



# Measuring Employment & Job Quality in Agrifood Systems: Accounting for Backward & Forward Linkages

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# Outline

- Why measure agrifood sector employment & value-added?
- Approaches to Measurement
- Results

# Why measure the Agrifood sector?

- In poorest economies, agrifood production & employment primarily on farm
  - Agriculture major source of jobs, but generally of low-quality
- With structural transformation, primary agriculture declines as a share of GDP, but linked activities grow
  - Purchases of farm inputs rise
  - Food wholesale, retail, logistics, processing & food services expand
  - More farm output processed into non-food products
    - Biofuels; cotton-yarn-textile-clothing; leather goods; wood products....
- Employment share of agriculture also declines, but **better jobs may emerge beyond the farm. Opportunities for poverty reduction?**
  - What is pre- and post-farm employment potential of agrifood sectors?
  - Are mid- and downstream jobs better paid and demanding greater skills?
  - Do gender wage gaps narrow with agrifood value chain development?

# Broad approaches to measurement

- Activity Approach
  - Measures value added in gross output of agriculture, food processing, food services and captures part of VA in input-supplying & output-using sectors
  
- Input-Output Approach
  - For *food products*, measures value added starting with final demand for both domestic & export uses
    - Captures backward linkages through Leontief model and accounts for direct & indirect use of all factors
  - For *non-food products*, captures forward linkages using Ghosh IO model to measure factor inputs that convert agricultural inputs into non-food products like biofuels, cotton clothing, wood products and leather shoes and garments.

# Activity Approach:

## What production factors are employed in readily identifiable agrifood activities?

- *Beyond the farm*, consider factor use in:
  - Agricultural input production
  - Food processing
  - Food services
  - Wholesale and retail trade, logistics, and transportation
- However, typically only considers direct factor use in production of inputs, such as factor use in producing fertilizer,
  - Why not indirect factor use, eg, natural gas for fertilizer?
- What about processing of agricultural products for non-food use?
  - Challenging because most IO tables do not disaggregate sub-sectors that rely on agricultural inputs, such as biofuels, natural fiber-based textiles & clothing, wood-based building materials, etc.
  - How to identify share of value added related to agricultural inputs? Gross output shares or shares for a subset, like fiber shares for textile products?

# Leontief IO Approach

## Step 1: VA and factor use for agrifood final demand

- Start from final demand for all outputs from the agrifood sector (*perfect aggregation for direct factor use & indirect (input) factor use*)

- Fundamental matrix equations for the economy:

$$X = A^D X + f^D$$

$$m = A^M X + f^M$$

where  $X$  is gross outputs;  $A^D$  matrix of domestic intermediate column shares;  $f^D$  vector of final demand, including exports;  $m$  a vector of imports;  $A^M$  matrix of imported products for intermediate use;  $f^M$  vector of imported products for final demand

- Use Leontief Inverse to get gross outputs needed to produce vector of final demand:

$$X = (I - A^D)^{-1} f^D$$

- Define a set of agrifood (<sup>a</sup>) components of final demand,  $f^{Da}$ , then

$$V^{Da} = V \cdot X^a = V \cdot (I - A^D)^{-1} \text{diag}(f^{Da})$$

where  $V$  is the matrix of factor shares in gross output &  $V^{Da}$  is the matrix of factors needed to produce agrifood commodities used for final demand

# Ghosh IO approach

## Step 2: Estimating VA and factor use for non-food agricultural outputs

- Use the **Ghosh model** to estimate forward linkages for non-food outputs
  - Fundamental equation for this model is:

$$X' - X'B = V'$$

where  $V$  is a vector of total factor returns in each sector.

- Vector  $B$  is defined unambiguously as row shares of interindustry flows

$$B = (\text{diag}(X))^{-1}F$$

where  $F$  is the matrix of interindustry flows of domestic products

- The gross forward-linkage output vector associated with our agrifood sectors,  $V_a$ , is thus:

$$X_f' = V_a' (I-B)^{-1}$$

- Forward linkage factor use

$$V_f = V \cdot \text{diag}(X_f)$$

# Leontief approach not quite comprehensive for our goal

- Leontief inverse approach captures the **direct VA** generated producing commodities for **agrifood final demand**, including **VA for inputs**
- Does not capture the part of agrifood output used to produce non-agrifood final outputs, e.g.:
  - Cotton & leather for textiles & clothing
  - Corn for biofuels
- Leontief approach lets us identify how much agrifood VA is **not** needed for final agrifood outputs
  - Around 10% of total
  - Assume the same input intensity as goods used for agrifood final demand

	Other	Agri-food	Final Demand	Gross Output
Other				
Agri-food			Agrifood final demand	
Value Added		VA to other		
	Input VA to other	VA		
	Input VA			

# Economy-wide IO Data

- Primary Source: GTAP 11c database (2017)
  - Identifies domestic & imported intermediate use
- Supplement from other sources to:
  - Split Accommodation & Food Services
    - detailed IO tables for 41 countries
  - Allocate domestic trade margins on final sales to individual products
    - supply-use tables for 35 countries
- In this presentation, identify 3 main subsectors that produce Agrifood goods
  - Agriculture, Fisheries, & Forestry; Food Processing; Food Services
- Employment & wage data  $\Rightarrow$  wage rates by sector & skill
  - World Bank Gender Disaggregated Labor Database (GDLD)
    - Gives data on wage bill & employment
      - Disaggregated by, sector, gender & skill level

# Identifying employment & wages

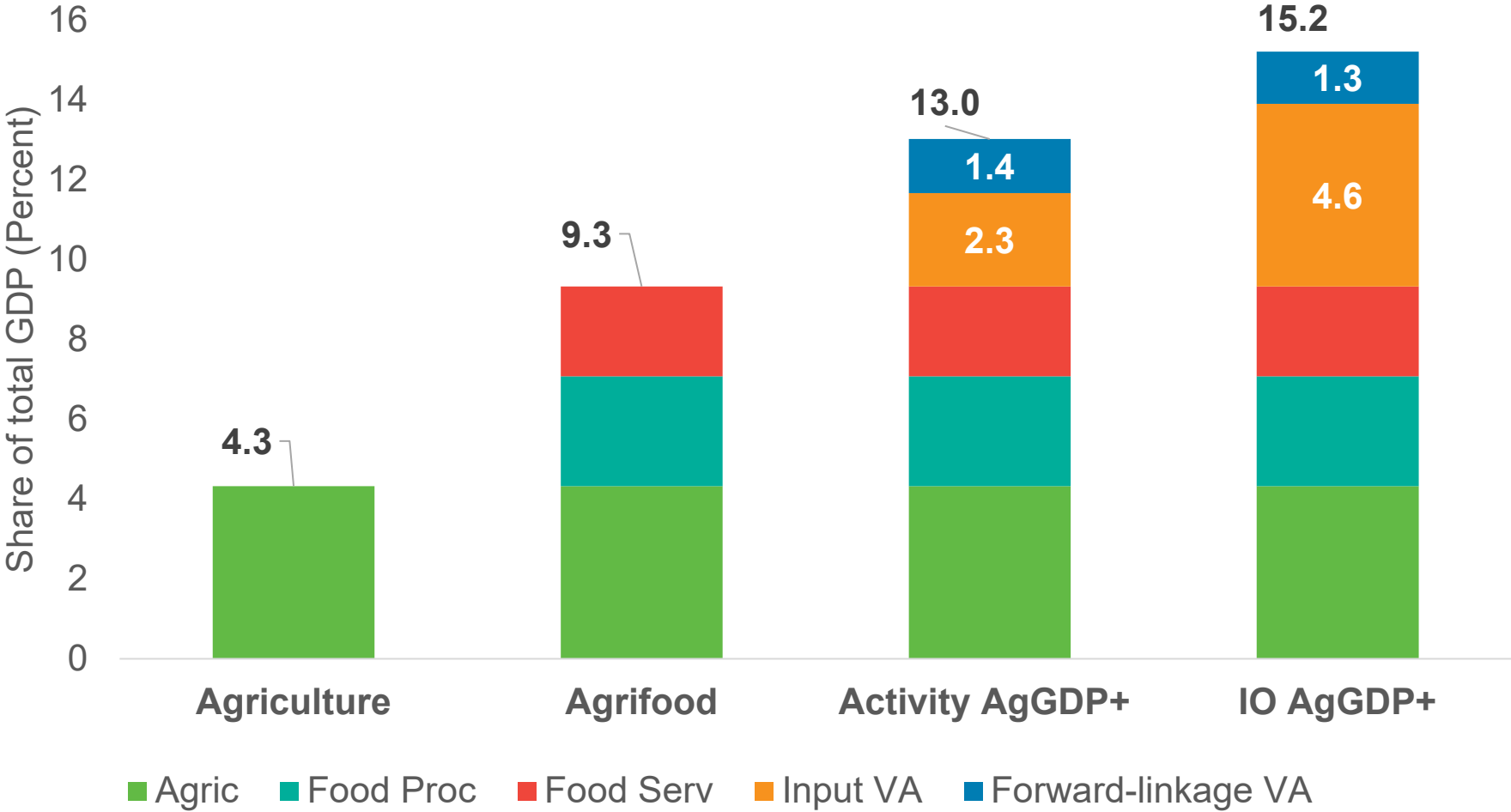
- GDLD provides labor payments and employment by sector and labor type
  - Use this to estimate wage rates by sector, skill and gender
- IO models identify factor payments, including wages by sector, skill & gender
  - Use wage rate estimates from GDLD to convert IO results on wages paid to employment by sector, by gender and by skill



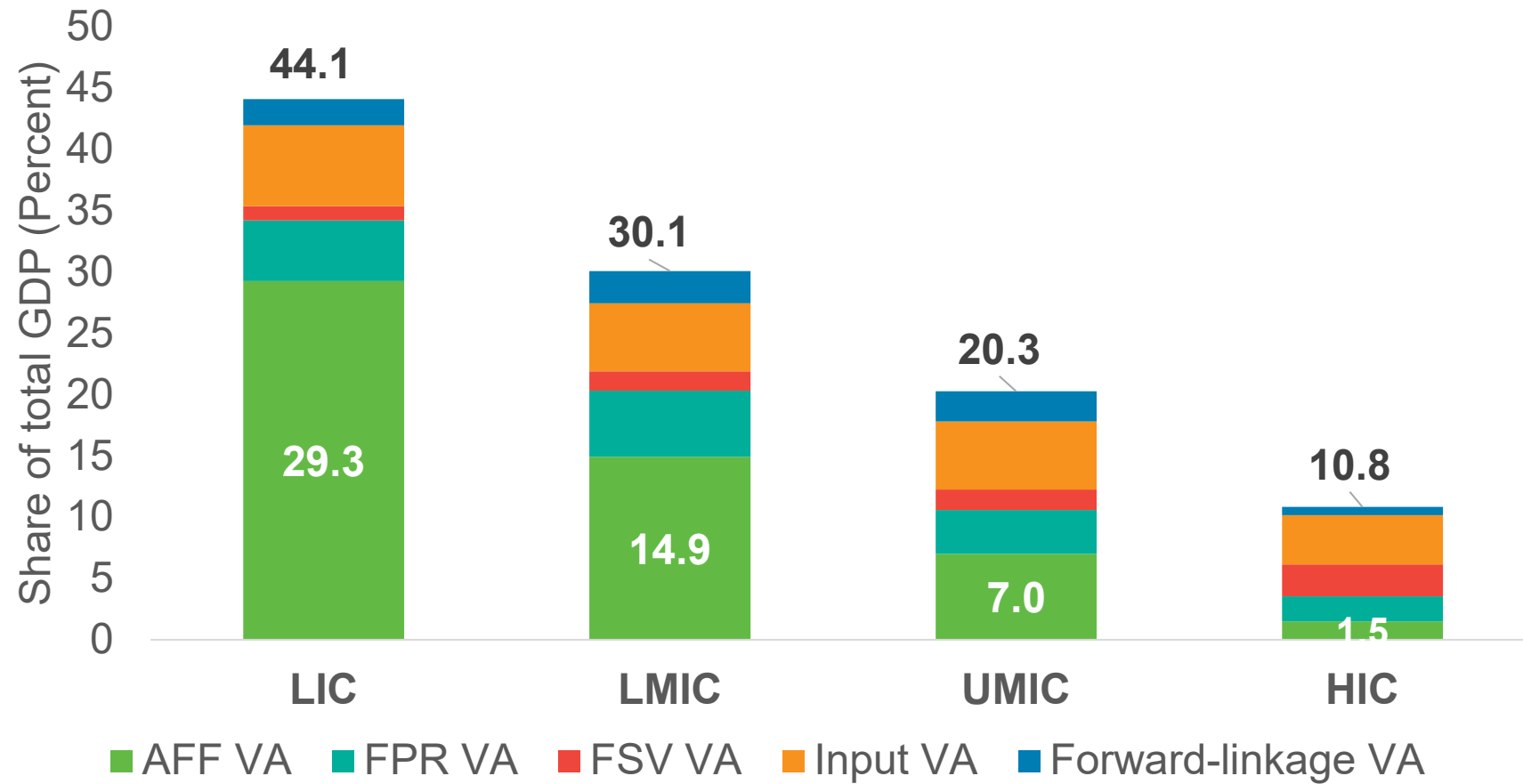
IFPRI

# Results

# Global Agrifood GDP by sector, % of Global GDP



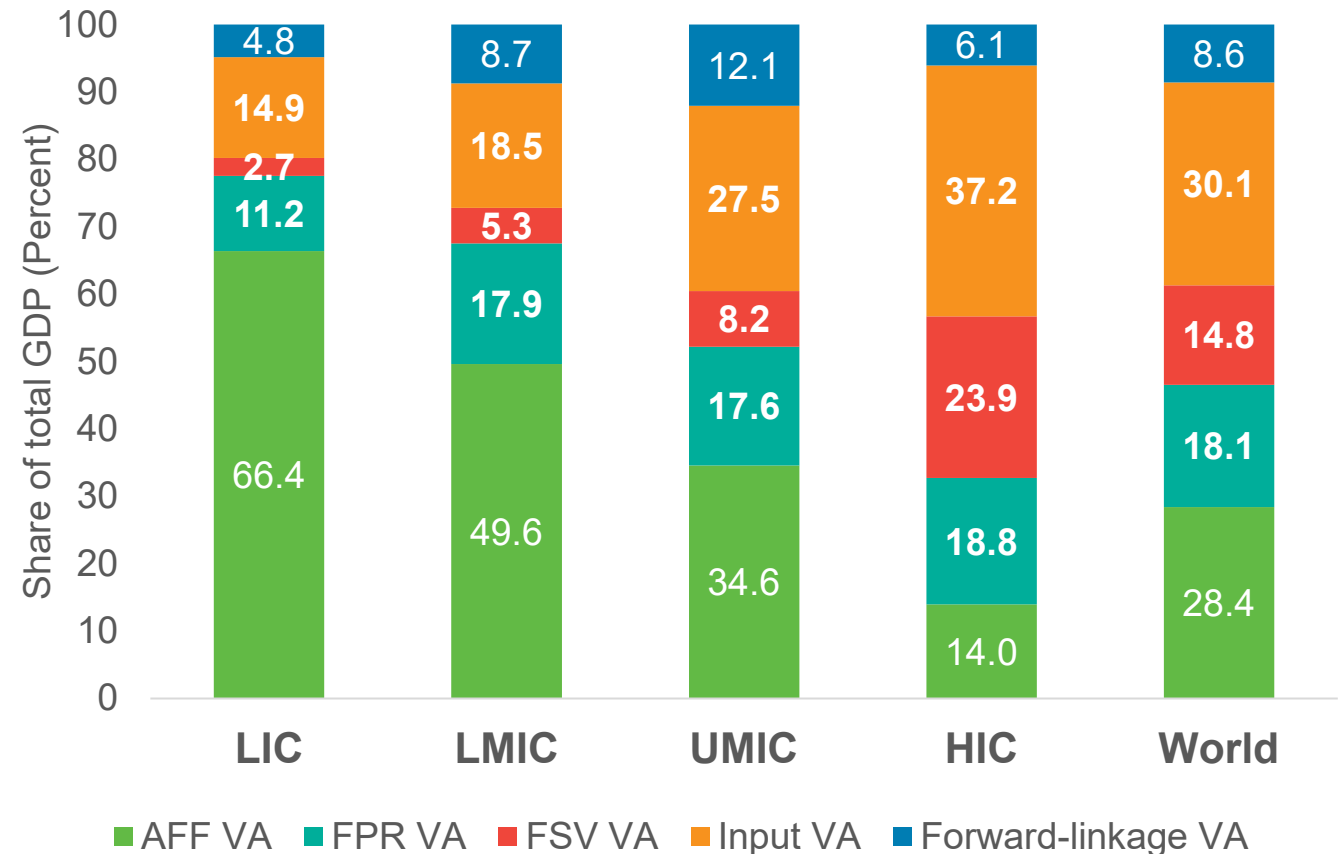
# Agrifood share of GDP falls, & moves off-farm, as incomes rise



# Food system becomes more industry & service based with development

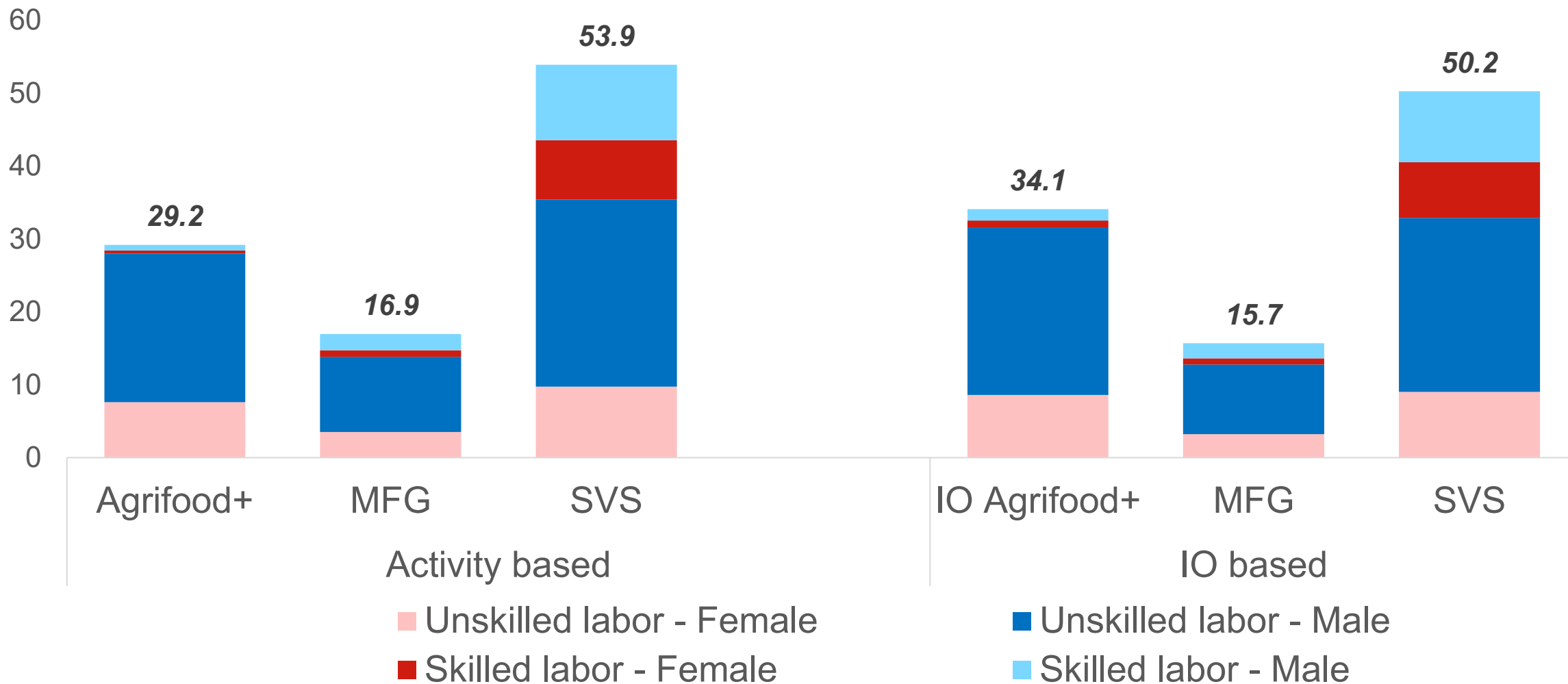
- Share of primary agriculture falls rapidly as agrifood system transforms
- Non-farm inputs (goods & services) large share in UMIC (>25%), but major share in HICs (>37%)
- Non-food forward linkages most important in UMICs (>25%)
- Input industries & food services shares largest in HIC (>60%)

**Composition of AFS by income level (% shares)**

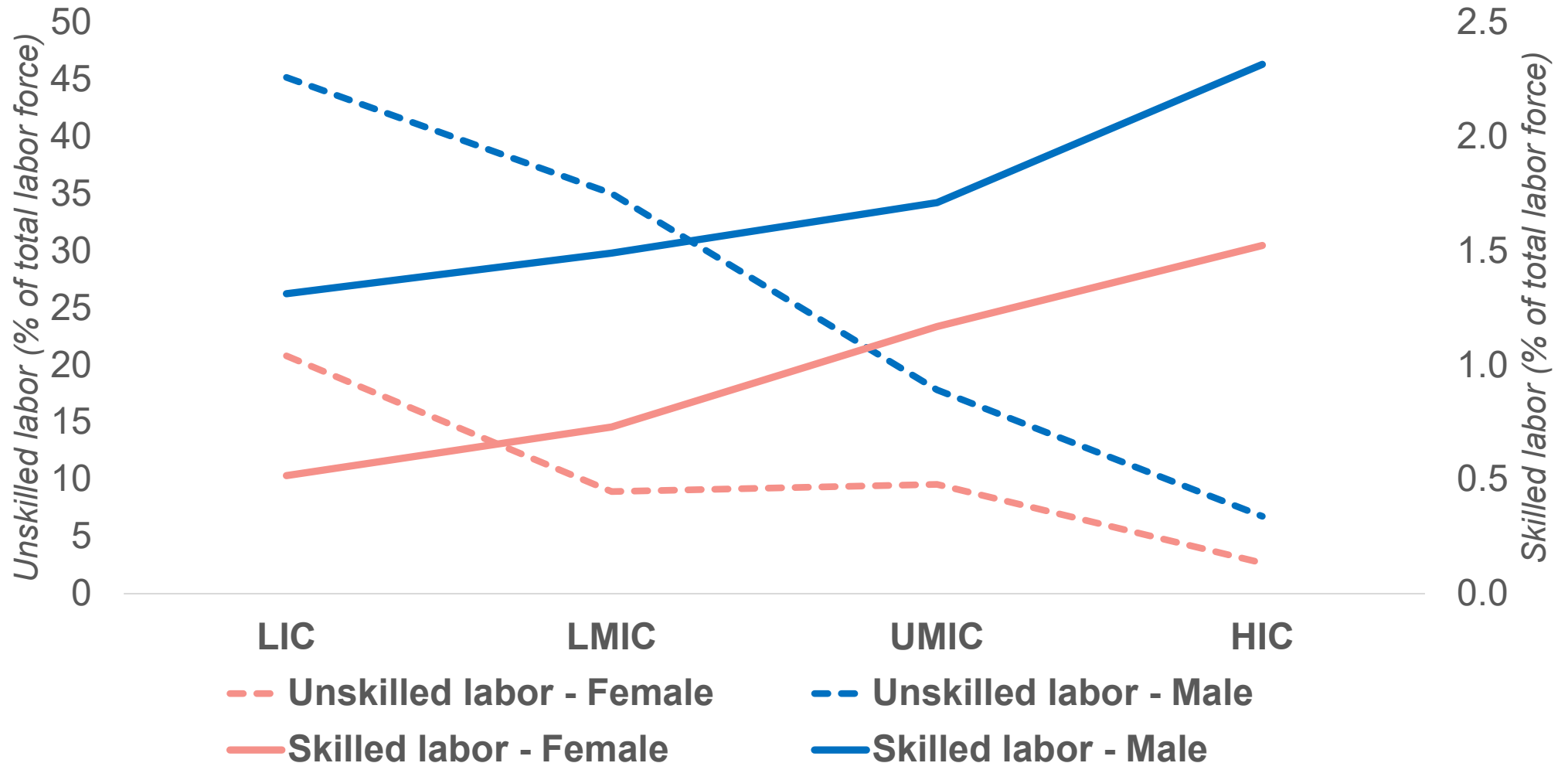


# Activity vs IO Approach (employment shares):

*Predominant use of male unskilled workers in agrifood sector.....*



*.... but shares of both male & female unskilled workers decline, average earnings increase & female-male wage gaps fall with agrifood sector development*



# Conclusions

- Important to consider the broader Agrifood Sector with both food and non-food components
- Two broad approaches to doing this:
  - Activity-based approach
  - IO (Leontief & Ghosh) approaches – exploit structure of entire economy
- IO approaches capture both direct & indirect factor use
  - Especially important for backward linkages
- Job quality improves with agrifood sector development: greater use of skilled labor beyond the farm
  - Pathway to transition away from low-skilled low-paid on-farm jobs and achieve poverty reduction through agrifood value chain development
- Full dataset and indicators will be made available through IFPRI's Food Security Portal