics

- Baseline report indicated n= 4,287 households with women= 4,509 and children under five 5,401

Map of PoSHAN Study Sites

- Mountains (n=7 VDCs)
- Hills (n=7 VDCs)
- Terai (n=7 VDCs)
- Sentinel sites (n= 3 VDCs)

- MSNP (n=1/6)
- Kisan (n=4/20)
- Suahaara (n=7/20)
- Sunaula Hazar (n=5/15)
- GAFSP (n=5/19)

VDC=Village Development Committee

Manohar et al., 2014

Does farm production raise intake only for the poor, as their lack of cash constrains access to markets?

Child dietary diversity score (0-7) by wealth quintile

Can own farm production fill this gap, for children in poorer households?

Spoiler alert: the answer turns out to be *yes*

The diamonds represent means and the box plot show median, 25th and 75th percentile

Dataset: Policy and Science of Health, Agriculture, and Nutrition (PoSHAN) 2013 and 2014

Does farm production raise intake only for older children, as they can consume the same as other family members?

Child dietary diversity score (0-7) by age category

Can own farm production fill this gap, for infants who need special care?

Spoiler alert: the answer turns out to be *no*

The diamonds represent means and the box plot show median, 25th and 75th percentile

6-23 months

24-59 months

Dataset: Policy and Science of Health, Agriculture, and Nutrition (PoSHAN) 2013 and 2014

Hypotheses, aims and potential significance

Hypothesis: A household's own farm production is associated with more child diet diversity and intake of each food group, but
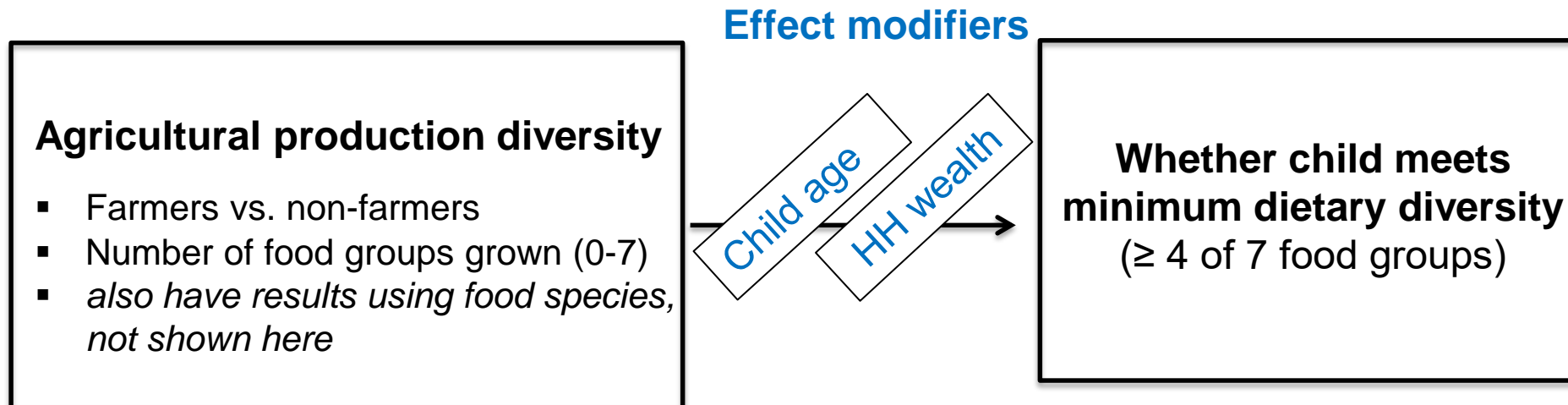- only for children in poorer households
- only for children at older ages

Aim: To identify mediating effects of household wealth and child age on the relationship between household food production and child dietary intake
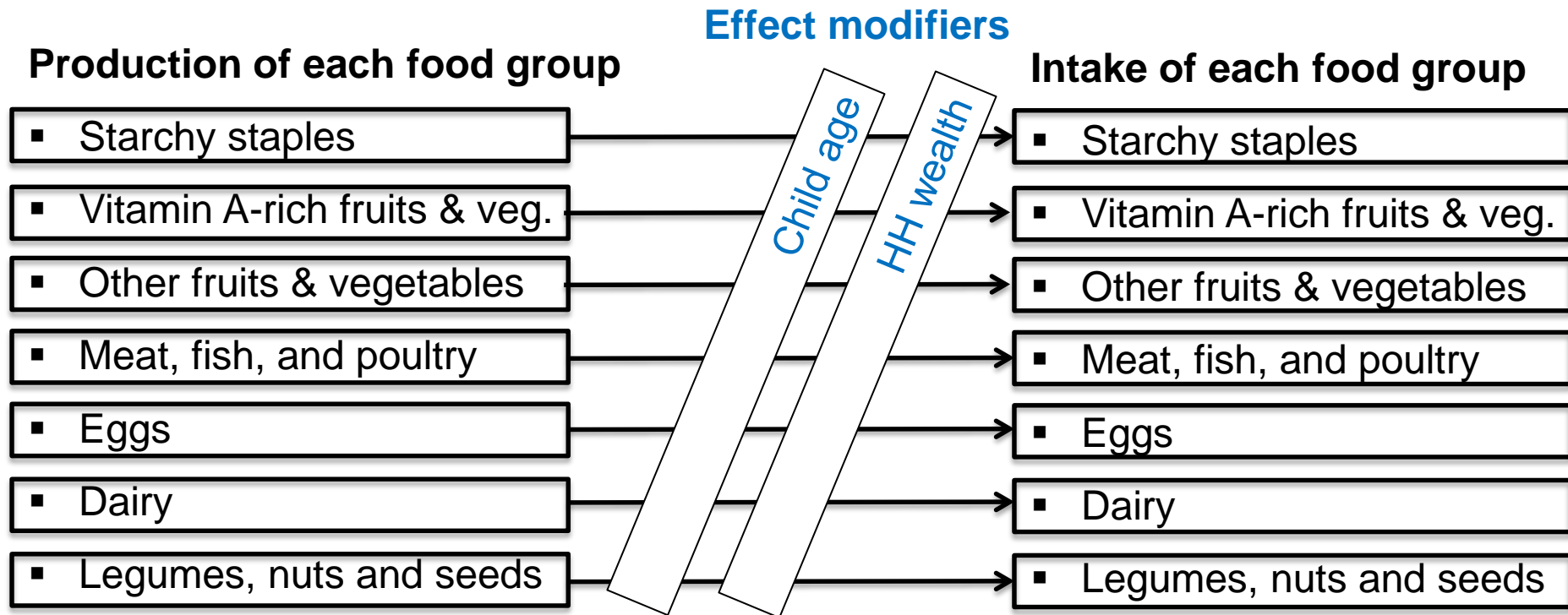
Implications: Evidence for these hypotheses would imply that:
- home garden and farm diversification programs could improve child diets mainly if targeted to the poorest in Nepal, and
- other programs would be needed to reach the youngest children.

How is production diversity linked to diet diversity?

Effect modifiers

Agricultural production diversity

- Farmers vs. non-farmers
- Number of food groups grown (0-7)
- *also have results using food species, not shown here*

Child age   HH wealth

Whether child meets minimum dietary diversity
(≥ 4 of 7 food groups)

How is production *of each group* linked to dietary intake of that group?

Effect modifiers

Production of each food group

- Starchy staples
- Vitamin A-rich fruits & veg.
- Other fruits & vegetables
- Meat, fish, and poultry
- Eggs
- Dairy
- Legumes, nuts and seeds

Child age

HH wealth

Intake of each food group

- Starchy staples
- Vitamin A-rich fruits & veg.
- Other fruits & vegetables
- Meat, fish, and poultry
- Eggs
- Dairy
- Legumes, nuts and seeds

How is production diversity linked to diet diversity?

Statistical test:
Logit with VDC and year fixed effects

$$MDDC_i = B_0 + B_1\ farmdiv_{ih} + B_2\ wealth_{ih} + B_3\ farmdiv_{ih}\ X\ wealth_{ih} + \delta\ Z_i + \alpha\ VDC_i + \gamma\ year + \mu_i$$

Outcome Variable:
Whether child meets minimum dietary diversity (≥4)

Mediating variable:
Wealth quintile (1-5)

Interaction term
to test for mediation

Farm production predictor variable:
- Food groups grown (0-7)
- Agricultural diversity quintile (0-5)
- Farmers vs. non-farmers (0 or 1)

Control variables:
- *Maternal*: Age, education, BMI
- *Household*: Caste, religion, land owned/rented
- *Child:* Sex, whether breastfed
- *Geography:* Altitude, ecological zone

VDC and year fixed effects
to absorb other characteristics of each place and time

How is production *of each group* linked to dietary intake of that group?

Statistical test:
Logit with VDC and year fixed effects

$$Cnsmptn'_{ih} = B_0 + B_1\,prdctn'_{ih} + B_2\,wealth_{ih} + B_3\,prdctn'_{ih} \times wealth_{ih} + \delta\,Z_i + \alpha\,VDC_i + \gamma\,year + \mu_i$$

Outcome Variable:
Consumption of each individual food group (from 1 to 7)

Mediating variable:
Wealth quintile (1-5)

Interaction term
to test for mediation

VDC and year fixed effects

Farm production predictor variable:
- Production of that same food group (from 1 to 7)

Control variables:
- *Maternal*: Age, education, BMI
- *Household*: Caste, religion, land owned/rented
- *Child:* Sex, whether breastfed
- *Geography:* Altitude, ecological zone

Household food production diversity is positively associated with child dietary diversity for older children in poorer households

	(1)	(2)	(3)	(4)	(5)
	MDDC ≥4 6-11 mo.	MDDC ≥4 12-17 mo.	MDDC ≥4 18-23 mo.	MDDC ≥4 6-23 mo.	MDDC ≥4 24-59 mo.
Number of food groups grown (0-7)	0.183 (0.17)	-0.086 (0.20)	0.430*** (0.13)	0.139 (0.10)	0.253*** (0.09)
Quintile of household wealth (1-5)	0.218 (0.31)	-0.034 (0.34)	0.786*** (0.20)	0.232 (0.18)	0.497*** (0.19)
Wealth X number of groups grown	-0.037 (0.05)	0.088 (0.07)	-0.137*** (0.04)	-0.030 (0.02)	-0.039 (0.03)
Controls	Yes	Yes	Yes	Yes	Yes
VDC & year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	396	399	800	1,635	4,343

Notes. Unit of observation is an individual child between 6-59 months. Standard errors in parentheses, clustered on VDCs. All results are from weighted logit regressions with fixed effects for each of 21 VDCs and 2 years. Survey weights are used for children in the balanced panel, in which each child is observed twice. The weights are 0.537 for Mountain, 1.711 for Hill and 0.834 for Terai.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Results hold with the larger, unbalanced sample

	(1)	(2)	(3)	(4)	(5)
	MDDC ≥4 6-11 mo.	MDDC ≥4 12-17 mo.	MDDC ≥4 18-23 mo.	MDDC ≥4 6-23 mo.	MDDC ≥4 24-59 mo.
Number of food groups grown (0-7)	0.083 (0.09)	-0.131 (0.13)	0.335** (0.10)	0.052 (0.07)	0.166** (0.08)
Quintile of household wealth (1-5)	0.211* (0.12)	-0.070 (0.21)	0.559*** (0.21)	0.160 (0.11)	0.369** (0.18)
Wealth X number of groups grown	-0.031 (0.03)	0.093** (0.04)	-0.096*** (0.03)	-0.007 (0.02)	-0.011 (0.03)
Controls	Yes	Yes	Yes	Yes	Yes
VDC & year fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	1,034	934	1,040	3,033	6,213

Notes. Unit of observation is an individual child between 6-59 months. Standard errors in parentheses, clustered on VDCs. All results are from weighted logit regressions with fixed effects for each of 21 VDCs and 2 years. Survey weights are used for children in the unbalanced panel. The weights are 0.449 and 0.504 for Mountain, 1.730 and 1.714 for Hill and 0.871 and 0.847 for Terai for panel 1 and 2, respectively. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

The link between farm production and child intake holds only for some food groups

Coefficients on the association between individual food group production & consumption mediated by child age

Production of:	6-11 mo. (cons.)	12-17 mo. (cons.)	18-23 mo. (cons.)	6-23 mo. (cons.)	24-59 mo. (cons.)
Vitamin A-rich F&V	0.71	0.61	1.24***	0.98***	0.45
Other F&V	1.16	0.50	0.73	0.56	1.08***
Meat	1.83	-1.76	0.87	0.12	0.21
Eggs	0.78	0.22	1.64***	1.32***	0.98***
Dairy	-1.71***	-0.49	0.98***	0.06	1.20***
Legumes, nuts & seeds	0.08	0.47	-0.36	0.03	0.63
Observations	396	399	800	1,635	4,343

Notes. Unit of observation is an individual child between 6-59 months.. All results are from weighted logit regressions with fixed effects for each of 21 VDCs and 2 years. Survey weights are used for children in the balanced panel. The weights are 0.537 for Mountain, 1.711 for Hill and 0.834 for Terai. *** p<0.01, ** p<0.05, * p<0.1

The link between home production and intake holds only for specific food groups, among older and poorer children

For **Vitamin A-rich F&V** child intake is positively associated with household production only for older children in poorer households. The same holds for **other F&V** except that richer households do not feed more other F&V at any age.

	6-11 mo. (cons.)	12-17 mo. (cons.)	18-23 mo. (cons.)	6-23 mo. (cons.)	24-59 mo. (cons.)
Vitamin A-rich F&V					
HH produces this group			1.24***	0.98***	
HH wealth			0.18*		1.20**
HH prod. X wealth			-0.27*	-0.21**	-0.15*
Other Fruits & Vegetables					
HH produces this group					1.08***
HH wealth					
HH prod. X wealth					-0.24*
Observations	396	399	800	1,635	4,343

Notes: Coefficients not significantly different from zero are not shown, and coefficients on control variables are also omitted. Unit of observation is an individual child between 6-59 months.. All results are from weighted logit regressions with fixed effects for each of 21 VDCs and 2 years. Survey weights are used for children in the balanced panel. The weights are 0.537 for Mountain, 1.711 for Hill and 0.834 for Terai. *** p<0.01, ** p<0.05, * p<0.1

The link between home production and intake holds only for specific food groups, among older and poorer children

For **Dairy**, child intake is positively associated with household production only for older children in poorer households. The same holds for **Eggs**, except that richer households feed more eggs at all ages.

	6-11 mo. (cons.)	12-17 mo. (cons.)	18-23 mo. (cons.)	6-23 mo. (cons.)	24-59 mo. (cons.)
Dairy					
HH produces this group			0.98***		1.23***
HH wealth			0.36***		0.42***
HH prod. X wealth			-0.28**		-0.26***
Eggs					
HH produces this group			1.64***	1.32***	0.98***
HH wealth	0.68***	0.37**	0.15*	0.27***	0.21***
HH prod. X wealth					
Observations	396	399	800	1,635	4,343

Notes: Coefficients not significantly different from zero are not shown, and coefficients on control variables are also omitted. For dairy, anomalous results for 6-11 month olds are also omitted. Unit of observation is an individual child between 6-59 months.. All results are from weighted logit regressions with fixed effects for each of 21 VDCs and 2 years. Survey weights are used for children in the balanced panel. The weights are 0.537 for Mountain, 1.711 for Hill and 0.834 for Terai. *** p<0.01, ** p<0.05, * p<0.1

Summary of findings

Agricultural production diversity and child dietary diversity is:

- Positively associated but only for older children (18 or 24 mo.)

- Positively associated but in poorer households (lowest one or two quintiles)

Individual food group production and consumption is:

- Positively associated for older children at all levels of wealth only for eggs

- Positively associated for older children at lower levels of wealth for fruits and vegetables, and dairy

Implications of the findings

- Farm-diversifying programs aimed at improving child dietary diversity will likely see benefits only after 18 months of age

- Improving dietary quality of younger children will require other kinds of complementary feeding interventions

- For older children, maximum benefits of these interventions can be seen when poorer households that are further from markets are targeted

- Except for eggs, production of food groups such as fruits and vegetables and dairy and its consumption are mediated by wealth
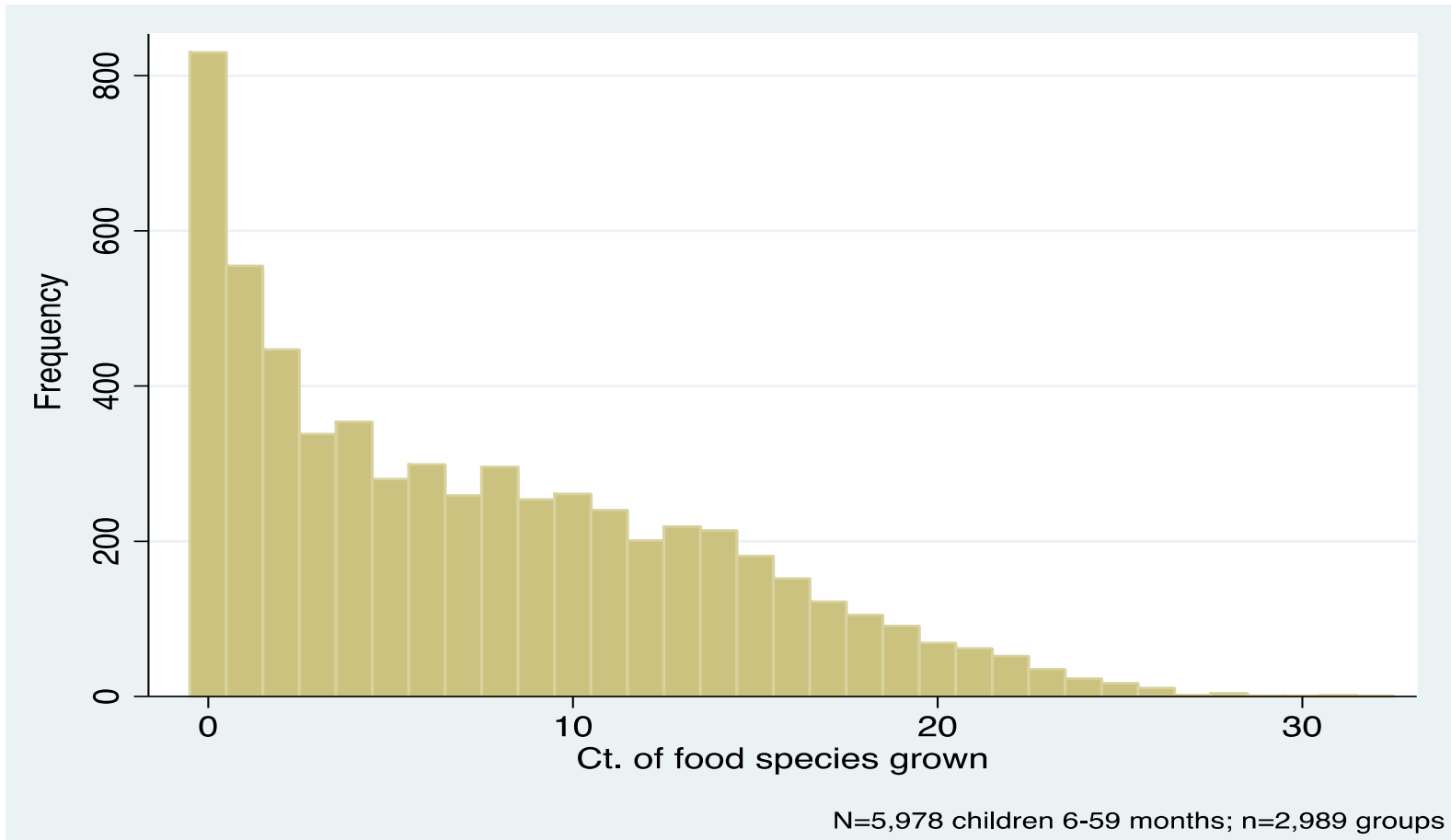
Appendix

Categorization of food items consumed by a child into food groups as per FAO

FAO food groups	Food items listed in 7-day food frequency questionnaire[+]
Starchy staples	Lito, rice, corn, wheat, millet, potato
Dark Green Leafy Vegetables (DGLVs)	Dark Green Leafy Vegetables (DGLVs)
Vitamin A rich fruits and vegetables	Carrots, pumpkin, drumstick, ripe mango, ripe jackfruit and ripe papaya
Other fruits and vegetables	Gundruk, green beans, green peas, gourd, okra, eggplant, green jackfruit, tomato, cauliflower, cabbage, guava, orange, apple, pineapple and banana
Flesh foods (meat, fish and poultry)	Chicken, duck, goat, buff, pork, fish and snails
Eggs	Egg
Dairy (milk and milk products)	Milk and curd
Legumes, nuts and seeds	Daal, maseura, legumes and peanuts

Categorization of crops and livestock produced by households for food

FAO Food groups	Crops and livestock produced for food
Starchy staples	Barley, buckwheat, finger millet, maize, potatoes, rice, sorghum, wheat, cassava, taro, and yam
Dark Green Leafy Vegetables (DGLVs)	Green leaves
Vitamin A rich fruits and vegetables	Sweet potatoes, carrots, drumstick, mango, melon, papaya, and pumpkin
Other fruits and vegetables	Banana, peas, apple, avocado, green beans, berries, bitter gourd, cabbage, capsicum, cauliflower, bottle gourd, chili, cucumber, eggplant, guava, lemon, lychee, okra, onions, orange, pineapple, peach, plum, radish, sponge gourd, squash, tomato, other fruit and vegetables
Flesh foods (meat, fish and poultry)	Cattle, buffalo, ox, cow, yak, goat, poultry, sheep, pigs, and fish ponds
Eggs	Poultry, guinea, fowls and pig
Dairy (milk and milk products)	Cattle, buffalo, ox, cow, yak, goat, and sheep
Legumes, nuts and seeds	Beans, chickpeas, groundnut, lentils, oil seeds, soybeans, and sunflower

Distribution of food species grown

N=5,978 children 6-59 months; n=2,989 groups

Dataset: Policy and Science of Health, Agriculture, and Nutrition (PoSHAN) 2013 and 2014

Results also control for altitude and zone

Source: www.mof.gov.np

Crop calendar and crops grown

Crop calendar for main crops grown in Nepal, by ecological zone (source: FAO/WFP, 2007)

Crop	Ecological Zone	Irrigation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Season
Paddy	Hills	Partial					TP	TP			H	H			Summer
		Year-round			TP	TP			H	H					Spring
	Terai	Rainfed						TP	TP		H	H	H		Summer
		Year-round			TP	TP			H	H	H				Spring
									TP	TP			H	H	Late Summer*
Maize	Mountains	Irrigated/Rainfed			P	P				H	H	H			Summer
	Hills	Rainfed			P	P				H	H				Summer
		Irrigated		P	P			H	H						Spring
	Terai	Rainfed				H	H			H	H				Summer
		Year-round		P	P			H	H						Spring
				H	H							P	P		Winter
Millet	Mountains	Rainfed					P	P			H	H			Summer
	Hills	Rainfed						P	P		H	H			Summer
Wheat	Mountains	Rainfed					H	H					P	P	Winter
	Hills	Rainfed			H	H	H					P	P	P	Winter
	Terai	Rainfed**			H	H						P	P		Winter
Barley	Mountains	Rainfed				H	H						P	P	Winter
	Hills	Rainfed			H	H						P	P	P	Winter

P = Planting; TP = Trans-Planting; H = Harvesting

* Recent option adopted by some farmers in the Eastern region, allowing two paddy crops a year.

** Supplemental irrigation is practiced in the east.

Note: Ecological zones do not fully reflect existing cropping patterns and the cropping calendar represents the most common practices within each zone.

NLSS: Determining market participation
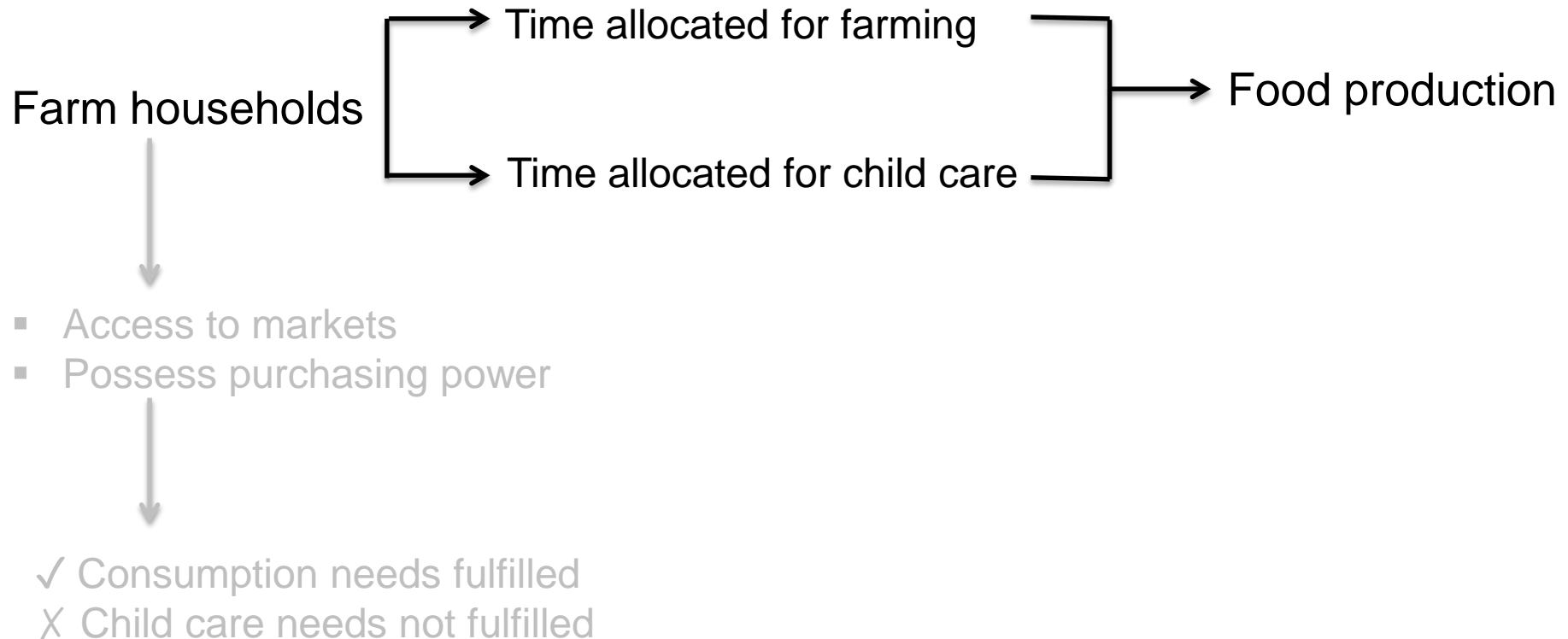
NLSS District-level means:

1) Value of food purchased in markets
2) Value of food obtained in donations
3) Value of food produced in household farms

We compute:

District's average share of food consumption that is purchased or donated (market use): (1+2/ 1+2+3)

- o 'High market use' districts = above or equal median market use
- o 'Low market use' =below median of market use

Economic model of farm households

Farm households

Time allocated for farming

Time allocated for child care

Food production

- Access to markets
- Possess purchasing power

✓ Consumption needs fulfilled
✗ Child care needs not fulfilled

Source: de Janvry et al., 1991; Foster and Rosenzweig, 2010; Eswaran & Kotwal, 1989; Bardhan & Udry, 1999

Economic model of farm households

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