

**Horticulture:**

Key Opportunities  
for Nutrition

July 9  
Washington, D.C.

**Fruit & Vegetable**  
**Production in Uganda:**  
**Greater F&V**  
**Consumption, Improved**  
**Food Security, Less**  
**Anemia**

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# Who we are (US Partners)



**Tufts**  
UNIVERSITY

Gerald J. and Dorothy R.  
Friedman School of  
Nutrition Science and Policy



**HARVARD**  
School of Public Health



**TUSKEGEE**  
UNIVERSITY



JOHNS HOPKINS  
**BLOOMBERG**  
SCHOOL of PUBLIC HEALTH

**PURDUE**  
UNIVERSITY



**USAID**  
FROM THE AMERICAN PEOPLE

## **Can Smallholder Fruit and Vegetable Production Systems Improve Household Food Security and Nutritional Status of Women?**

- Nassual Kabunga, Shibani Ghosh, Jeffrey K. Griffiths (IFPRI, Tufts, Tufts). IFPRI Discussion Paper 01346 (published online April, 2014)
- Links **Agricultural Production to Household Consumption to Improved Household Food Security and Decreased Anemia.**

## **Nutrition Innovation Lab – over-arching questions**

- In what ways do agriculture investments achieve significant measurable impacts in nutrition? Can impact **pathways** be **empirically demonstrated**?
- How can large-scale programs best incorporate such knowledge into **cost-effective multi-sectoral interventions** to improve nutrition?
- How can policy and program implementation **processes** be enhanced to support both nutrition-specific and nutrition-sensitive actions?

# Supposition:

**↑food = ↑income & ↑nutrition  
and thus to better health**

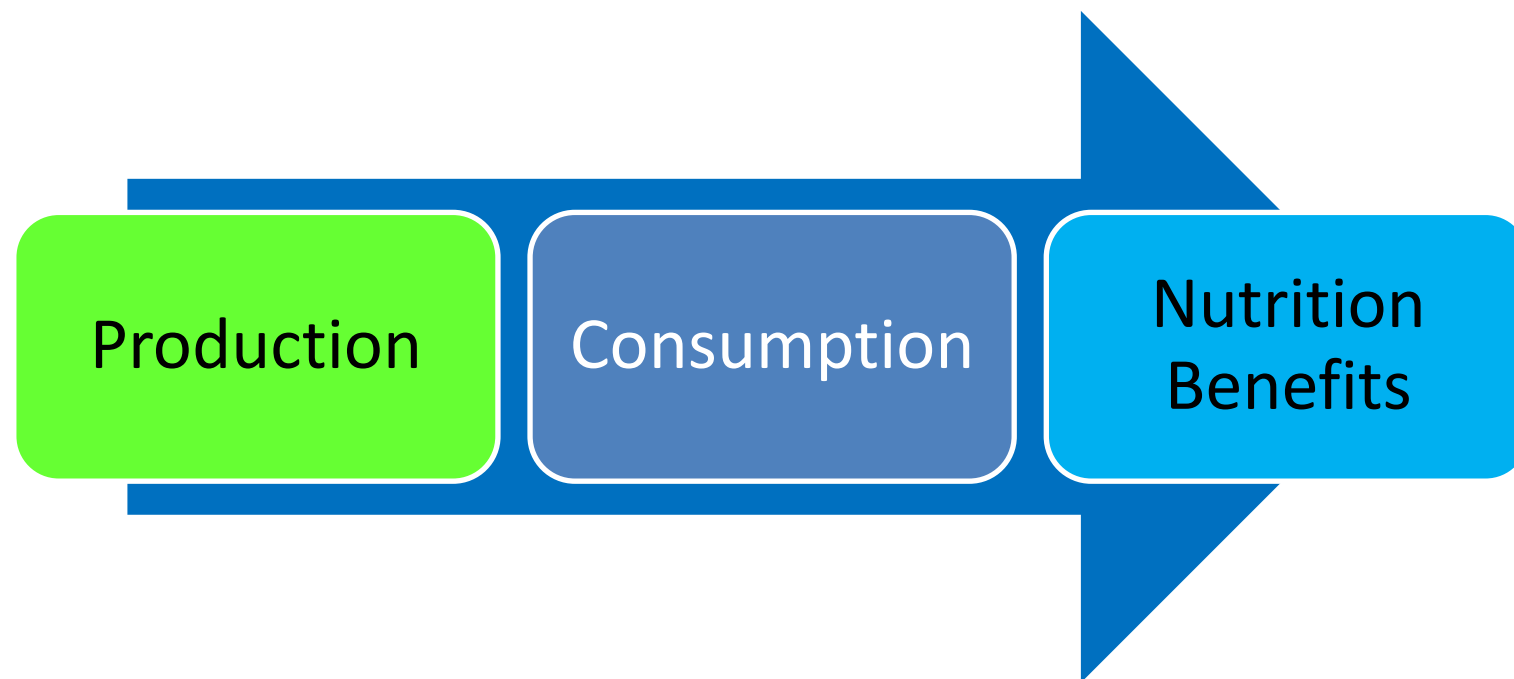
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**Higher Income = Can afford more  
food, more diverse/healthier diet**

**Higher production of food = more  
food available in household**

**→ *In general, data lacking***

# Agriculture → Nutrition Pathways Are Biologically Plausible



Evidence for the effectiveness of targeted agricultural programs on maternal and child nutrition (with the exception of vitamin A) is limited, so many opportunities.

# Agriculture → Nutrition Pathway Is Biologically Plausible

Production  
F&V

Consumption  
of F&V

Nutrition  
Benefit:  
↓ Anemia

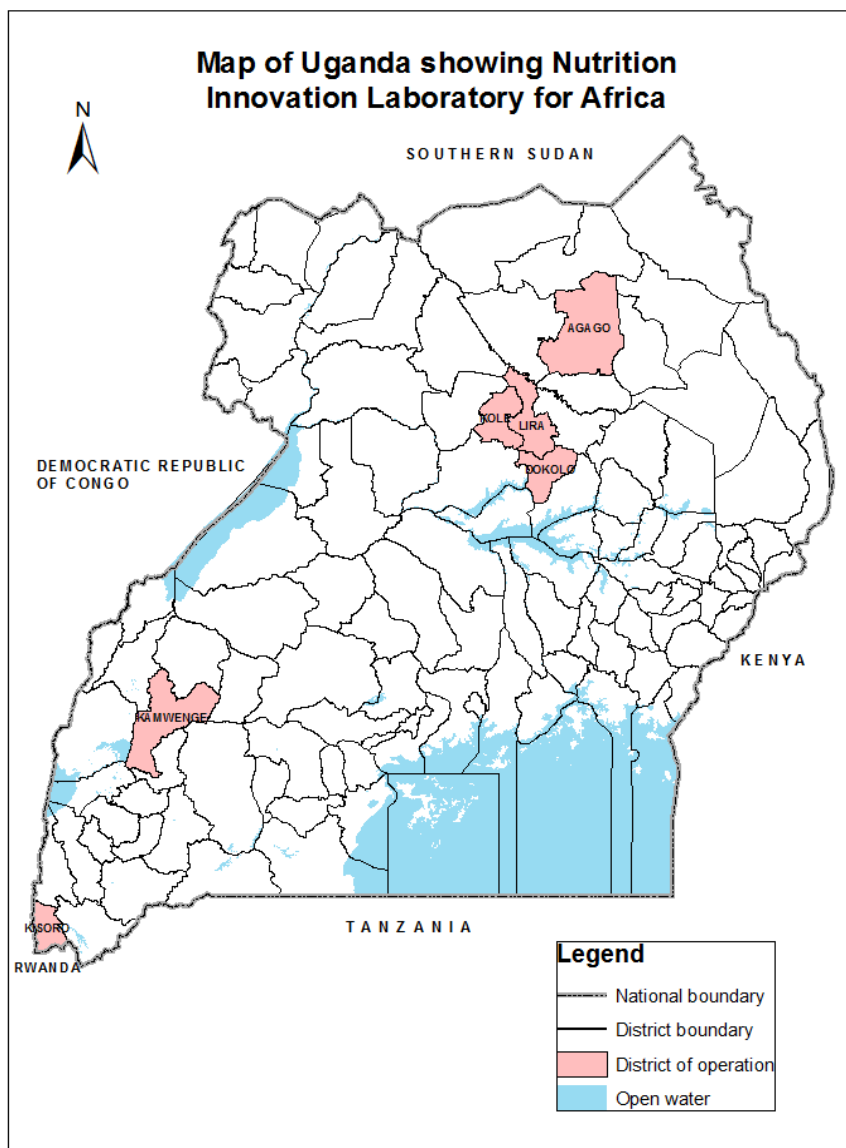
Specific Nutrients needed for the synthesis of blood red cells



# Why is decreasing anemia important?

- Severe anemia strongly linked to death during pregnancy and childbirth.
- Increases death rates during pneumonia.
- Higher risk of babies being born with low birth-weight or prematurely ...
- Existing toll from malaria, hookworm, HIV.
- *Most common nutritional deficiency globally.*





Enumerate agricultural, livelihood, food security, nutritional, health, and gender outcomes in vulnerable households and populations

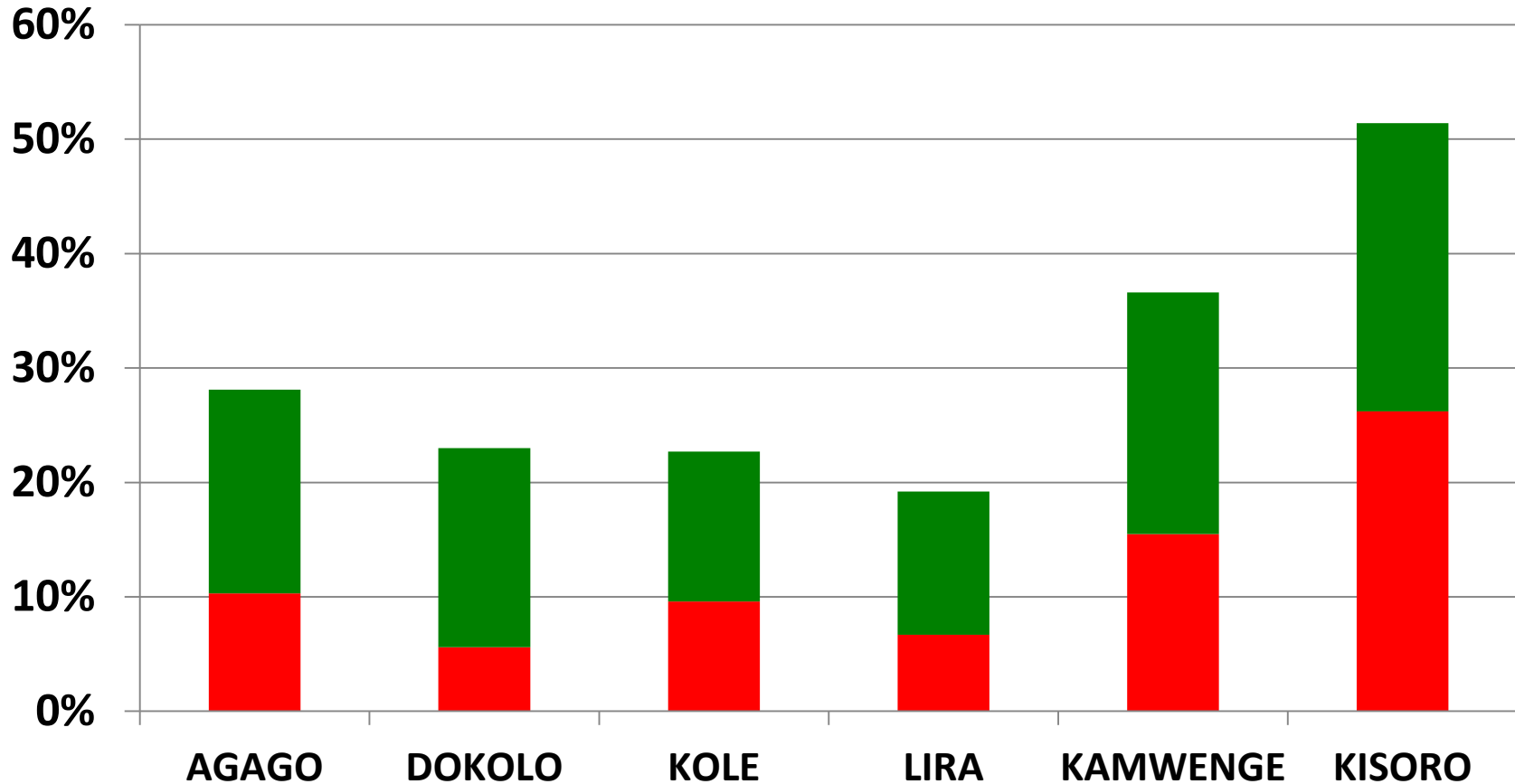
3,630 households in 6 districts

> 2,700 variables

~ 10 million bits of data

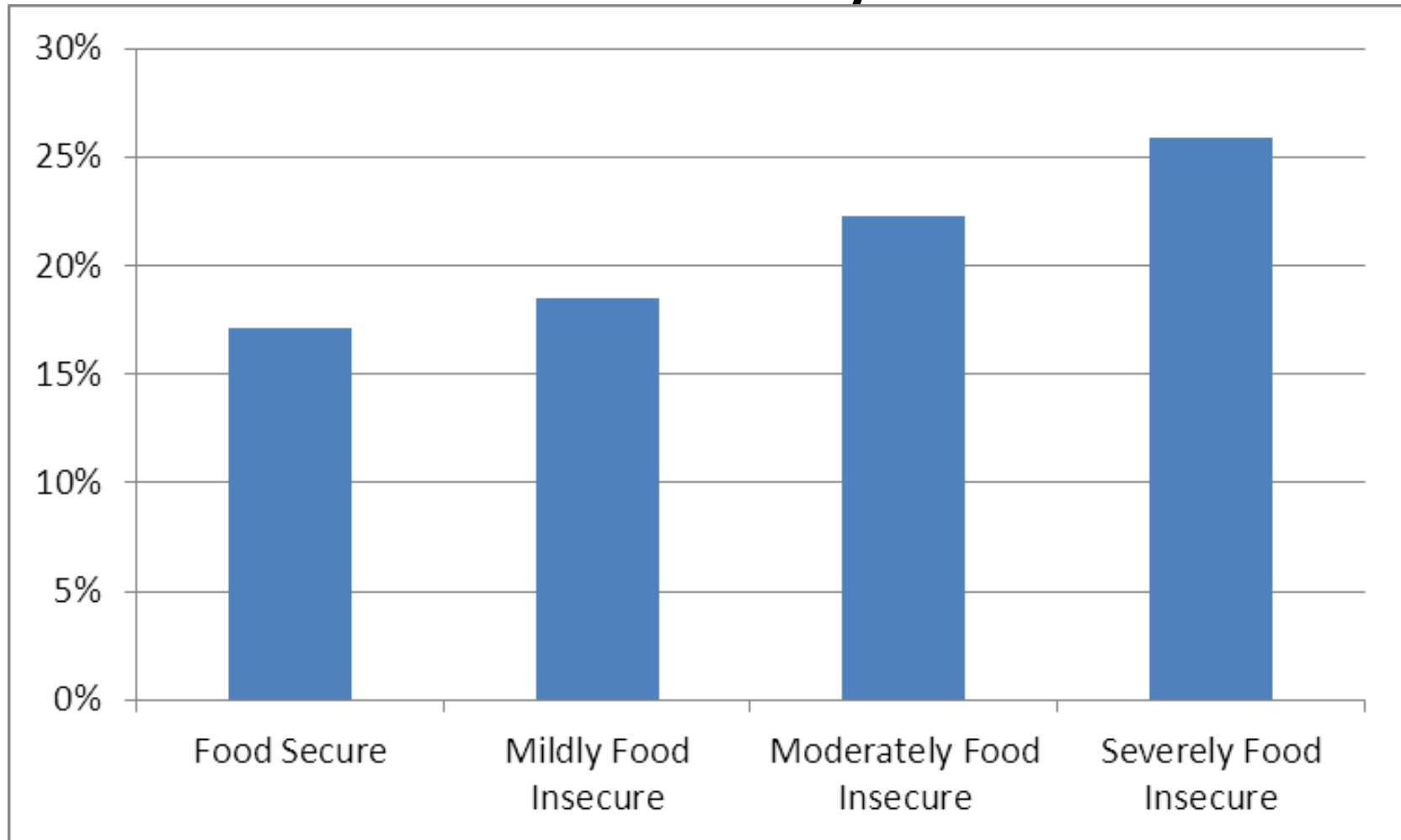
# Stunting Among Children Under Five

■ Severe ■ Moderate



**N=4500 children under five years of age**

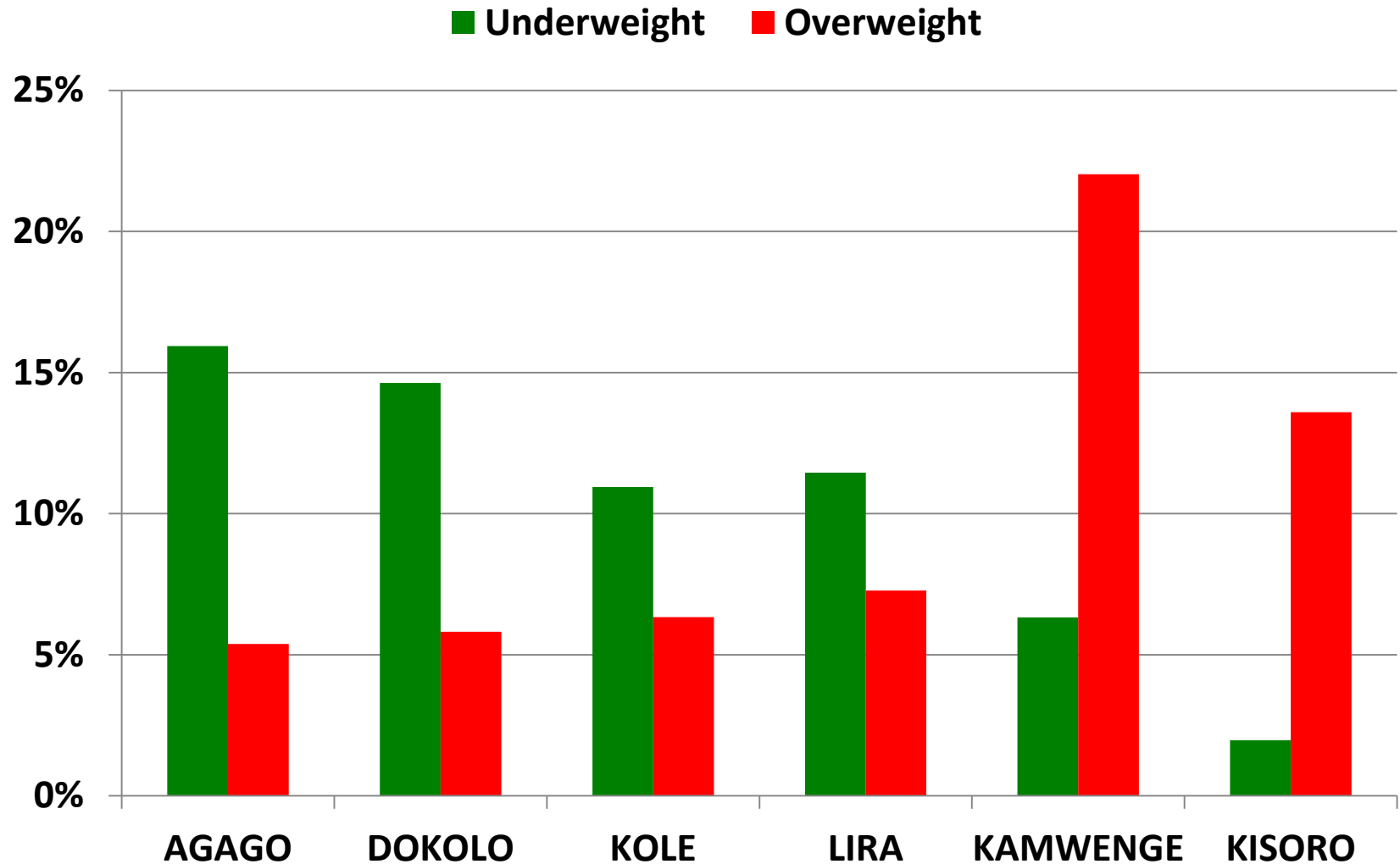
# Child Stunting and Household Food Security



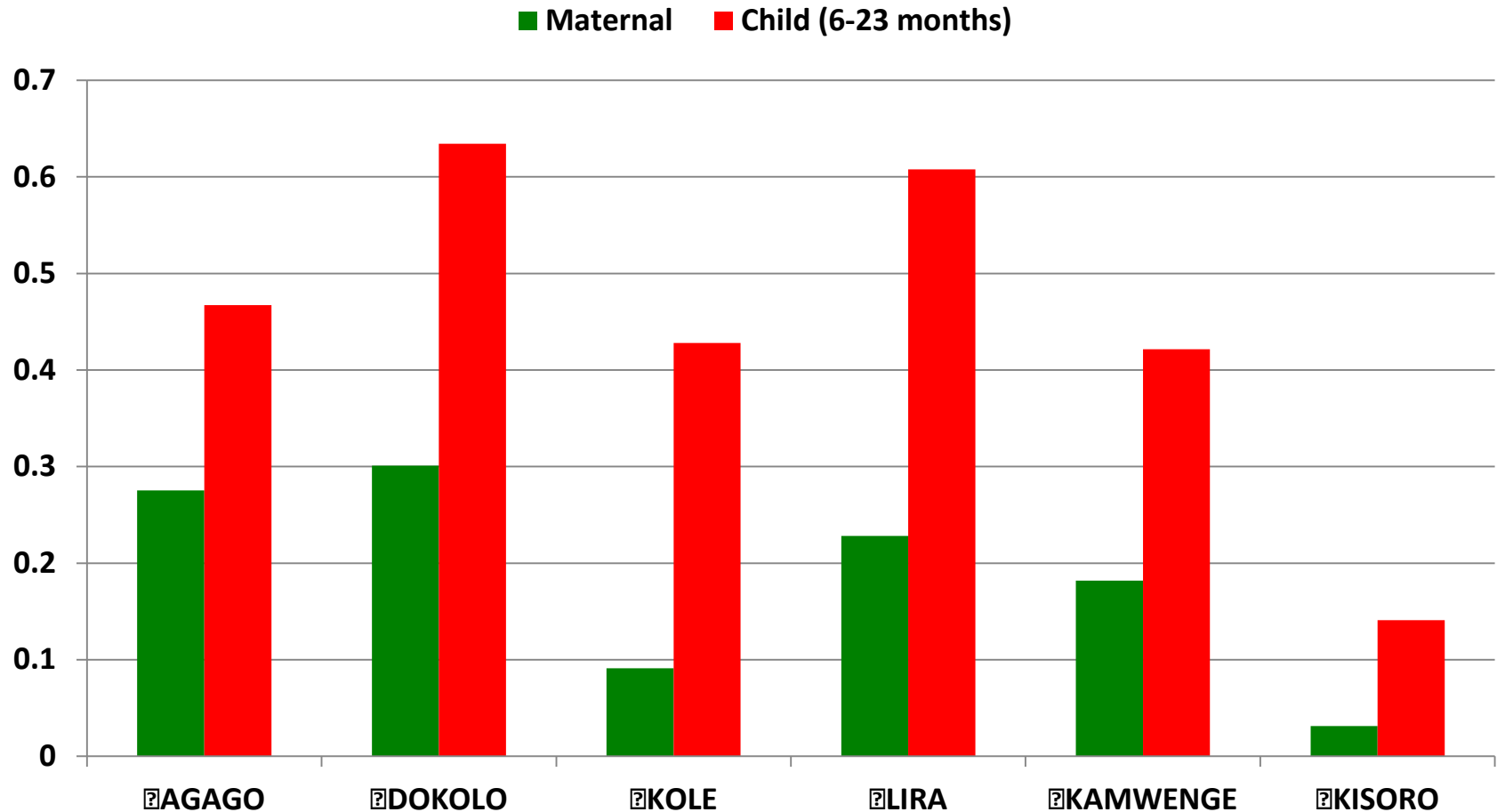
# Household Food Insecurity

- Household Food Insecurity Access Scale (HFIAS) is measured on a scale of 0=food secure to 27=very food insecure
- Female-headed households are more food insecure
  - Female-headed households have a mean HFIAS of 9.4
  - Male-headed households have a mean HFIAS of 7.4
- Household food insecurity increases the risk of maternal but not child anemia
  - One unit increase in HFIAS increases the odds of maternal anemia by 1.6%

## Maternal Underweight versus Overweight



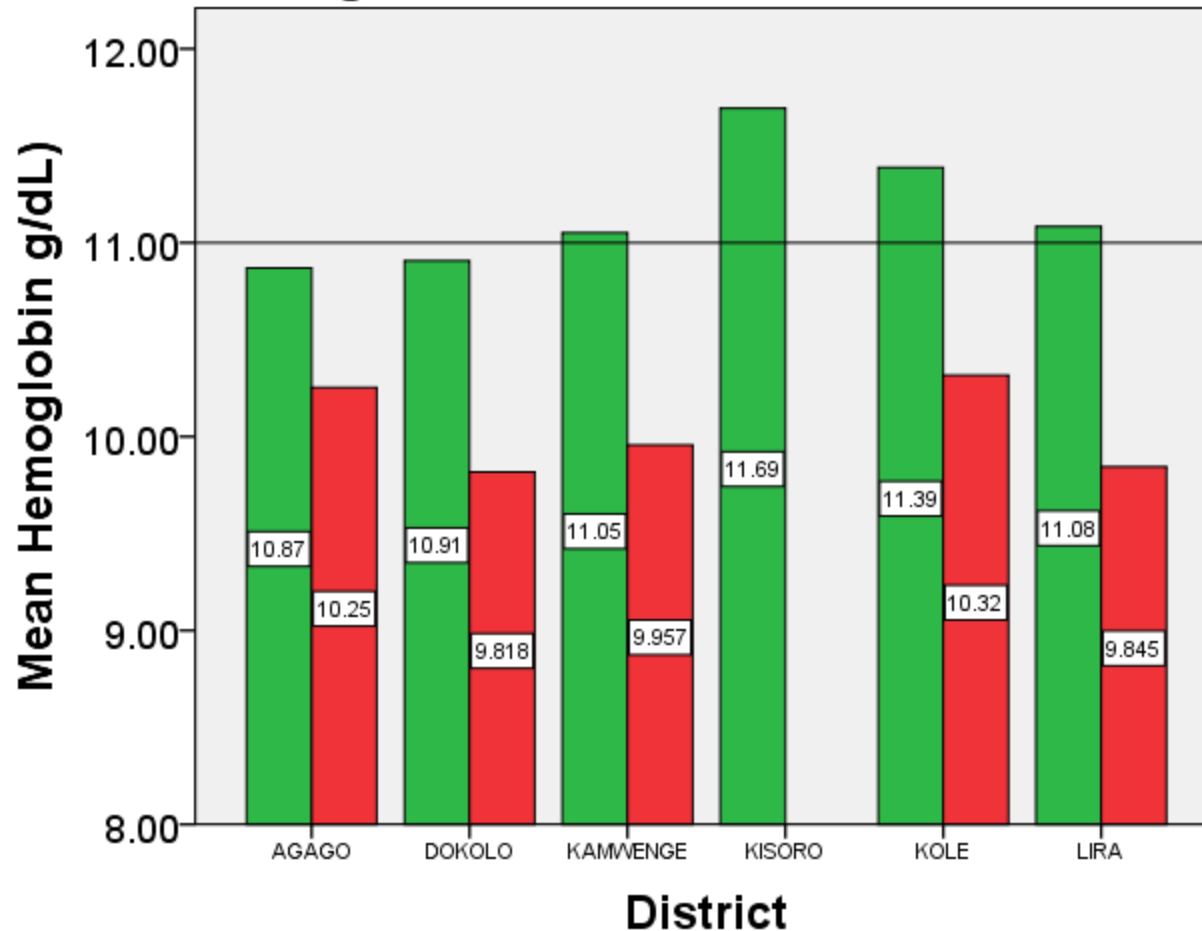
## Maternal and Child Anemia



A child is 37% more likely to be anemic if its mother is anemic.

# Nutrition Innovation Laboratory for Africa

Mean Hemoglobin in children  $\leq$  24 months.



Green – no falciparum malaria

Red – with f. malaria

\*Kisoro – no index children had malaria (the altitude is  $> 1500$  m)

\*All differences between children with and without malaria in a given district are significant



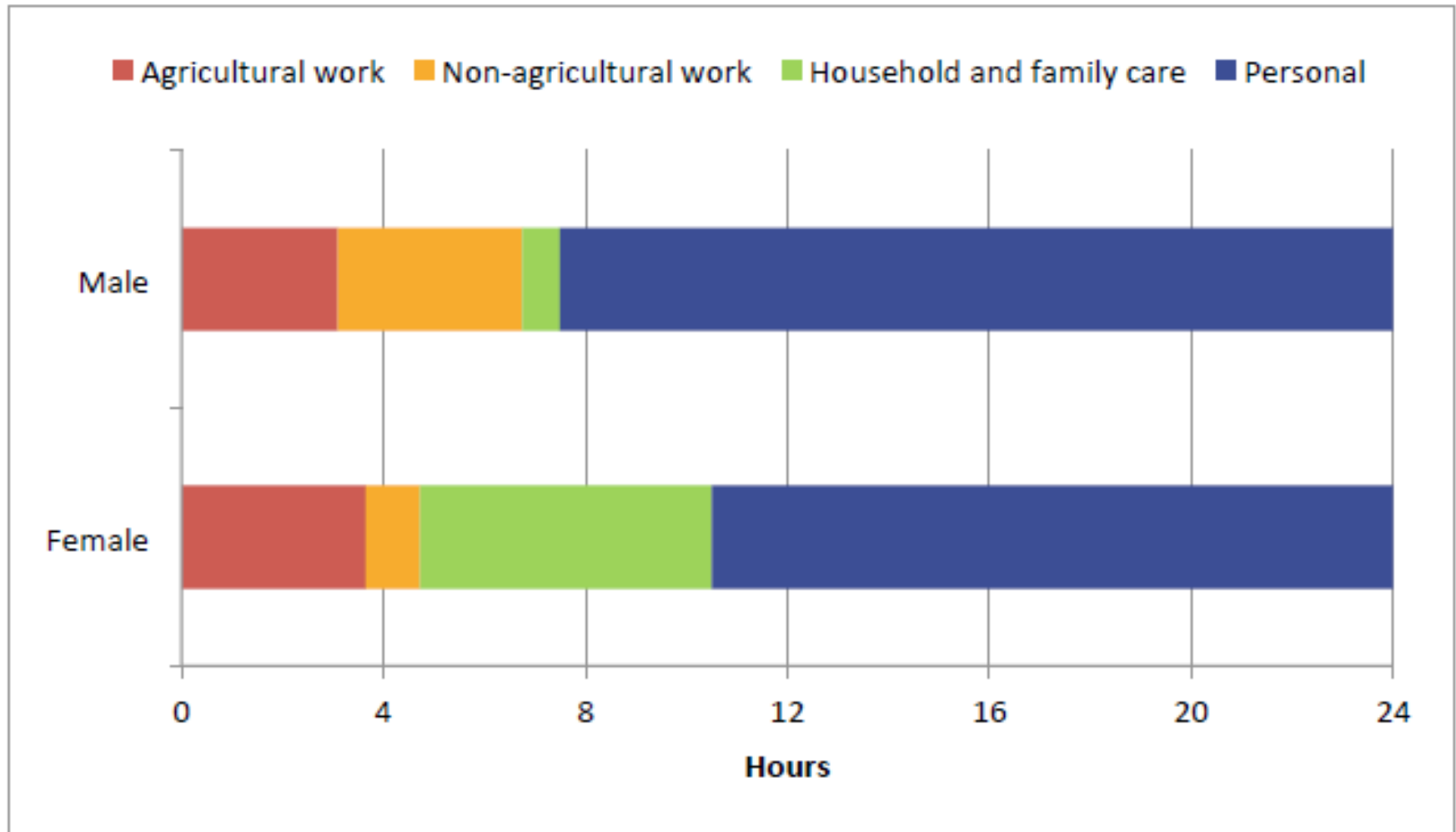
# Agricultural Inputs and Practices

District	Improved seed	Agrochemicals	Improved drying	Improved storage	Improved marketing
Agago	19%	3%	11%	18%	13%
Dokolo	39%	3%	12%	13%	26%
Kole	68%	13%	13%	12%	29%
Lira	34%	37%	33%	16%	43%
Kamwenge	6%	25%	16%	1%	5%
Kisoro	9%	34%	35%	2%	2%
<b>All</b>	29%	19%	20%	10%	20%

- Use of agricultural inputs and improved practices is low overall
  - Higher in Lira
  - Lower in Agago and Kamwenge

# Nutrition Innovation Laboratory for Africa

Figure 28: Gender and Time Use



## Hypotheses

- Households that own/cultivate at least one type of fruits and/or vegetables are relatively more food secure
- Individual women (15-49yrs) living in F&V **producing** households **consume** more F&Vs – increased food diversity
- Individual women caregivers living in F&V producing households are less likely to be **anemic**

- 
- **Food-based strategies** are considered sustainable and culturally much more acceptable than other interventions

## Methods

- Sample of 3630 households across 6 Ugandan districts. The dataset is a baseline used to track the effectiveness of the USAID/Uganda Community Connector Project.
- For each household we collect data on:
  - Crop enterprises –classify households as F&V producers vs. non-producers
  - Food intake diversity patterns in last 24 hrs for a woman
  - Household socioeconomics – including a module on qualitative assessment of household food security (HFIAS)
  - Anthropometry and take blood samples to test for Hemoglobin levels and malaria (for a caregiver 15-49 years)

## Uganda Context

- Most F&Vs in Uganda grow wildly or on fallowed land, are considered low-value and grown mainly by women for food
- There are ready markets and increasing demand for a wide range of F&V domestically, regionally and internationally
- In Uganda, consumption of F&V per capita falls short of daily recommended intake by 20 - 50%.
- Uganda can potentially produce more than 225 kg of F&Vs annually per capita (155% of the WHO recommendation)
- There have been only a few deliberate efforts to intensify F&V production in Uganda, few rigorous research on F&V, most are descriptive studies.

## Methods -Quantifying food insecurity from the HFIAS

- Upon these two factors or clusters, we are able to construct two indices – “food insecure” and “severely food insecure”
- We take advantage of these constructs to compare food insecurity outcomes across F&V producers and non-producers
- We also compare the hemoglobin levels across F&V producers and non-producers
- **To rule out any potential selection bias – most behavioral effects in the population are never random – we employ propensity score matching techniques – match F&V producer households to similar non-producing households.**

Propensity matched sample sizes  
(leads to reduction in potential bias 83-88%)

Analysis	F&V Producers	F&V non-Producers
Last 24 hours: F&V consumed	76%	64%
<b>Food Insecurity</b>	<b>830</b>	<b>2,386</b>
<b>Food Consumption</b>	<b>839</b>	<b>2,404</b>
<b>Hemoglobin (Anemia)</b>	<b>814</b>	<b>2,334</b>



## Methods – the HFIAS module

	% “never” response
1. Did you worry that your household would not have enough food? (FIQ1)	41.48
2. Were you or any household member not able to eat the kind of foods you preferred because of lack of resources? (FIQ2)	25.48
3. Did you or any household member eat just a few kinds of food day after day due to lack of resources? (FIQ3)	27.21
4. Did you or any household member eat food that you preferred not to eat because of a lack of resources to obtain other types of food? (FIQ4)	30.54
5. Did you or any household member eat a smaller meal than you felt you needed because there was not enough food? (FIQ5)	48.31
6. Did you or any household member eat fewer meals in a day because there was not enough food? (FIQ6)	55.83
7. Did you or any household member go to sleep at night hungry because there was not enough food? (FIQ7)	79.07
8. Did you or any household member go a whole day without eating anything because there was not enough food? (FIQ8)	85.54
9. Was there ever no food at all in your household because there were no resources to get more? (FIQ9)	92.97

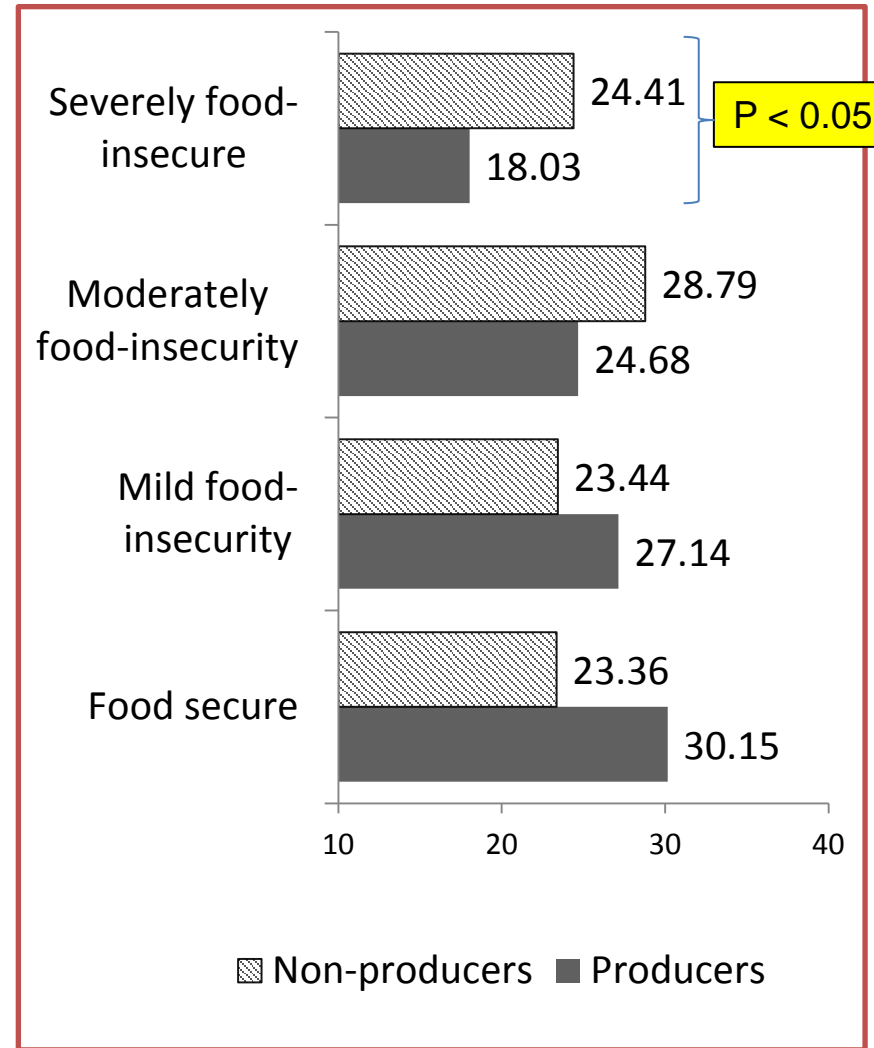
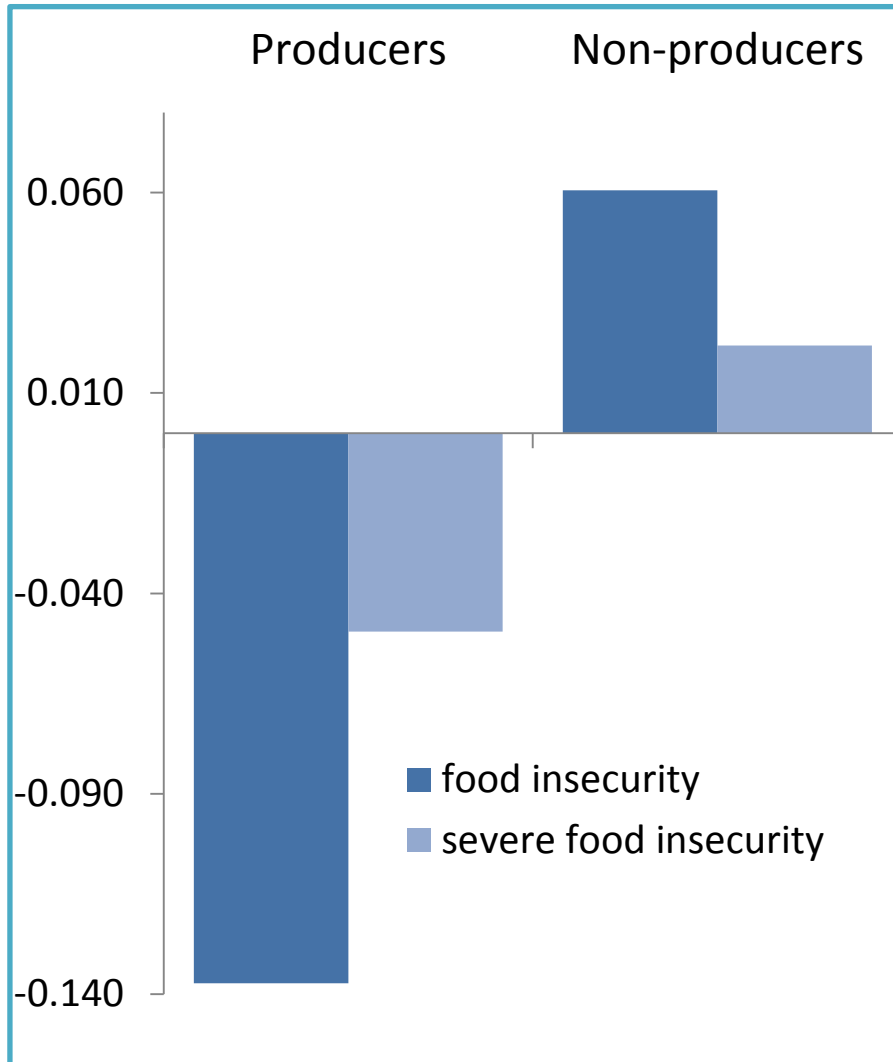


## Methods -Quantifying food insecurity from the HFIAS

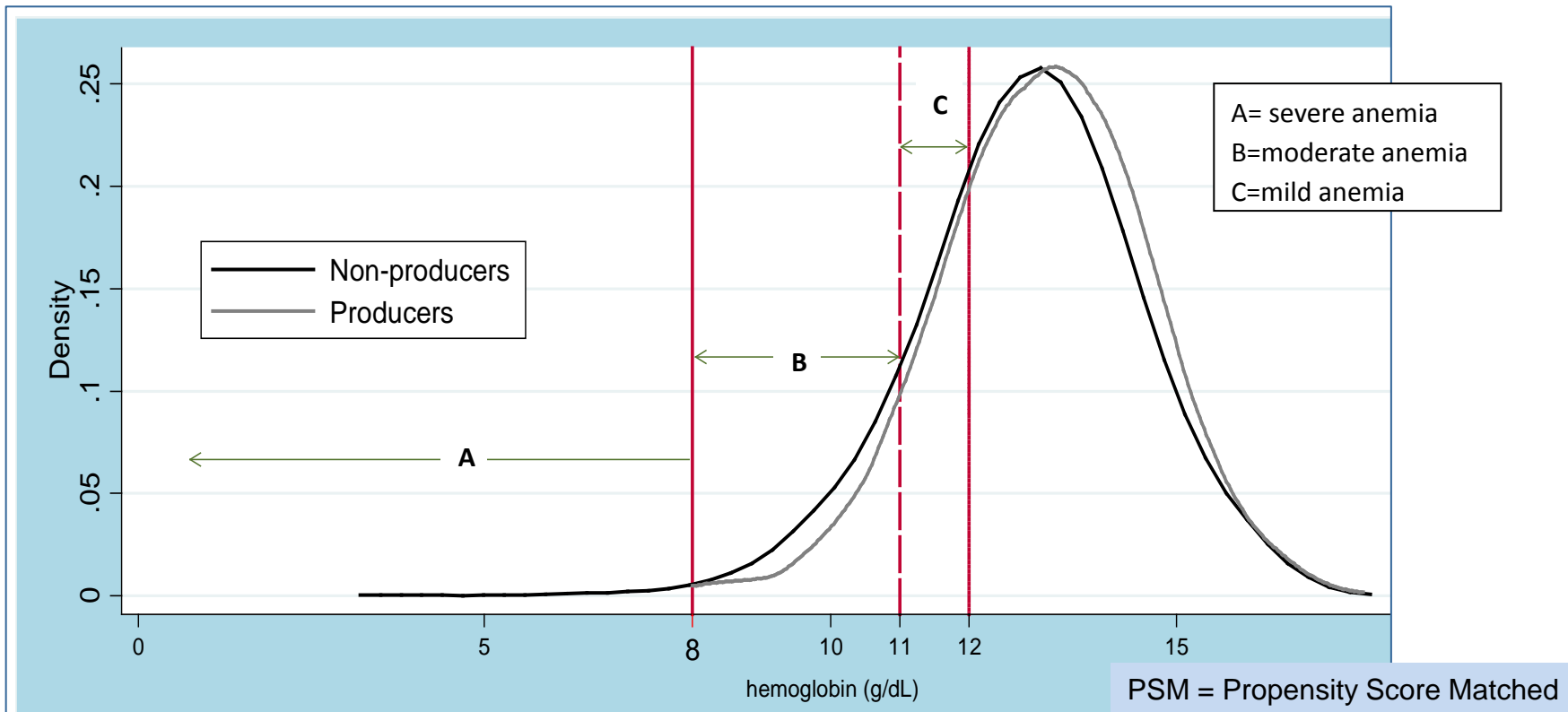
- We use principal factor analysis to find subdomains or responses that are highly correlated with each other and define common patterns within the dataset

Variable (sub-domains)	Factor 1 'Food insecurity'	Factor 2 'Severe food insecurity'
FIQ1	<b>0.634</b>	0.154
FIQ2	<b>0.850</b>	-0.078
FIQ3	<b>0.850</b>	-0.067
FIQ4	<b>0.771</b>	0.010
FIQ5	<b>0.550</b>	0.347
FIQ7	0.144	<b>0.613</b>
FIQ8	-0.001	<b>0.745</b>
FIQ9	-0.127	<b>0.731</b>

# F&V Producers Have Less Food Insecurity



# F&V production: effect on maternal anemia (PSM)



	F&V Producers	Non-producers	Change (producers vs. non-producers)	t-value and significance
Hemoglobin (g/dL)	13.03	12.84	+ 0.19 g/dL	3.34, $p < 0.01$
Maternal anemia (%)	21.37%	25.47%	- 16.1%	-2.65, $p < 0.01$
Mat. anemia, PSM	20.97%	24.29%	-13.7%	-1.70, $P < 0.10$
Severe anemia, PSM	0.00%	0.36%	-100%	-2.19, $p < 0.05$
Moderate anemia, PSM	7.03%	9.54%	-26.3%	-1.97, $p < 0.05$

## Fruit & Vegetable Production in Uganda Leads To: **Improved Food Security, Less Anemia**

- F&V *production* significantly  $\uparrow$  F&V *consumption*. (76% vs 64%,  $p < 0.01$ ). F&V producing households had less food insecurity, *especially* the most food insecure.
- Women living in F&V households had higher Hgbs ( $p < 0.01$ ) and were  $\sim 15\%$  less likely to be anemic. Few interventions achieve this level of anemia reduction.
- No *severely* anemic women were found in F&V households, and *moderate* anemia was reduced by a quarter ( $p < 0.01$  each). These groups have the greatest morbidity and mortality related to their anemia.
- *This links F&V production, better food security, and less anemia.*

## Fruit & Vegetable Production in Uganda Leads To: **Improved Food Security, Less Anemia**

- These are results obtained from rural communities with no known F&V intensification. **We think that the benefits are likely to be larger if there are deliberate interventions to intensify F&V productions.**
- The potential benefits of F&V intensification certainly go beyond household and individual welfare benefits to other things:
  - local economy-wide wage employment effects
  - integration into high value markets, etc.





- **Food – Diverse, Adequate**
- **Clean water & Sanitation**
- **Safe foods (no mycotoxins!)**